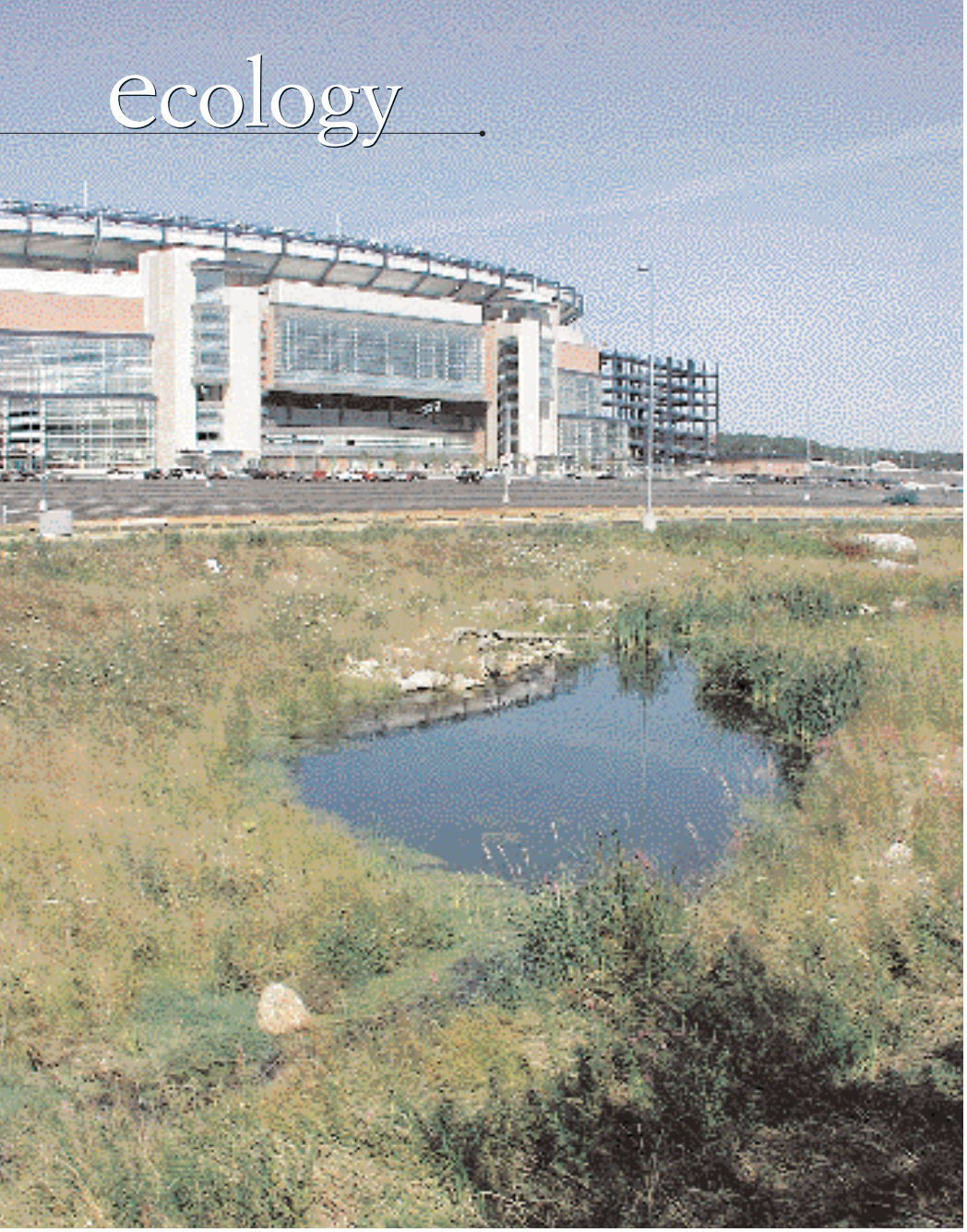

The daylighted and restored Neponset River establishes itself as the New England Patriots' new Gillette Stadium nears completion in the summer of 2002. In the foreground, one of many pool features punctuates the river channel's sinuous course.

