city sink

carbon cycle infrastructure for our built environments | **Denise Hoffman Brandt**

City Sink is a design research proposal for a meta-park of dispersed landscape infrastructure to boost carbon stocks with biomass and through formation of long-term sequestration reservoirs for soil organic carbon in New York City and Long Island. City Sink research merges urban land-use life cycles and the carbon cycle to describe a systemic response to elevated atmospheric carbon levels which provoke climate change. The project is a model for re-imagining urban landscapes as urban ecological infrastructure.

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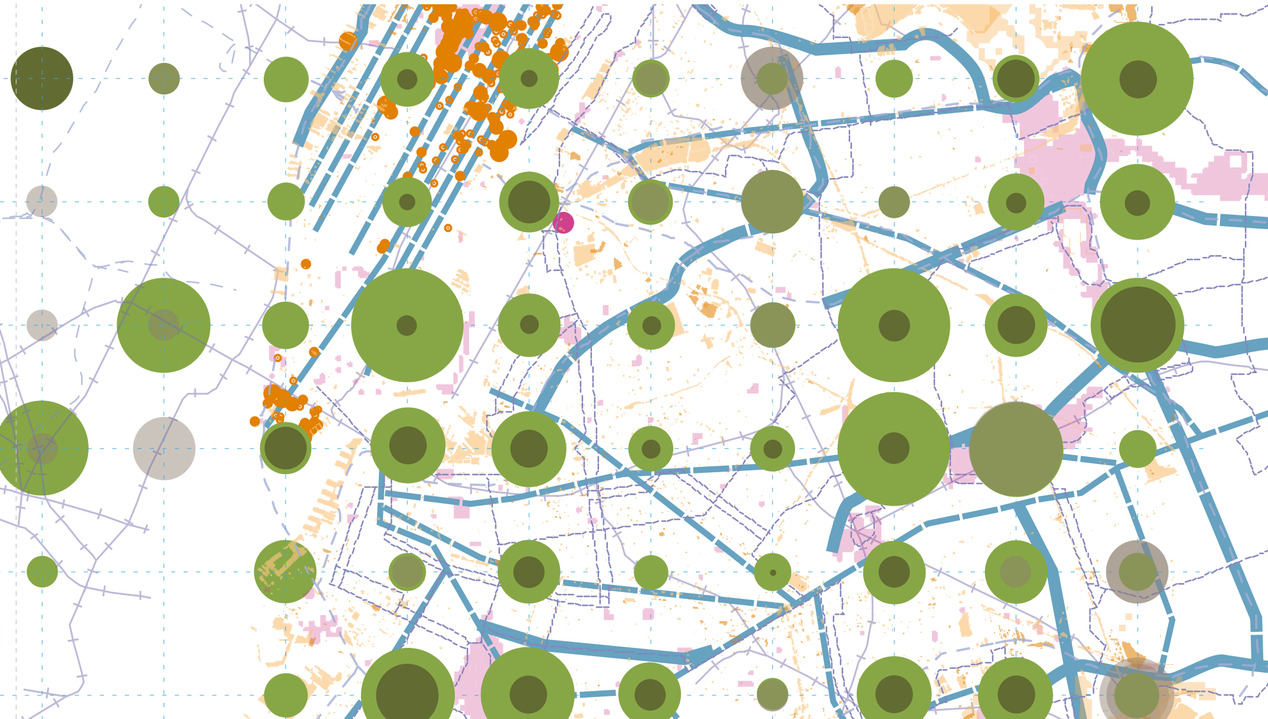

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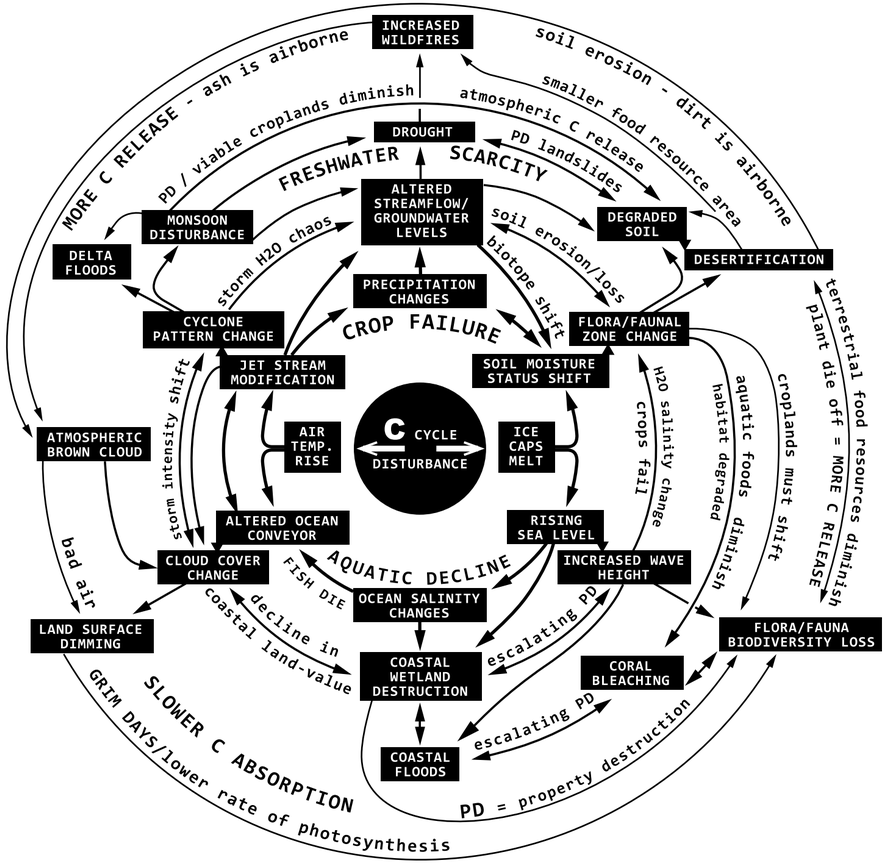

City Sink is a proposition for a multiform infrastructure to increase carbon stocks in biomass and long-term sequestration reservoirs for soil organic carbon in New York City and Long Island. Viable tactics for implementing urban and suburban carbon sinks in temperate zones are described with landscape scenarios that illustrate their potential to expand public awareness of cities as ecosystems by simultaneously supporting dynamic civic, environmental and economic processes.

City Sink is a strategic vision for urban landscape planning and design that builds relationships between environmental processes, non-human biotic systems and social and civic urban life.

Biosphere Carbon Cycle Disruption: formatted to recall Ebenezer Howard's *Garden City* diagrams, this graphic describes some of the complex relationships in human and environmental systems that are triggered by, and reciprocally escalate, global climate change.

