

Northern Guilford Middle School

First Day Of Classes: January 22, 2007

Open House: January 23, 2007



The School Project Summary

The Guilford County School District has established itself as the leading school system in North Carolina in promoting green design. From the school board to the facilities planning team, the school system has become a significant force within North Carolina in promoting sustainable design. The school district is the first in the state to develop its own set of detailed green design specifications, the G3-Guilford Green Guide. As a matter of practice, the district encourages its architects and engineers to think beyond LEED to incorporate holistic, innovative, green solutions that are strongly tied to the students' curriculum. Through its leadership, the schools now being constructed in Guilford County are clearly some of the most sustainable in the country.

Northern Guilford Middle School is an excellent example of their commitment to promoting sustainable design. Designed by **Innovative Design Inc.**, of Raleigh, North Carolina, a nationally recognized leader in sustainable design, the school features a comprehensive and well-integrated set of green strategies that include:

- A new daylighting design that has never been implemented in any facility
- A holistic water cycle approach (rainwater for toilet flushing to a Living Machine to underground irrigation to the aquifer) coupled with bio-swales and wetlands
- Energy-efficient building shell, with radiant barriers and white reflective roofs
- Underfloor air distribution system
- Indirect lighting with photocells and occupancy sensors
- Solar water heating and photovoltaic systems
- 3-D experiential learning centers linking curriculum to sustainable design features
- Recycled materials and use of local products
- Indoor environmental quality management
- The 70 million year old Nicklas Mosasaur Fossil



Northern Guilford Middle School

The School Introduction

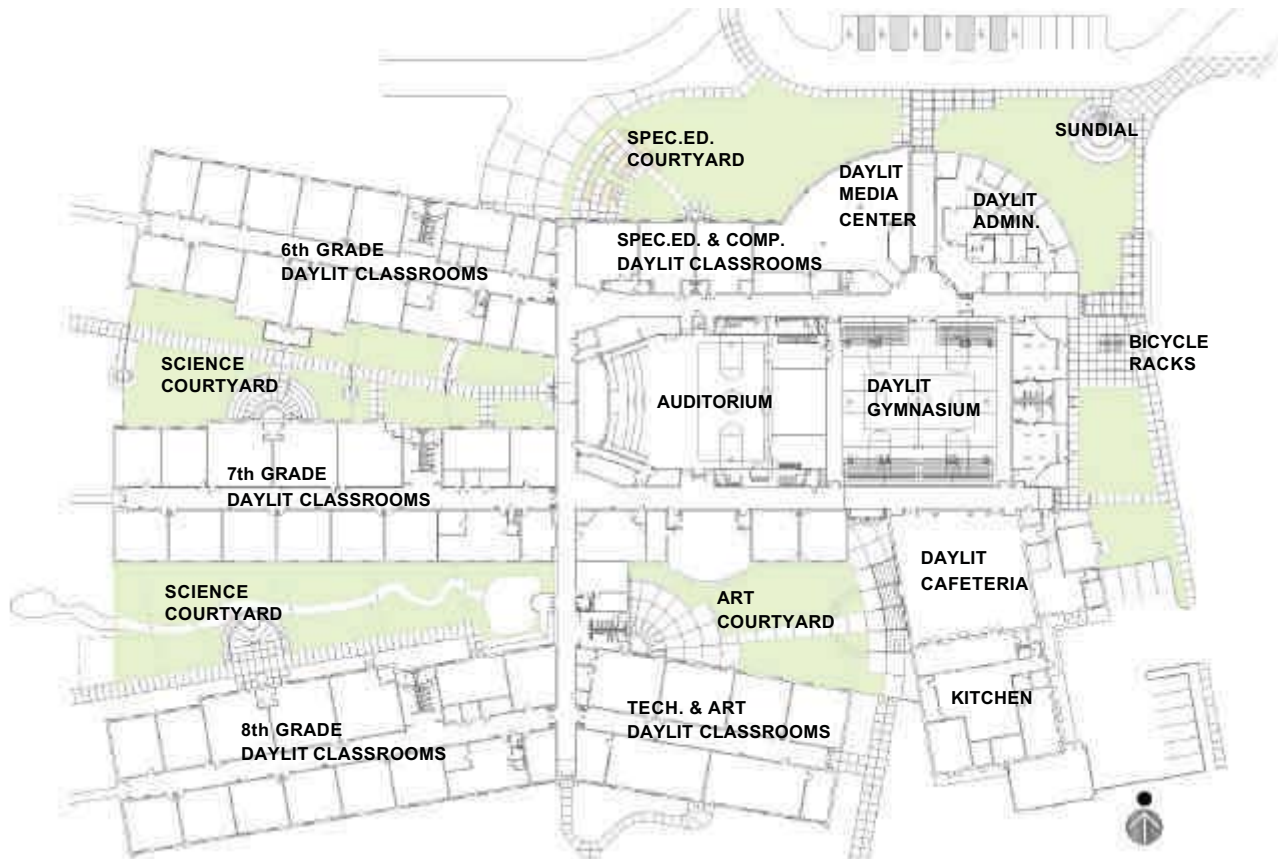
The Northern Guilford Middle School is being constructed as a 3-D textbook so the students, teachers and the community can learn about sustainable design strategies and how they reduce the impact that human development has upon our environment. The middle school has 140,000 square feet and includes classrooms for 950 students plus dining, gymnasium, auditorium, science, art, music, technology, media center and administration facilities. To minimize cost and maximize environmental benefit, the sitework for both the adjacent high school and middle school were designed by Innovative Design. This work includes rainwater harvesting, extensive bio-swales and three constructed wetlands, wastewater treatment, and subsurface irrigation systems.

