Created Wetlands in Green Infrastructure, Why Not a Greater Role?
Learning Objective

Awareness of why Stormwater Wetlands should be considered Green Infrastructure
First a bit of History
we are familiar with this circle of hydrology
WATER CYCLE WE WORK WITH

Runoff is Low, Groundwater and Base Flow Benefits

Runoff is High, Groundwater and Base Flow Reduced

Characteristics of Stormwater Runoff
the difference may be >45% and

This Simply Means:

• Runoff from 1 acre of parking is equivalent to 16 times more stormwater than from 1 acre of meadow (Schueler, 1994)
• Increased flows mean more bankfull streams with greater discharges and subsequent increased erosion and stream channel enlargement (Hollis and Schueler, 1994)
The Water Cycle We Work With

Runoff is Low, Groundwater and Base Flow Benefits

Runoff is High, Groundwater and Base Flow Reduced

Uncontrolled Stormwater Runoff is no longer acceptable
Stormwater Management Design Manual

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David A. Paterson, Governor
Pete Grannis, Commissioner
Since 2011, Stormwater Management Planning has emphasized a holistic approach toward resource protection, water quality treatment, flow volume control, and long term maintenance cost reduction.

The term ‘Green Infrastructure’ is now incorporated into the planning process along with the term ‘Runoff Reduction’ (RRv).

This has introduced a wide array of possible practices at multiple scales to manage and treat stormwater, maintain and restore natural hydrology and ecological function by infiltration, foster evapo-transpiration, capture and reuse stormwater, and protect and establish vegetation features in the landscape.
Stormwater Management – 5 Steps

• Implement Sensitive Site Planning
  – Identify natural resources, drainage patterns
  – Devise strategies for protecting/restoring resources

• Find Water Quality treatment volume (WQv)
  – Calculate required WQv for basic site design

• Reduce runoff through green infrastructure
  – Experiment with green infrastructure techniques that reduce site area required for standard SMP’s by applying RRv capacities for each on a site

• Apply standard stormwater management practices
  – Use standard SMP’s to meet remaining needs for WQv

• Establish runoff volume and peak rate control
  – Apply channel protection volume, overbank flood control, and extreme flood control requirements
Stormwater Site Planning and Practice Selection

Step 1: Site Planning (Requires Consideration of the Following to MEP)

A. Conserve Natural Areas
   1. Preservation of Undisturbed Areas
   2. Preservation of Buffers
   3. Reduction of Clearing and Grading
   4. Locating Development in Less Sensitive Areas
   5. Open Space Design
   6. Soil Restoration

B. Reduce Impervious Cover
   1. Roadway Reduction
   2. Sidewalk Reduction
   3. Driveway Reduction
   4. Cul-de-sac Reduction
   5. Building Footprint Reduction
   6. Parking Reduction

Step 3: Reduce Runoff by Applying Green Infrastructure Techniques and SMP’s

1. Conservation of Natural Areas
   8. Build Stormwater Planters
2. Sheetflow to Buffers or Filter Strips
   9. Install Rain Barrels or Cisterns
3. Use Vegetated Open Swales
   10. Build Green Roofs
4. Install Planting / Tree Boxes
   11. Install Porous Pavements
5. Disconnect Rooftop Runoff
   12. Use Standard SMP’s Infiltration, Bioretention and Dry Swales
6. Daylight Original Streams
7. Build Rain Gardens
Stormwater Site Planning and Practice Selection

Step 4. Apply Smp’s for Remaining WQv
1. Stormwater Ponds
2. Stormwater Wetlands
3. Filters
4. Infiltration
5. Open Channels

Step 5. Apply Volume and Peak Rate Control
1. Infiltration
2. Dry Detention
3. Blue Roofs
4. Underground Storage

The practices in Steps 1 and 2 are good site planning techniques. Some can be achieved through environmentally sensitive design. Others require buy in by developers, planning boards, and departments of transportation.