Contents

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Introduction

The nature of City Sink

Carbon culture

Several years ago I asked a class of fourth-year architecture students to look out the window and name something natural. The class unanimously cited the grass growing up between the cracks in the sidewalk as the only natural phenomenon in their view of the landscape which included busy people, evaporating puddles of runoff from rainfall that morning, rusting steel signs, dried windblown leaves and sunlight. The students described the crab grass as evidence of nature struggling to survive in the city; as if the brutish forces of urbanization were oppressing the wild and wonderful potential for lawn. The metaphor of dueling urban and environmental forces obstructed the student's view of their own world, and exemplifies the insufficiency of normative ideas of city versus nature.

A majority of Americans believe that climate change is a real phenomenon, and many "do not understand why." (Leiserowitz & Smith, 2010) This makes sense in a context of commonly held cultural beliefs in both the natural world as a force to be controlled for human benefit and a force beyond human understanding and authority. This is an era of both natural capital (Hawken et al. 1999) and natural disasters.

City Sink research grew out of concern that this schizoid cultural ideation, wherein human engagement in natural processes is rarely understood as a complex web of relationships, and is instead reduced to:

• Plants or planted areas, see above;
• Green as a cultural fad (see the embarrassingly trivial 2006 Vanity Fair Green issue featuring a cover of celebrities in leaves and the discontinuance of even that journalistic effort by 2011);
• Acts of God, this is a culturally complex construct which can lead to avoidance of curtailing degrading human-environmental interactions, not to mention reductive—and scary—political assertions that natural phenomena can be an indicator of a God's wrath at the American political system. (Michelle Bachman: "I don't know how much God has to do to get the attention of the politicians. We've had an earthquake; we've had a hurricane..." St. Petersburg Times August 29, 2011.)

This project is grounded in the idea that by focusing environmental discourse, policy and practice on building public awareness that citizens, and the cities they live in, are natural, the inertia created by apparent unyielding economic imperatives and denial of (or guilt over) human destructive capacities, can be overcome. Landscapes must communicate the intricacy of ecological relationships, and by this I mean not just what are typically perceived to be natural systems, but the human constructed systems which are now inextricable within them. Only by building an understanding of the relationships of humans—as biota (living organisms of a particular period or region)—within complex ecosystems, will it be possible to challenge complacent public attitudes toward entrenched practices that are degrading environmental systems at a scale far beyond a single city or even nation. This project suggests that the design milieu must act ecologically, and focus on building robust human social and cultural relationships to environmental processes across many scales.

Before getting into the specific propositions of the City Sink project, clarification of the meaning intended by some of the terms that occur repeatedly, and that are often used without specificity in design discourse, seems important. Ecology is the system of relationships between an organism and its environment. Since no single organism exists in isolation within its environment, ecological relationships are complex; inextricable across many species and processes. Here, the environment is interpreted as both the earth's physical processes and the social networks that have irrevocably shaped them.

Two fundamental concepts associated with this definition are community and ecosystem. This project accepts Soulé's position that:

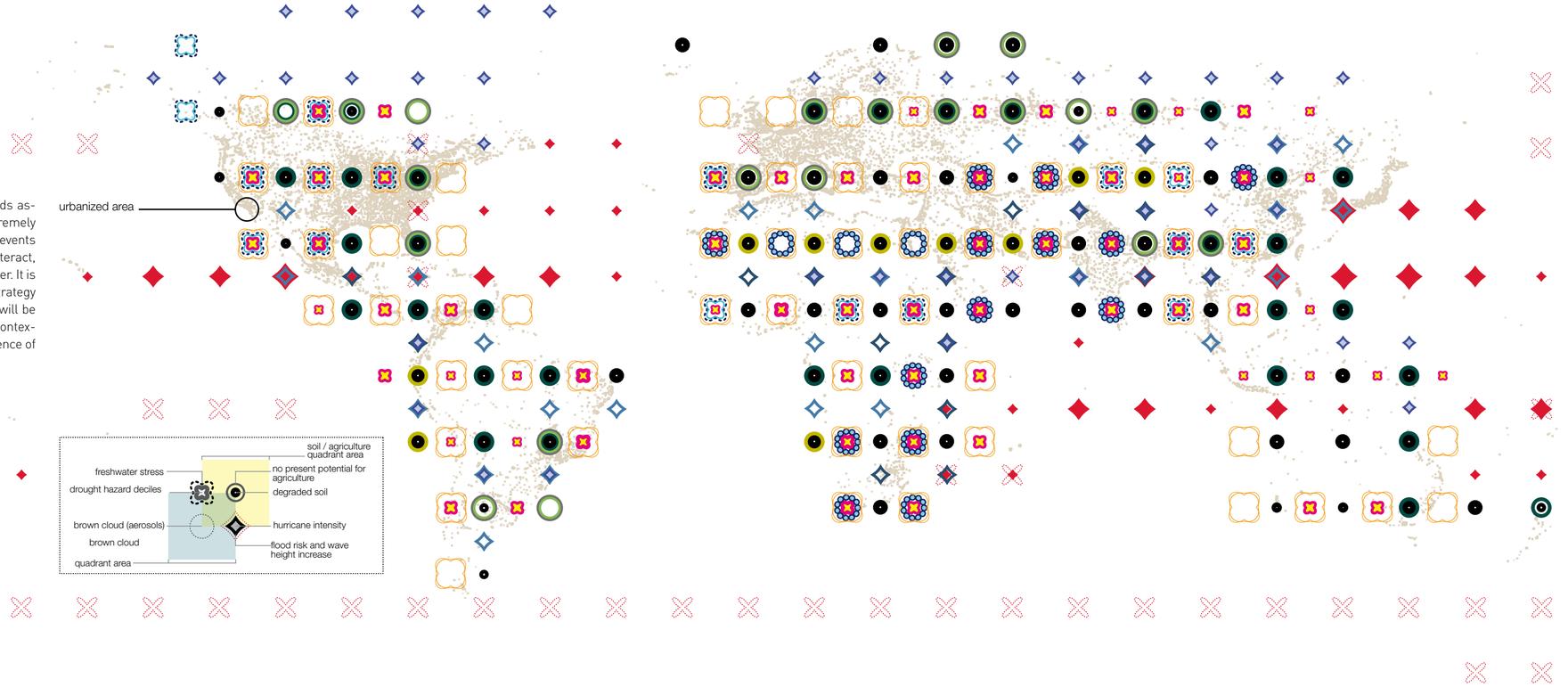
"biotic communities, a misleading term, are constantly changing in membership. The species occurring in any particular place are rarely convivial neighbors; their coexistence in certain places is better explained by individual physiological tolerances… Most interactions between individuals and species are selfish, not symbiotic. The principle of balance has been replaced with the principle of gradation—a continuum of degrees of… disturbance."
(Soule 1995 p. 143, and cited by Callicott 2002 p. 95)

The ramifications of this concept are manifold. The references to community in this project are not intended to evoke an ideal of altruistic and definitive cooperation. Rather, communities are considered to be boundless—they incorporate a gradation of cohesive identity—and self interest, whether they are plants or people.