Like all other schools designed by Innovative Design, the Northern Guilford Middle School has been designed to consume less than half the energy of typical schools. Northern Guilford Middle School has been 'Designed To Earn The Energy Star', in accordance with building energy consumption standards as set by the United States Environmental Protection Agency (USEPA). Detailed, hourly DOE-2 building energy simulations for this project place it among the top 10% in its category nationally.



Site Design Orientation

The school has been oriented on an east-west axis to maximize the southern solar potential for daylighting, passive solar, solar domestic hot water, and photovoltaic applications. East and west glazing is minimized to reduce heat gains. Certain site features have been retained to later serve as 3-D teaching tools. As much as possible, the surrounding site has been left undisturbed to sustain a 'natural' landscape.



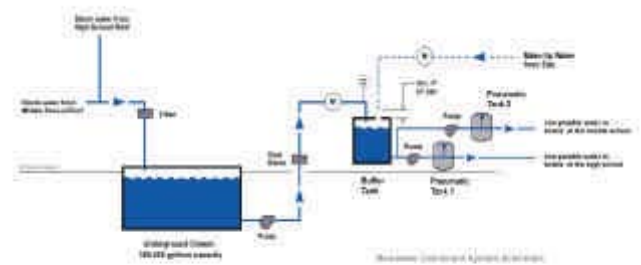
Water Management

The school features a holistic water cycle approach (rainwater to toilet flushing to a “Living Machine” to underground irrigation to the aquifer) that is coupled with bio-swales and wetlands.

