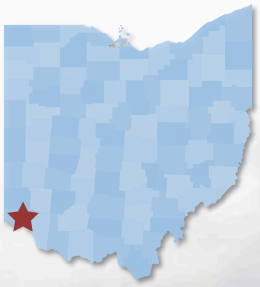
# CLARK MONTESSORI HIGH SCHOOL

## Cincinnati, Hamilton County

***Date Completed:*** 3rd Quarter 2011



***Description:*** Green stormwater controls were included as part of the construction of a new school building for Clark Montessori High School. These included vegetative roofs, pervious pavements, and bioretention facilities.

***Project Size:*** Project area: 11 acres (67% estimated to be impervious surfaces); drainage area approximately 98,900 square feet.

*Below: Clark Montessori High School Intensive Green Roof in Cincinnati*
*(photo: Glaserworks Architecture and Urban Design)*

## ENABLED IMPACT PROJECT UPDATE

# PROJECT: CLARK MONTESSORI HIGH SCHOOL

**PROJECT PARTNER: CINCINNATI PUBLIC SCHOOLS**
**PROJECT STATUS: Nearing Completion**
**CSO BASIN(S): NO. 469**
**WATERSHED: Duck Creek**

PROJECT GROUNDWORK
your pipeline to clean water

### *PROJECT LOCATION*

The project is located on Erie Street, east of downtown Hyde Park in Cincinnati, Ohio

### *SITE DESCRIPTION*

**Project size/setting:** The project area is 11 acres, of which 67% is estimated to be impervious surfaces. The school is located in an urban residential setting and is a re-build of an existing school.

**Drainage area to green infrastructure:** The drainage area is approximately 98,900 square feet.


### *GREEN INFRASTRUCTURE FEATURES*

Construction of a new school presented an opportunity to incorporate multiple green stormwater controls. The local community is also very supportive of environmental projects.

**Vegetative Roofs**

Two vegetative roofs were installed at Clark: 9,200 sq. ft. of intensive roof and 5,500 sq. ft. of extensive roof. Both are layered rather than tray systems. The intensive roof, which can be accessed on foot from an adjacent hillside, includes a permanent sub-surface irrigation system.

**Pervious Pavements**

Two types of pervious pavements were installed, including 13,000 square feet of porous concrete and 2,000 square feet of permeable pavers. There are no underdrains beneath these items.

**Bioretention Facilities**

Two bioswales, three stormwater planters, and one rain garden were installed on the school grounds. None of these features were installed with underdrains due to sandy soils encountered during construction.

### *MSD FUNDING*

Design: $68,115

Construction[2]: $714,469

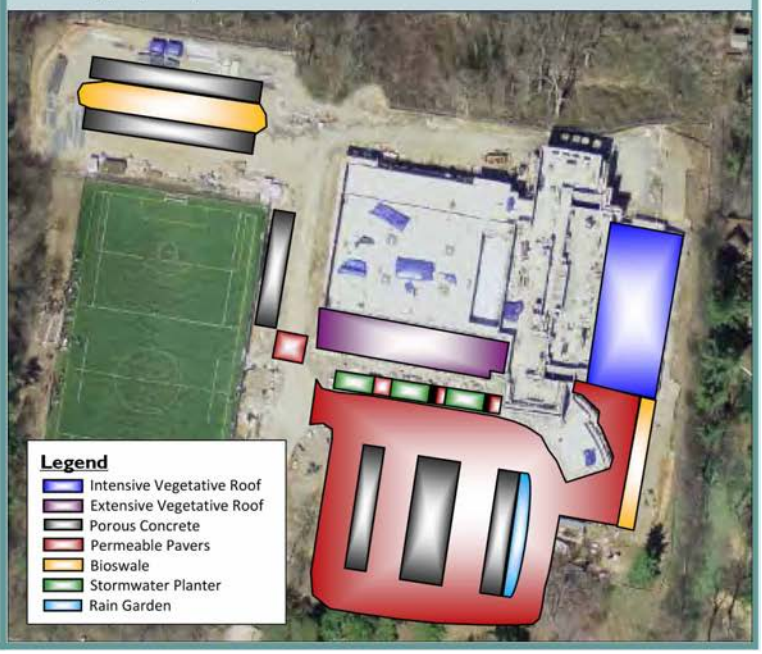
The MSD-funded share for construction of the green stormwater control for this project represents 7% of the total school construction cost[2].

### *PROJECT BENEFIT*

The project demonstrates the use of green controls in an urbanized educational institution setting. The features are highly visible to students, staff, and visitors to the school. The estimated annual volume of captured runoff is up to 1,875,000 gallons based on the typical year[1]. The estimated construction cost per captured gallon is $0.39.

### *MONITORING*

MSD partnered with USEPA to install monitoring equipment in various BMPs. Water content and temperature sensors were installed in the porous concrete in the northwest parking lot. EPA has also installed monitoring equipment in the bioswale bioswale in the same parking lot to measure water content there. The EPA performance data will be shared with MSD. Once the project construction is complete, seasonal site inspections will be conducted quarterly to assess long-term viability of the green controls and to identify potential operation and maintenance issues. Site visit will also be conducted after high intensity wet weather events to assess performance of the controls and, where appropriate, overflow structures.