New Light on the Neponset

In the Boston area, a public/private partnership "daylights" a stretch of river. BY THOMAS S. BENJAMIN, ASLA, AMY GREEN, AND KEN DESHAIS

The building of the New England Patriots' new Gillette Stadium (completed and opened in 2002) provided an opportunity to restore a 3,300-foot-long stretch of the Neponset River in Foxborough, Massachusetts. In the case of the Neponset, the river restoration coincided with the Patriots' need to provide a large new parking area for the new 68,000-seat, multiuse stadium. Building a racetrack on the site in the 1940s had required that the river be realigned and entombed in an underground culvert up- and downstream of the track. The silt-clogged culverted and open portions of the Neponset ran directly across the old racetrack and adjacent to the new stadium site precisely where the necessity for parking was greatest. The new stadium needed parking close to the facility, and the Neponset needed "daylighting" and restoration. Both goals were achieved in the Neponset River Restoration Project, which was finished some months prior to the new stadium.

The restoration project relocated this portion of the Neponset back to its alignment prior to construction of the racetrack, creating a new 8.4-acre riparian corridor that allows much freer river flow and wildlife movement. According to the Rocky Mountain Institute, which has documented river and stream daylighting projects around the world, this daylighting project is one of the first of its kind undertaken in the northeastern United States and one of the larger projects nationwide.

In the Rocky Mountain Institute's report, *Daylighting: New Life for Buried Streams* (2000), by Richard Pinkham, the term "daylighting" describes "projects that deliberately expose some or all of the flow of a previously covered river, creek, or stormwater drainage." The modern era has engineered rivers and streams beyond recognition, hiding them away in concrete confinements and straight-jacketing flows below ground level, thereby inhibiting the abundant natural functions and benefits of waterways. Daylighting can increase flood storage, reduce runoff velocities, improve water quality, re-create aquatic and riparian habitat and wildlife corridors, link urban greenways that reconnect people with water, increase civic pride and sense of place, and add aesthetic value and educational opportunities. Another benefit can be the cost savings associated with replacing deteriorated or nonfunctional drainage infrastructure with an open waterway, which can be easier to maintain in the long run. The idea of daylighting seems to be catching on: The Rocky Mountain Institute has studied some 25 daylighting projects within the United States and is considering 25 others.

Even though the Patriots could have built their parking lot around the existing river, they chose to design an alternative that

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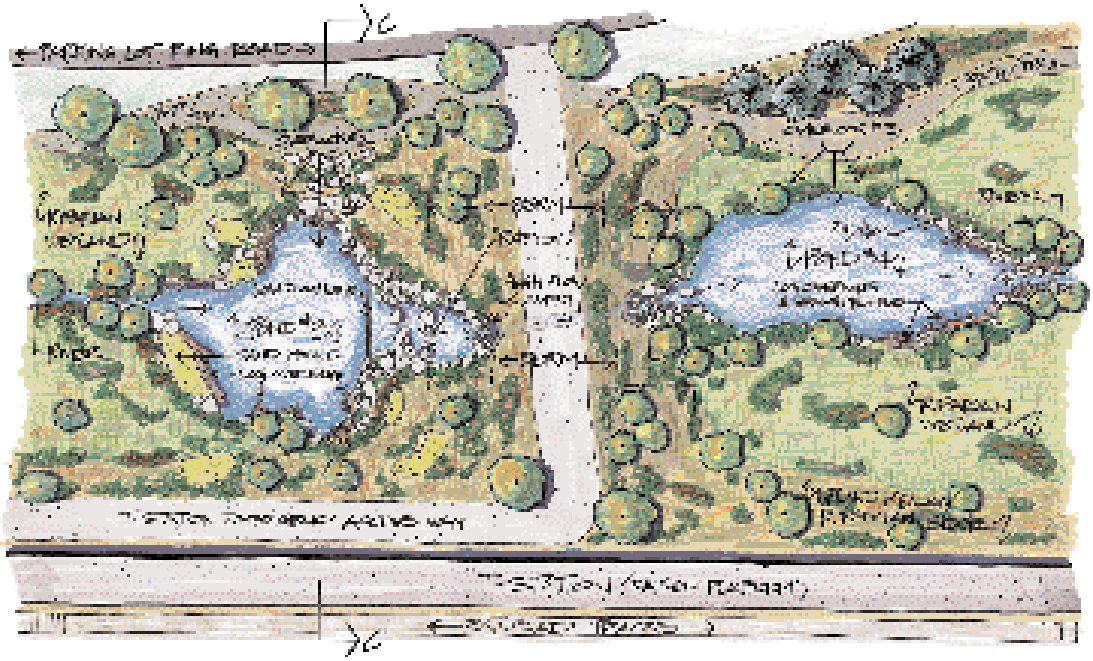
relocated the river away from the main development areas and daylighted it. A number of alternative strategies to meet regulatory requirements were considered, but the compelling vision of restoring the river with a substantial green corridor alongside it won the day. A key contributing factor was the early establishment of a public–private working group—consisting of the Patriots' managers and professional staff, state and federal regulatory agencies, local officials, and the Neponset River Watershed Association—to expedite the complex permit-approval process. The working group allowed the project to proceed at the rapid pace required for the Patriots to simultaneously daylight the river and provide parking for ongoing events during construction of the new stadium.

