

# Better Site Design Principles for Local Implementation



NYS Water  
Resources Institute



Cornell University



**Barbara Kendall**

NYS Department of Environmental Conservation



# I. Introduction: Environmental Priority of Stormwater

## Regulation of Point Sources



- Most point source water quality problems have been addressed (factories, wastewater treatment plants)

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**90% of remaining water quality problems are from nonpoint sources**



**↑Uncovered salt storage**

**Trash in stormwater pipe↓**



**←Sediment covering PAVED road**

## Water Quality Impacts - Pollutants in Urban & Industrial Stormwater:

- Oil & Greases
- Metals
- Nutrients
- Bacteria
- Pesticides
- Herbicides
- Temperature
- Sediment



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Stormwater runoff isn't only fast, but it's highly polluted, by many measures. Some places on the landscape, such as gas stations, can have extremely high pollutant concentrations because of the activities that occur on them.

Temperature: Stormwater running over paved surfaces warms up and can impact cold-water fish habitat in streams, lakes and rivers

Metals: Copper, zinc, lead, cadmium

Nutrients: Nitrogen & phosphorus

# Stormwater Impacts:

Water Quality

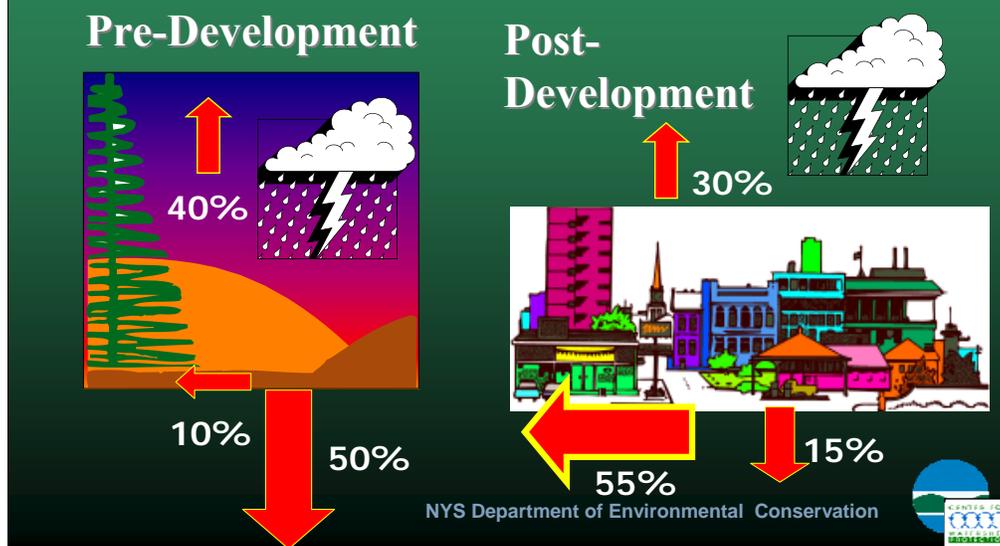
*AND*

Water Quantity . . .

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# What happens when we develop?



Changes in the water cycle associated with land development.

Increases in impervious cover, combined with transformation from forest to less permeable urban soils impacts the destination of rainfall:

A greater fraction runs off the surface

A smaller fraction recharges groundwater, or feeds streams as “baseflow”

Typically slightly less evapotranspiration, due to loss of forest and plant cover.

## Water quantity impacts from flooding:

- Loss of life
- Damage to property
  - FEMA statistics:



- FEMA paid \$592 million to NYS (Jan. '78–Apr. '08)
- 79,661 claims

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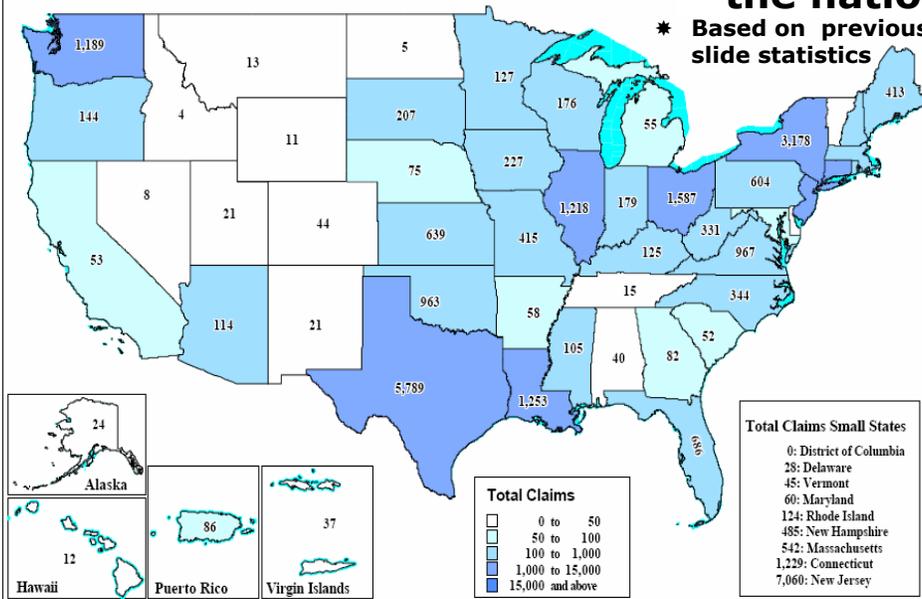
Source: <http://www.fema.gov/business/nfip/statistics/pcstat.shtm>

