

# WATER SHAPES

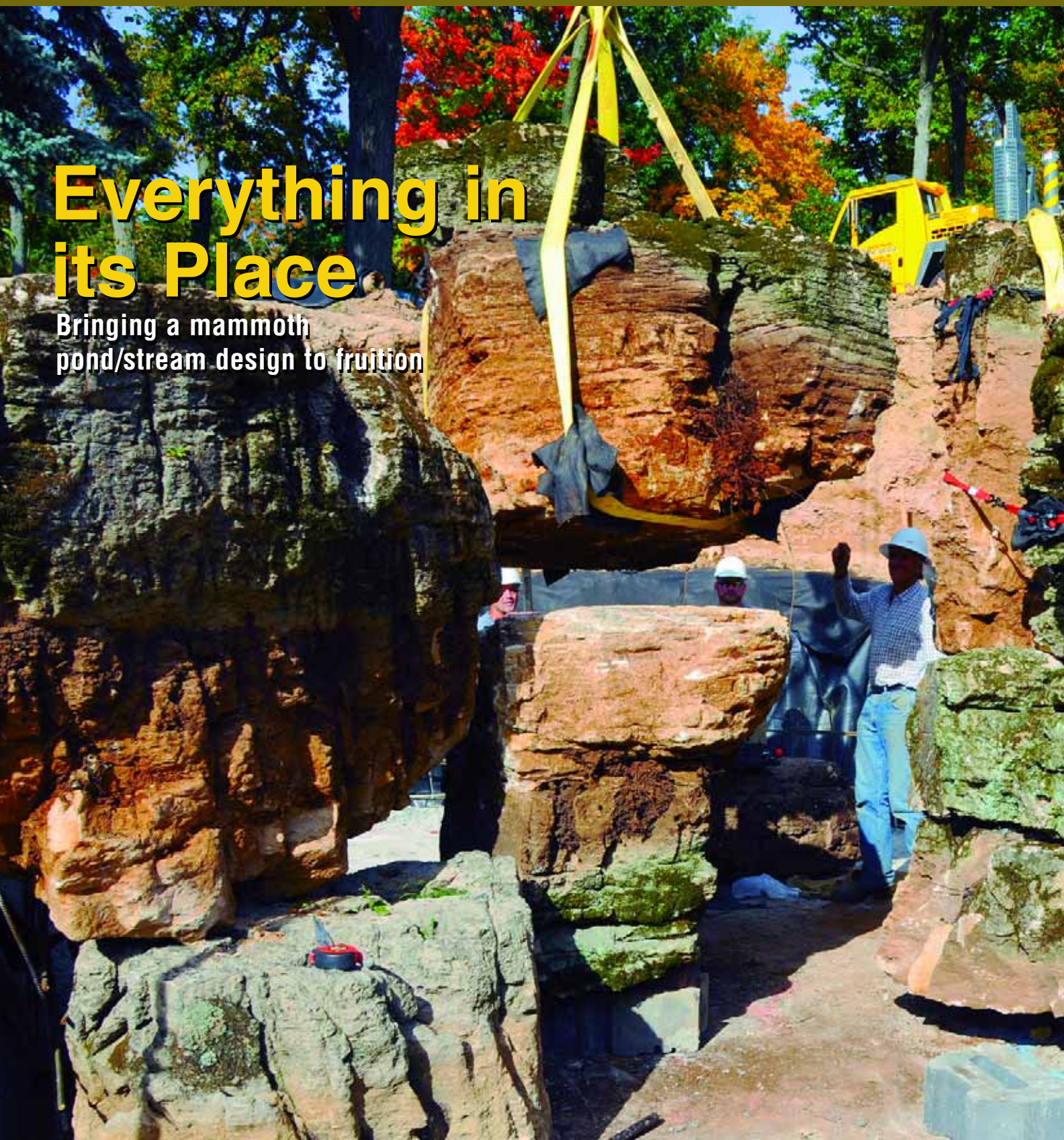
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On the Cover: Photo courtesy Anthony Archer Wills, Copake Falls, N.Y.



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## Out of Sight

By Eric Herman

If you're like most people, you probably don't give much thought to where the water we drink originates. Our supplies of this precious commodity are so reliable, ample and safe that we mostly just go to the tap and use what we need.

I was once that carefree, but no more. As I see it, ignorant bliss is actually inexcusable these days, not only because each of us needs a ready supply of potable water to survive and maintain the quality of our lives, but also because so many of us live in places where water scarcity is becoming an issue.

I also recognize that, at root, this magazine is about water – and that almost everything we do and you do assumes its ubiquitous availability. Usually, in fact, it takes serious threats of usage restrictions to prompt us to think about water on the public-utility scale in any sort of detailed or meaningful way.

It's time to change all that. As any of you who follow the magazine probably know by now, we've started covering "green" topics in more frequent and deliberate ways in the past year or so, using our October 2009 "True Green" issue in particular to delve into design solutions and issues related to increased environmental awareness.

Frankly, I find all of this information fascinating – a thread as thought-provoking as any we've ever woven into our pages. This month, as an example, you'll find on page 38 an article entitled "Replenishing the Supply," which I wrote myself after visiting a major water-treatment facility last summer. I won't steal my own thunder by saying much more than if you're interested in watershaping on a truly monumental (even mind-blowing) scale, this feature's just for you.

In preparing to write the article, I uncovered points of interest that didn't make their way into the text. I was, for instance, stunned to learn that our nation's 300-million-plus population is served by more than 156,000 *separate* public-water systems, all of them operating under standards first established in the Clean Water Act of 1972.

More amazing still is the fact that, even in these times when you can't help noticing that our infrastructure could use some help, the U.S. Environmental Protection Agency reports that more than 96 percent of all public-water utilities in the nation operate in full accordance with those standards. That's not perfect, of course, but given all of the challenges faced by our water supplies, it's truly a marvelous accomplishment.

As I see it, we in the Watershaping Industry would all do well to know more about our chosen medium and its role as one of our most precious resources. Doing so, I think, will influence the way you think about, work with and manage water in your projects and put you in a better position to answer your clients' increasingly persistent questions.



A whole bunch of people have been caught short by a recent change I had to make in my e-mail address, which is now [ericshapes@gmail.com](mailto:ericshapes@gmail.com). I thought I'd done everything it took to have e-mails forwarded from my old box, but apparently nothing is as simple as it should be these days.

Sorry if this has tripped you up.