With this interpretation of community; organizational "disturbance or perturbation (is) ecologically incorporated and normal, not external and abnormal." (Callicott 2002 p. 95) Relationships between communities, and communities and their environment, would therefore be characterized by this instability. Climate change can be seen as a disruption of an array of earth system processes instigated by self-interested human communities with limited understanding of the implications of their actions. The processes that trigger

Point distribution map of global hazard plotted with speculative climate change impacts

The plot shows that escalating environmental hazards associated with climate change are pervasive yet extremely variable. Seemingly sporadic spatial and temporal events conform to global process regimes that overlap, interact, and are capable of amplifying or diminishing each other. It is apparent from the diverse field that no overarching strategy for dealing with elevated atmospheric carbon levels will be viable. Successful climate hazard adaptation will be contextually specific in order to negotiate the unique confluence of hazards in a given region.



atmospheric brown cloud
2000-2010 optical depth 0.5-0.8
increased coverage / optical depth

degraded soil
areas of increased or extreme soil degradation
new areas of degradation

no present potential for agriculture
extreme desert (-2% veg. cover)
closed forest (+70% canopy cover)
areas of low projected vegetation potential (sideleaf area index -2.5 to less than -10)

flood risk
high hazard/vulnerability
extreme flood hazard
projected increased runoff (+20%)

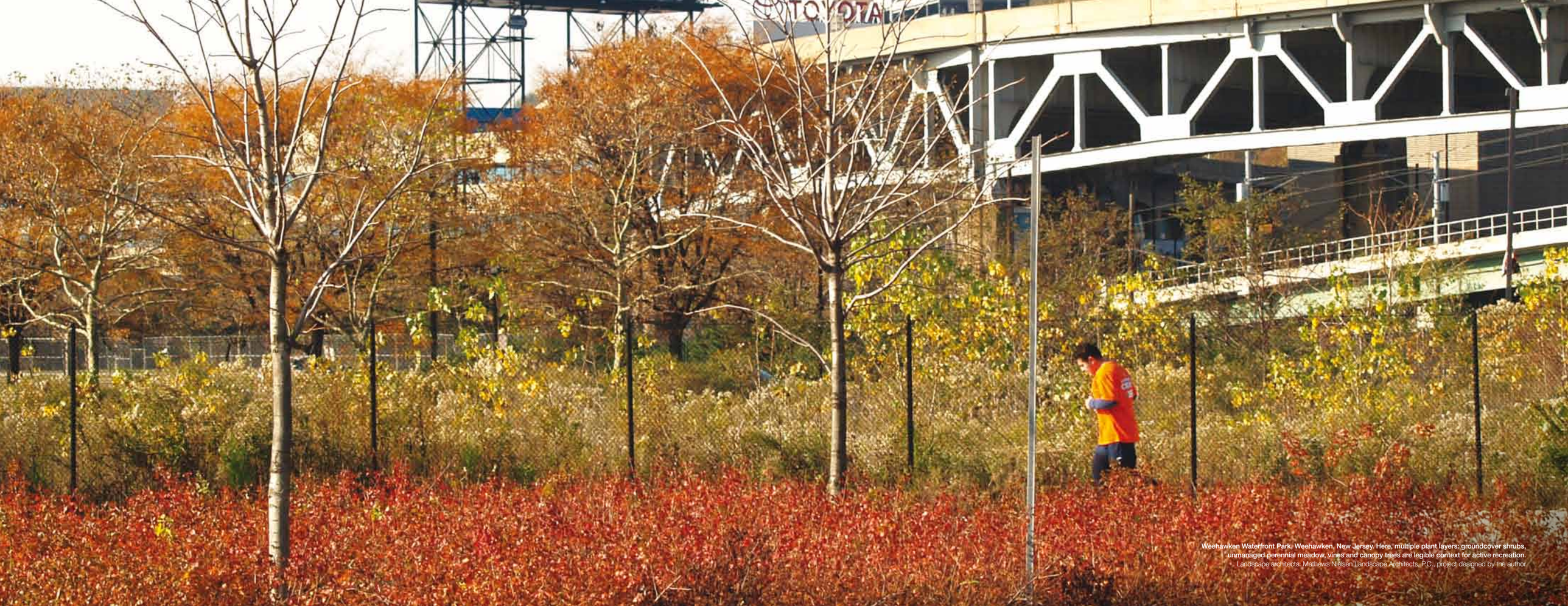
hurricane intensity
(miles/hour winds) 50 - 95
96 - 130
131 - +155
projected increased wave height (ratio greater than .1)

freshwater stress
(current use percentage of availability) 20%-40%
+ 40%
(projected 2025) 20%-40%
+ 40%

current drought hazard WASP deciles
(any occurance in quadrant) 5th to 7th
8th to 10th
(+1/4 coverage) 8th to 10th

future drought hazard Palmer Index
-3 to -20

Data sources: seismic-Giardini et al. 2000, brown cloud-UNEP, flood-CARE 2008, hurricane-UNEP-GRID Europe 2000, NASA/IPCC Fourth Assessment Report freshwater stress-UNEP-GRID Earthscan 2000, drought-World bank/Columbia University, soil-International USDA/IPCC, Soil Reference and Information Centre Wageningen 1990, vegetation potential, Jonathan Adams, Biological Sciences, Seoul National University, Gwanak-Do, Seoul, South Korea, UNESCO World Water Development Report 3/Chapter 12 2009



Weehawken Waterfront Park, Weehawken, New Jersey. Here, multiple plant layers: groundcover shrubs, unmanaged perennial meadow, vines and canopy trees are legible context for active recreation.
Landscape architects: Mathews Nielsen Landscape Architects, P.C., project designed by the author

Big roads with fluctuating traffic flow levels, lots of sporadically occupied big parking lots, mostly or wholly unoccupied paved or compacted commercial lots, and short and long term abandoned industrial lots are all animated by social and economic shifts characteristic of suburban land use life cycles. Parts of the outer Boroughs of New York City, and much of the land area of Long Island, are subject to these dynamics.

The functional inefficiencies of suburban morphology are now becoming apparent in the market as suburban form is reducing desirability of suburban land and big paved lots lie empty.