National Flood Insurance Program

**Total Number of Claims \* NYS 9<sup>th</sup> in the nation**

OCTOBER 1, 2006 THRU SEPTEMBER 30, 2007

\* Based on previous slide statistics



Source Report: W2RC1040

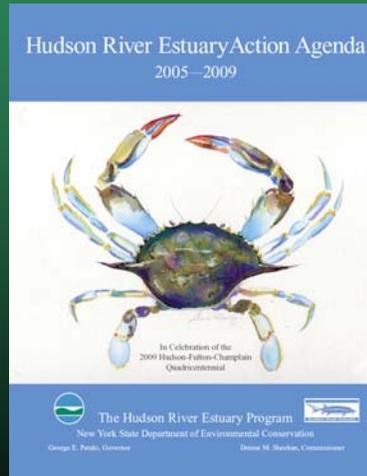
## Water quantity impacts from flooding:

- Damage to streams and rivers
- Destruction of habitat



# The Hudson River Estuary Action Agenda – 12 Goals

- **Goal #4 - Watershed and Tributary Conservation**
- **Better site design - a tool for watershed protection**



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## Solution: Better Site Design

Development design  
that seeks to:



◀ Preserve  
undisturbed  
areas

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**Solution: Better Site Design**  
**Development design**  
**that seeks to:**



◀ **Reduce  
impervious  
cover**

- **Roads**
- **Parking  
lots**
- **Driveways**

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## Solution: Better Site Design



**Development  
design  
that seeks to:**

**◀ Better  
integrate  
stormwater  
treatment**

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## Goal: marketable, cost-effective product

### Conventional Development

- Lots: 108
- Cost: \$1.54 million
- Open Space: 11.3 ac.
- Nitrogen: 191 lbs/yr.
- Phosphorus: 24 lbs/yr

### Builders for the Bay Development

- Lots: 108
- Cost: \$1.24 million
- Open Space: 19.9 ac.
- Nitrogen: 105 lbs/yr.
- Phosphorus: 10 lbs/yr



**II. Where does  
*Better Site Design*  
fit in to the  
NYS Stormwater  
Program?**

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## Federal Stormwater Regulations

- **Phase I - 1990 (USEPA)**

- Industrial activities
- Large municipalities
- Construction disturbing **>5 acres**



- **Phase II - 1999 (USEPA)**

- Construction disturbing **≥1 acre**
- Smaller municipalities
- **(based on census), schools, universities**



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**Phase II Administered by  
NYSDEC with two General  
Permits: **\*new items\*****

**1. Construction Permit  
(SPDES General Permit  
for Construction  
Activities **GP-0-08-  
001**)**

- **Effective **May 1, 2008****
- **Replaced GP-02-01**



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## General Permit **GP-0-08-001**

- All construction activities disturbing  $\geq 1$  acre of soil (about 208' x 208')
- **Owner/operator must:**
  - **File NOI (Notice of Intent) to DEC**
  - **Prepare Stormwater Pollution Prevention Plan (SWPPP)**

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**Phase II Administered by NYSDEC  
with two General Permits:**

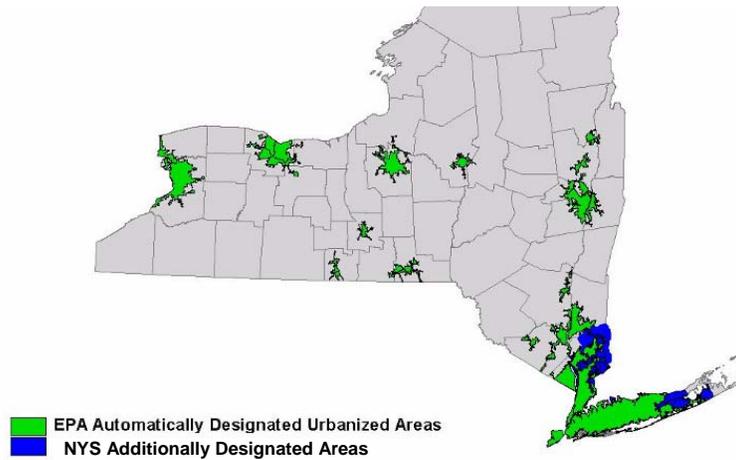
**2. MS4 Permit - SPDES General  
Permit GP-0-08-002 (replaces  
GP-02-02)**

- **Municipal Separate Storm  
Sewer Systems (MS4's) in an  
urbanized area**
- **2003 - 2008, municipalities  
developed a community-wide  
Stormwater Management  
Program**

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**MS4 Permit - Certain Areas:  
Population Center of 50,000 with  
surrounding area of 1,000 people  
per square mile or more**



# SWPPP Review

Review SWPPP locally in:

- Site plans
- Subdivisions
- Single family home building permit 1 acre or more soil disturbance size

(specify smaller area in local law if desired)



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# SWPPP Review

- Town Engineer review SWPPP
- Provide recommendations to Planning Board, ZBA, Code Enf. Officer
- **NEW: MS4 SWPPP Acceptance Form then signed by one of:**
  - Principal executive officer
  - Ranking elected official
  - Duly authorized representative

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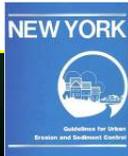
The image shows a small, partially visible document titled "MS4 SWPPP Acceptance Form". It is a form with various fields and checkboxes, likely used for accepting a Stormwater Pollution Prevention Plan (SWPPP) for a Municipal Separate Storm Sewer System (MS4). The form includes sections for project information, acceptance details, and signatures. The text is small and difficult to read, but the title and structure are clear.