Daylighting projects require a broad range of skilled professionals to create diverse, high-functioning riparian systems. The design of these systems must take into account hydrologic conditions and other environmental factors as well as cost and schedule constraints, and it must comply with regulations. On this project, the interdisciplinary design team led by Rizzo Associates, Inc., based in Framingham, Massachusetts, included landscape architects specializing in bioengineering practices, wetland scientists, civil and structural engineers, and permitting experts. The Boston-based firm of Haley & Aldrich, Inc., provided critical geotechnical support. The Patriots and their design team first presented the design concept to the involved regulatory agencies in July 2000.

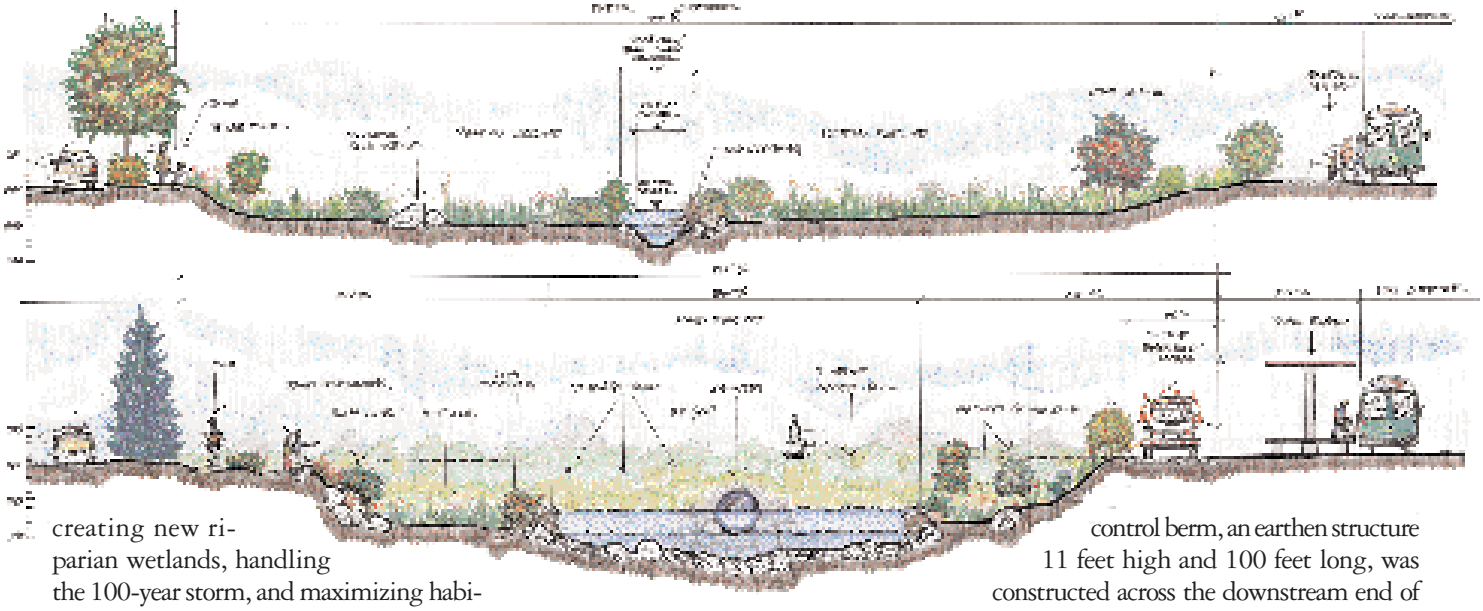
Extensive investigation of subsurface conditions of soils, groundwater and surface hydrology, and nearby vegetation communities provided critical parameters as the design work moved forward. Using river morphology analysis of nearby existing reference reaches of the upper Neponset, the team determined the new river's fluvial requirements. Data was gathered on the existing reaches' cross-sectional, longitudinal, and sinuosity dimensions, as well as the flow regimes accommodated therein, and the new river channel was sculpted accordingly. The analysis phase also pointed to some of the challenges facing the designers. For example, geotechnical test borings found suitable conditions in approximately two-thirds of the proposed 8.4-acre corridor but showed a potentially high groundwater table in the uppermost third. Here the corridor was adjacent to an active railroad line and would be most narrow and require the steepest side slopes. The design ultimately addressed slope seepage and its possible destabilizing effects by providing a contingency plan for slope stabilization in these areas. The plan allowed for infield decisions during construction that minimized the use of rock for stabilizing the banks.