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# In This Issue

## April's Writers

**Anthony Archer Wills** is a landscape artist, master water-gardener and author based in Copake Falls, N.Y. Growing up close to a lake on his parents' farm in southern England, he was raised with a deep appreciation for water and nature – a respect he developed further at Summerfield's School, a campus abundant in springs, streams and ponds. He began his own aquatic nursery and pond-construction business in the early 1960s, work that resulted in the development of new approaches to the construction of ponds and streams using concrete and flexible liners. The Agricultural Training Board and British Association of Landscape Industries subsequently invited him to train landscape companies in techniques that are now included in textbooks and used throughout the world. Archer Wills tackles projects worldwide and has taught regularly at Chelsea Physic Garden, Inchbald School of Design, Plumpton College and Kew Gardens. He has also lectured at the New York Botanical Garden and at the universities of Miami, Cambridge, York and Durham as well as for the Association of Professional Landscape Designers and the Philosophical Society. He is a 2008 recipient of The Joseph McCloskey Prize for

Outstanding Achievement in the Art & Craft of Watershaping.

**Paolo Benedetti** is founder and principal at Aquatic Technology Pool & Spa (Morgan Hill, Calif.), a firm dedicated to the design and construction of luxurious residential watershapes and exterior environments. He earned a degree in business management from California State University, San Jose in 1984 and has continued his education in watershape design and construction through courses in materials science, art history, architecture, color theory and many other topics. Among his accomplishments, Benedetti was one of the first designers to be certified by the Society of Watershape Designers through the Genesis 3 Design Group. He has performed countless forensic case studies involving failed pool structures, consulting for property owners and contractors alike, and is also a prolific writer, having written numerous technical articles for pool and construction trade magazines including numerous past contributions to *WaterShapes*. Benedetti is currently an instructor in the Genesis 3 con-



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struction schools and is a Genesis 3 Platinum member.

**Eric Herman** is editor of *WaterShapes*. A career writer and editor with more than 25 years' experience, he has published and edited articles for publications across a wide range of industries, technical subjects and cultural interests. A native of southern California, he graduated from California State University at Fullerton in 1983 with degrees in Journalism and English literature. In addition to his work in magazines, he has published poetry and written screenplays, technical manuals and speeches and is an aspiring novelist. Herman has worked for McCloskey Communications since 1996 and was the founding editor of *WaterShapes* in 1999.

**Lynn Wolff**, FASLA, is principal and president of Copley Wolff Design Group, Boston. She has more than 25 years' experience in planning and designing projects for public and private clients and is a registered landscape architect in Massachusetts, New York and Connecticut. Specializing in complex urban projects requiring expertise in project management for multi-disciplinary teams, multiple clients and extensive cultural, historical, public-art and public-participa-

tion components, she collaborates with design professionals, artists, government agencies and neighborhood groups to design spaces that reflect the diversity and cultural richness of their surroundings. To those ends, Wolff's practice has encompassed a broad range of urban parks, streetscapes and community designs in numerous Boston neighborhoods and throughout New England. **John Copley**, ASLA, is the firm's founder and owner. He has extensive professional experience in site planning, design and implementation of projects throughout New England and the United States, with responsibilities encompassing all aspects of office management, project management, design and construction observation and community participation. His projects often require sensitive design and detailing that are consistent with historical contexts – but also contemporary in spirit – and he is also actively involved in public planning and design related to affordable housing and town planning. Through the years, he has played key roles in award-winning urban-landscape projects, including the Frog Pond renovation on Boston Common, Dudley Town Common in Roxbury, Mass., and the First Church of Christ, Scientist in Boston.



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# Aqua Culture



## In Hot Water

By Brian Van Bower

**I**t seems like ages ago, those glowing days when a spa – whether separate from or connected somehow to a swimming pool – stood on the absolute cutting edge of residential watershaping.

These days, by contrast, systems designed to deliver hot water and hydrotherapy to our clients have become so familiar that they're almost taken for granted. From what I've heard, it's almost reached the point where discussions leading up to some of the best custom projects are treating spas as an assumption rather than as a key part of the conversation.

Personally, I think that's short-sighted. Clients still love relaxing in hot water, and the more we're able to customize these vessels to meet clients' needs and desires, the happier they will be with a project's outcome. As I see it, there's huge potential here to up the ante, distinguish what I do and thrill my clients – and the only way to do so

**Clients still love relaxing in hot water, and the more we're able to customize these vessels to meet clients' needs and desires, the happier they will be with a project's outcome.**

is to ask questions, gather information and respond to what I learn as best I can.

### what's in a name?

In considering why spas have tended to become marginalized, it is perhaps not beside the point that we in the watershaping trades still are not consistent in what we call these things. Some advocate calling them "hot tubs," while others call them "whirlpools" and still others insist on labeling them as "Jacuzzis."

I don't want to step into the middle of this terminological dispute, but for clarity's sake I always have and always will call them "spas" – and most major dictionaries back me up. I prefer this term because, among all the options, it does the best job of suggesting luxury and relaxation while carrying implications of therapy and healthfulness for good measure.

It also doesn't help, clarity-wise, that these watershapes exist in portable, manufactured forms (in polymer compounds, fiberglass or stainless steel) in addition to being available in concrete as parts of swimming pool systems. I actually straddle this duality: Even though I custom-design elaborate concrete spas for the vast majority of my projects, I own and use a portable spa that sits on a wooden deck about 10 yards away from my pool.

I do so because there's no escaping the fact that portable spas offer a range of benefits that are hard to achieve in concrete spas. Mainly these have to do with the near-infinite array of jet and seat configurations they make available – and I've long said that the manufacturers of these spas deserve full credit for finding so many creative ways to make me happy.

This wealth of possibilities comes at a relatively affordable price compared to what it costs to deliver similar features in a concrete spa. Moreover, portables can be purchased, brought on site, plugged in, filled with water and be ready for use almost immediately, bringing a level of instant gratification that's impossible to achieve in concrete.

On top of all that, manufactured spas are fairly easy to service and maintain, come with an array of control options, can include sound systems, televisions and elaborate lighting features – and can be moved from one place to another without much difficulty.

Continued on page 12

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That's a long list of advantages, but in my book they're counterbalanced by the fact that these vessels just don't look good. It's true that manufacturers have worked hard to improve the appearance of their portable spas with various skirt treatments, tasteful interior surface finishes and pleasing textures, but compared to what can be achieved with inground concrete spas, they just don't measure up.

At the same time, it must be noted that concrete spas are gaining ground when it comes to hydrotherapeutic features and internal contours. They haven't reached a level where they're favorably comparable to portables, but it is undeniable that they are catching up and that the main balance point has to do with what's more important to the client: functionality or appearance?

## the touch

In the bad old days (and to this very day to a distressingly large extent), the norm for concrete spas was a ring of six of the same jets placed around the walls and benches with no real attempt made to personalize the client's experience. I've never settled for that one-size-fits-all approach, striving to elevate the functionality of my systems to approach the performance of portable spas as best I can while also providing superior aesthetic results.

Following on with my last two columns about client interviews, the degree to which my clients want spa features customized to their needs and desires is something that comes out in our early conversations.