**Part I/Basic SWPPP:  
Erosion & Sediment  
Control Plan -  
Controlling stormwater  
DURING construction:**



**•All  
construction  
projects  
disturbing 1  
acre or more  
of soil**



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The Instruction Manual for the Stormwater Construction Permit is a new publication that outlines the basic requirements of a SWPPP and instruction for preparing the NOI and NOT.

## Basic Concept



**Part 2 of SWPPP –  
Water Quality & Quantity – controlling  
stormwater after development is  
complete**

**(Parts 1 + 2  
= Full  
SWPPP)**



- **1 acre or more soil disturbance FOR:**
  - Multifamily, Commercial, Industrial
  - 303(d) listed (impaired) waters
  - Total maximum daily load (TMDL) watersheds

**Basic Concept** We no longer want to pave over as much as possible and send water down the pipe as fast as we can



**Keep and treat water on-site  
before discharging to local  
waterways**



**Stormwater Pond**



**Rain Garden**



**Approved Stormwater Management Practices in: *NYS Stormwater Management Design Manual***



## New Chapter 9 Redevelopment Projects

- Rain Gardens
- Cisterns
- Green Roofs
- Stormwater Planters
- Permeable Paving
- Proprietary Practices



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Later on this morning we will talk about these more in-depth.

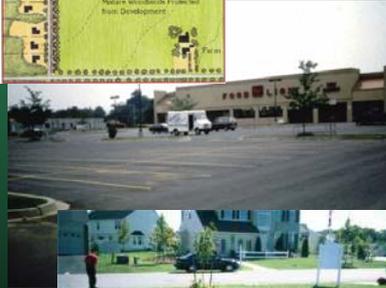
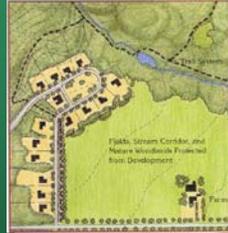
# III. Better Site Design Principles

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# What is Better Site Design? *An Approach to Development*

- **Preserving Natural Features and Using Conservation Design**
- **Reducing Impervious Cover**
- **Source Control for Stormwater Management**



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1. Avoid the impacts
2. Reduce the impacts
3. Manage the impacts

## BSD & Impacts of Development

- **Preserving Natural Features and Using Conservation Design** →
- **Reducing Impervious Cover** →
- **Source Control for Stormwater Management** →
- **Avoid the impacts**
- **Reduce the impacts**
- **Manage the impacts**

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1. Avoid the impacts
2. Reduce the impacts
3. Manage the impacts

## Guidance for Better Site Design

- **NYSDEC “Better Site Design” Guidance Paper – on DEC website (18 principles)**
- **Center for Watershed Protection Book and Code & Ordinance Worksheet (1998)**
- **NYSDEC Hudson River Estuary Program REVISED Code & Ordinance Worksheet for NYS (2008)**

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1. Avoid the impacts
2. Reduce the impacts
3. Manage the impacts

# **BSD Principles #1 - 12 Preserving Natural Features and Using Conservation Design**

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## PRINCIPLE NO. 2 Locate Sites in Less Sensitive Areas



One obstacle to establishing and maintaining a buffer is the demand for development along streambanks with an unobstructed view. These Greene County houses are also highly susceptible to flooding.

## Town of Dover – October 9, 2005 flood– 100-year floodplain



Flood-  
plains:  
•Provide  
storage  
for large  
flood  
events;  
•Protect  
property

## PRINCIPLE NO. 3 Preservation of Undisturbed Areas: Delineate Conservation Areas FIRST

- Protect during:
  - Design
  - Construction
  - Home occupancy-permanent conservation



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## PRINCIPLE NO. 4 Preservation of Buffers

*US Forest Service*



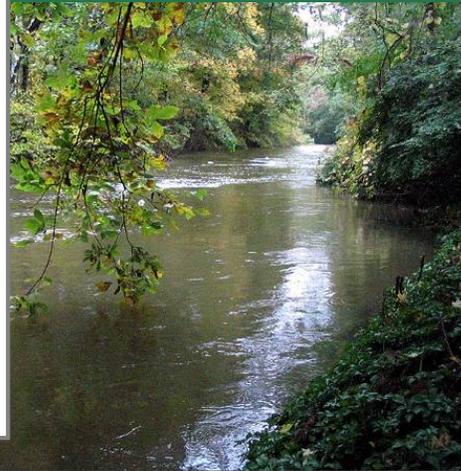
- Delineate buffers on plans.
- Protect during:
  - Design
  - Construction
  - Home occupancy
- Non-structural stormwater infiltration
- Consult local codes