Aging out and depopulation of Long Island communities has been linked to the perception that suburban form is an outdated landscape idea. The format of suburban living is simply no longer as desirable as it once was. It has proved difficult to market traditional, subdivision neighborhoods with large, single family homes to diverse demographics (young college graduates and small families) that municipalities hope to lure into tech-industry jobs to build up a waning tax base. Who wants to sit in traffic on asphalt, run across mammoth asphalt parking lots to shop, or experience the alienation of double-wide asphalt streets in a commercial core? This black top lifestyle generates a by-product of vast wasted tracts of defunct stores and vacant lots.

Carbon planning offers potential to bypass obstructive value-judgments of suburban sprawl. Infilling gaps with carbon sinks temporally synchronized to land use cycles can activate waste-land, improving both the performance and the image of suburban ecological systems.

Big Roads

Big Parking Lots

Lots Of Lots

Wasted Space

Multi-family living can be a rich social milieu, and mixed use development will diversify lifestyles to increase the appeal of the suburbs to a wider demographic.
Cars idle in traffic, burning fossil fuels so the daily commute is a daily grind.
Policy to support regional and local rail systems makes sense for both human and environmental ecologies.
Expanded public transportation networks can be linked to carbon sink infrastructure implementation.

0 10 miles

Long Island existing carbon source and sink
Data source: Long Island Index: land use maps and aerial photos

SOURCE → SINK

THE LAWN IS OVER high maintenance chemically-supported plantings are NOT GREEN

Suburban green is really Carbon Black

Looking at the view from the expressways and low density neighborhoods, Long Island appears greener than New York City's five Boroughs. However, traditional suburban development planning disrupts terrestrial and atmospheric carbon cycling. Auto dependence, large footprint homes amid continuously manicured planting areas, and widely dispersed commercial/industrial facilities escalate atmospheric carbon emissions, offsetting any benefits of increased area for carbon sink.

This map, interpreted from land use data and aerial photos, illustrates degrees of current source-sink on Long Island contingent on impervious surface and vegetative cover. Industrial areas create hotspots of carbon source. Residential subdivisions are a mix of biomass-soil sink areas offset by zones of higher emissions related to automobiles, home heating and energy-use. Forested land is an indicator for pockets of existing and potential sink across the Island. The encroaching development "threatening sink potential at the eastern end of Long Island" could be stemmed by planning initiatives to account for whole-island ecologies. This would enable preservation and expansion of valuable wetlands and forested areas while encouraging downtown densification.

Residential lawns are the archetypal image of *natural* suburban lifestyles. Keeping up with the Joneses often requires chemical treatments, irrigation—or at least regular watering in periods of low rainfall—and reliance on engineered, monoculture seed-stock. Lawns have a lot of carbon leakage; fertilizer and pesticide production facilities are big carbon and pollution emitters. New carbon infrastructure offers an opportunity to re-imagine all aspects of suburban lifestyle—including the lawn.

“Great works are often born on a street corner or in a restaurant’s revolving door.”
Albert Camus

City Sink landscapes are the landscapes of everyday events. A pervasive sink network in cities and suburbs does not preclude diversity of experience. Sinks can be elegant, starkly utilitarian or even gritty.

Green can be ***‘noir’.***

23rd Street, Flatiron District Manhattan, with strip sinks

On death and taxes...

In traditional urban landscapes, trees are often objectified rather than recognized as agents in ecological processes. In the carbon sink landscape, maintenance regimes that seek to neutralize environmental processes to retain a scenic status quo are replaced with temporally adjusted practices that reveal life cycle processes. Revaluing all aspects of the cycle, such as dead wood, means accepting that plant life cycle and successional conditions are not always neat, and the mandate for maintenance often arises from a short-term desire to appear managed.

This map shows proposed distribution of Deadwood Benches to instigate succession to woodland in existing lawn areas of Prospect Park, Brooklyn. Design Trust for Public Space High Performance Guidelines recommend a 60% decrease in lawn area for NYC parks

Base map Source: ©2011 Google – Imagery ©2011 DigitalGlobe, USDA Farm Service Agency, GeoEye, Bluesky, Sanborn, Map data ©2011 Google

Trees, both living and dead, are important ecological components. Urban landscape management plans prioritize manicured and ornamental effects, investing tax dollars and energy inputs into maintaining artificially fixed landscape scenes—devoid of dead plant material.

In the carbon sink landscape, maintenance regimes that disrupt environmental processes to retain a picturesque status quo are replaced with temporally adjusted practices that reveal life cycle transformation. This entails accepting that ecosystems are not always neat, and the mandate for energy intensive maintenance is a by-product of dysfunctional attitudes towards nature in the city.

Tax dollars support energy intensive management practices that transform plant-soil systems into atmospheric carbon sources rather than capitalizing on their potential as terrestrial sinks. Cities are currently seeking to decrease atmospheric carbon emissions, and new plantings are emblematic of those efforts, but when it comes to trees, the most iconic component of urban landscapes, *green* is not always really green.

David Nowak's research (2002) indicates that landscape management protocols can have a significant impact on stored carbon rates. He notes that carbon storage in urban trees is only 4.4% of the total stored carbon in non-urban forest ecosystems. Urban forestry programs that seek to elevate that percentage in a meaningful way will have to alter management practices to achieve sink rather than produce source carbon emissions.

"When fossil fuels are used to manage or maintain vegetation, the carbon emissions will offset the carbon gains through time. Eventually more carbon will be emitted due to maintenance activities than will be sequestered by a tree."

(Nowak, et al. 2002)

A high percentage of street trees are short-lived. Mechanical harvesting, transport and mulching of dead trees negate the benefits of carbon storage in tree biomass. Nowak found that 50% of biomass stored carbon is released within three years of mulching, with the remainder lost over a period of 20 years. Above-ground biomass that is land-filled however, releases carbon much more slowly—at a rate of only 3.7% in the first five years. Recycling dead wood can reduce the rate of carbon emissions, and dead wood can be used to improve and diversify forest growth. Dead trees support a variety of microscopic and insect species at various stages of decay (Jonsson et al. 2005).

Maintenance regimes are generally designed to value only living trees. The legibility of trees as ecosystem components is lost, to the detriment of both human and nonhuman biotic habitat. Dead trees provide avian and small mammal habitat, as well as cycling nutrients back into soil. Some pathogenic fungi cannot survive on dead wood, so its presence protects germinating trees. An Institute for Eco-System Studies project looked at the effects of dead wood on carbon and nutrient dynamics. On the property's lowland flood plain, old logs were hot spots for dissolved organic carbon (DOC) production.