Often, what they want leads me to conduct extensive research into hydrotherapy-jet options. The spectrum of what's available these days is amazingly broad, and I find myself considering various water volumes, aerating effects, pulsing or swirling actions, individualized adjustments, jet-type groupings and varieties of jets designed to do something for just about every part of the human body.

With inground spas, I have the freedom to configure systems in pretty much any way the customer wants (budget permitting), so it's an area where I think in terms of being as creative as possible on their behalf. And because I know that spas are, by nature, *intimate*, I see that

they offer me an opportunity to create personal and emotional links between the clients and their systems.

This is why, in my conversations with clients, we always get into highly detailed discussions about how they plan to use the spa (for partying, relaxation or hydrotherapy). I also ask them about their experiences with other spas, both portable and concrete, and focus in particular on seating and jet configurations.

Once I know they're fully engaged, I'll ask them to sit in chairs and describe where they want the jets to hit them. If one of them says, "On the shoulder," I'll gently poke them there so they can imagine the jet action.

I've found that this simple process is a powerful way to bond with my clients, partly because it requires physical contact and trust, but more important be-

simply have on/off options, perhaps with a separate control for a blower. As have manufacturers of portable spas, we've found that our clients enjoy having choices among active functions, at times wanting to isolate on the lower back but not the shoulders, on the feet but not on the calves – whatever the case may be. This is a degree of functional control that *dramatically* increases enjoyment of the spa.

Throughout the spa, we also create "stations" – that is, specific seating locations that often provide different types of jets and seating combinations. We might set up an area suited to two people, for example, or address the needs of a single very tall person. We'll even cater to the kids by elevating a bench area for their use. Again, it all depends what the clients want and how much information you're able to draw out of them.

**It's hard to keep up a bad mood in a spa: It's a relaxing, healthy, luxurious and even romantic environment, ready for daily use.**

cause it has a profound effect on the way they'll feel about their spas later on: When they first sit down in the water and feel the jets hitting them right where I touched them, they'll remember that experience and know that these jets – these wonderful sources of comfort and therapy – were placed there *just for them*.

You simply cannot put a dollar value on those feelings of pride, momentary pleasure and long-term enjoyment.

## configuring relaxation

Spa design on this level often involves blending the physical with the psychological. Often, for example, we'll create what might be called a "king's chair" and/or a "queen's chair" or both for a project – spots in the vessel we consider to be prime locations with the best views, the most jets and the easiest access. These are the most "active" seats in the spa and might include wide arrays of jets to soothe backs, legs, shoulders and whatever else might be desired.

Here and in other locations, we'll set up "either/or" scenarios where the clients have control over which sets of jets are on or off. Lesser quality inground spas will

Truly, the possibilities here are limitless. We'll create two or three seating levels to accommodate people of different heights, for example, or to give clients what they want with respect to being submerged at different levels. We'll set up spaces between stations where there are no jets at all to please those who like to take breaks from the jet action but don't want to interrupt anyone else's enjoyment of the spa.

In all of this, I constantly take cues from portable spas, basically because so many suppliers have developed wonderful jet arrays and seating arrangements that merit imitation. But the simple fact is that many of these effects are *incredibly* difficult to achieve in concrete.

In the world of concrete spas, those same maneuvers have to be executed using concrete-installation techniques – that is, the eyes, arms and elbows of laborers wielding trowels and meeting exacting plans down to fractions of inches over multiple radii, corners, slopes and variable edges. Happily, there are contractors with enough skill to pull these things off nowadays – but these *aren't* people you can find with any consistency across the country.

This is why some clients and their builders choose to sink prefabricated spas into the ground. It's not the best solution, the best look or anything I'd ever endorse, but it works for some people.

## wonderful details

When you find the right crew, however, there are some utterly amazing things that can be done with concrete to upgrade the spa experience.

One key area has to do with basic ergonomics: In common, old-school concrete spas, for example, the tendency was to set up benches that defined 45-degree angles for the back and legs. In our spas, by contrast, we almost always now include angled-back seating (typically a three-inch slope for 18-inch rises) and often use David Tisherman's famous detail in which he rolls the edges or creates a horizontal ledge at the top of his spas to make them easier on necks.

We've also responded to our clients' desires by including strong jets in our spas. It might not be a need they can identify up front, but when we give them the capability to experience very strong jet action, they usually get to love it. So whenever there's a question, we tend to go strong, as a rule installing jets with 25 gallon per minute flow rates. (We make them adjustable and tend to place them lower in the vessel where that much power is needed to massage an aching lower back, for example.)

In organizing these jet arrays, I think things through in ways that allow me to avoid using blowers to induce air into the therapy jets – one of my pet peeves in spa design because I see their presence as an admission on designers' or builders' parts that they haven't figured things out adequately and need a blower to make up for system deficiencies. In truth, a therapy jet supplied with adequate flow at the proper velocity works quite well without any assistance from a blower.

Early in my career and again in recent years, I've used blowers not for air induction but instead for creating air bubbles that rise from the seat and benches of spas. I took a hiatus from this detail after working with several doctors on hydrotherapy rehabilitation projects who

told me that the air bubbles offered little or no benefit.

But whether they create useful therapy or not, I had to bring them back because they make a spa look supremely inviting: The steam rising above a bubbling cauldron of a spa has great visual appeal, so we've gone back to offering blower/air bubbler rings if it's important to our clients.

I let them know that they're paying extra for something that looks good but has little (if any) physical benefit – and if they're willing, I'm all for installing a blower for this purpose. In the old days, we just drilled holes through a spa's interior finish into a pipe poured into a concrete cap on the benches, and it was rather crude and inexact. Now, we use flush plastic fittings that allow for a much neater installation.

When I work in cooler climate zones, we always locate the intake for the Venturi effect (or a blower, if we use one) in a place where it'll be fed by warm or at least warmer-than-ambient air. When jets are fed by cold air, they can create quite a shock when the cold bubbles hit the bather's skin; moreover, their coolness increases the burden on the heating system.

Taking that concept a step farther (based on a suggestion from my Genesis 3 colleague Paolo Benedetti and some others), we now add heated water to the *bottom* of the spa in a separate, isolated loop. This prevents the problem of the air-induction system cooling the warm water while increasing overall heating efficiency and calming the water.

## keeping track

As is true of almost everything associated with watershaping, spas have developed tremendously through the past several years, and the numbers of possible features I could discuss – both functional and aesthetic – could fill many more pages here.

Just think about waterfalls that pour warm water onto bathers' back and shoulders: That's a feature that's become popular in pampering spas. Or how about stand-up spa wells? Those have become quite the thing for clients who want full-body massages. Cold-water spas have become popular as well.