The design for the new section of daylighted river was based on requirements for

The evolution of a river. Depicted from top to bottom: preconstruction condition, April 2001; stabilization of the newly excavated river corridor, June 2001; and the corridor after substantial vegetation establishment (despite drought), August 2002.

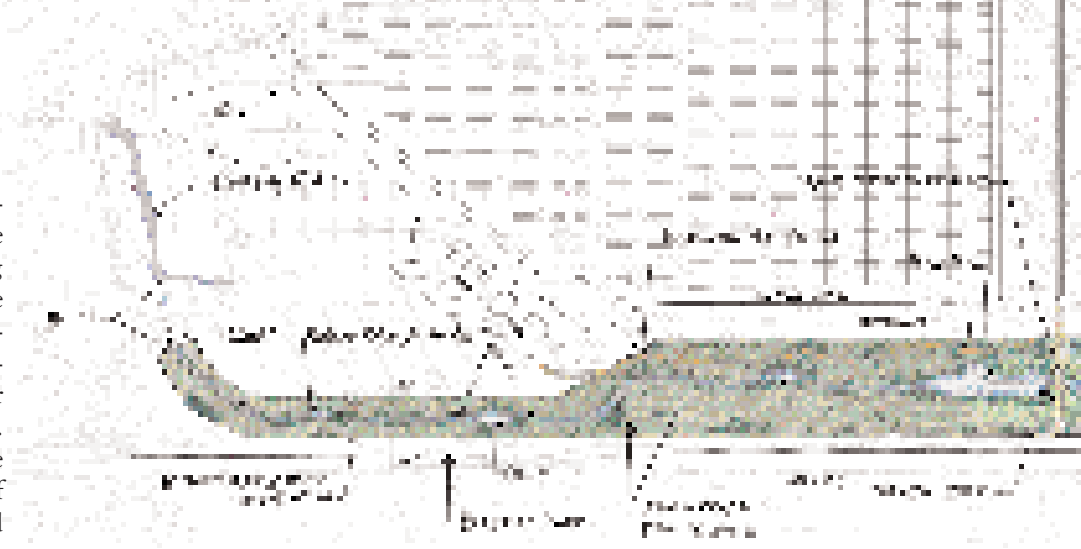


Right, **rendered plan of the multipurpose, flood-control access berm flanked by two ponded segments of the river channel.** ***Below,*** **cross-section drawings illustrate diverse channel corridor conditions and features including a pond at the access berm, woody revetments along channel banks, boulder perching sites, and varied vegetation types (all native to New England).**



creating new riparian wetlands, handling the 100-year storm, and maximizing habitat values. The vision called for creating a river as close to natural in function and appearance as possible. Site constraints required that the 8.4-acre linear corridor be configured with a narrow 60-foot-wide section in the upper third and a section with a width of about 140 feet for the remaining majority of the downstream corridor. It was planned that riparian wetlands would cover the bottom of the wide section and that upland side slopes would become meadows transitioning to old fields. A large flood-control berm, an earthen structure 11 feet high and 100 feet long, was constructed across the downstream end of the corridor to control the 100-year-storm flows. A broad but short box culvert conveys flows under the berm, providing the only real constriction to flow. (The river enters the upstream end of the site through another broad, short box culvert.) With a walkway

Interplanted with wetland grasses and forbs, channel edges, *left,* are secured with rounded gravel, irregularly sized riprap and coir rolls. Live cuttings from native shrubs sprout along the banks. ***Right,*** **woody revetments—such as fallen tree shelters and root wads recovered from the stadium site construction—immediately stabilized channel and pool edges prior to vegetation establishment. The flood-control access berm is in the background.**