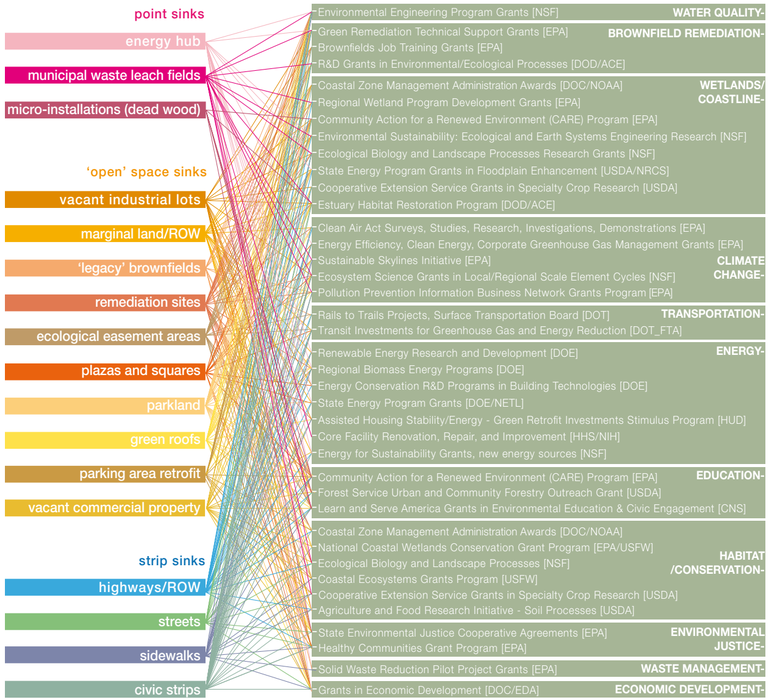
"… while it only covers 3% of the soil surface in the lowlands, dead wood is responsible for 25% of DOC leaching."

(IES 2003)

Retaining dead wood in park landscape management plans would boost ecosystem functions without emissions. Dead wood could be used to accelerate successional processes in parks, speeding up woody encroachment into managed lawn areas. Human access systems generally necessitate reduction of plant layers to canopy trees and groundcover or low shrubs in order to accommodate circulation and security standards. Prioritizing for the operation of carbon sinks means revaluing public domain to encompass complex, layer-dependent plant systems.

Layered plantings maximize biomass and amplify both soil organic carbon and the experiential intensity of urban landscape. When there is an expectation that complex plantings should appear tidy, maintenance costs of pruning, clearing debris, fertilizing and pest management go up exponentially as species are added to plant lists. Reducing ongoing management costs means not just accepting, but finding value in a looser look. Naturalized conditions have a conceptual appeal, but it can be difficult to convince the public that the boom and bust of plant life cycle change is appropriate in an urban context.

Upland forest floor



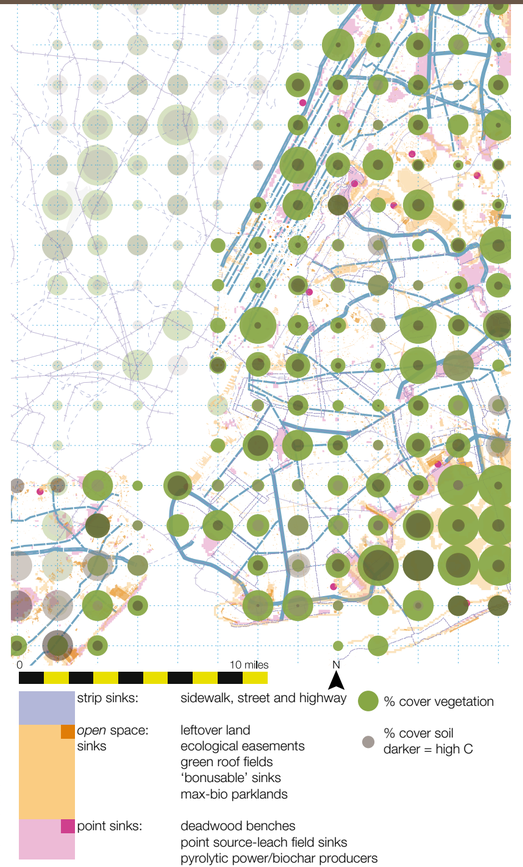
City Sink apparatus linked to cross sector funding opportunities
Research Assistant: Kerry Lowe

City Sinks optimize cross-sector funding

The square-foot cost of urbanized land is so high that few, if any, institutional entities would have the cash to buy up land for a new infrastructural system of any kind. Carbon sink planning initiatives must be capable of opportunistic integration into existing urban systems and structures to be cost effective. This project suggests that infrastructure, such as a carbon storage network, can be planned to latch onto existing physical structures, can be adapted to existing policy, and can optimize funding mechanisms to maximize performance.

The matrix you see here illustrates the web of federal funding options in various sectors for the sink typology defined in the following chapters. The myriad potential funding opportunities for each component are possible because City Sink infrastructure is designed to simultaneously perform social (education, environmental justice, transportation, energy, economic development) and environmental functions (water quality, coastal habitat, contaminant remediation, and waste management).

Infrastructure is generally subsidized by state, local and private-sector dollars, so investment fluctuates with the boom and bust of economic cycles. Recessions and other downward market trends can suppress investment regardless of the need for expeditious action. Designing landscapes that engage multiple urban system processes expands the scope of available funding sources to release environmental action from that constraint.



New York City Sink network with point distribution plot of future carbon storage
Data sources: Van Alen Institute Gateway
Project maps: Spatial Information Design Lab (SIDL)
2009 and New York City Open Accessible Space
Information System Cooperative (OASIS) 2009

NYC Future Carbon Sink

The point distribution plot for New York City's future carbon storage, speculatively based on the modest proposals for implementation described in the following chapters, blooms with sink sites. A few examples:

- The 2009 assessment indicated discord between soil and biomass systems in areas dominated by street trees, since they increase carbon stocks in biomass but do not optimize soil condition. The plot renders a still variable, but more consistent, field of organic soil carbon storage based on expanding areas of pervious surface, revising practices to focus on above and below ground plant-soil processes and installing small-scale pervasive in-ground urban plantings (Strips and Open spaces).
- The degraded wetland areas of Jamaica Bay are shown to be enhanced and expanded by carbon offset credit investment.
- The major parks are represented with greater carbon storage capacity due to Max-Bio tactics and apparatus like the Deadwood Bench.
- Densely occupied zones like Midtown Manhattan, the Financial District, Downtown Brooklyn and parts of Queens are now animated by diverse policy and structures such as Green Roof Fields, Bonusable sinks, and Sidewalk and Street strips.

The following chapters will describe this array of working policy and working parts that could amplify urban carbon stocks as shown above. The apparatus universally act to boost carbon in soil and biomass based on the principle that to generate more ecologically viable cities, the mission is to construct more robust and diverse urban ecosystems.

