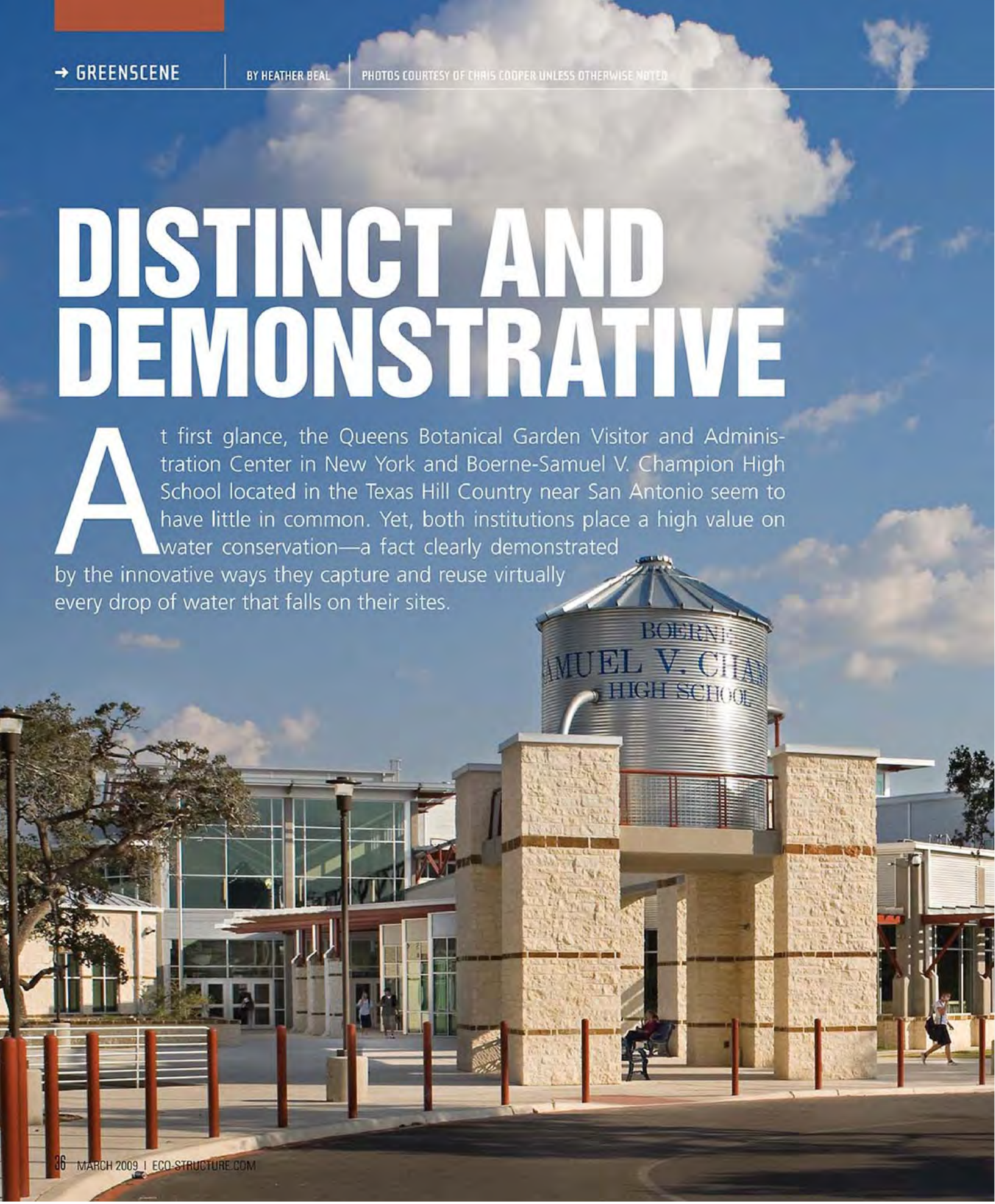
BY HEATHER BEAL | PHOTOS COURTESY OF CHRIS COOPER UNLESS OTHERWISE NOTED

# DISTINCT AND DEMONSTRATIVE

At first glance, the Queens Botanical Garden Visitor and Administration Center in New York and Boerne-Samuel V. Champion High School located in the Texas Hill Country near San Antonio seem to have little in common. Yet, both institutions place a high value on water conservation—a fact clearly demonstrated by the innovative ways they capture and reuse virtually every drop of water that falls on their sites.