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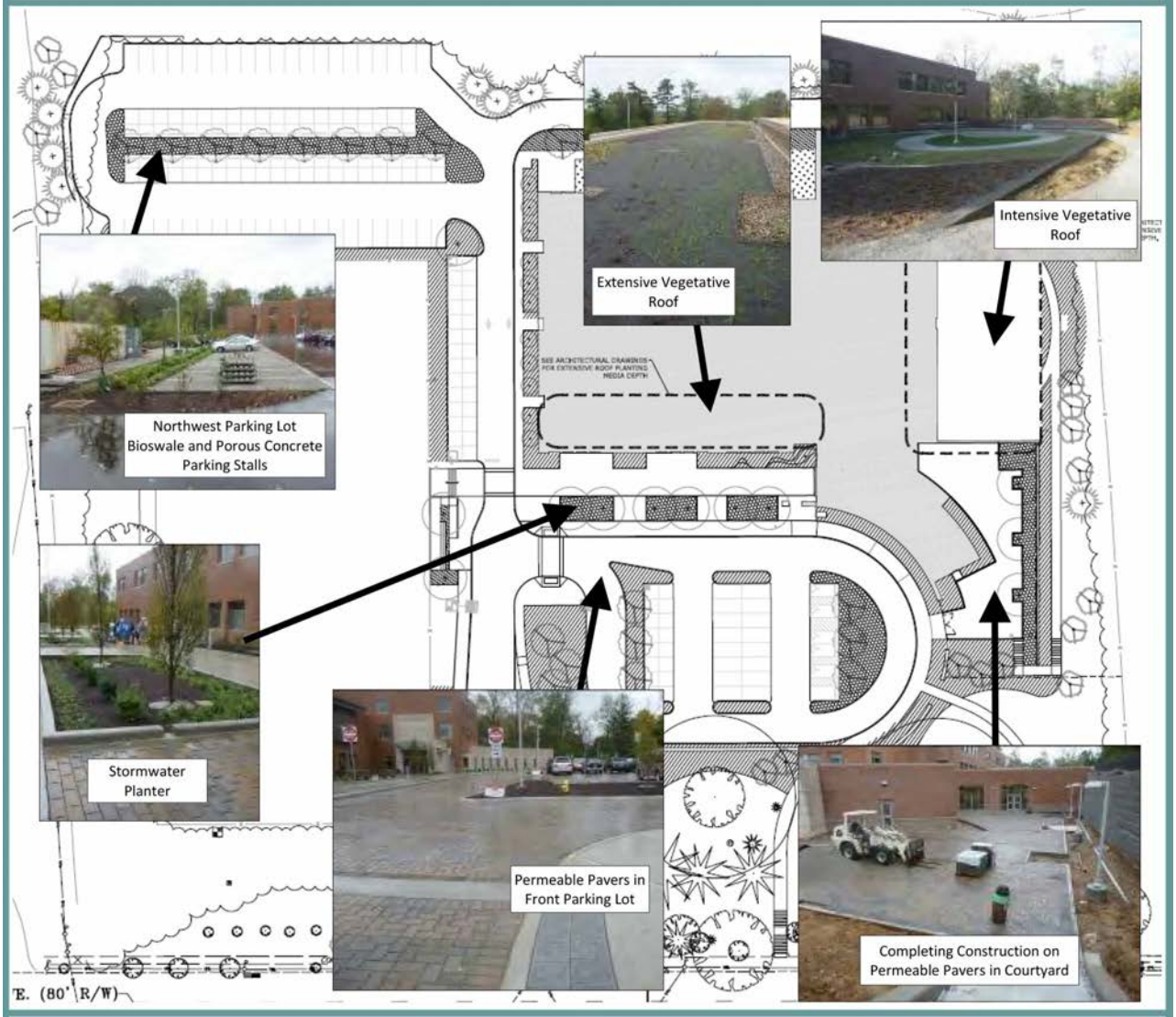
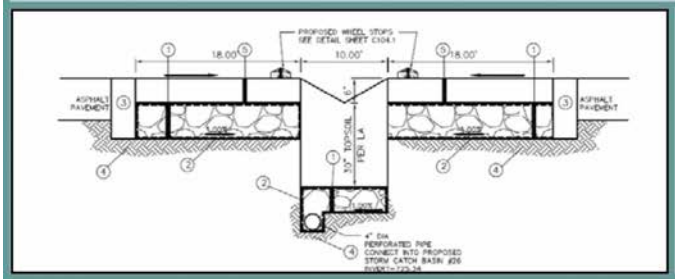
PROJECT GROUNDWORK
your pipeline to clean water

### Clark Montessori Site Plan




### Cross Section of Porous Concrete and Bioswale




The porous concrete was poured without a permanent curb between the concrete and the bioswale. This was done to allow runoff to flow directly into the sub-surface of the bioswale after infiltrating through the porous concrete parking stalls. Wheel stops are used in place of a curb to stop cars from driving into the bioswale and compacting the soil. During construction, the perforated pipe was installed, but not connected to the downstream catch basin, as the soils were sandy enough for full infiltration of the runoff.