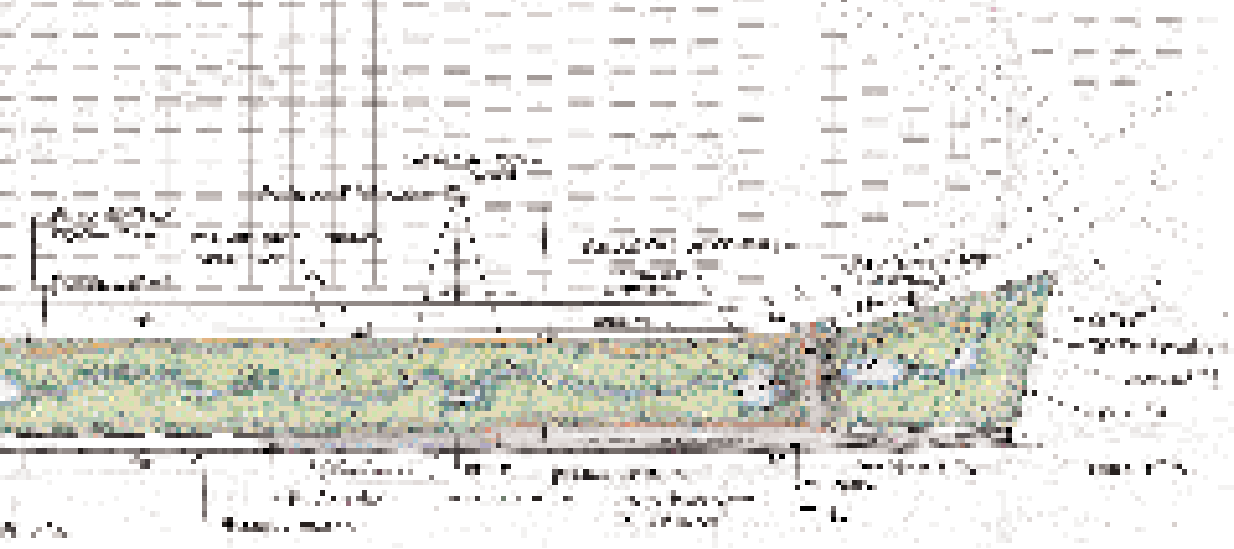


on top, this berm doubles as a public accessway, connecting a railroad station to the stadium grounds and providing sweeping views of the river corridor and stadium. The berm further provides critical emergency access to the station. Two of the corridor's larger ponded areas, averaging about a quarter acre each, flank either side of the access berm.

Stormwater from the stadium site flows into the river corridor at a number of points after pretreatment in vegetated swales located within the adjacent parking areas. These best-management-practice features are part of an extensive stormwater management plan for the overall stadium project. Some additional water-related innovations included in the larger stadium project are state-of-the-art wastewater collection and on-site water treatment systems, which allow treated effluent to be reused for specific, non-potable functions such as irrigation of landscaped areas within the stadium site.

Regarding the river channel itself, a pool-riffle system was designed that varied in width, depth, and velocity throughout the corridor. Shallower, faster-moving riffle sections cause the water to speed up and provide aeration, while quiet waters of the deeper pools and ponds allow for natural deposition of suspended solids and resting/hiding spots for fish and other aquatic wildlife. The river's sinuous course mimicked that found in existing reaches upstream and downstream of the relocation site. Variations in sinuosity and profile depths provide water quality benefits such as filtration of suspended solids and diverse aquatic habitat. Rounded gravel was chosen as a bottom substrate to provide a natural-looking, stable river bottom. With habitat in mind, nooks and crannies and other imperfections that shelter aquatic wildlife were incorporated in the design and ultimately constructed along the channel banks.