Step 3 references practices to reduce runoff volumes (RRv)

Steps 4 and 5 reference stormwater wetlands but only for control of remaining water quality (WQv) and runoff volume and rate control thereby potentially missing the point for what the wetlands can actually accomplish.
One Uses Green Infrastructure to

- Reduce runoff volume, peak flow, flow duration
- Slow runoff flow to increase time of concentration (Tc) and promote runoff infiltration and evapo-transpiration
- Improve groundwater recharge and discharge
- Protect downstream water resources (streams, wetlands)
- Reduce downstream flooding
- Reduce combined sewer overflows (CSO’s)
- Provide water quality improvements
- Reduce thermal pollution in receiving watercourses
- Improve wildlife habitat

and plants may even play a major role
Green Infrastructure Features That Wetlands Perform

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and Plants Really Perform a Major Role
Historical Note

Previous stormwater management regulations allowed for the implementation of green infrastructure practices for redevelopment projects, generally urban sites where land is limited for other actions.

Now the stormwater management regulations require the use of green infrastructure practices in all development.
one must wonder why stormwater wetlands have now taken on what appears to be a rather secondary role
have we forgotten that Stormwater Wetlands really are the Original Green Infrastructure?
to many people wetlands present an air of mystery and to some are even places of muck and yuck
wetlands provide multiple functions and values all key components of Green Infrastructure
wetlands are original green infrastructure with added values
or is it that
the stormwater manual has created a framework for a non-functioning ecosystem
Manual’s Examples of Ponds / Wetlands

in plan view they appear appropriate
24 hour detention for 1 year storm

Permanent Pool

Basin fills +5 feet in 1 year storm, 2 feet in < 0.1 foot of rain. Is it a sustainable ecosystem?

Example in Manual

3" Dia outlet pipe

Wow
Approach to the basin site

Steep outside

In 2012 the slope and fence line have grown in screening views into the basin but the system does not function as a natural system.

Steep inside

Residential site water quality / detention basin

Shallow pool, fish or mosquito habitat?
or is it that
engineers and landscape architects really do not feel comfortable building stormwater wetlands
stormwater management 2012

stormwater planters, bioretention basins, porous pavement, roof gardens, open swales, too

Rain Barrels and Cisterns

Rain Gardens
In many instances stormwater management functions from the engineering point of view but plans have not considered the potential to be an integral part of the site plan and not just be technical features in the back lot area.
Sheet flow to swales then flow to bioretention basins then flow to dry pond for peak flow control. The numbers work but the system lacks something.
Shallow pockets in surface of dry pond hold water for periods.

The Bioretention Basins hold water when area has extended dry period.
summer heat and shallow standing water leads to mosquitoes all with the potential for several diseases
One needs to repeat that Wetlands are original Green Infrastructure,

- Reduce runoff volume, peak flow, flow duration
- Slow runoff flow to increase time of concentration ($T_c$) and promote runoff infiltration and evapo-transpiration
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- Reduce thermal pollution in receiving watercourses
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with a Stormwater Wetlands focus
It’s a created wetland built to specific standards.
Wetland plants grow in hydrology based zones

SATURATED ZONE
WATER 0–6 INCHES
BURREED, BULRUSH, SEDGES, CATTAIL, THREE SQUARE, SPIKE RUSH, GRASSES, MAY BE SEASONALLY DRY

DRAW DOWN ZONE
WATER 6–12 INCHES
CATTAIL, WATER LILY, SPIKE RUSH
PICKEREL WEAKE, SUBMERGENTS
USUALLY WET OR SATURATED, BUT SOMETIMES MAY BE DRY

NORMAL (PREDICTED) WATER LEVEL
WATER LEVEL AT DRY SUMMER PERIOD

DEEP WATER ZONE IN POND SYSTEMS
PONDWEEDS

PERMANENT WATER ZONE
WATER 12–18+ INCHES NORMAL
DUCK POTATO, PONDWEED, COONTAIL
WATER LILY, BLADDERWORT, DUCKWEED
MILFOIL, AND OTHER SUBMERGENTS
IN DRY SEASON OF YEAR MAY HAVE WATER DEPTH OF 4–6 INCHES