# WATER CONSERVATION IS ON DISPLAY AT AN URBAN VISITOR CENTER AND HILL COUNTRY HIGH SCHOOL

PHOTOS COURTESY OF JEFF GOLDBERG/ESTO

Boerne-Samuel V. Champion High School (left) and Queens Botanical Garden Visitor and Administration Center (above) are exemplary models of water conservation.

"The city and school district asked us to find ways to be environmentally friendly," says Mark Oppelt, AIA, president of San Antonio-based O'Neill Conrad Oppelt Architects Inc., and co-leader of the Boerne-Champion High School project team. Because the school district is the largest water user in the city of Boerne, reducing demand for this precious resource made sense.

San Antonio's River Walk served as a reference. "River Walk was built as a flood-prevention project," Oppelt explains. "Storm water drains into a large tunnel buried 40 feet [12 m] below ground that runs from the north to the south end of town. Kent Niemann [AIA, a partner for Pfluger Associates Architects, San Antonio] and I realized we could design a similar system for Boerne-Samuel V. Champion High School that would capture HVAC condensate, rainwater and storm-water runoff, then use these for irrigation. We chose 5-foot- [1.5-m-] diameter piping and had it waterproofed and installed below grade where it collects and stores storm-water runoff."

Oppelt and Niemann also decided to install major system components at a higher elevation to reduce the system's demand for electricity. Rainwater and condensate flow from rooftop chillers into a 10,000-gallon (37854-L) cistern proudly perched above the high school's main entry. Water from the cistern and underground collection pipes flows into a sump. "This is a gravity-fed system until moisture sensors trigger the pumps to send water into pressurized irrigation pipes," Oppelt says.

Timers also ensure water is pumped back to the top of the system every four hours. This aeration cycle prevents the water from turning septic. A smaller version of the water-harvesting system serves landscaped areas surrounding what is known as the ranch complex, a cluster of buildings dedicated to vocational-technical training.

## DRAINAGE

Although reducing the demand for potable water was a top priority, the project team took care to minimize the broad environmental impact of the buildings, their systems and any site alterations.

"THIS IS THE LARGEST WATER-RECLAMATION SYSTEM SERVING ANY SCHOOL IN TEXAS."
— Mark Oppelt, AIA, president of O'Neill Conrad Oppelt Architects Inc.

Queens Botanical Garden Visitor and Administration Center was the first new public building in New York to achieve LEED Platinum certification from the Washington, D.C.-based U.S. Green Building Council. PHOTO COURTESY OF JEFF GOLDBERG/ESTO

A conventional drainage scheme would have discharged storm water directly into Brown's Creek, which traverses the school district's site and flows into Cibolo Creek on the neighboring nature preserve. Pollutants entering these waterways could threaten not only natural habitats—such as the blue heron rookery—but also could contaminate Edward's Underground Aquifer, San Antonio's main source of drinking water. Diverting and reusing the majority of the site's storm-water runoff significantly reduces those risks.

The architects placed the buildings so 90 percent of the trees on the school district's thickly forested site were left undisturbed. Trees that had to be removed were ground into mulch and used for landscaping. The civil engineers mapped the site to make sure the drainage system they designed worked with existing natural features.

Inside Boerne-Samuel V. Champion High School.

Although the water-harvesting system added $265,000 to the project budget, Oppelt says school trustees "jumped at the chance" to play a leadership role. "We estimated a payback period of six to seven years, but it will likely be shorter," Oppelt says. The system is expected to exceed its initial goal of reusing 10.7 million gallons (40.5 million L) of water per year. Under drought conditions, the goal changes to 3.6 million gallons (13.6 million L) per year. The engineers estimated 1,000 gallons (3785 L) of condensate would be collected per day. The system has been collecting three to four times this amount.

"This is the largest water-reclamation system serving any school in Texas," Oppelt says. "It's also the only system we can find that uses oversized piping to increase the storage capacity."

## WATER IN THE CITY

Capturing and reusing storm-water runoff is of paramount importance in densely populated urban areas, too. During periods of high or rapid rainfall, New York's combined wastewater system can be overwhelmed, allowing storm water to mix with raw sewage before being released into local waterways.