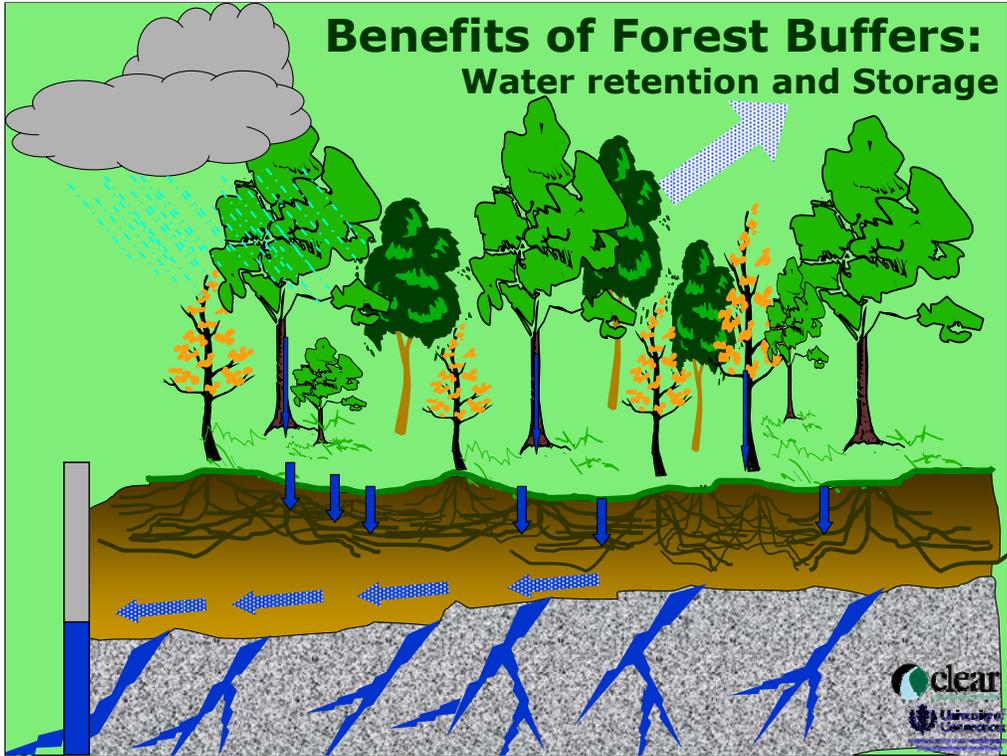
The buffer network functions as an integral part of the stream ecosystem. In many regions, these benefits are multiplied when the streamside zone is in a forested condition.

Benefits of Tree  
Planting in Buffers:

- Increases nutrient uptake
- Reduces runoff through rainfall interception
- Aids infiltration
- Provides shading
- Reduces mowing costs
- Discourages geese
- Trees absorb CO<sub>2</sub>

**PRINCIPLE  
NO. 6 Stream  
and Wetland  
Buffer Uses**





## **\$\$ Economic Benefits of Buffers**

- **Maryland: developers receiving 10-15% premiums for lots next to forest & buffers**
- **Pennypack Park Greenway (Phila.)  
+33% value of nearby property  
+\$3.3 million in real estate values**
- **Amherst, MA: added costs of forest retention always recouped in increase sales price**

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Maryland and Amherst, MA references: See “Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers”, Chesapeake Bay Program, USDA, 1997, revised 1998. Section XII.  
Philadelphia reference: Chesapeake Bay Foundation, 1996. A dollars and sense partnership: economic development and environmental protection.

**Hudson  
River  
Estuary  
Program:  
*Trees for  
Tribes***



**Walkkill River**



## PRINCIPLE NO. 7 Open Space Design



Although open space development (or cluster design) has been advocated by planners for many years, they are only rarely applied in the development process. In 95% of communities surveyed by Heraty (1992), clustering is a voluntary, rather than a mandatory development option. In addition, open space developments often require a special exception zoning variance (i.e. they are not a by-right form of development) or additional review step which require more time for review. As it turns out, open space development is not always widely exercised by developers.

Open space developments encourage the evaluation of development designs to determine if they really meet impervious cover reduction and land conservation goals. Open space developments can reduce impervious cover, stormwater runoff, and construction costs. While open space developments are generally not feasible for residential densities of more than eight dwelling units per acre, communities should consider making open space development a by-right option .

## PRINCIPLE NO. 8 Specify Management of Open Space

- Homeowners Assoc.
- Land Trust
- Municipality

• Put on subdivision plat, site plan, in deed (conservation easement)



A survey of local open space design regulations conducted by Heraty (1992) revealed that open space requirements were poorly defined in most communities. Less than a third required that open space be consolidated, only 10% required a specific portion of the open space to be maintained as natural areas, and only a few specified allowable uses for open space areas. In addition, community associations and residents often lack financial, legal, or informational resources to maintain different types of common areas.

Open space maintained in a natural condition has a minimal annual maintenance cost, and communities should encourage developers to retain as much natural open space as possible. Communities should explore more reliable methods to assure that responsibility for open space management can be met within a development by creating a community association or shifting responsibility to a land trust or park through a conservation easement.

## PRINCIPLE NO. 9 Reduction of Clearing & Grading

- Delineate on plans & on the site
- Limit to minimum needed for:
  - Buildings
  - Roads & Utilities
  - Wastewater
  - Stormwater
- Free landscaping



NYS Stormwater Regs/  
Better Site Design Overlap

- **Most communities allow clearing and grading of an entire development site, with a few exceptions for regulated areas such as jurisdictional wetlands, steep slopes, and floodplains.**
- **The preservation of natural areas helps balance the impacts of development by maintaining the natural hydrologic cycle and limiting the amount of disturbed soils.**
- **Clearing should be limited to the minimum area required for building footprints, construction access, and safety setbacks.**
- **Existing tools that could be adapted to limit clearing include:**
  - **erosion and sediment control ordinances**
  - **grading ordinances**
  - **forest conservation or tree protection ordinances**
  - **open space development**

# Natural landscape costs

- Maintain or install a natural landscape
- Over 10 yrs, may be 1/5 the cost of conventional landscape maintenance