Rainwater Catchment

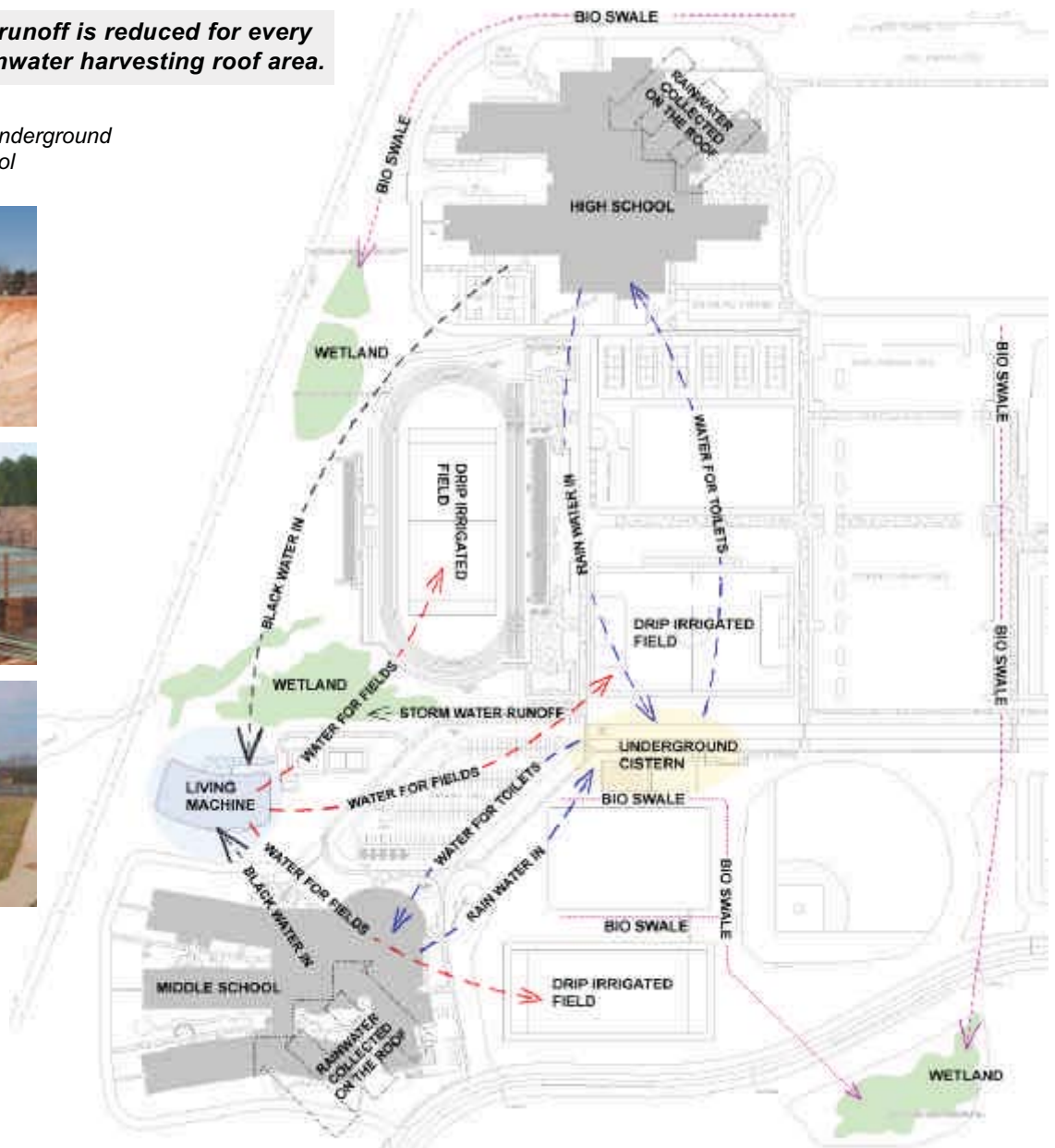
The school’s innovative, sustainable cycle of water usage is one of the most unique features and a lesson for the students in ecology. Rainwater is collected from the roof areas of the middle school and adjacent high school and is stored in a centrally located 360,000 gallon tank, the top of which also serves as a basketball court for the school. Used primarily for toilet flushing, this part of the water cycle saves 4 million gallons of water annually. A reserve of water is always maintained in the tank for fire fighting.

Below: Schematic representation of the rainwater collection system used at the school.



One pound of nitrogen runoff is reduced for every 8,660 square feet of rainwater harvesting roof area.