.05
Working Policy

Policy making is design. The rules of the game define the character of the play. Carbon sink sites require policy to establish protocols for, and management to validate, carbon storage performance. The City Sink proposal asserts that designing the logic for how urban landscapes work is a foundational design act. Working Policy sets terms for City Sink site proliferation, and it provides the mechanism by which carbon cycling and land use life cycles are synchronized.

Working policy and working parts are reciprocally related. Policy impacts design criteria and design invention can stimulate new policy. The proposals described in this section accord with the parameters described in the previous section. Working policy initiatives are explored here that alter normative land management practices at many scales, from zoning a regional network to establishing productive performance criteria for urban inactive land.

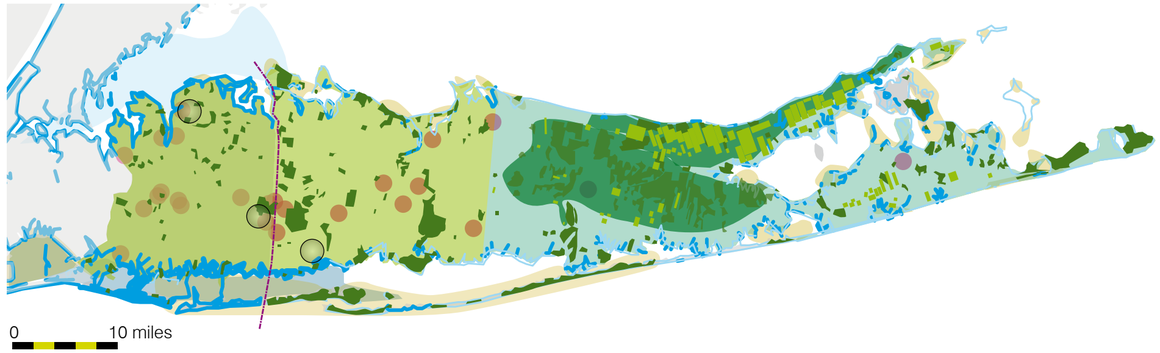
Queens Fields

Ecological Easements

Utility easements, the right of a public entity to use real property for a specific purpose, are a common mechanism to provide civic benefits on private land. Easements usually provide access to, or encompass an infrastructure and the right of way to maintain it. As soft infrastructures (storm water management bioswales, for example) become more common in practice due to their financial and material efficiencies, administrative mechanisms such as this will allow the new systems to be planned for optimal performance.

Open Spaces

Cities and suburbs are full of verges, rights of way, marginal land, vacant lots and all manner of seemingly unusable space. This terrain is often active in subtle ways, sustaining non-human biota, or *used* in a manner that does not register with typical land use profiles. The strategy for *Open* Space delineated here takes the position that no space is devoid of use or value, and offers ideas for how strategic overlays of sink function, in time and space, can animate territory.



Long Island C-Burbia Plan

Working Policy operates at multiple scales, from regional plan to local neighborhood initiative.
Map data source: Long Island Index

Oak Point Ave, Bronx 10474
Description: Publicly owned lot (New York City Transit)
Classified as vacant. Primary Zoning: M3-1
Length: 213' Width: 47' Total Area: 1.09 acres
Notes: Inside the fence dense shrubs have colonized part of an unused parking lot.

land use life cycle	short	long
lot size	small	large
degree of permeability *assumes blacktop removal	permeable*	
estimated soil organic carbon	low	high
amount of detritus	low	high
degree of visible contaminants	low	high
degree of visible vegetation	none	
degree of light	full sun	
visible water	dry	
degree of compaction	low	high
salinity / air particulate level		high

PHYTO LAB - This industrial site has asphalt paving and a scale that is too small for production, but large enough to offer adequate space for testing plant mitigation of soils contaminated by bituminous compounds.

Tiffany Street, Bronx 10474
Description: Privately owned lot
Primary Zoning: M3-1
Length: 185' Width: 425' Total Area: 4.27 acres
Notes: Appears to be inactive industrial site.
Opportunistic vegetation visible. On water's edge.

land use life cycle	short	long
lot size	small	large
degree of permeability	permeable	impervious
estimated soil organic carbon	low	high
amount of detritus	low	high
degree of visible contaminants	low	high
degree of visible vegetation	none	full
degree of light	full sun	
visible water	dry	wet
degree of compaction	low	high
salinity / air particulate level		high

SALTMARSH/MARITIME SHRUBLAND/BIOFUEL - This waterfront site has potential for a native plant gradient from saltmarsh to successional shrubland. The flatter areas of the site have productive capacity for biofuels.

Tiffany Street, Bronx 10474
Description: Publicly owned lot (New York City Transit)
Classified as Industrial / Manufacturing
Primary Zoning: M3-1
Length: 200' Width: 100' Total Area: 0.46 acres
Notes: Paved loading dock appears largely dormant.

land use life cycle	short	long
lot size	small	large
degree of permeability *assumes blacktop removal	permeable*	
estimated soil organic carbon	low	
amount of detritus	low	high
degree of visible contaminants	low	high
degree of visible vegetation	none	full
degree of light	full sun	
visible water	dry	
degree of compaction		high
salinity / air particulate level	low	high

MARITIME GRASSLAND/BIOFUEL - This site is also large enough to serve a dual purpose for native species habitat and productive land to support community green jobs.

Ryawa Avenue, Bronx 10474
Description: Publicly owned lot (Sanitation) Primary Zoning: M3-1
Length: 424' Width: 394' Total Area: 6.86 acres
Notes: Lot appears underused, possibly as overflow parking for sewage treatment plant. Gravel road inaccessible to public. Dense shrub vegetation growing along water's edge.

land use life cycle	short	long
lot size		large
degree of permeability	permeable	impervious
estimated soil organic carbon	low	high
amount of detritus	low	high
degree of visible contaminants	low	high
degree of visible vegetation	none	full
degree of light	full sun	
visible water	dry	wet
degree of compaction	low	high
salinity / air particulate level		high

SALTMARSH/MARITIME SHRUBLAND/BIOFUEL - This relatively large waterfront site amplifies the native habitat impact of site 2 and expands neighborhood biofuel production to support local industry.

Viele Ave, Bronx 10474
Description: Publicly owned lot (NYC DEP) Classified as vacant.
Primary Zoning: M3-1
Length: 600' Width: 200' Total Area: 2.64 acres
Notes: Large lot. Cracked paving, opportunistic weeds - shrubs.
Adjacent to Barretto Point Park.

land use life cycle	short	long
lot size	small	large
degree of permeability	permeable	impervious
estimated soil organic carbon	low	high
amount of detritus	low	high
degree of visible contaminants	low	high
degree of visible vegetation	none	full
degree of light	full sun	
visible water	dry	
degree of compaction		high
salinity / air particulate level		high

NURSERY PRODUCTION - Neighborhood nursery production can take advantage of the nearby market infrastructure for local community benefits. The project can be incrementally implemented, moving from container plants to urban-adapted trees and shrubs.