SEASONAL SATURATION ZONE
WATER FRINGE TO SEASONALLY MOIST SOIL;
SWEET FLAG, WILD IRIS, GRASSES, SMARTWEED, BEAK RUSH, PATH RUSH, FERNS, SHRUBS, WILDFLOWERS, AND SEDGES. NOTE — WILL BE SEASONALLY DRY

UPLAND SLOPE FRINGE
SEASONALLY MOIST LOWER SLOPE – MIXED HABITAT

NOTE: WIDTH OF THE SEVERAL PLANT ZONES IS DEPENDENT UPON SITE SLOPES AND SEASONAL WATER LEVEL CHANGES WITHIN WETLAND OR POND. WIDTH OF SHALLOW SHELF SHALL BE 8–15’ AT WET PONDS AS PLANT FILTERS AND FOR CHILD SAFETY

NOTE: IN GENERAL 25 PERCENT OF CREATED WETLAND SHELF AREA IS PLANTED TO CLUMPS OR QUART SIZE CONTAINER STOCK. PLANT SPACING IS 18”OC IN CLUSTERS WITH GROUPS OF SPECIES SET IN A RANDOM PATTERN ACROSS WETLAND SURFACE.

TYPICAL WET POND/WETLAND SECTION
SHOWING LOCATION OF VEGETATION ASSOCIATIONS
DETAIL NOT TO SCALE

Wetland plants grow in hydrology based zones
Plants make the wetland function well.
Stormwater wetlands can be designed to be displays that mass native species for seasonal color and aesthetic interest but must work with the water regime
WETLAND SECTION

EXAGGERATED SCALE

WETLAND SURFACE AREA RAISED ABOVE NOMINAL WETLAND SURFACE

DRAINAGEWAY IN WETLAND BELOW NOMINAL SURFACE

DISPLAYS DESIRED HUMMOCK AND HOLLOW FEATURES FOR VIABLE WETLAND HABITAT

SEASONAL HIGH WATER LEVEL IN WETLAND

SEDGES, GRASSES, FLOWERS

CATTAILS RUSHES

ISLAND IN WETLAND FOR SHRUB GROWTH

SHRUB GROWTH

BOULDER

DRAINAGEWAY IN WETLAND BELOW NOMINAL SURFACE

NOMINAL OVERALL GRADIENT ACROSS WETLAND TO OUTLET
(ALKSO MAY BE CALLED NORMAL WATER LEVEL OR THE MID-SUMMER WATER SURFACE)

NOT TO SCALE
Operational Guidelines for Creating Self-Sustaining Stormwater Wetlands

• Consider hydrogeomorphology, ecology and climate
• Adopt a dynamic landscape perspective for the design
• Know that stormwater contains nutrients and pollutants
• Develop naturally acting variable wetland hydrology
• Avoid over-engineered structures in the design
• Provide appropriate micro-topographic basin features
• Pay attention to subsurface soils and its structure
• Select appropriate surface soils for plant growth
• Know if invasive or aggressive species are in watershed
• Consider impacts of seasonal groundwater elevations
• Mitigate complications of disturbed/degraded sites
• Conduct monitoring as part of system management
Viable Stormwater Wetlands Have

- Cyclical patterns of inundation / drawdown
- Water level changes <6” in >90% of storm events
- Design flexibility to mimic natural wetland values
- Higher sediment loading than natural wetlands
- Sediments that are enriched with pollutants
- Natural growth often from a limited seed bank
- Potential for aesthetic opportunities in site plan
Viable Stormwater Wetlands

- Capture and Treat stormwater runoff volumes
- Pretreat runoff before reaching wetland (forebays)
- Create diversity of depth zones in the ecosystem
- Establish a diverse and dense plant community
- Create a functioning natural buffer zone (+25’?)
- Provide habitat features that attract wildlife
- Have physical features that help control vectors
- Function with preventative maintenance features
- Are focused to be built in disturbed/altered sites
Now Stormwater Wetland Examples

not recent stormwater wetlands but work tested by time
Stormwater Wetlands as Gardens

Understanding basic features of wetland hydrology and knowing how stormwater runoff functions one can establish landscape ecosystems with surface elevations and selected plant materials that will grow in permanently aquatic, seasonally inundated, or even a transitional runoff reflective space. The created ecosystem will be functional as well as have potential for aesthetic value.