Below: Construction of the underground rainwater cistern at the school



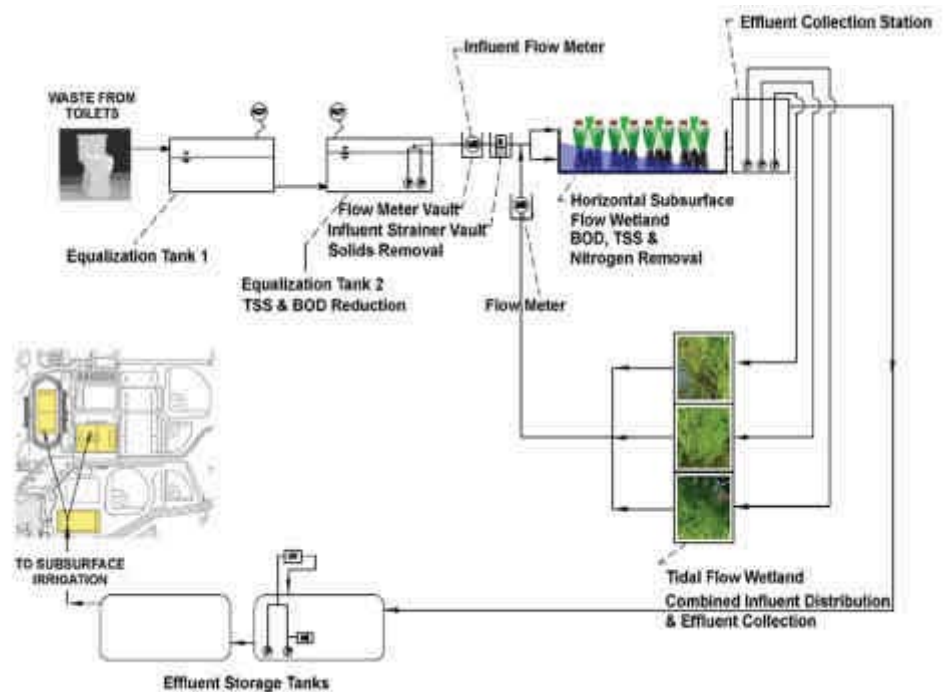
Schematic representation of the overall water management cycle on site

Living Machine™

The next component of this water cycle is the hybrid horizontal and tidal flow wetland **Living Machine™** system. The **Living Machine™** uses plant-based strategies to cleanse 40,000 gallons of wastewater per day from the middle and high school buildings and produces enough clean water to irrigate three athletic fields. This environmentally-sound, on-site treatment strategy costs less than other pre-treatment strategies and helps to reduce the amount of nitrogen entering the watershed. It was incorporated because there are no central sewer lines within miles of the site. This part of the water-saving strategy saves an additional 5 million gallons per year by using the water twice. The cost of extending the city waste lines to the site would have been at least \$4 million more expensive to the school system.

Additionally, a sub-surface piping system is utilized for irrigating the three athletic fields. It uses 40% less water than conventional sprinkler irrigation due to reduced evaporation. The final significant benefit of this water strategy is that clean water is returned to the aquifer.

Schematic Diagram of the Living Machine



Bio-swales & Constructed Wetlands

A series of bio-retention swales and three constructed wetlands capture all rainfall that does not fall on the roof areas, further minimizing nitrogen runoff before being discharged to the local streams and rivers. No storm water will be discharged directly to local storm sewers. One of the wetlands will also be used as part of the school's science curriculum, offering the students a unique opportunity to study local eco-systems.



Above: Constructed wetlands and bioswales at Northern Guilford Middle School

About the fossil display:

The *Nicklas Mosasaur Fossil* is dated at 70 million years old, and was found near Chadron, Nebraska, in July 2005 by Dr. Steven D. Nicklas.

The 14 foot long display consists of the skeleton's original bones, laid out as they would have looked in life. The skeleton is surrounded by the original shale material in which the bones were found.

About the Mosasaur:

The Mosasaur (species *Clidastes propyhton*) is an extinct marine reptile that lived in the sea that existed then in central North America. Mosasaurs grew to 50 feet long and had large, strong teeth that were deeply lodged into their jawbone, telling us that their bite was equivalent to that of a Tyrannosaurus Rex. They were land-based reptiles that returned to the sea, bore live young, and had to surface for air from time to time like other reptiles such as turtles.



Above: Dr. Steven Nicklas with the Mosasaur fossil, at the site of discovery, and when delivered at Northern Guilford Middle School

Discovered by:

Archeologist Dr. Steven D. Nicklas and his son, James B. Nicklas, found the bones in July of 2005, during an annual trip Dr. Nicklas organizes for amateur fossil hunters. The skeletal remains were transported to Dr. Nicklas' shop at the Elachee Nature Science Center in Gainesville, Georgia, where he reconstructed the skeleton and created the display. The skelton is composed of 85% original bone with only 15% restoration.



Reason for Donation:

During the early phases of the school's design, Michael H. Nicklas, president of Innovative Design, the architects for Northern Guilford Middle School, had discussed with his brother, Steven D. Nicklas, the possibilities of having one of his brother's discoveries included in the school. The goal was to reinforce the overall objective of creating the school as a teaching tool. By incorporating the Mosasaur in the school, it is hoped that the students will make the connections between the extinction of past species and the issues of sustainability that we face today.