We're also seeing details that have become the rage with swimming pools crossing over to spas. Nowadays, for example, it's no great surprise to see perimeter-overflow spas or vanishing-edge spas, and in many cases fountain jets and nozzles are being added to these compositions to turn them into ongoing water effects when nobody's in the water. I'm also seeing a revolution in the materials being used on spas, including great stone and tile, and tremendous strides are being made in lighting these vessels with fiberoptic and/or LED lights and in tricking them out with audiovisual systems.

Through all of this, however, we do well to keep our minds glued to the fact that spas are the source of profound health benefits.

If you haven't done so already, you should take a look at the fascinating studies initiated by the National Swimming Pool Foundation for factual verification of the value of these products: Not only is hydrotherapy great for aching muscles, arthritis and stress, but it's also been shown recently that immersion increases the heart's pumping capacity and, among other things, the body's ability to use oxygen and process nutrients. And you don't have to be a psychologist to know that it's hard to keep up a bad mood in a spa: It's a relaxing, healthy, luxurious and even romantic environment, ready for daily use.

So if you're one of those who've become jaded and tend to take spas for granted, I'd suggest it's time to step back and consider anew just how wonderful these systems are, the tremendous value they bring to our clients and the creative opportunities they afford us as we work to increase the beauty, functionality and joy to be found in our watershapes. **WS**

**Brian Van Bower** runs Aquatic Consultants, a design firm based in Miami, Fla., and is a co-founder of the Genesis 3 Design Group; dedicated to top-of-the-line performance in aquatic design and construction, this organization conducts schools for like-minded pool designers and builders. He can be reached at [bvanbower@aol.com](mailto:bvanbower@aol.com).

# On the Level



## Permeating Issues

By Bruce Zaretsky

I've taken up a fair amount of my column space in *WaterShapes* with discussions of the wise use of water, and for good reason: What could be more important to water-shapers than knowing how to make the best possible use of the material that defines our profession? And what could be better than the fact that it's possible to approach the subject in positive ways that bode well for the future?

The common thread in all of this coverage – whether it's about conservation, constructed wetlands or rainwater harvesting – is that, ultimately, our aim must be to preserve the integrity of water, to cleanse it for return to the groundwater system and to use what we need and no more. Pursuing these goals is good for the planet, our businesses and, when all is said and done, for our overall quality of life as residents of this planet.

One major topic I've yet to mention has to do with one of the single greatest threats to our waterways, whether they be lakes, rivers, streams or oceans: The plain fact is that much of the surface water that now flows into them is loaded with pollutants.

With multiple generations of residential,

**Our aim must be to preserve the integrity of water, to cleanse it for return to the groundwater system and to use what we need and no more.**

commercial and industrial construction, we've steadily displaced soil, wetlands and woodlands and have replaced them with hard, impermeable surfaces in the form of roofs, parking lots, driveways, roadways and other surfaces onto which we drip oil, antifreeze, transmission fluid and other toxins that wash off into our storm sewers and flow into our waterways.

To compensate, we need to think in terms of rainwater harvesting and green roofs and other water-controlling techniques – one of which, these days, has to do with getting water to flow *through* pavement rather than *over* it.

### permeable surfacing

Some of you are doubtless familiar with the array of permeable pavements now available in the marketplace, but my experience in the field tells me that many of us in the trades are not yet up to speed with this exciting surfacing technology. As I see it, this is something we should *all* get familiar with right away: It's the sort of concept we should be mentioning in every conversation we have with clients; should be pushing in every meeting with local officials; and should include in every proposal we advance to general contractors and engineers.

They function just as advertised: Instead of forming solid surfaces, permeable pavements allow water to pass through them and either percolate into the soil or flow into subgrade drainage systems for controlled release into waterways.

The past few years have seen lots of breakthroughs in this arena, and it's even reached the point where formerly "solid surface" products including asphalt and concrete can now be made to allow water to pass through instead of running off. At this point, these materials are typically used for low-speed traffic areas including parking areas and driveways and they're even installed in familiar ways – the exception being that the base material contains little (if any) stone dust mixed in with the crushed stone or crusher run.

According to one supplier, permeable concrete with 20 percent voids can store up to an inch of rainfall within its structure, and the further claim is that, with a proper base of six to twelve inches of dust-free crushed stone, the capacity is significantly higher and helps to alleviate any issues with water retention in the concrete and the frost damage that might result in winter.

Beyond these direct substitutions for solid surfacing materials, there are also the permeable pavers that have become familiar

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# On the Level

in most markets. Most of us, in fact, are sometimes painfully familiar with the prolific number of concrete paver systems that have been offered for about 30 years now: Interestingly, these systems started out by offering a less-expensive method for installing pavements with the added advantage that the pavers could be pulled up and replaced fairly seamlessly if subsurface work needed to be done.

The original edge of these concrete pavers was their interlockability: Indeed, early on many were shaped to resemble I-beams or keyholes to speed installation and make any single unit in a finished area unmovable without moving an entire section. As such, this was an alternative to the herringbone patterns that brought four-way locking to bricks and conventional concrete pavers.

Until recently, these systems were also sold on the basis that, as individual units, these pavers formed flexible surfaces that could withstand both vertical and later-

al forces without failing because individual units could actually “roll” with applied weight changes. As a result, they became a popular choice for roadways and public access ways in any situation where there were below-grade utilities to which access might be needed.

Where poured materials such as concrete and asphalt will always betray where a repair has been done, dry-laid concrete pavers can be lifted up, stacked out of the way and reset after repairs are made with no apparent surface changes.

## another level

Through the years, these paver systems have become much more sophisticated, with lots of attention being paid to their aesthetics. As they’ve gained popularity and marketability, more and more design options have been introduced, including various shapes, tumbled products and even styles that approximated the look of real stone.

Yes, many of these products pose distinct aesthetic challenges and will never find use in high-end projects, but through the years, plenty of pavers have come along that do a fair job of resembling real brick and stone and have proved themselves worthy in a broad range of applications. And they *do* hold up well to vehicular traffic, making their use as driveways and parking areas both viable and reliable.

The key with these projects when it comes to permeability is the way they are installed: Many concrete pavers are designed with small spacer bars or nubs on their sides that create gaps of approximately an eighth of an inch between pavers. Thus, after the pavers are set into place, the tamping process drives bedding sand back up in between the pavers to lock them in place.

This small gap is these pavers’ route to permeability: Rather than all of the rainwater reaching these surfaces running off, a good portion of the water instead flows through the gaps into the ground. We still pitch any paving to allow surface water to run off, regardless of permeability, but the fact is that this is a step in the right direction relative to solid surfacing.

Seeing an opportunity in the desire for increased permeability, manufacturers have recently begun producing pavers that are designed and engineered for installation with significantly larger gaps to be filled with coarse sand or finely crushed stone (but still no stone dust, which tends to cake and become impermeable). The idea is to capture that much more water within the system before it can run off the surface.