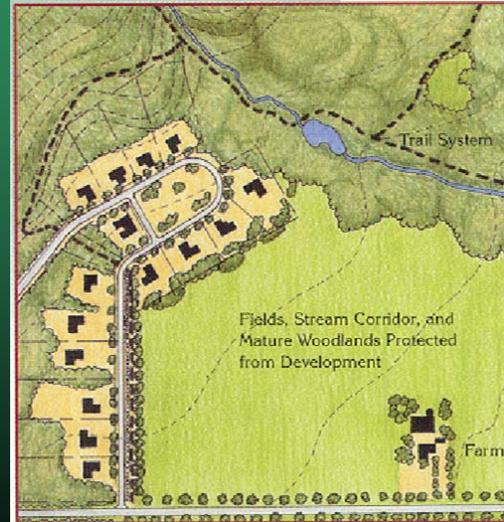


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## PRINCIPLE NO. 10 Tree and Forest Conservation

- Preserve at least 5 acres of forest stands
- Delineate on plans & on the site
- Require best management practices for forestry



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- **Most communities allow clearing and grading of an entire development site, with a few exceptions for regulated areas such as jurisdictional wetlands, steep slopes, and floodplains.**
- **The preservation of natural areas helps balance the impacts of development by maintaining the natural hydrologic cycle and limiting the amount of disturbed soils.**
- **Clearing should be limited to the minimum area required for building footprints, construction access, and safety setbacks.**
- **Existing tools that could be adapted to limit clearing include:**
  - **erosion and sediment control ordinances**
  - **grading ordinances**
  - **forest conservation or tree protection ordinances**
  - **open space development**

## Economic Benefits of Trees

■ Bank of America real estate agent survey:  
- Homes with treed lots 20% more saleable



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Reference: See “Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers”, Chesapeake Bay Program, USDA, 1997, revised 1998. Section XII. `

## Economic Benefits of Trees

- **Austin, TX – Tree canopy reduced stormwater flows by 28%, saving city \$122 million**

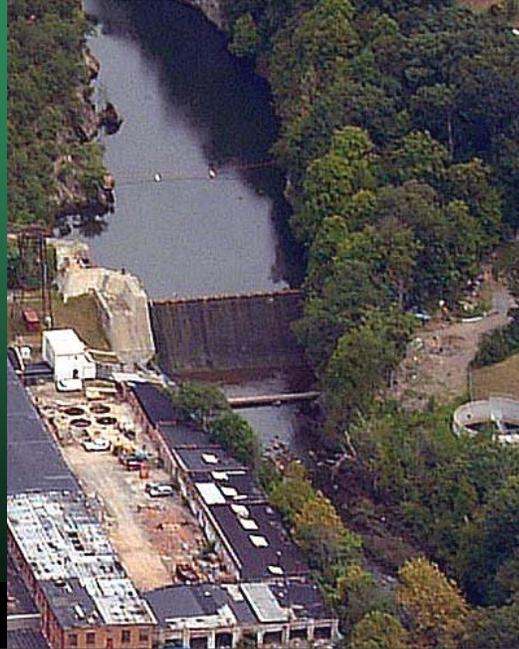


Photo of urban forest is actually of the Fishkill Creek in Beacon, New York (Dutchess County).

Reference:

MacDonald, 1996. Forests and the Quality of the Urban Environment.

# Principles #13 - 21 Reducing Impervious Cover

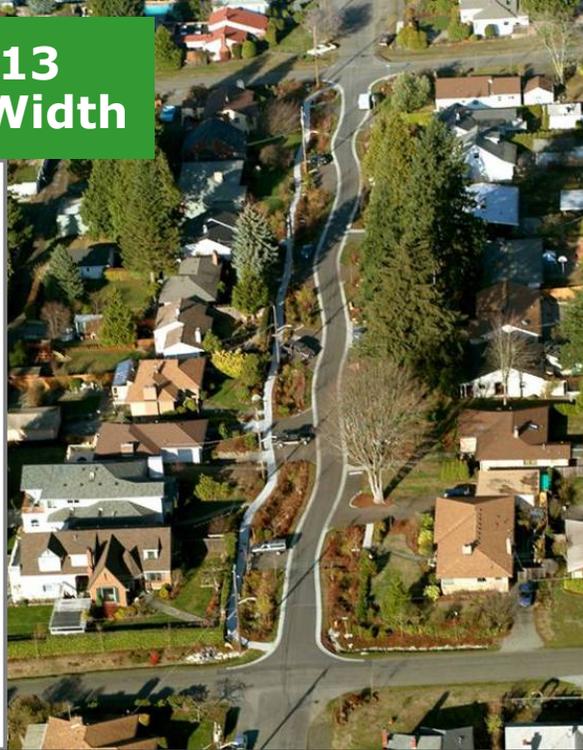
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## PRINCIPLE NO. 13 Reduce Street Width

### Benefits:

- Reduce traffic speeds
- Improve safety
- Reduce impervious cover
- Design for:
  - \* density
  - \* traffic demand
  - \* access
  - \* parking



Excessively wide residential streets can often be attributed to blanket applications of high volume/ high speed highway design criteria applied to local subdivision streets and a perception for the need for on-street parking on both sides and unobstructed access for emergency vehicles. Communities have a significant opportunity to reduce impervious cover by revising their street standards so that street widths are minimized. Residential streets widths should be designed according to traffic volumes while providing adequate parking and access for residents and service, maintenance, and emergency vehicles. Using queuing streets and basing the number of parking spaces created on a per dwelling unit system are two techniques that have been implemented to address concerns about narrow streets. Several national engineering organizations have recommended residential streets as narrow as 22 feet in width (ASSHTO, 1994 and ASCE, 1990).