Donated by:

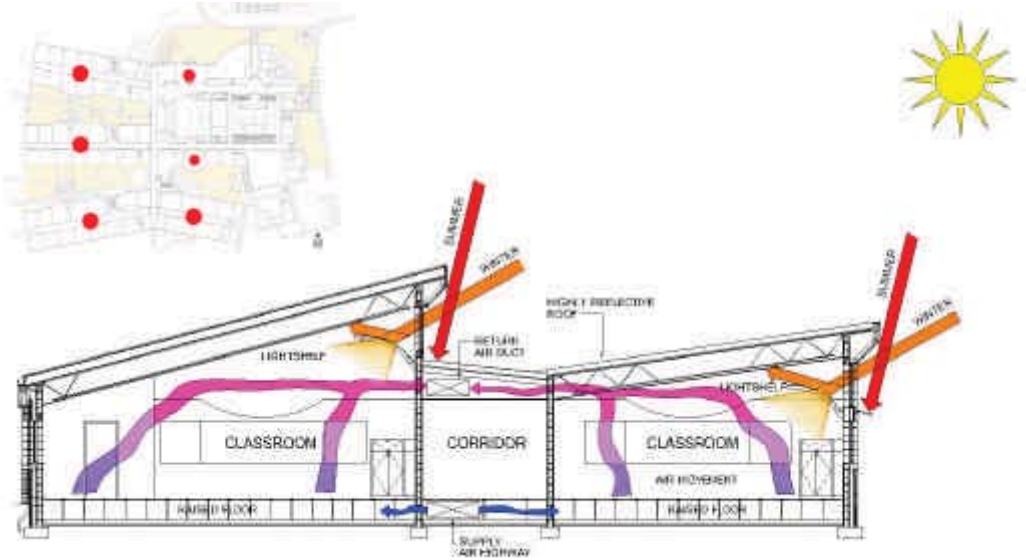
To make this donation possible, Dr. Nicklas contacted individuals and companies with a history of making similar donations. Christopher Smith, seeing the benefit to the school, was kind enough to provide the financial resources necessary to donate the 70 million year old Mosasaur to Northern Guilford Middle School.

Left: The Nicklas Mosasaur Fossil mounted in the main entrance hall at Northern Guilford Middle School

Innovative Daylighting Design

The use of natural daylight is the primary energy saving strategy as well as a significant factor improving student performance. At Northern Middle, a new approach to daylighting is being incorporated for the first time anywhere. This significant breakthrough in daylighting design utilizes a unique curved, translucent interior lightshelf, which in combination with highly reflective ceiling tiles enables the light levels within the classroom spaces to be very uniform while requiring 40% less glass than is normally used in other daylighting applications. Because of the translucent nature of the lightshelf and the design of the aperture, glare is minimized.

Natural light is the primary source for all educational and administrative spaces during two-thirds of the daylight hours. Daylighting reduces the need for fluorescent lighting and also the school's air conditioning. The daylighting, roof assembly, and underfloor air distribution system reduced the installed tonnage by 82 tons.



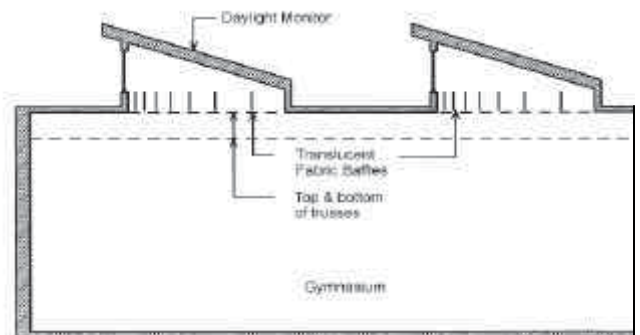
Schematic section of classrooms showing daylighting strategies

Above: Exterior & interior light shelves at Northern Guilford Middle School

Daylight Monitors

Daylighting in the gymnasium and dining areas of the school is provided by south-facing roof monitors with translucent fabric baffles in the light wells. These features eliminate direct glare and effectively diffuse light throughout the spaces. Clear, double glazing is used to maximize visible light transmittance and minimize glass-to-floor ratio. Adequate overhangs over the monitor windows protect the spaces from direct light during peak cooling periods.