For more information about Project Groundwork, the Enabled Impact Program, or this project please email MaryLynn Lodor, Environmental Programs Manager at: MaryLynn.Lodor@cincinnati-oh.gov .

**ENABLED IMPACT PROJECT UPDATE**

## PROJECT: CLARK MONTESSORI HIGH SCHOOL

**PROJECT PARTNER: CINCINNATI PUBLIC SCHOOLS**

***Lesson Learned: Vegetative roofs should be planted after all other roofing is complete.***

The intensive and extensive vegetative roofs were planted prior to much of the other work being performed in the vicinity of the vegetative roofs. Construction taking place adjacent to and on the vegetative roofs disturbed—and in some cases killed— the plants on the roofs. Once installed, plants on vegetative roofs should be cared for until they are fully established. In this case, however, care was handed over to the roofing company. The landscape company returned to the site to tend to the plants once construction was finished. All the plants that were disturbed or killed were eventually replaced. Maintenance of the plants is now

Uprooted plants on the vegetative roof.

Dead plants on the vegetative roof.

***Lesson Learned: Soil testing is necessary to determine important design features needed to maximize the feasibility of green infrastructure.***

Soil testing was completed on site, but not in the exact location of the proposed green feature locations. During construction, sand seams were found on site, which indicated that infiltration rates may be high, and therefore, underdrains may not be necessary. This finding was not brought to the attention of the design engineer or landscape architect on the project until much of the construction had occurred. At that point, one underdrain had already been installed, and all the underdrains for the site had been ordered. Although no additional soil testing was completed, the decision was made to plug the underdrain that was already installed and to install all other green features on site without underdrains. In some cases the engineered soil had also been placed. The soil contained sand, as per the design. The sand would make the feature drain too rapidly—so the engineered soil was removed and replaced with a non-sand soil mixture. This additional effort and cost may not have been necessary.

Underdrain to be installed in the bioswale.

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**PROJECT PARTNER: CINCINNATI PUBLIC SCHOOLS**

***Lesson Learned: Construction equipment should not be driven on the green infrastructure during or after construction to avoid compaction and unnecessary clogging of the features.***

Sediment build up from mud on construction equipment was tracked over the gravel base of a pervious paver parking lot. Once the pavers were installed, this machinery continued to travel across the pavers with mud on the tires, causing the system to clog prematurely. In addition, the plastic was removed from the pervious concrete before finishing construction in the surrounding area, allowing excess silt and sediment to accumulate in the voids. The property owner will need to have the pavement area vacuumed to remove these materials.

Exposed dirt adjacent to the newly installed porous concrete can cause sediment build up and clog the system.

Exposed dirt adjacent to the newly installed porous paver system can cause sediment build up and clog the system.

***Lesson Learned: A barrier is necessary between a parking stalls and a green infrastructure.***

Parking blocks were not included in the design of this parking lot bioswale. Students and staff using the lot have accidentally driven their cars over the edge of the parking stalls, getting stuck in the bioswale and causing ruts in the amended soil. Parking blocks were placed prior to opening the parking lot to the general public. Bollards are to be installed at either end of the bioswale.

Tire ruts in the soil.

Tire ruts in the soil.

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***Developer/Client/Owner:***
Metropolitan Sewer District of Greater Cincinnati (MSDGC)
1600 Gest St.
Cincinnati, OH 45204
www.msdgc.org

***Designer/Consultant:***
Glaserworks Architecture and Urban Design
304 E. 8th Street
Cincinnati, OH 45202-2231
http://www.glaserworks.com/

***Key Features:***

- Vegetative Roofs
- Pervious Pavements
- Bioretention Facilities

***Lessons Learned:***

- Vegetative roofs should be planted after all other roofing is complete
- Soil testing is necessary to determine important design features needed to maximize the feasibility of green infrastructure
- Construction equipment should not be driven on the green infrastructure during or after construction to avoid compaction and unnecessary clogging of the features
- A barrier is necessary between a parking stall and green infrastructure

***Project Cost:*** $68,115 for design (limited to design of green stormwater infrastructure), $714,469 for construction (limited to construction of green stormwater infrastructure)

***Maintenance Cost:*** Maintenance of the green stormwater infrastructure facilities is performed by Cincinnati Public Schools; specific operating & maintenance costs have not been provided to MSDGC. MSDGC does perform quarterly inspections to check for areas in need of attention or improvement to ensure the infrastructure continues to function properly and as intended.

***Funding Sources / Incentives:*** The Metropolitan Sewer District of Greater Cincinnati (MSDGC) was the original funder. Monies were provided through MSDGC's Green Demonstration Program grant source: $68,115 for design, $714,469 for construction (MSD-funded share represents 7 percent of the total school construction cost.)

***Applicable Zoning Regulations:*** None

***Additional Comments:*** Design review (performed by Strand Associates) suggests a potential annual stormwater capture volume of 1.875 MG on an annual basis based on a typical year rainfall.