## QUEENS BOTANICAL GARDEN VISITOR AND ADMINISTRATION CENTER, FLUSHING, N.Y.

### GREEN TEAM

OWNER / Queen's Botanical Garden, Flushing, www.queensbotanical.org
LANDSCAPE AND WATER DESIGN / Atelier Dreiseitl, Überlingen, Germany, www.dreiseitl.de
LANDSCAPE ARCHITECT / Conservation Design Forum, Elmhurst, Ill., www.cdfinc.com
CIVIL AND STRUCTURAL ENGINEERS / Weidlinger Associates, New York, www.wai.com
ARCHITECT / BKSK Architects LLP, New York, www.bkskarch.com
MECHANICAL, ELECTRICAL AND PLUMBING ENGINEERS / P.A. Collins P.E., New York, www.pacollinspe.com
GENERAL CONTRACTOR / Stonewall Contracting Corp., College Point, N.Y., www.sccnyc.com
MECHANICAL CONTRACTOR / AWL Industries Inc., Brooklyn, N.Y., (718) 388-5500
PLUMBING CONTRACTOR / Pinnacle Plumbing & Heating Corp., Flushing, (917) 468-0649
GREEN-ROOF CONTRACTOR / Furbish Co. LLC, Baltimore, www.furbishco.com
ENVIRONMENTAL BUILDING CONSULTANT / Viridian Energy & Environmental, New York, www.viridianee.com
COMMISSIONING CONSULTANT / STV Inc., New York, www.stvinc.com
PHOTOVOLTAIC CONTRACTOR / altPOWER Inc., New York, www.altpower.com

### MATERIALS AND SOURCES

CAST-IN-PLACE CONCRETE WITH RECYCLED CONTENT / Best Concrete Mix Corp., Flushing, N.Y., (718) 539-5946
GREEN-ROOF MANUFACTURER / Henry Co., El Segundo, Calif., www.henry.com
PHOTOVOLTAIC SYSTEM / Powerlight Corp., San Jose, Calif., www.sunpowercorp.com
SOLAR-REFLECTIVE WATERPROOFING ROOF MEMBRANE / Carlisle Coatings and Waterproofing, Wylie, Texas, www.carlisle-ccw.com
SALVAGED HEMLOCK FOR FORMWORK / Citilog Inc., Pittstown, N.J., www.citilogs.com
CONCRETE EXTERIOR PAVERS / Hanover Architectural Products, Hanover, Pa., www.hanoverpavers.com
LOW-FLOW FIXTURES, FLUSHED WITH RECYCLED GREYWATER / Sloan Valve Co., Franklin Park, Ill., www.sloanvalve.com
WATERLESS URINALS / Falcon Waterfree Technologies, Grand Rapids, Mich., www.falconwaterfree.com
COMPOSTING TOILETS / Clivus Multrum Inc., Lawrence, Mass., www.clivusmultrum.com

PHOTO COURTESY OF JEFF GOLDBERG/ESTO

When the board and key staff of Queens Botanical Garden, Flushing, N.Y., resumed the master planning process for their 39-acre (16-hectare) site in the late 1990s, they realized they had a rare opportunity to show how water that fell on or flowed through buildings and land could be captured and reused. "We also wanted to demonstrate how gardens can be effective water-management tools," says Jennifer Ward Souder, director of capital projects for Queens Botanical Garden.

Souder and the board selected a collaborative team led by Atelier Dreiseitl, Überlingen, Germany; Conservation Design Forum, Elmhurst, Ill.; and BKSK Architects, New York, to determine how to achieve these functional objectives while celebrating the distinctive qualities of water. Phase I of the master plan, which was completed in September 2007, includes construction of a 16,000-square-foot (1486-m²) visitor center, 6,000-square-foot (557-m²) horticulture and maintenance building, and series of landscaped areas and gardens.

"We wanted to include elements that reveal how water moves and explore its other experiential qualities, such as the interplay of light, color and sound," Souder explains. "Because we didn't want to use potable water for these elements, we used rainwater instead."

Rainwater that runs off the visitor center's roofs and exterior paved areas is channeled to a cleansing biotope that uses sand, gravel and plants to filter the water before it is stored in a 24,000-gallon (90850-L) underground tank. Cleansed water is pumped back to the "fountain of life" at the main entry, where it gurgles and flows into a meandering stream, through a water channel and back into the cleansing biotope where the cycle begins again.

A separate system collects greywater from sinks, showers and dishwashers, then sends it through a constructed wetland. Gravel, sand and the root systems of plants remove contaminants before the treated water is pumped back into the visitor center where it is used to flush toilets. Although it is relatively small, the constructed wetland can scrub and recycle up to 4,000 gallons (15000 L) of water per week.

