Stormwater and Ecological Management Opportunities May 2008



2008 NEWARK CAMPUS CAPACITY STUDY



AYERS | SAINT | GROSS







University of Delaware Newark Campus

Stormwater and Ecological Observatio

- Unique geologic setting on fall line (divide between Piedmont and Coastal Plain)
- Two major watersheds (White Clay Creek and Christina River)
- Opportunities to reestablish and improve north/south "green" corridor
- Opportunities to develop integrated stormwater management to both improve existing conditions and address future growth



White Clay Creek / Laird and Main Campuses



White Clay Creek / Laird Campus

- Significant erosional features due to uncontrolled or inadequately controlled runoff
- Large student parking lot is source of many impacts which need to be addressed
- New dorms have missed several landscape opportunities to provide integrated stormwater management
- Existing best management practices are mix of good bad and ugly
- Stormwater management has challenges with steeper Piedmont setting





Christina River / South Campus







Stormwater and Ecological Analysis Overview

South Campus

- Several existing BMPs in place but abundant other stormwater management opportunities
- Coastal Plain setting provides opportunities to infiltrate. Flatter slopes means areas may stay wetter longer.
- Research forest somewhat impacted due to uncontrolled runoff
- Opportunities to work with neighbors to east to create vegetated buffer
- Create buffers along streams and wetland areas
- Make pathway and ecological corridor connections to main campus
- Look to daylight conveyances and incorporate more vegetated swales and depressional areas for water quality treatment and recharge





From GIS base maps analyses were performed

Streams and floodplains were mapped and forest patches >25 ac were identified



Forested areas were visited

Qualitative plot data was taken (see points)

Scores were tallied

Using the scores, areas were statistically ranked based on ecological value: Red = high value, Yellow = medium value, Green = low value



Green areas, with low scores, are more suitable for development.

Yellow areas are more intact and valuable areas, where development should be carefully considered

Red areas are more ecologically valuable and less suitable for development



Areas 1 and 2 support the most ecologically intact forest investigated







Areas 3 and 4 contain Fairfield Run and Blue Hen Creek. Both streams are heavily impacted by stormwater. These areas directly affect water quality in White Clay Creek.







Area 5 is a relatively isolated fragment of forest, the channel of the stream which flows through it is deeply incised and eroded.



Areas 6 and 7 have qualities which enhance their ecological value such as older forest canopy trees and wetland areas.

Stormwater Management Zones

- Laird Campus Zone
- Central Campus Zone
- Athletics Zone
- Agriculture Zone
- Facilities and Biotech Park Zone

Laird Campus

Green Infrastructure Opportunities

Stormwater curb extensions

Streets

St

Stormwater tree pits

Permeable pavers

Infiltration

Filter Strips

Grass swales

Existing Conditions

Proposed Conditions

Curb Extension – Stormwater Planter

Existing Conditions

Proposed Conditions

Curb Extension – Stormwater Tree Pit

Existing Conditions

- There are examples across campus of good management and runoff control/treatment practices.
- At the Dickinson Complex curb cuts allow runoff to enter a rain garden/bioretention area.

Bioretention/Rain Garden

Stormwater planters

Detention

Infiltration Trench

Cisterns

Grass channel/ Filter Strip

Regenerative Stormwater Conveyance

Laird Campus Zone

Rooftops

Existing Conditions

Proposed Conditions

Linear bioretention/ Bioswale

Regenerative Stormwater Conveyance

Grass channel/ filter strip

Bioretention islands

Infiltration

Permeable pavers

Reforestation/ impervious cover removal

Parking

Existing Conditions

Proposed Conditions

Permeable Pavers

Perimeter Sand Filter

Existing and Proposed Conditions

 Retrofitted curb cuts have been implemented, offering some benefit. However, in some cases they are not well designed or maintained for optimum treatment.

Proposed Conditions

Linear Bioretention

Existing Conditions

Proposed Conditions

Linear Bioretention

Existing Conditions

Proposed Conditions

Regenerative Stormwater Conveyance

Preliminary Opportunities

- Stormwater Retrofits (LR)
- Stream/Outfall Repair (LS)
- Invasive Plant Removal (LI)