Again, to enjoy the full benefits of this increased permeability, the base must include a bedding course (typically a crushed stone with no dust or fines) set atop a permeable base layer. This way, almost all of the water that penetrates the surface flows down through the base and either flows into a catchment system (for example, a French drain set below the base layer or a large-scale subterranean storage area) or percolates into the ground itself.

To be sure, some pollutants might pass through the gaps in these systems, but much of the load would be captured in the bed-

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ding and base systems and would be significantly diminished as it moved through the system. Even in simple relative terms, this is far better than running all of the surface water to a catch basin or storm sewer for direct introduction to our waterways, unchecked and completely unfiltered.

## gaining traction

The advantages of these permeable paver systems are so apparent that they're being embraced by more and more municipalities and organizations. In one example, the City of Chicago has installed permeable pavers in miles of alleyways; before, these alleys would flood during storms, but now they are completely dry soon after the rain stops falling.

That sort of experience is being backed up by research. Indeed, a study done by the Toronto & Region Conservation Authority (TRCA) in 2005-2006 found that a permeable-paver test plot showed a runoff of less than 10 percent of the water from a two-and-three-quarter-inch storm of five hours' duration. By comparison, an asphalt test plot experienced runoff approaching 100 percent under the same conditions.

TRCA also conducted a water-quality analysis to test for retention of heavy metals, oils, grease and other pollutants. Many of these tests have shown lower concentrations of pollutants including zinc and lead compared to the asphalt test area, and additional studies are aimed at quantifying these advantages. Suffice it for now to say that stopping the water before it runs unchecked into fragile waterways offers a better (if not the best) solution.

Make no mistake: I'm still a major proponent of using raingardens, constructed wetlands and bio-retention swales to manage the runoff from parking lots, but I recognize that not all sites are suitable for such systems, whether it's due to pre-existing conditions or space constrictions. In these cases, the use of permeable pavements is a viable means of minimizing the need for catch basins that empty directly to storm sewers.

This is also an approach that can be used with hardscape playgrounds, large driveways, patios and even substantial

pathways. Indeed, while I recognize that permeable surfaces are not the *only* solution to runoff issues, I see that in the right context and the right setting, they represent another option in a growing spectrum of ways we can make the best and wisest use of our most precious natural resource. **WS**

**Bruce Zaretsky** is president of Zaretsky and Associates, a landscape design/construction/consultation company in Rochester, N.Y. Nationally recognized for creative and inspiring residential landscapes, he also works with healthcare facilities, nursing homes and local municipalities in conceiving and installing healing and meditation gardens. You can reach him at [bruce@zaretskyassociates.com](mailto:bruce@zaretskyassociates.com).

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## Bright Ideas

By Mark Holden

**I**t has always bothered me: Why do we take devices that draw electrical current and install them in aquatic environments where humans get in the water? Even if precautions are taken, isn't this risky business?

Certainly, suppliers have come up with all sorts of measures designed to protect bathers from any potential hazard, and I have nothing but praise for the ingenuity they've displayed in surrounding their products with safeguards that minimize concern. But based on my own observations and experience, I must say that this is nonetheless a greater risk than most of us perceive.

Why so? Well, no matter how well-meaning and conscientious suppliers are, they don't control what happens in the field with every project and therefore face a near-insurmountable safety challenge. At the most basic level, that challenge rises from the fact that, in all of nature, two of the most unyielding and unwieldy beasts are water and electricity, with water al-

**I believe a revolution in the field of underwater lighting is upon us in the form of the latest generation of LED technology.**

ways seeking its own level and finding ways to escape the structures that confine it and electricity similarly always seeking and moving along paths of least resistance.

When you factor in the fallibility of human installers, I'm surprised there aren't more incidents having to do with exposure to stray currents in pools.

### getting specific

Even doing our best on all fronts – from the equipment manufacturer to the code writer to the installer – there are still risks to be considered. On one of my very own projects, for instance, we used all of the right equipment and complied with all applicable codes and followed recommended installation procedures to the letter but still ended up exposing bathers to stray current.

Following the rules, it seems, is not enough!

As you may have noticed through my recent columns, I've been in a place lately where I've spent a huge amount of time evaluating and reevaluating what we do as watershapers, largely because I've run into a whole bunch of bright students of landscape architecture who are adept at challenging assumptions.

They've forced me to look at our industry with open eyes, and one side effect has been that I've spent a lot of time bucking against convention and looking at ways of building watershapes without the use of established products and practices. The fact that times are tough has accelerated these thought processes: The idea that we can "stay the course" in the current marketplace seems absurd to me.

As far back as last April, I used this space to write about three technologies that represented the sort of change I was interested in, the first two being variable-speed pumps and a fresh approach to water sanitization. The third had to do with lighting – and I'm coming back to it now because the abovementioned experience I had with stray current in one of my projects made me realize that the time for a complete change was upon me.

The great thing is that I believe a revolution in the field of underwater lighting is upon us in the form of the latest generation of LED technology.

Originally, the appeal of LEDs came largely by virtue of the "wow factor." Arrays of these lamps can easily be used to generate colorized light shows that thrill our clients and make us look like geniuses for managing to find something new under the sun.

From my perspective, however, the instant availability of millions of colors is now the *least* of the benefits LED technology has to offer us. Sure, it will always appeal to clients who buy on an emotional level, but as I now see it, there's a whole range of benefits that are far more important for us and our clients that have to do with safety and operational efficiencies.

### weighing risks

Producing light from charged semi-conductors is, of course, nothing new to the world. It's not even revolutionary to put these devices under water.

What is new, however, is the variety of applications into which these devices are finding their ways – a range that seems to broaden every day as LEDs take over in automobile headlights, streetlights and traffic signals as well as for less-critical applications in flashlights and, yes, the lighting of pools, spas, waterfeatures, fountains, streams and waterfalls.

But our industry has been late in coming to the technology, and some say it had to do with a lack of output from LED fixtures. Now, however, there's no such excuse: Not only can sources of electroluminescence produce every color in the rainbow, but they can do so at lighting levels comparable to standard incandescent systems.

As suggested above, however, colors and intensity are only part of what's happening with LEDs these days: Not only are they viable, but they also offer a pile of benefits that we simply can't overlook.

Each year, we at Holdenwater step away from our offices in Fullerton, Calif., to conduct safety inspections on public swimming pools. All too often, what we find is sobering, especially when it comes to the conditions of the underwater lights.