Below: Daylighting at the Gymnasium (left) and Dining Hall (right)



Schematic section of gymnasium showing daylight monitors

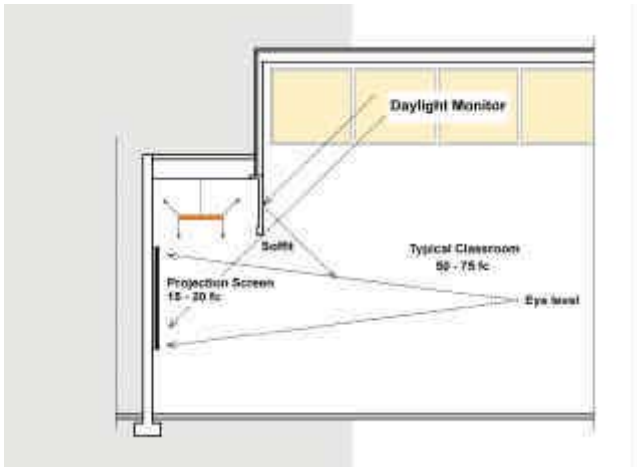
A 1999 study by the Hescong Mahone Group on 21,000 student records from 2000 classrooms in California, Washington, and Colorado found that students with the most daylighting in their classrooms progressed 20% faster on math tests and 26% faster on reading tests in one year than those with the least daylighting.

Interior Architectural Shading

Another innovative daylighting strategy used in the classrooms is a unique interior dropped soffit that slopes up towards the rear of the space. This architectural element is situated to intentionally shade the projection screen area and the TV monitors mounted on the wall without blocking views, and without the need for manual/automatic window shading devices.

Below: Section showing light levels achievable through the shading strategy, without blocking views

Below: Unique soffit shape shades the projection screen and TV placement areas in the classroom



Daylight-responsive electrical lighting design

Indirect fluorescent lighting is installed throughout the school building. The lighting is dimmable and controlled by an occupancy sensor and a photo-cell sensor that work in conjunction with the natural daylight to minimize artificial light usage.

Underfloor Air Distribution

An underfloor air distribution system has been incorporated in classrooms, the media center and administrative offices. The raised floor system greatly enhances comfort, air quality, flexibility, and energy-efficiency. This system also saves initial construction cost by reducing the need for expensive steel ductwork.

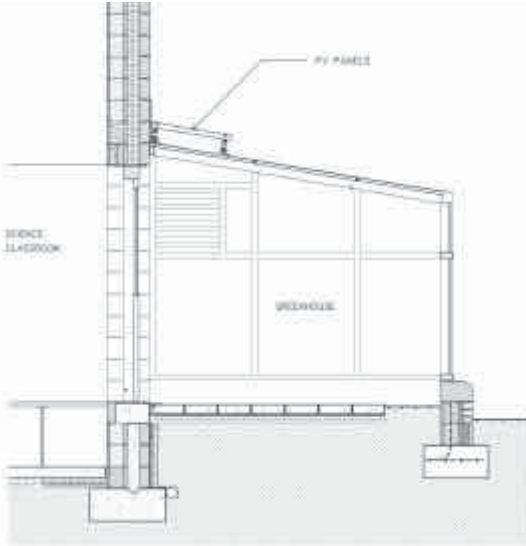
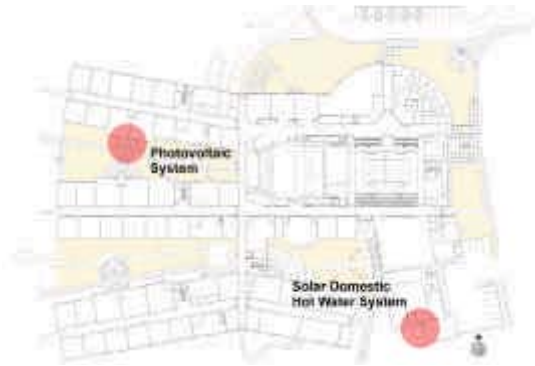


Left: Underfloor air distribution HVAC system under construction in one of the classrooms at the Northern Guilford Middle School.

**Solar Energy
Solar Hot Water & PV**

The solar thermal system provides approximately 75% of the hot water for the school, the majority of which is used for the cafeteria.