Preliminary Opportunities

Laird Campus (Laird, Dickinson, Rodney) Stormwater Retrofits (LR-X)					
Site ID	General Location	Representative Opportunity	Relative Cost		
LR-1	Sorority Parking Dry Pond	Wetland Creation/Enhancement	\$\$		
LR-2	Laird Campus Resident Lot	Linear Bioretention/ Permeable Paver	\$\$ - \$\$\$		
LR-3	Laird Campus Resident Lot	Linear Bioretention/ Permeable Paver	\$\$ - \$\$\$		
LR-4	Hollowell Drive Outfall	Stormwater Wetland	\$\$\$		
LR-5	Dallam Road	Curb Extension - Stormwater Tree Pit	\$		
LR-6	Forest Lane	Curb Extension - Stormwater Planter	\$		

Laird Campus (Laird, Dickinson, Rodney) Stream/Outfall Repair (LS-X)

Site ID	General Location	Representative Opportunity	Relative Cost
LS-1	Laird Campus Resident Lot	Regenerative Stormwater Conveyance	\$\$-\$\$\$
LS-2	Christiana Towers Outfall	Regenerative Stormwater Conveyance	\$\$
LS-3	Christiana Towers Outfall	Regenerative Stormwater Conveyance	\$\$
LS-4	George Read Outfall	Regenerative Stormwater Conveyance	\$\$

Laird Campus (Laird, Dickinson, Rodney) Invasive Management (LI-X)

Site ID	General Location	Representative Opportunity	Relative Cost
LI-1	Blue Hen Creek at Hollowell Drive Outfall	Invasive Eradication (multi-flora rose and privet)	\$

\$ < \$30K \$30K < \$\$ < \$100K	\$\$\$ > \$100K
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Central Campus



Green Infrastructure Opportunities







Turf areas







Stormwater curb extensions



Stormwater tree pits



Permeable pavers

Infiltration

Filter Strips

Grass swales

Streets





Infiltration, Bioretention & Stormwater Tree Pits





Curb Extension – Stormwater Planter









Infiltration Trench

Detention

Bioretention/Rain Garden

Stormwater planters

Cisterns



Grass channel/ Filter Strip

Rooftop





Downspout Disconnect to Rainbarrel





Downspout Disconnection to Rain Garden





Green Roof







Linear bioretention/ Bioswale

Perimeter bioretention

Grass channel/ filter strip



Bioretention islands

Infiltration

Permeable pavers

Reforestation/ impervious cover removal

Parking





Existing and Proposed Conditions



 Parking lot behind the Center for the Arts - another example of good management and runoff control/treatment practices.







Bioretention

Turf



Grass channels

Reforestation

Native vegetation





Downspout Disconnection to Rain Garden





Stream Buffer Planting





Detention/ rainwater harvest



Pervious concrete



Permeable Pavers



Stormwater planters/bioswales

Quads





Landscape Conversion: Native Vegetation





Landscape Conversion: Designed Public Use & Rain Garden



Preliminary Opportunities

- Stormwater Retrofits (CR)
- Buffers (CB)

Preliminary Opportunities

Central Campus Stormwater Retrofits (CR-X)				
Site ID	General Location	Representative Opportunity	Relative Cost	
CR-1a	Gilbert Complex	Downspout Disconnection to Rain Garden	\$	
CR-1b	Gilbert Complex	Downspout Disconnection to Rain Garden	\$	
CR-1c	Gilbert Complex	Downspout Disconnection to Rain Garden	\$	
CR-2a	Cannon Hall	Downspout Disconnection to Rain Garden	\$	
CR-2b	New Castle Hall	Downspout Disconnection to Rain Garden	\$	
CR-2c	Sussex Hall	Downspout Disconnection to Rain Garden	\$	
CR-2d	Robinson Hall	Downspout Disconnection to Rain Garden	\$	
CR-2e	Warner Hall	Downspout Disconnection to Rain Garden	\$	
CR-3	Russell Complex	Landscape Conversion	\$	
CR-4	Gilbert Complex	Green Roof	\$\$	
CR-5a	Roselle Center for the Arts	Downspout Disconnection to Rain Garden	\$	
CR-5b	Roselle Center for the Arts	Downspout Disconnection to Rain Garden	\$	
CR-6	Kent Hall Parking	Parking Lot Bioretention Island	\$\$	
CR-7a	Chambers Street	Curb Extension - Stormwater Planter	\$	
CR-7b	Benny Street	Curb Extension - Stormwater Planter	\$	
CR-8	Morris Library	Green Roof	\$\$\$	

Central Campus Stormwater Buffers (CB-X)

Site ID	General Location	Representative Opportunity	Relative Cost
CB-1	Gilbert Complex	Stream Buffer Planting	\$

