



# Green Infrastructure & Stormwater Management CASE STUDY

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## Frick Chemistry Laboratory

**Location:** Princeton, NJ

**Client:** Princeton University

**Design Firm(s):** Hopkins Architects; Payette Associates; Michael Van Valkenburgh Associates; Arup; Nitsch Engineering; Van Note-Harvey Associates; Turner Construction

**Landscape architect/Project contact:** Robert Rock, ASLA, Michael Van Valkenburgh Associates; Nicole Holmes, Nitsch Engineering

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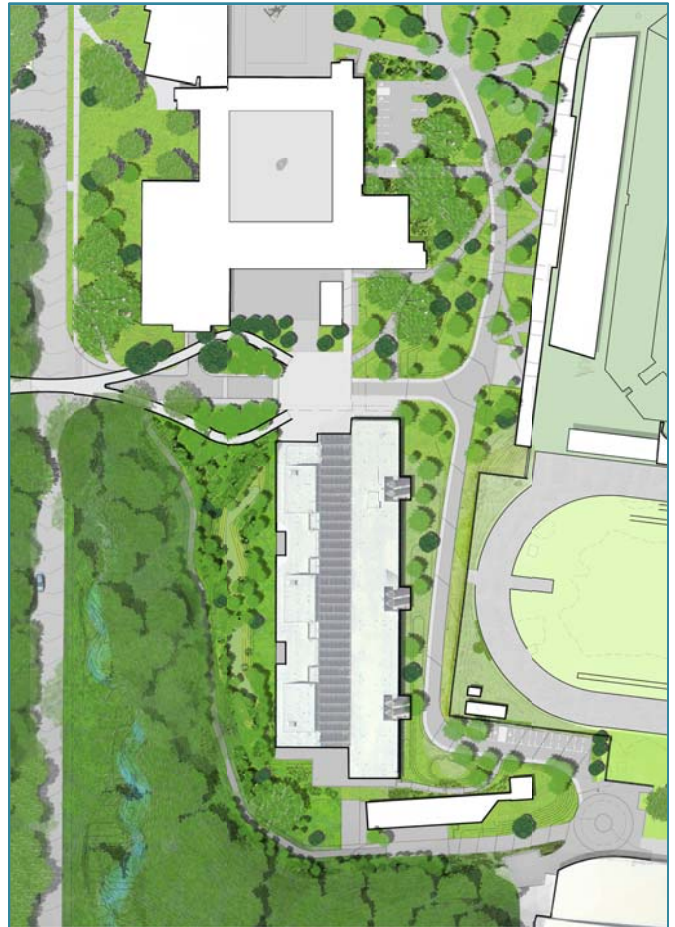
### Project Specifications

**Project Description:** The Frick Chemistry Laboratory project at Princeton University restored a formerly developed site adjacent to a stream corridor. The project significantly reduced impervious cover, expanded/enhanced the stream buffer, and removed a point source discharge to the stream. The project integrated stormwater into both the landscape and building systems. The project includes three bioretention basins that treat half the rooftop and the project's impervious site areas. Stormwater runoff from a driveway is directed to one of the bioretention basins via a grass swale. Stormwater runoff from the remaining half of the building rooftop is directed to a 12,000 gallon rainwater harvesting tank, which is used to supplement the building toilet flushing demand.

### Project Type:

Institutional/education

Part of a redevelopment project



**Design features:** Bioretention facility, rain garden, green roof, cistern, curb cuts, engineered soils for increased permeability, and expanded woodland buffer zone to adjacent stream.

**This project was designed to meet the following specific requirements or mandates:**

State statute, county ordinance, local ordinance, developer/client preference, Princeton's Campus Plan (2005)



**Impervious area managed:** 1 acre to 5 acres

**Amount of existing green space/open space conserved or preserved for managing stormwater on site:** 1 acre to 5 acres

**The regulatory environment and regulator was** supportive of the project.

**Did the client request that other factors be considered, such as**

**energy savings, usable green space, or property value enhancements?** The Frick Chemistry Laboratory was one of the first projects implemented under Princeton University's Campus Plan (2005). The primary goal of the planning initiative was to accommodate significant academic expansion while preserving the historic beauty and walkability of the campus. Some of the primary focuses of the Campus Plan included the preservation/restoration of existing natural resources, the enhancement/re-creation of woodlands from Lake Carnegie along the stream corridors, and the implementation of low-impact development and landscape-integrated stormwater management techniques. The Chemistry Building project met or exceeded all the landscape and stormwater-related goals of the Campus Plan, thus contributing to the overall improvement of the Campus. The client requested the team consider state-of-the-art sustainability features including: exterior glazing with sunscreens, optimization of daylighting, sensor-controlled lighting, photovoltaic panels, ceiling-mounted chilled beams, high-efficiency fume hoods with automatic sash closers, and a rainwater harvesting system.