Photovoltaic systems have been incorporated into the science courtyard as an educational tool and to provide electricity used by the greenhouse. A separate, remote photovoltaic system has been implemented to light the main school sign. The aerators in the wetland areas are also powered using photovoltaics.



Above: Section of the greenhouse showing the PV system



Above: Main School Entrance Sign and Greenhouse

**Eco-Education
3-D Classrooms**



Every aspect of Northern Middle is an opportunity to enhance experiential learning. Five educational courtyards are designed to provide students hands-on learning environments. A special sensory garden courtyard has been designed for challenged students and stresses multiple sensory experiences. The main courtyard includes a sundial.

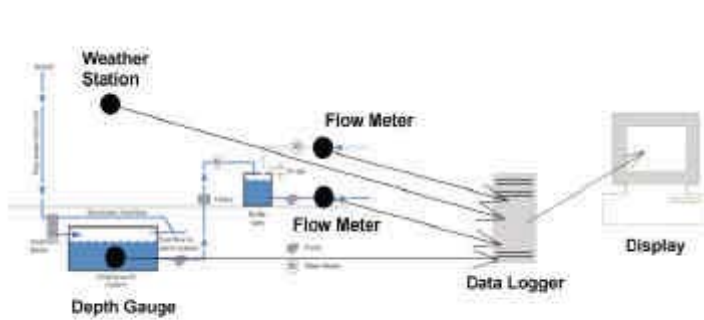
Many of the sustainable features, including the **Living Machine™**, constructed wetlands, solar hot water system, rainwater collection, PV systems, and weather station, are highly visible as well as interconnected through computer monitoring systems. These sustainable strategies, strongly linked to their science curriculum, give students unique opportunities to learn through first-hand experience. Further, they can use their computer monitoring systems to compare the performance of their systems to other schools.

Left: Examples of 3-D educational tools at Northern Guilford Middle School

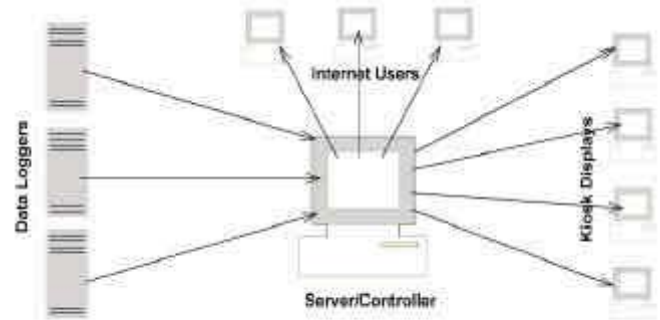
Computer Monitoring of Sustainable Features

Monitoring provides an interactive graphic interface to help educate visitors and students about the different sustainable systems being used at the school. Further, Internet (online) monitoring systems allow multiple interfaces to connect and be available to internet users at schools, and other educational facilities. The following systems will be monitored real-time:

- Solar water heating
- Photovoltaic systems
- Daylighting
- Rainwater harvesting
- **Living Machine™**
- Weather Station



From Sustainable Sources to Data Loggers



Web-based Eco-education

Materials Recycling & Local Products

Materials with recycled content include carpeting, metal roofing and acoustical ceiling tiles. A construction waste management plan was required by the G3-Guilford Green Guide during construction to minimize waste going to landfills. Almost 60% of the total construction waste has been diverted for recycling. Also, the school will implement a program for daily recyclable.

Locally manufactured masonry products are the predominant structural and finish materials. The specifications were developed to encourage local products and manufacturers, and preference was given to local manufacturers during the bidding process.

Indoor Environmental Quality Management

A U.S. General Accounting Office investigation of the conditions of our country's 80,000 public schools concluded that over half the schools in the United States had poor indoor environmental conditions – factors that were directly affecting the health, safety and comfort of 42 million students. Innovative Design addresses these issues by implementing the following measures in all of its buildings:

- No adhesives used for carpet tiling
- Low VOC paints and adhesives
- High MERV filters used throughout
- Xeriscaping to minimize use of pesticides
- Radon testing during construction of all spaces
- Indoor Air Quality Management Plan required during construction
- Air quality testing prior to occupancy
- Increased ventilation using outdoor air
- CO₂ sensors to determine need for outside air
- Sound control using green acoustic products
- 100% daylighting in all classrooms