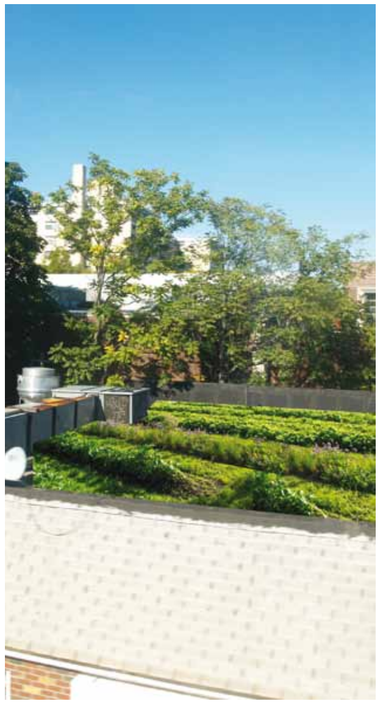
Bryant Avenue, Bronx 10474
Description: Privately owned lot. Primary Zoning: M3-1
Length: 50' Width: 100' Total Area: 0.11 acres
Notes: Empty paved lot. Sign on fence states 'for rent.'
Former auto parts business. Probable brownfield.

land use life cycle	short	long
lot size	small	large
degree of permeability *assumes blacktop removal	permeable*	
estimated soil organic carbon	low	high
amount of detritus	low	high
degree of visible contaminants		high
degree of visible vegetation	none	full
degree of light	full sun	
visible water	dry	
degree of compaction		high
salinity / air particulate level	low	high

PHYTO LAB - This small site exemplifies a phased approach to neighborhood ground contaminant remediation. Individual lots can be tested, and either sealed for continued production or put into a long-term phyto-remediation program depending on the local property market.

Weehawken Waterfront Park, Weehawken, New Jersey. Interstitial spaces in active areas can be designed as low maintenance carbon sink zones. In this park, the municipality required extensive active recreation facilities leaving minimal space and funding for areas that could be animated by non-human biotic processes. The park was designed to optimize in-between spaces, and this area has become a bee and butterfly haven.
Landscape Architect: Mathews Nielsen Landscape Architects, P.C., designed by the author

A new view from the 7 train



Public Utility:
City Sink urban landscape propositions

Van Alen Institute. April 21-30, 2009

A gallery view of Public Utility at the Van Alen Institute, the introductory exhibit of the City Sink project study of the five Boroughs of New York City.
Photo credit: Alex Arroyo, Van Alen Institute

Brooklyn Queens Expressway, Brooklyn Drape Highway Sound Bio-Wall Retrofit

The Staten Island case study area accommodates 3400 feet of Sound Bio-Wall retrofitted onto 1800 feet of linear distance of expressway. The wall shown lines both sides of the expressway, and most of the wall is completely exposed to roadway view.

New sound wall benefits:
69300 sf of planted surface and **51975 cy of high organic soil mix.**

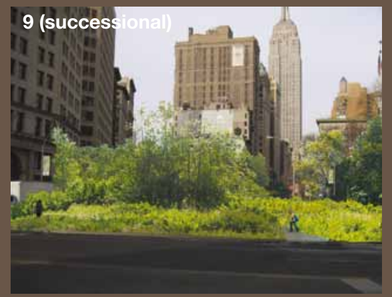
Staten Island case study area

Staten Island Drape Sound Bio-Wall case study:

The narrow *Drape* profile allows the retrofit to be implemented even in tight spaces. The existing mute concrete wall would be activated by resurfacing with the Drape to reveal systemically changing yet locally unique climate characteristics in all seasons. The daily commute would be transformed by a creeping consciousness of dynamic environmental systems.
Sound Bio-Wall construction can be integrated, and mutually beneficial, with adjacent sink apparatus:
• Biofuel grasslands can be planted on highway verges to generate organic material as an energy resource.
• Max-Bio planting could be installed to support a carbon offset program for civic emissions, and a lush entry route into New York City.
• Phyto lab plantings could be a research resource for study of plant adaptations to highway conditions.
In each case, the *Drape* Sound Bio-Wall planting could synchronize with the larger strategy by supporting a seed bank for material to colonize the verge or simply by acting as a dramatic backdrop for driving.

Both views illustrate the Drape installed along the Staten Island Expressway adjacent to residential neighborhoods.

Flatiron District Strip Sink Views



Deadwood Bench and dead wood, Woodstock, New York, 2009

Deadwood Bench: a small management change with extensive capacity to escalate rates of carbon sink and reduce atmospheric carbon emissions.

Gallery Deadwood Bench Installation, Van Alen Institute, Public Utility: City Sink urban landscape propositions, April 2009
Photo credit: Alex Arroyo, Van Alen Institute

Deadwood Bench Redux, the bench is shown installed in a gap in the woods from recent construction disturbance, Woodstock, NY June 2009.

Gallery installation view of bench seat and hand-held video display of wood gathering, sorting and cutting filmed by Elisabetta Terragni
Photo credit: Alex Arroyo, Van Alen Institute

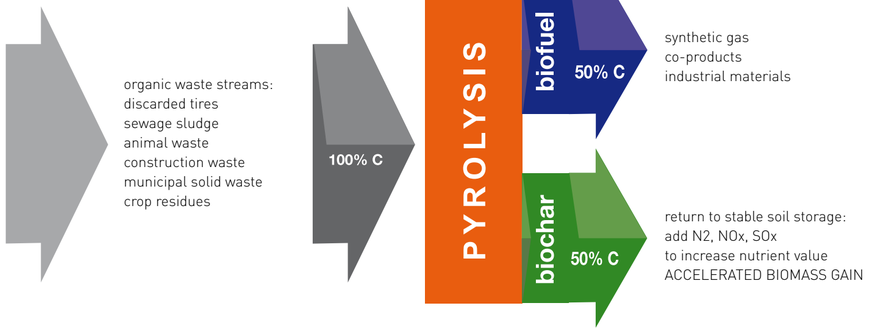
Maintenance regimes that seek to neutralize environmental processes in order to retain a scenic status quo can turn planted areas into carbon emitters instead of carbon sinks. City Sink is a proposal to recover temporally adjusted practices that reveal life cycle processes associated with carbon sink landscapes.

Plant life cycle and successional conditions are not always neat, and the mandate for maintenance often arises from a short-term desire to appear managed. The City Sink proposition asserts that design encompasses land management practices, and design initiatives must seek to change land management practices in accord with environmental life cycles.