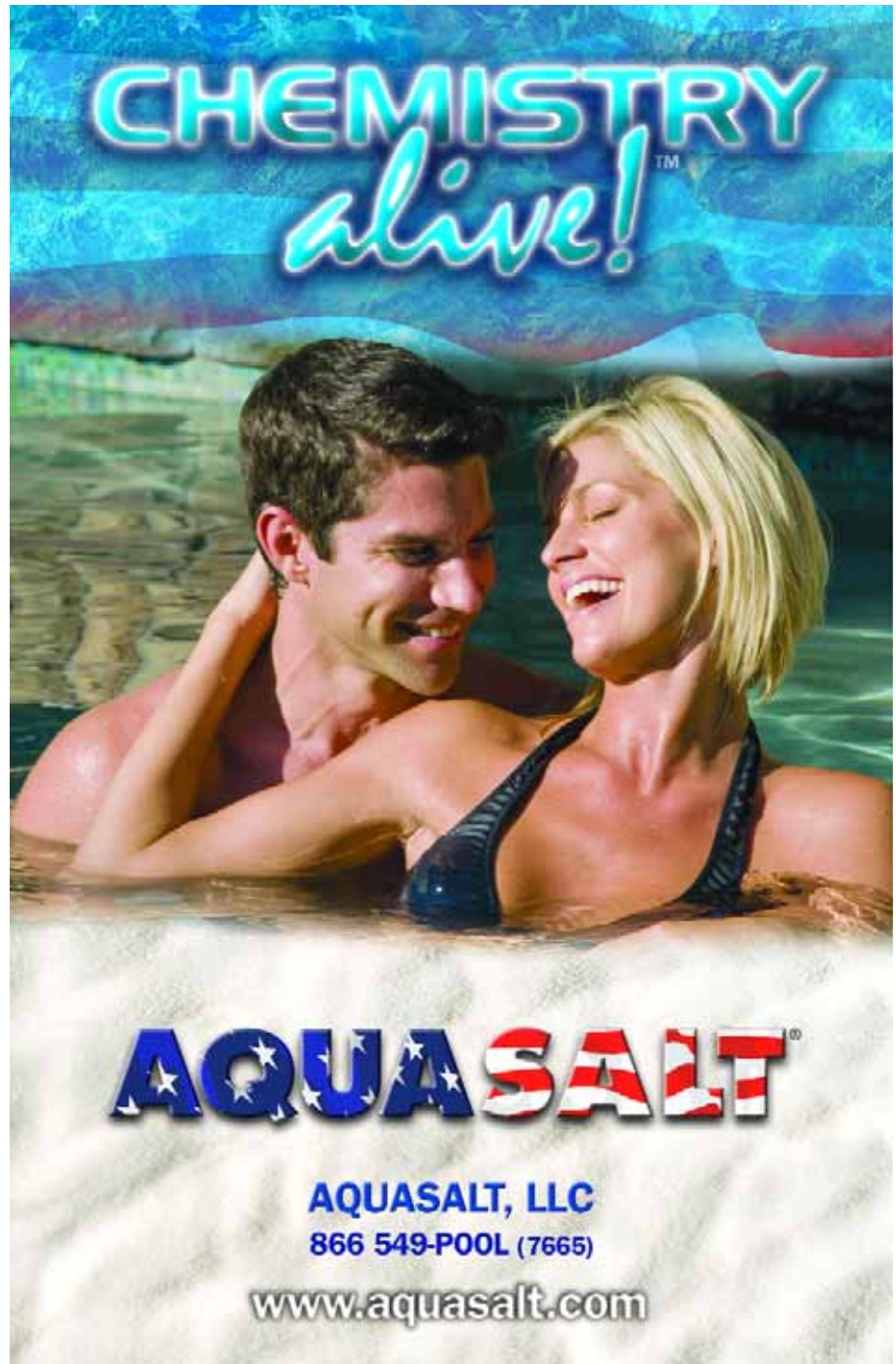
As we all should know, light niches are tricky to build, so it should come as no surprise that we find all sorts of problems with how they've been installed. Sometimes it's a problem with the bonding wires that results from application of potting compounds in ways that compromise system integrity. Other times it has to do with apparently routine lamp replacement and damage done in the process that creates leaks. And where we might find that a high

percentage of lights in a single large pool might be in great shape, we'll most likely find a couple that fail the inspection.

Overall, however, the picture's not so bright: Conservatively, I'd say that we find water in 30 to 40 percent of the "dry" fixtures we inspect. If it's not faulty housings, then it's seals that haven't been replaced as

they should have been. Either way, the situation is potentially dangerous.

Yes, these fixtures are attached through GFCI-protected circuits and we all talk about how well they work. And we're also well versed in the benefits of grounding and bonding, but the real question is, would you be willing to let your kids



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jump in a pool with a flooded light fixture? I sure wouldn't.

There is, I'm happy to say, a better option nowadays that not only removes the niche from the water but also eliminates the need for bonding. It may not be the "standard" approach, but I believe firmly that it's a *better* one.

## making the change

So let's size up the situation: We need a safer, more economical, more cost efficient, easier to install, more versatile and more ecologically responsible alternative to the antiquated lamps and fixtures we've been using for more than a half a century. As I see it, LEDs fill the bill – but not

all LEDs are created equal.

A year ago, my research into countless underwater LEDs led me to identify a single product that, I thought, rose above the rest in terms of addressing our issues and needs – that is, Nexxus Lighting's Savi Note LED system. Since then, the company has introduced Savi Melody and Melody Blanco (the latter with white light only for commercial applications): Both excel in so many arenas that I think they've set the bar at an all-new level and should become the standard by which other systems are evaluated.

(If this seems like a product endorsement, it probably qualifies – but that's definitely not my point: My intention here is to offer this product as an example of the type of innovative thinking we need and something we need to bring up in our conversations with other lighting suppliers to encourage them to get up to speed. I'm not picky: I'll use anybody's product that rises to or exceeds this level of performance.)

What makes this product different is the fact that the majority of LED underwater fixtures now on the market persist in feeding line voltage direct to the wet niche, where this 120-volt current is stepped to low voltage to make the light-emitting diodes disperse the photons we perceive as visible light. If the fixture needs low voltage, why put the transformer in the niche?

That's apparently a question the folks at Nexxus answered differently from everyone else: The Savi Melody system puts the transformer up on deck, with only low-voltage power transmitting to the underwater LEDs. That seems simple enough, so why on earth is anyone still doing things the old way?

In addition, these new fixtures can be installed into inch-and-a-half apertures on the wall of a pool or spa with no niche or bonding wire. The fixture is housed in a foot-long piece of pipe with a bushing on the back end that steps down to a one-inch conduit running to a transformer that can be placed up to 150 feet away from the fixture. Sounds good to me: quick to install, and lamp replacement will be a breeze – although the lamps are rated for 50,000 hours, so that won't happen



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too often. (This is particularly beneficial for public pools, especially when you consider the maintenance requirements of conventional incandescents.)