Bioengineering techniques for channel and slope stabilization included features such as woody revetments. Trees and root wads (root masses from fallen trees) recovered from the stadium site construction were anchored in key spots along the channel to dissipate



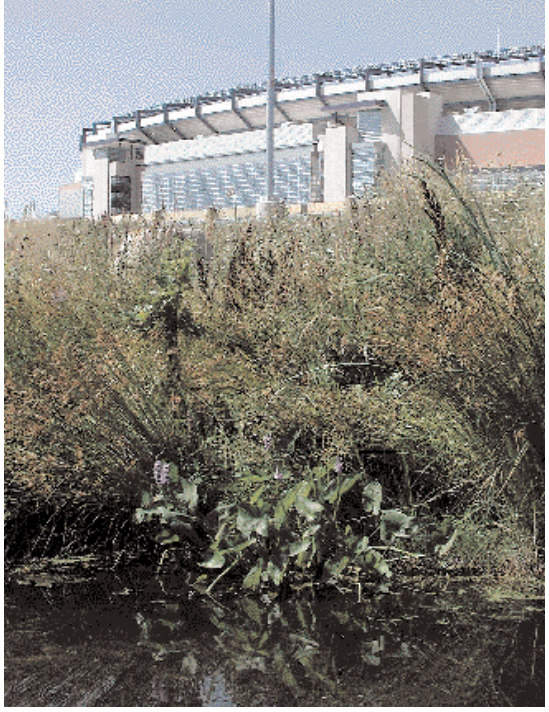
The conceptual plan, *left,* prepared in the summer of 2000, illustrates the restored river's diverse, naturalized channel.

flow force against the banks while creating shaded shelter areas. Coir rolls were installed in combination with riprap, which was typically limited to bank toe areas and the few seep areas. Extensively seeded with native wetland species, newly constructed riparian wetlands areas were secured with biodegradable matting and then planted with native wetland herbs, shrubs, and tree species. Live stakes—cuttings from native wetland shrub species including dogwood, willow, arrowwood, and elderberry—also provided cost-effective rapid cover and stabilization along channel banks. Upland side slopes received similar treatment, this time using native upland species, including wildflower patches. These slopes included large, placed-boulder outlooks/perching areas as well as sandy turtle nesting areas.

From the downstream to the upstream ends, the river corridor's excavation produced some 44,000 cubic yards of material from under the previous parking lot and racetrack. Excavation depth approached 15 feet below existing grade in the new channel's deeper pool areas. Much of the excavate was reused as fill for other stadium site improvements in upland areas. Timing was particularly critical due to the immediate need for parking and the associated diversion of the river's flow from its existing channel into the new channel. Furthermore, the preferred installation time for much of the specified vegetation was early in the growing season. Corridor excavation began in April 2001, closely followed by excavation and initial stabilization of much of the channel. Bioengineering work and planting were largely completed by July 2001. The Neponset's diversion into the new channel occurred in late July. Just prior to diversion, members of the working group, the community, and their children rolled up their sleeves and got into the river to conduct a wildlife rescue mission. Scores of minnows,

frogs, turtles, butterflies, and crayfish were relocated just upstream of the new river site in the hopes that they would soon inhabit it.

Despite droughts during both the 2001 and 2002 growing seasons, and with active irrigation during 2001 only, vegetation has rapidly established itself in the corridor. As vegetation has flourished, aquatic wildlife, birds, and mammals have begun to discover the new Neponset River channel. During the 2002 growing season, turtles, frogs, crayfish, and fish fry could be observed in abundance throughout the new river channel, and the tall grasses of the wetland and upland areas were abuzz with insects. The corridor leaves the impression that the upper Neponset is somehow whole again. In May 2002, the Gillette Stadium project received an Environmental Merit Award from the EPA for its commitment to the environment shown in the river restoration and other environmentally minded improvements.



Heavily seeded and planted native wetland vegetation, such as violet-flowered Pickerelweed *(Pontederia cordata),* thrives along the daylighted Neponset's banks, as Gillette Stadium stands ready to welcome its first fans for the 2002–2003 football season.

From concept to reality in just one year thanks to an exemplary public–private cooperation effort, the relocation and reconnection of the Neponset corridor have brought new life to one of metropolitan Boston's significant rivers and watersheds. **LA**

Thomas S. Benjamin, ASLA, a registered landscape architect with Rizzo Associates, was the primary author of this article. Amy Green and Ken Deshais, both of Rizzo Associates, were contributing authors.

PROJECT CREDITS

Client: New England Patriots football franchise.

Design consultants: Rizzo Associates, Inc., A Tetra Tech Company, Framingham, MA.

Geotechnical consultants: Haley & Aldrich, Inc., Boston.

Landscape contractor: Cameron's Landscaping, Farmington, NH.

Earthwork contractor: A. A. Will, Stoughton, MA.