\$ < \$30K	\$30K < \$\$ < \$100K	\$\$\$ > \$100K

Athletics



Green Infrastructure Opportunities













Rooftop





Bioretention

Stormwater planters

Detention

Infiltration Trench

Cisterns

Grass channel/ Filter Strip

Athletics Zone





Combined Treatment : Cistern & Linear Bioretention

Athletics Zone

Parking

Perimeter bioretention



Bioretention islands

Permeable pavers

Reforestation/ impervious cover removal












Parking Lot Bioretention Island

Athletics Zone







Bioretention



Grass channels



Reforestation

Native vegetation

Athletics Zone





Stream Daylighting

Athletics Zone



- Stormwater Retrofit (ATR)
- Stream/Outfall Repair (ATS)

Athletics Stormwater Retrofits (ATR-X)				
Site ID	General Location	Representative Opportunity	Relative Cost	
ATR-1a	Rust Ice Arena	Cistern	\$\$	
ATR-1b	Rust Ice Arena Parking	Parking Lot Bioretention Island	\$\$	
ATR-2	Carpenter Center Parking	Parking Lot Bioretention Island	\$\$	
ATR-3a	Football Parking	Parking Lot Bioretention Island	\$\$	
ATR-3b	Football Parking	Parking Lot Bioretention Island	\$\$	

Athletics Stormwater Stream/Outfall Repair (ATS-X)

Site ID	General Location	Representative Opportunity	Relative Cost
ATS-1	North of Baseball Drainage	Stream Daylighting	\$\$
ATS-2	North of Track Drainage	Stream Daylighting	\$\$

\$ < \$30K < \$\$ < \$100K \$\$\$ > \$100K

Agriculture



Restoration Opportunities













Stormwater Wetland





Stream Buffer Planting







Stream Buffer Planting



- Stormwater Retrofit (AGR)
- Buffers (AGB)
- Invasive Plant Removal (AGI)

Agriculture Stormwater Retrofits (AGR-X)						
Site ID	General Location	Representative Opportunity	Relative Cost			
AGR-1	Dairy Unit Drainage	Stormwater Wetland	\$			
AGR-2	Worrilow Hall Drainage	Stormwater Wetland	\$			
Agriculture Stormwater Buffers (AGB-X)						
Site ID	General Location	Representative Opportunity	Relative Cost			
AGB-1	East of Dairy Unit	Stream Buffer Planting	\$			
AGB-2	West of Equine Center	Stream Buffer Planting	\$			
AGB-3	North of Equine Center	Stream Buffer Planting	\$			
AGB-4	Neighborhood on East Property Line	Buffer Planting	\$			
Agriculture Stormwater Invasive Management (AGI-X)						
Site ID	General Location	Representative Opportunity	Relative Cost			
AGI-1	Forest Patch North of Equine Center	Invasive Eradication (multi-flora rose)	\$			

\$ < \$30K < \$\$ < \$100K \$\$\$ > \$100K

Facilities and Biotech Park Zone



Green Infrastructure Opportunities













Facilities and Biotech Park Zone

Streets





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Stormwater tree pits

Stormwater curb extensions

Permeable pavers

Infiltration





Grass swales

Filter Strips

Rooftop





Bioretention

Stormwater planters

Detention

Infiltration Trench

Cis

Cisterns

Grass channel/ Filter Strip

Parking



Linear bioretention/ Bioswale







Grass channel/ filter strip

Bioretention islands

Infiltration





Permeable pavers

Reforestation/ impervious cover removal





Bioretention



Grass channels

Reforestation



Native vegetation

Facilities and Biotech Park Zone





Stream Restoration

Facilities and Biotech Park Zone



- Stream/Outfall Repair (FBS)
- Invasive Plant Removal (FBI)

Facilities and Biotech Park Stream/Outfall Repair (FBS-X)					
Site ID	General Location	Representative Opportunity	Relative Cost		
FBS-1	Forest Patch West of Institute of Energy	Stream Restoration	\$\$-\$\$\$		
Facilities and Biotech Park Invasive Management (FBI-X)					
Site ID	General Location	Representative Opportunity	Relative Cost		
FBI-1	Stream West of Institute of Energy	Invasive Eradication (multi-flora rose and privet)	\$		

University of Delaware Restoration Opportunities

- Stormwater Retrofits
- Outfall/ Stream Repair
- Buffer Restoration
- Invasive Plant Species Management



University of Delaware Restoration Opportunities

- Stormwater Retrofits
- Outfall/ Stream Repair
- Buffer Restoration
- Invasive Plant Species Management



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