AASHTO 2004	Minimum width of traveled way (ft) for specified design volume (vehicles/day)		
	Design speed (mph)	Under 400	400 to 1500
15	18	20 <sup>1</sup>	20
20	18	20 <sup>1</sup>	22
25	18	20 <sup>1</sup>	22
30	18	20 <sup>1</sup>	22
40	18	20 <sup>1</sup>	22
45	20	22	22
50	20	22	22
55	22	22	24 <sup>3</sup>
60	22	22	24 <sup>3</sup>
Width of graded shoulder ea. side of road (ft)			
All speeds	2	5 <sup>1,2</sup>	6

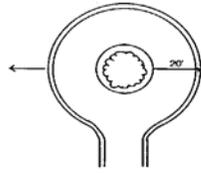
Design according to density and traffic demand - Two references from AASHTO:

- Chart in this slide is from, “A Policy on Geometric Design of Highways and Streets,” AASHTO, 2004.

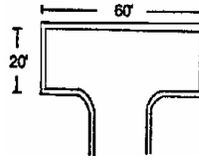
- A chart showing 18-foot width including both traveled way and shoulders for major or minor access, recreational and scenic roads, when speed is 35 mph or less, can be found in, “Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT≤400),” AASHTO, 2001.

## PRINCIPLE NO. 16 Cul-de-Sac Reduction

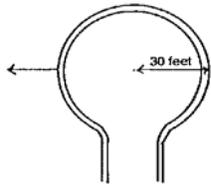
75% less  
impervious  
cover



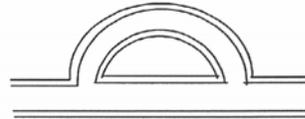
40 FT CUL-DE-SAC  
W/ ISLAND



T-SHAPED  
TURNAROUND



30 FT RADIUS  
CUL-DE-SAC



LOOP ROAD

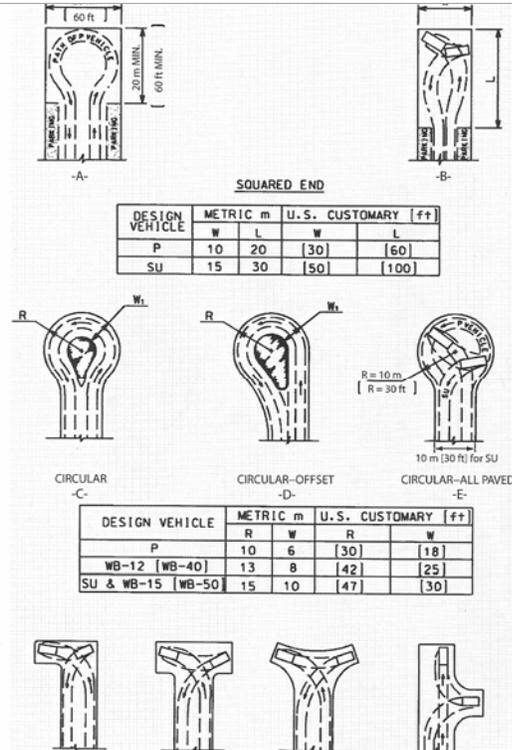


Alternative turnaround options include a loop road and a t-shaped (also called a hammerhead) turnaround. Loop roads are semi-circular and provide two points of entry and exit, serving twice as many residential units as compared to cul-de-sacs (Bucks County, 1980). Hammerheads generate 75% less impervious cover than a 40 foot cul-de-sac but are generally only applied when streets are less than 200 feet long or when lot sizes are very large.

## Local codes

### Research

- Use AASHTO\* guidelines— County and State use AASHTO, therefore town should
- \*American Association of State Highway and Transportation Officials



- HREP staff interviewed Dutchess County Highway Senior Engineer.
- He said that AASHTO is the standard for the county and NYS.
- Towns can update their Highway Specifications in accordance with what the County and State recommend.
- Note: Town of Pine Plains is updating their Highway Specifications

## PRINCIPLE NO. 17 Sidewalk Reduction



Reduce impervious surface by using:

- Alternative designs
- One side of street only
- Alternative surfaces

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Most codes require that sidewalks be placed on both sides of residential streets (e.g. double sidewalks) and be constructed of impervious concrete or asphalt. Many subdivision codes also require sidewalks to be 4 to 6 feet wide and 2 to 10 feet from the street. These codes are enforced to provide sidewalks as a safety measure. However, rather than enforcing rigid requirements across the board, developers should design sidewalks with the goal of improving pedestrian movement and diverting it away from the street.

Communities may wish to consider allowing sidewalks on only one side of the street or eliminating them where they don't make sense. Communities should also consider reducing sidewalk widths to 4 feet and placing them further from the street. In addition, sidewalks should be graded to drain to front yards rather than the street. These alternatives will reduce impervious cover or mitigate its effects while still providing practical, safe, and attractive travel paths.

## PRINCIPLE NO. 18 Driveway Reduction: Alternative & Shared Driveways



Reduce stormwater management costs through:

- Shorter driveways
- Permeable materials
- Flat areas ideal

Most local subdivision codes are not very explicit as to how driveways must be designed. Most simply require a standard apron to connect the street to the driveway but do not specify width or surface material for driveways. Typical residential driveways range from 12 feet wide for one car driveways and 20 feet for two. Shared driveways are discouraged or prohibited by many communities.

Shared driveways can reduce impervious cover and should be encouraged with enforceable maintenance agreements and easements. Secondly, the typical 400-800 square feet of impervious cover per driveway can be minimized by specifying narrower driveway widths, reducing the length of driveways and front setbacks (see principle #13), and providing incentives for permeable paving materials.