These new LEDs are also far greener than conventional lights that consume 500 watts. The Savi Melody runs on just 14 watts and has the output equivalency of a 350-watt incandescent lamp. That might be a slightly lower output, but the energy savings are amazing. And with the white-light only performance of Melody Blanco, public and institutional watershapes can now use them and comply with most Health Department rules.

Moreover, these LEDs have an edge no conventional light can touch when it comes to depth of placement: Where most incandescent-system suppliers specify placement at 18-inch depths for a variety of reasons, LEDs can be placed just about anywhere, such as on the edges of beach entries or thermal shelves. They're great in compact spaces, and they even work in kiddie pools – where lights are required by code but incandescent fixtures can't be used because of the shallow depths and fiber optics don't typically generate enough light.

### valuably unobtrusive

I don't just build and inspect watershapes: I also design them. For years, I've been bothered by the visual intrusions that result from the big stainless steel rings, the bulging lenses and the tremendous hot spot that is created by a system that only manages to illuminate one area of a watershape effectively.

The small LED fixtures are about as big as traditional wall returns and indeed are installed in that same sort of wall fitting. They're so discrete that I'm happy to use several of them around my watershapes, partly because they're unobtrusive, but also because they help me create an even glow throughout a vessel.

And when I take away the cost of organizing and installing the niche, the bonding wire and the potting compound for incandescent lights and paying to have all that work done, the new LED option is considerably less expensive than the conventional approach.

When you add it all up, I see this

change in direction as the responsible answer to our need to make clients happy, control costs, make our projects safe, conserve energy and reduce our carbon footprint. It's the kind of thing my students demand, and increasingly it's just what my clients want.

All that and cool colors, too. 

**Mark Holden** is a landscape architect and a landscape and pool contractor specializing in watershapes and their environments. He has been designing and building watershapes for nearly two decades, and his firm, Holdenwater of Fullerton, Calif., assists other professionals with their projects. He is also an instructor for the Genesis 3 schools and at California State Polytechnic University in Pomona. He can be contacted at [mark@waterarchitecture.com](mailto:mark@waterarchitecture.com).



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# Earthbound Endeavors

By Anthony Archer Wills

*Devising watershapes that appear as though nature made them, says Anthony Archer Wills, requires both careful planning and expert execution – especially when the project is on a grand scale, as is the case with the one covered here. In this, his second article on a huge pond/stream/waterfall complex, he details the painstaking process he pursued in building a system that is nearly 800 feet long and includes caves and other intricate custom details.*

Last month, we began our discussion of a large pond, stream and waterfall system for a historic upper Midwest estate found on the forested shore of a scenic lake. As related there, the project was to include three major ponds and a series of complex waterfall structures connected by streams rising close to the top of the gently sloping property.

To sum up, the space we were working with measured approximately 300 feet wide and 800 feet long – a large section of a 35-acre estate marked by scores of mature trees that largely governed the watershapes' configurations. Moreover, as there were no natural rock formations or outcroppings on site, we faced the need to create them while working without any cues from the local landscape.

Through the design stage, the clients made it clear that they were looking for a system that was scaled properly to the setting; that provided views and reflections complementing the home and verdant landscape; and, finally, that presented their children with ample places to play while also giving them access to areas where quiet contemplation of a glorious overall setting was possible.

We completed our early work under the eagle eyes of local historic-conservation agencies with which we were happy to co-exist. This proved, however, a time-consuming and occasionally difficult process that added months to the design phase and ended up severely compressing the time frame in which construction work could be done. With the assistance of my good friend Dave Duensing and his expert staff (David B. Duensing & Associates, Ponte Vedre Beach, Fla.), we finally were able to roll up our sleeves and dig into the many tasks at hand.

## Phase by Phase

In projects of this size and complexity, it's not unusual for the work to unfold in stages as a consequence of the difficulties in crew scheduling, working around weather and







the seasons and a host of other complicating factors. In this case, construction ultimately took place in three major phases, with the first covering installation of the majority of the system.

In this initial burst of activity, we installed the large pond at the base of the system. It's situated close to the home and is framed by the huge pillars forming the entrance to the estate's formal gardens. There's fine lawn that runs to the water's edge, and we placed a complex range of four-foot-high waterfalls that descend from a second, smaller pond located just above. On this level, we built a beautiful boardwalk through (proposed) Lotus beds and constructed six-foot-high waterfalls that flow into the pond's far side. Behind these waterfalls, we built two small caves designed with the children in mind and, finally, completed this part of the project by installing the third pond, which in this project contains the natural-filtration system.

All of this was done in a mad scramble of activity in slightly more than two months, with the water in, the pumps working, the turf laid and everything for the most part finished in time for a huge summer party.

The second phase, which had to be completed before winter set in, included construction of the high waterfall and the large, complicated grotto we built behind it.

The following spring, we returned to

complete our work on site, finishing the two streams at the top of the property that feed the high waterfall. We also dealt with installation of the rock formations in the landscape around the watershapes and applied a wide array of finishing touches throughout.

As completed, the system includes three pump vaults that move water up the system in relays – from the bottom pond to the middle pond, then from the middle pond to the filter pond and, finally, from the filter pond up to the headwaters hidden at the top of the system. The flow starts as a humble trickle, with injection points hidden along the streams gradually increasing the flow as they approach the high waterfall and water moves down the chain and eventually reaches the bottom pond.

Our objective throughout the construction process was to create structures that would last indefinitely. The key in this case had to do with the way we worked with the liners – a component of these systems that I prefer to make as functionally bulletproof as possible.

Preparing for the liner starts in the excavation process, which in this case was simplified by the fact that we were working in sandy, gravelly soil – consistent and very well drained with no issues at all related to groundwater and no subsurface rock formations to slow us down. In rapid order, we were able to install our below-liner, overflow and pump-

vault drains and tie them all to the deep stormwater lines that already existed on the property.

The material we removed during excavation was very clean and by chance included some lovely colored pebbles and rounded stones that we used later on top of the liner.

### Preparing the Spaces

From the start, we knew that a project of this scale could only be made using liners. Using concrete would certainly have been prohibitively expensive, and it was likely that two other options – the use of puddle clay or bentonite – would likewise be quite costly and would in any event be problematic given the nature of the substrate and complexity of the system.

So liners it was to be: We started by compacting the excavated ground so everything would rest on smooth, firm surfaces. We then applied a dressing of clean sand topped by heavy geotextile matting. Above that, we placed a 60-mil EPDM liner (supplied by Firestone Specialty Products, Indianapolis), covering it with yet another layer of the geotextile matting – basically to sandwich the liner and protect it from physical damage as well as degradation attributable to the sun's ultraviolet radiation. We further protected the shallow planting areas with stainless steel mesh.