### SHADES OF GREYWATER

Although Boerne-Samuel V. Champion High School and Queens Botanical Garden's Visitor Center employ basic water-conservation equipment, such as low-flow plumbing fixtures, some of the strategies and technologies used by the botanical garden are not legal elsewhere. Texas doesn't allow greywater to be reused indoors nor does it permit installation of waterless urinals or composting toilets. The two composting toilets in the staff restrooms of the Queens Botanical Garden's Visitor Center call cultural norms into question and face one legal challenge. Souder says the project team selected models that use 3 ounces (85 g) of water for a foam rinse after each flush because,

although this isn't necessary, "people are used to some sort of rinse occurring." The long-term goal is to use the compost as a fertilizer and topsoil amendment for the botanical gardens, but this is not yet legal in New York. It may be legal, however, by the time the compost is ready to be harvested in three to five years. Fortunately, according to Souder, there are only "a couple shovels full" of compost in the treatment container after nearly two years of use.

The 3,000-square-foot (279-m²) vegetated roof installed atop the visitor center's auditorium is a particular point of pride. "This was one of the least complicated parts of our project, yet we are thrilled with its performance and beauty," Souder says. The green roof absorbs 80 percent of the rainwater that falls on it; creates a habitat for insects, birds and plants; provides insulating qualities for the building below; and mitigates the heat-island effect. Using indigenous plants on and around the buildings further conserves water because native species already have adapted to the climatic conditions of New York and don't require mechanical irrigation.

Adhering to local building-industry requirements while integrating a complex series of water elements, specialized systems and planned gardens with the visitor center's architecture made project coordination a major challenge. "Wicks Law still was in full effect in New York during this construction project," Souder explains. "As a result, we had to have separate contracts for plumbing, heating, ventilation, air conditioning and electrical contractors. We had a huge team; it would have been a lot easier to have all disciplines report to our general contractor."

Queens Botanical Garden Visitor and Administration Center was the first new public building in New York to achieve LEED Platinum certification from the Washington, D.C.-based U.S. Green Building Council. Projections indicate that its demand for potable water will be 80 percent less than that required by buildings of similar size, complexity and function. The visitor center already has achieved its design goal of zero stormwater runoff.

Although the regional regulations and physical contexts shaping the designs for Boerne-Samuel V. Champion High School and Queens Botanical Garden Visitor and Administration Center vary, both are exemplary models of water conservation.

>> HEATHER BEAL writes about architecture and sustainability from Edina, Minn.

USING INDIGENOUS PLANTS ON AND AROUND THE BUILDINGS FURTHER CONSERVES WATER BECAUSE NATIVE SPECIES ALREADY HAVE ADAPTED TO THE CLIMATIC CONDITIONS OF NEW YORK AND DON'T REQUIRE MECHANICAL IRRIGATION.

## BOERNE-SAMUEL V. CHAMPION HIGH SCHOOL, BOERNE, TEXAS

### GREEN TEAM

OWNER / Boerne Independent School District, Boerne, www.boerne-isd.net
ARCHITECT AND INTERIOR DESIGNER / O'Neill Conrad Oppelt Architects Inc., San Antonio, www.ocoarchitects.com, and Pfluger Associates Architects, Austin, Texas, www.pflugerassociates.com
LANDSCAPE ARCHITECT / Cooper/Lochte Landscape Architects, San Antonio, (210) 821-6570
STRUCTURAL ENGINEER / Danysh & Associates Inc., San Antonio, (210) 341-5161
CIVIL ENGINEER / Moy Civil Engineers, San Antonio, (210) 698-5051
HVAC AND PLUMBING / HMG & Associates, San Antonio, www.hmg-associates.com
IRRIGATION CONSULTANT / Garza Consulting and Irrigation, San Antonio, (210) 490-1192
CONSTRUCTION MANAGER / Joeris General Contractors, San Antonio, www.joeris.com

### MATERIALS AND SOURCES

CISTERN MANUFACTURER / Spec-All Products, Austin, Texas, www.specallproducts.com
OVERSIZED UNDERGROUND PIPING / Advanced Drainage Systems, Hilliard, Ohio, www.ads-pipe.com
ROOF MANUFACTURER / U.S. Intec, Wayne, N.J., www.usintec.com
IRRIGATION PIPING, CONTROLS AND PUMPS / Aquavar Pump Controls, Monroe, Wash., www.aaawater.com/aquavar/index.htm
WEIR STRUCTURE / Joeris/Urban Concrete, San Antonio, www.urbanconcrete.com

THE ENGINEERS ESTIMATED 1,000 GALLONS (3785 L) OF CONDENSATE WOULD BE COLLECTED PER DAY. THE SYSTEM HAS BEEN COLLECTING THREE TO FOUR TIMES THIS AMOUNT.