## PRINCIPLE NO. 20 Shared Parking



Use most of the parking spaces most of the time

Pilot project research:  
2 Model Shared Parking Agreements

**Many communities often determine minimum parking ratios by adopting and modifying requirements of neighboring communities or by using the Institute of Transportation Engineers information publication. In many cases, these parking ratios are excessive and there are no set maximum parking ratios. The fear of complaints and loss of customers, as well as the requirements for commercial loans are disincentives for setting maximum parking ratios. As a result, many parking lots are often fully utilized only for a few hours each year.**

**Communities should check their codes to make sure that the minimum and maximum number of spaces required is consistent with the demand for uses. By referring to a wide range of national, regional and/or local studies as opposed to just one source, communities can evaluate their parking needs more accurately, thereby reducing the need to create unnecessary parking spaces. This type of assessment can reduce construction and stormwater management costs.**



## PRINCIPLE NO. 21 Parking Lot Design Standards

While reducing the number of parking spaces created is essential to reducing the amount of impervious cover, reducing the size of standard parking stall dimensions is another opportunity. Parking lots can also be reduced by minimizing standard parking dimensions in length and width, amending parking codes to require a fixed percentage for compact cars, and requiring designation of spillover parking areas using alternative paving materials. Some real challenges to these techniques are that there is an increasing trend toward larger sports utility vehicles and the performance of alternative pavements is not well documented. In addition, construction costs for alternate pavers are generally greater than conventional surfaces, but the reductions in stormwater management and storm drainage construction and maintenance may offset those costs.

# **Principles #22 - 28 Source Control for Stormwater Management**

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Curb and gutter systems are required for many jurisdictions, particularly in medium to high density residential projects and sometimes even in low density residential projects. While curb and gutters allow the quick transport of stormwater, it does not provide treatment of the stormwater which is often polluted from vehicle emissions, pet waste, lawn runoff, etc.

Open vegetated channels remove pollutants on site by allowing infiltration and filtering to occur, unlike curb and gutter systems which move water with virtually no treatment. Engineering techniques have advanced the roadside ditches of the past which suffered from erosion, standing water and break up of the road edge. Grass channels and dry swales are two such alternatives and with proper installation under the right site conditions, they are excellent methods for treating stormwater on site. In addition, open vegetated channels can be less expensive than curb and gutter system.



(c) DRY SWALE



(d) WET SWALE

Dry Swale –

- Good for residential areas
- Prevents standing water that makes mowing difficult and generates complaints

**PRINCIPLE NO. 23  
Bioretention &  
Raingardens**

Landscaping  
specs &  
Native Plant  
Guide →

New York State  
Stormwater  
Management  
Design Manual  
October 2001

**NYS Stormwater Regs/  
Better Site Design Overlap**

Although parking lots are a significant source of stormwater pollution, not all communities do not require developers to provide stormwater quality control. In addition, opportunities to minimize the amount of stormwater runoff generated or to manage runoff are often overlooked. Parking lots can be made more attractive and provide stormwater management. Bioretention areas, dry swales, perimeter sand filters, and filter strips, are some of the different strategies that can be used to treat stormwater before it enter our streams.

**PRINCIPLE NO. 23**  
**Bioretention &**  
**Raingardens**



Under  
construction



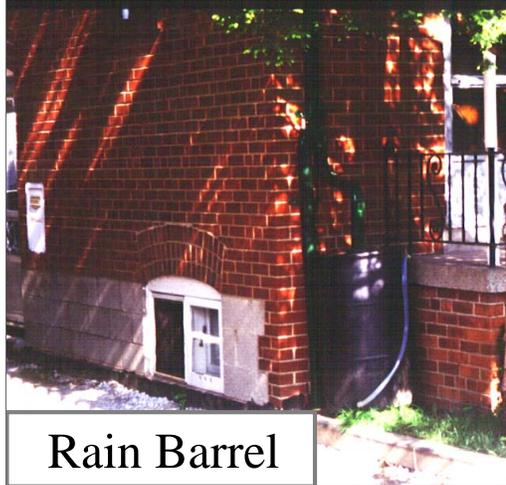
Completed

# PRINCIPLE NO. 23 Bioretention & Raingardens



•Rockland  
County Park  
– boy scout  
project

## PRINCIPLE NO. 24 Rooftop Runoff Mitigation – Direct Rooftop Runoff to Pervious Areas



Rain Barrel



Rain Garden

Often, code requirements discourage the storage and treatment of rooftop runoff on individual lots, thus bypassing opportunities to promote bioretention and infiltration. Most subdivision codes require that yards have a minimum slope to facilitate drainage away from house foundations for fear of nuisance ponding, basement flooding, or ice formation on driveways or sidewalks.

Sending rooftop runoff over a pervious surface before it reaches an impervious one can decrease the annual runoff volume from residential development sites by as much as 50%. Some possible techniques to encourage treatment of rooftop runoff on-site include directing flow into BMPs (infiltration swales, infiltration trenches, or dry wells), encouraging sheet flow through vegetated areas, directing runoff to depression storage areas, or using a rain barrel.



We talked yesterday about Better Site Design Techniques to reduce impervious area, such as narrower streets, reducing cul-de-sacs, and reducing parking. Today we will show how this reduced impervious area is important when planning a site design for stormwater management.