The Deadwood Bench is constructed of just that—dead wood—that would otherwise be mulched. Mulching releases carbon into the atmosphere at a relatively rapid rate, and reduces the potential benefits of biomass carbon absorption inherent in tree growth that offset the energy inputs of plant installation and maintenance. The bench is designed to instigate collection and propagation of windblown seeds; in other words, it acts as a successional trigger to accelerate biomass carbon storage.

The Deadwood Bench surface is accruing organic material for new growth, 2011.

Pyrolysis Power / Biochar Production



Flow diagram of organic cycle with pyrolysis
Image source: NASA earthobservatory.nasa.gov/images

Biochar and Pyrolysis
Image sources: I-Cans for Educators from web .pdf by Jock Gill, Peacham, VT www.greaterdemocracy.org/wp-content/uploads/2010/11/iCans-for-Educators-11.pdf and Biochar Image Source: Betchkal/Flickr. Permission: Creative Commons. www.climate.org/climatelab/Biochar

Bio-energy produced by pyrolysis (an anaerobic low T burn) produces biochar as a by-product. Biochar is a high-carbon content soil amendment that increases biomass growth rate. This is a two-prong attack on high atmospheric carbon counts since it boosts vegetative biomass while producing low-carbon emission energy.

"Combustion of bio-oil in an engine, boiler or turbine will release CO2. However, in general these emissions are biochar. In addition, bio-oil combustion results in remarkably low emisions of NOx and SOx. Finally, remember that biooil is produced from waste which would otherwise decompose completely into CO2 and methane..."

"Biochar has been shown to be stable in soils for up to 2000 years. That is an order of magnitude longer than any other carbon storage technology."
*Disarming the Bio-Char Wars, www.re-char.com

"A hectare of metre-deep terra preita can contain 250 tonnes of carbon, as opposed to 100 tonnes in unimproved soils from similar parent material... That difference of 150 tonnes is greater than the amount of carbon in a hectare's worth of plants."
"Putting the carbon back: Black is the new green," Emma Marris *Nature* 442, 624-626 (10 August 2006)

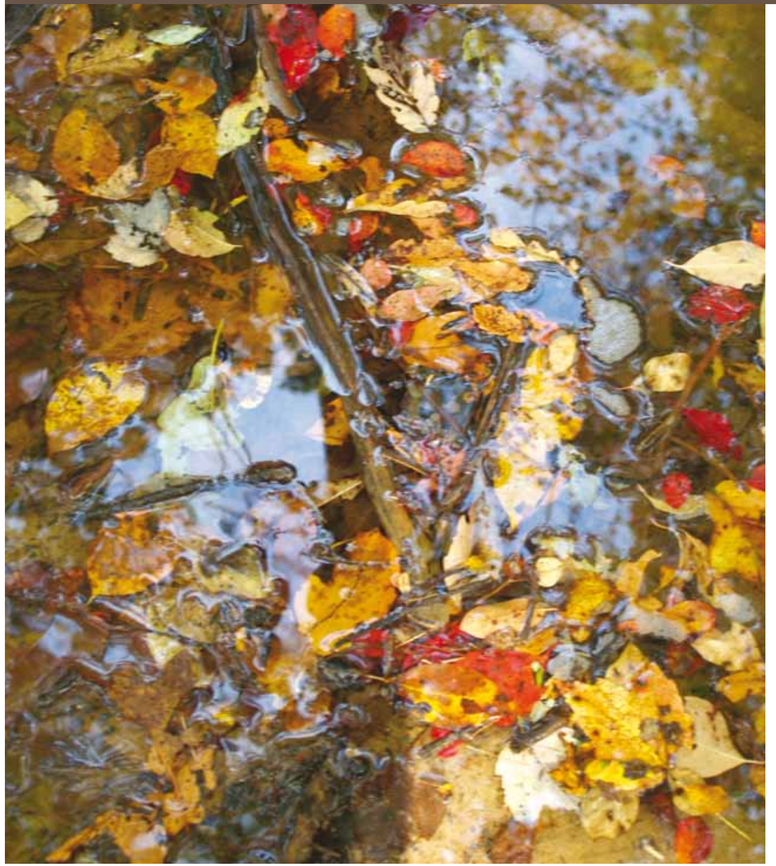
Pyrolysis is a carbon negative process; meaning upwards of 90% of the CO2 that would be released through combustion is captured as biochar.

Some mycorrhizal fungi prefer to germinate on charcoal; biochar directly supports carbon transfer mechanisms.

Pyrolysis Power / Biochar Production

Pyrolysis as an energy source is still being investigated for urban-scale use. A pyrolysis power plant operating in Hamm Germany, managed by RWE Energie, generates approximately 75 MW of gas energy, which is around 15 MWe at normal steam turbine conversion efficiency. Fuel is supplied by a variety of sources, local recycling centers and municipal waste processing. The byproduct of this operation has chemical contaminants that would be inappropriate for biochar to support food production. However, biofuel grassland production could be increased to supply at least a percentage of the fuel stock for the plant to create a viable feedback loop.

Biochar (*Terra Preta* or black earth) has been used as an agricultural soil additive for thousands of years; it boosts biomass and aids in the transfer of carbon into soil. The real power of this concept for the city is in its modeling of a feedback loop between urban energy systems and soil building. Both phases of the cycle operate to terrestrially sink carbon rather than release it into the atmosphere.



Clogged catch basin, Downtown Brooklyn

New York City is innovative in its reliance on a protected watershed (instead of an expensive chemical treatment plant) for its potable water supply. The success of this initiative could be a model for similar schemes to avoid the high costs of mechanical facilities compared to land management operations.

Why not approach waste water systemically too?

Outer Coastal Plain Wetland, Cheesequake State Park, New Jersey

Phyto Leach Fields provide point source treatment for urban waste water

Sewage treatment plants trade off minimal space requirements for high energy inputs. This made sense in a scenario of high land values and cheap unlimited energy resources. Carbon consciousness changes the terms of that assumption. Less energy use and increased biotic habitat have to be factored into a new urban order.

"Wetlands as an ecology are more productive in biomass production than any other environment except the rainforest."

"The prodigious amounts of biomass that are produced are the result of the equally large masses of nutrients and sediments that are washed into the lowlands where most wetlands occur."

"Sewage is essentially water and fertilizer. Wetland plants require water and fertilizer, and unlike dry land plants, they can grow in saturated soils and standing water and consume several times the nutrients used by dry land crops."

"Thus the use of wetlands as a treatment process can be considered a form of agriculture, with the 'crop' consisting of clean water."
Campbell and Ogden, Constructed Wetlands in the Sustainable Landscape, 1999

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