Example 1
Stormwater wetland rain garden watercourse and basin functioning as an aesthetic site feature receiving, cleansing, and controlling stormwater runoff from a condominium.
Site
Greater than 50% green or blue

Key Feature
site plan configured using stormwater systems as primary elements in the overall design

Older design that seems to meet a frame for 2012, with a record of what occurred over time

Example 2
1977-1978

Pond and wetland designed to filter and control site runoff up to the 100 year storm event.
Runoff is Reduced, Groundwater and Base Flow Benefit

Corporate land use continues within what has become a viable, natural habitat niche around stormwater management pond and wetland

Green Infrastructure?

20+ years later
We must remember that stormwater ponds and wetlands designed to reduce runoff volume, foster infiltration and evapotranspiration, and improve water quality can be fully coordinated with site engineering and an owner's plans. Should they not be called Green Infrastructure?
2010 – 30+ years later

owners goals achieved and pond and wetland remains
Created Stormwater Wetlands

Laboratory of Ornithology

Dryden, Lansing, Ithaca, New York
Display of the Site Plan

MULTIPLE PATHWAYS
BASED UPON SURFACE FLOW

EXISTING / RESTORED
WETLAND SYSTEM
RUNOFF BIOFILTERS

CONSTRUCTED
WETLAND
RUNOFF
BIOFILTER
BASINS

WET MEADOW
DEPRESSION
RUNOFF FILTER

VEGETATED FOR
SURFACE FLOW

GRAVEL PAVED
PARKING SPOTS

PAVED SITE
DRIVEWAYS

CONSTRUCTED
WETLAND
RUNOFF
BIOFILTER

WILDLIFE
POND

BUILDING

OUTFALL TO POND

SITE DESIGN BY SUSAN CHILD

Stormwater Management
From day 1 parking lot, drive, roof runoff wind up here
To enter the building you must cross the wetlands
After filtering through wetland water flows under bridge
Then flows in outlet channel connecting to wildlife pond
Site starting to grow in 2002
Now a quick jump in time to 2009
Stormwater wetland and also a key site design feature is this not Green Infrastructure displayed?
Can stormwater wetlands include habitat features?

why not have some fun
BOULDERS AND SMALLER STONE FOR INTERSTICE AREAS
SHALL BE SUPPLIED FROM A LOCAL QUARRY SOURCE AND
SHALL BE MATERIALS INDIGENOUS TO THE LOCAL AREA.

NATURALISTIC BOULDER GROUP EDGE
RESTORES STABLE FRINGE, ANGLED FACE
STONES AT 1 ON 1.5 MAXIMUM

STORM RETENTION LEVEL
From Top of Log Weir

NORMAL WATER LEVEL
IMPOUNDMENT LEVEL BELOW WEIR ENABLES INFILTRATION AND/OR
EVAPOTRANSPIRATION

WETLAND ELEVATION

NATIVE SPECIES PLANTINGS
OF MEADOW GRASS, FIELD
FLOWERS, AND SHRUBS

FLOW FROM A NUMBER OF UPPER ELEVATIONS
APPROXIMATE ELEVATION = 1073

FILTER FABRIC UNDER BOULDERS

RUN OF CRUSHER STONE FILL BETWEEN
AND UNDER BOULDERS

2’ MIN. DEPTH
“When you design we of the sensitive Natural World challenge you from the world of developed and modified landscapes to think of us, think of what you could do, and then plan stormwater management with sensitivity”

A. Frog
Stormwater Wetlands / Green Infrastructure

Photos and Graphics
Donald Ferlow, GHD, and public sources
NYS Stormwater Management Manual

The End