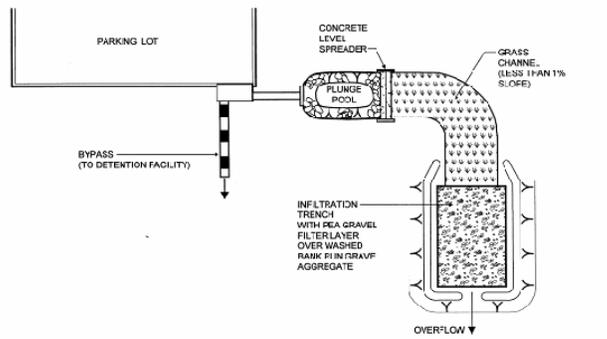
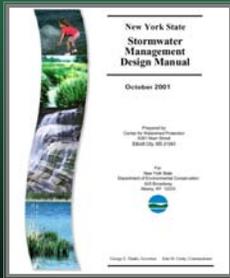
# PRINCIPLE NO. 25 Infiltration

Don't use in "hot spot"  
land uses

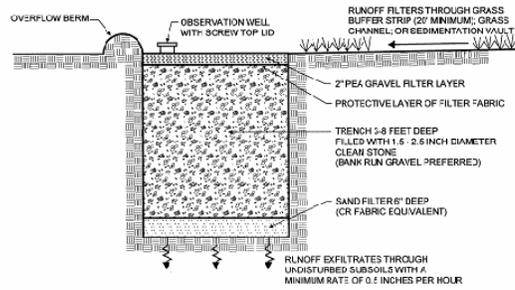
## NYS Stormwater Regs/ Better Site Design Overlap



# PRINCIPLE NO. 25 Infiltration



PLAN VIEW



SECTION

## PRINCIPLE NO. 25 Infiltration



Use permeable pavers:

- Low-traffic areas
- Overflow parking

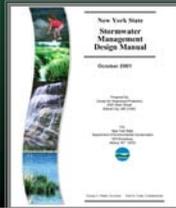
**PRINCIPLE  
NO. 25  
Infiltration**

Permeable pavers:  
•Flat areas ideal



## PRINCIPLE NO. 27 Stormwater Ponds & Wetlands

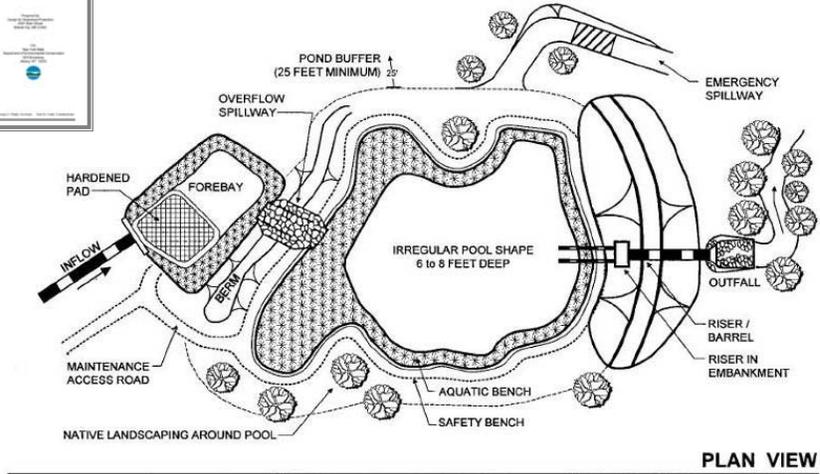
- **Goal #1:**  
Ecologically  
functioning  
system -  
plants help  
remove  
pollutants



Landscaping specs &  
← Native Plant Guide

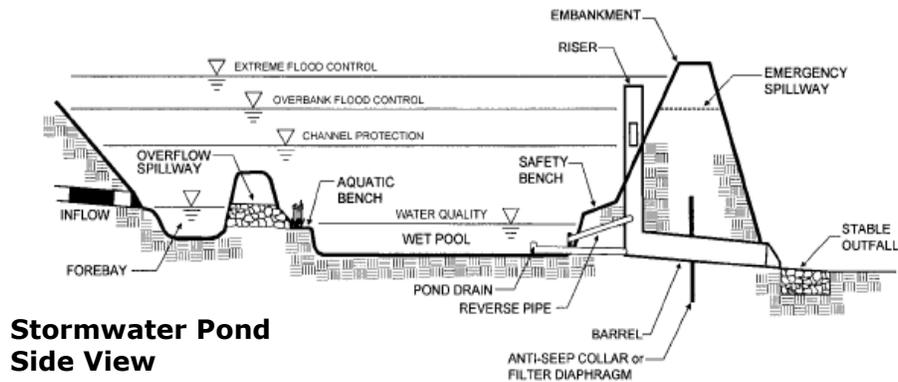


Figure 6.2 Wet Pond (P-2)



## Stormwater Ponds & Wetlands

- **Goal #2: Flood control - nested volumes:**
  - Extreme (100-year) flood control
  - Overbank (10-year) flood control
  - Channel protection (detain 1-year storm)
  - Water quality



**Stormwater Pond  
Side View**

**How do we integrate these  
principles  
into municipal codes?**

*Conduct a Better Site Design  
Roundtable  
(later this morning)*

NYS Department of Environmental Conservation





## Summary

Improve our development projects and communities with Better Site Design:

- Preserve undisturbed areas
- Reduce impervious cover
- Use pervious areas for stormwater treatment
- Achieve a marketable, cost-effective product

NYS Department of Environmental Conservation



**Barbara Kendall**  
**NYSDEC - HREP**  
**(845) 256-3163**



**21 South Putt Corners Rd**  
**New Paltz, NY 12561**



**NYS Water  
Resources Institute**

**[blkendal@gw.dec.state.ny.us](mailto:blkendal@gw.dec.state.ny.us)**



**<http://www.dec.ny.gov/lands/42053.html>**

NYS Department of Environmental Conservation