## Cost & Jobs Analysis

**Estimated Cost of Stormwater Project:** \$500,000-\$1,000,000 (Public funding: Not available)

**Related Information:** A large component of the estimated cost for the stormwater project was the interior plumbing work (pumping and piping) associated with the rainwater harvesting system (estimated cost = \$370,000). The estimated cost for installation of the stormwater tank

was and additional \$154,266, and the remaining sitework associated with the stormwater project was estimated at \$94,200.

**Was a green vs. grey cost analysis performed?** Yes, the premium on the rainwater harvesting system was justified by performing a life cycle cost analysis to demonstrate that a 10- to 15-year payback system was feasible assuming water cost inflation at 2% above the base rate. The client/contractor determined there was no premium on the landscape, but there was an overall premium on the bioretention basins compared to traditional infrastructure.

**Cost impact of conserving green/open space to the overall costs of the site**

**design/development project:** Conserving existing green space did not impact the overall cost of the project. The existing site selected for the project contained a parking lot and existing building. The redevelopment site provided more than enough real estate to accommodate the footprint of the new Frick Chemistry Laboratory building (and the loss of parking was absorbed in the existing campus parking infrastructure), leaving a significant amount of area to transform to green space. With the increase in green space in the developed condition, the project increased the woodland buffer zone to the adjacent stream and created a new nature path through the forested landscape that travels past the bioretention areas.

**Cost impact of conserving green/open space for stormwater management over traditional site design/site development approaches (grey infrastructure)?** Slightly increased.

**Number of jobs created:** Approximately 40 (faculty, staff, researchers) at day 1, increasing to approximately 120 over time (including Facilities)

**Job hours devoted to project:**

Planning and Design: 11,500 job hours for site/landscape/stormwater design  
 Construction: 1,141,400 hours thru 8/31/2010 (project total, inclusive of building work)  
 Annual Maintenance: Grounds & Buildings: 13,832 hours/year; Life Safety & Security: 327 hours/year; Building Services: 20,800 hours/year; Engineering: 2,080 hours/year  
 Other: Office of Design and Construction and Princeton Engineering: 22,880 hours

**Performance Measures**

**Stormwater reduction performance analysis:**

On an annual basis, the project is estimated to reduce the volume of stormwater discharge by approximately 583,270 gallons through the "greening" of the site, with an additional 582,861 gallons of stormwater estimated to be reused annually for building toilet flushing, equating to over 1.1 million gallons of stormwater retained on-site annually. The project is estimated to reduce the peak rate of stormwater discharge for the 2-year, 24-hour storm event by approximately 6%. The project is estimated to reduce the volume of stormwater discharge for

the 2-year, 24-hour storm by approximately 42,200 gallons (or by 8%), including a 3-day drawdown in the rainwater harvesting tank.

The site construction was completed in the Fall of 2010, and monitoring devices have not been installed to measure actual performance. The above values represent estimates based on design models. Monitoring of the stormwater systems is proposed as part of graduate student research work.

**Community & economic benefits that have resulted from the project:** The Frick Chemistry Laboratory was also fully coordinated with the construction of the new Streiker Pedestrian Bridge (separate project) over Washington Road that will connect to the future Neuroscience and Psychology Building to create a new "Natural Sciences Neighborhood". These projects will transform a currently underutilized corner of Campus with new, world-class facilities and improved connectivity and pedestrian linkages to adjacent athletic facilities and the rest of the Campus community. The creation of a new nature path through the enhanced and restored woodland presents both recreational and environmental benefits for the Campus community. The University is also in the process of planning for a stream channel restoration project to restore the degraded stream segments of the Washington Road stream.

### Project Recognition

Awards through the AIA, SCUP, ASLA, and several other professional organizations.

### Additional Information

Because the building occupies land that once housed the armory and a 124-space parking lot, the University engaged in a robust demand management program and a comprehensive system of consolidated parking facilities to absorb the loss of parking spaces in existing parking lots and further enhance the Tiger Transit shuttle system and car-pool program and to improve linkages to pedestrian and biking pathways. In their review and approval of the new Frick Chemistry Laboratory, members of the Regional Planning Board of Princeton expressed appreciation and support of the numerous sustainable elements of the new construction. They noted the reduction in impervious coverage, creation of the rain gardens, creative use of photovoltaic panels for shading, and the sophisticated heating and cooling systems as areas of particular interest.