Atop the liner, everything else would



Our Phase One work on the lowest of the project's three large ponds began with excavation and compaction and then placement of an expansive, multilayered lining system. Where required, we also added concrete foundations for the rockwork and waterfalls before covering and protecting the liner with gravel and finally adding the water. By the time we'd filled the lowest pond, we were already well under way with the same sort of installation process with the middle pond.



be built: all the foundations for the waterfalls, the soil beds for both the emergent and aquatic plantings, the foundations for the rocks and allowance for islands or the fountain we had been discussing. This was not a job that could be hurried: A great expanse of surface needed to be covered and protected while we also had to deal with the system's intricacies – meaning Duensing's crews had to do a great deal of cutting and seaming and flanging of numerous pipes through the liners (and do it all expertly, which they did).

As I've explained through some previous *WaterShapes* articles (and particularly "Sculpting Edges" in the August 2005 issue), the treatments applied at the water's edge absolutely dictate how you work with the liner at these margins and how far beyond the water the material must extend.

If it's to be a hard or block edge, little extra liner is required, really just enough to flip it over the back of the edge structure. If it's a rock edge, by contrast, the liner will reach beyond the rocks and stop at a point about six inches above the planned water elevation. Alternatively, if you want a marshy edge, the liner might extend quite a long way beyond what is perceived as the body of water – upwards of ten to 20 feet beyond the edge to allow you to merge the aquatic and terrestrial plantings.

Suffice it to say that with a project this extensive, all of those approaches came into play in different sections of the composition.

Once the liner installation was complete, we began creating the foundations for the waterfalls and major rock formations. This process began with the pouring of steel- and glass-fiber-reinforced concrete pads as raft-like structures at the base of the major elevation transitions. The degree of reinforcement depended on the size, heights and weights of the rocks we intended to use. In all cases, we ordered concrete mixes to achieve the high psi strengths indicated by the engineer in the structural plans.

These rafts serve three basic purposes: First, they established structural bases for the rocks in which they could be locked in place. Second, they enabled us to move rocks around with relative ease





compared to moving and adjusting rocks on a liner or even in soil. (The differences here are extraordinary: You can easily move a two-ton rock with a pinch bar on a concrete surface, nudging it around easily to attain the perfect position. Doing the same thing on mud or a liner is a slow, ghastly job.)

Finally, the rafts of concrete protect the liner and spread the load and were perhaps most important to realizing our desire to make the liner failure-proof. In this, we take advantage of the fact that a 60-mil EPDM liner has 400-percent elasticity and that it is also sandwiched between two layers of almost unbreakable, non-stretch material. In other words, we do not have to worry about it tearing as it takes the weight of all that applied concrete as well as the rocks we'll ultimately place atop it – truly a wonderful system.

### Engineered Endurance

Once the rocks were placed, we drilled holes and pinned them in place with rebar. Having connected all the rebar, we encased it in a poured and vibrated mass of fiber-reinforced concrete backfill. At that point, the rocks become integral units on their rafts of concrete and were very stable indeed: If the ground were to move, the structure would move along with it as one piece.

I'm the first to concede that I tend to over-engineer these structures. In some cases, I have drawn up plans calling for two reinforcing layers and have subsequently been told by engineers that one would have been sufficient. As I see it, however, the cost of structural failure is so great compared to the cost of some ex-

The parade of trucks that showed up to deliver the 500 tons of rock we ordered created quite a traffic jam. (The trove we'd selected included outstanding pieces covered in moss and lichen – and even a few upon which small trees had sprouted!) Once the material was transferred to our holding area, we began the laborious process of moving rock around the site by whatever means was necessary, placing the heavier pieces with cranes and maneuvering smaller pieces into just the right spots by hand.

tra material that this is an affordable form of insurance against future problems.

In making these adjustments, I don't casually deviate from the engineer's prescriptions. In doing so, I rely on years of experience in working with these materials in critical applications and have developed an intuitive feel for managing the masses and stresses involved in projects such as this. I know what works, in other words, and find myself pleased to see that the engineers generally agree with me and support my assessments.

By contrast, in flat areas where rocks are just sitting and not holding back the ground, stability is not nearly as important: If they move around a bit over time, there's no damage done. By the same token, these free-floating rocks are very important in aesthetic terms, as they give the appearance of having fallen away from the larger geological formations. As a result, we do treat them seriously and make certain they are as stable and secure as they need to be.

As was discussed in last month's article and at the outset of this one, there were no existing rock formations on this property or any to speak of in the local area. As a consequence, we had to create them from scratch. On the one hand, this made the job somewhat easier because we didn't have to worry about matching something down the road or up the hill or on another part of the property. On the other, it meant we had to bring in *lots* of rocks and make them look natural.

All of the rock used on this project was sourced from a remote quarry in the Mississippi Valley. It's a beautiful, water-worn limestone with extraordinary surface features. In addition, it's essentially the peelings off the very top of the quarry. For the most part, these upper-level scrapings are discarded in favor of the unfissured subsurface stone that can more readily be machined to various shapes and sizes.

What we were after instead were the top pieces that had been exposed to moving water, oxidation, erosion and plant material – the raw stuff of natural outcroppings and watercourses in all their rugged glory.

This particular stone was a bedded, sedimentary rock that had been laid down



millions of years ago and formed from millions of tiny fossils. Erosion had exposed wonderful, layered patterns and imperfections that give footholds to all sorts of wonderful mosses, ferns and lichen. At the quarry, we were simply amazed by the plants we saw growing among these rocks: There were *Aquilegias* and even small trees and sage brush that had sprouted and were thriving in the cracks.

In virtually all respects, this stone had precisely the character and features we were after.

### Shepherding Rock

I made three trips to this quarry to choose the rock.

I've always seen stone selection as a hugely important process and spend a great deal of time finding those pieces that are suitable and will work well within the composition. I start with a rough shopping list of what I must have – say, 100 pieces of four-foot-high rock, 10 pieces of six-foot-high rock and so on. I'm also looking for pieces that might serve as spillways or for other



**In the second project phase, the work became more vertical with development of the tall waterfalls that would eventually flow into the top pond and behind which we were to place a large grotto. The stones were quite large – but even so had to be stacked to achieve the elevations we desired – and had so much character that the process was as much about the joy of discovery as it was about the hard labor of placing, shimmying and securing the boulders.**

specific purposes in the watercourse. In this case, for instance, I found a number that had saddles in the middle where the stone's surface had been worn down by flowing water.

In walking around, I will sometimes happen upon “must have” pieces that enchant me and that I know I will incorporate. Such a piece might be really wacky, with an unusual shape or possessed of odd surface features. In this particular quarry, I found a massive piece of rock shaped something like a hump-

back whale. I also found a number of wonderful pieces that looked good from every angle – just the sort of thing to use as “islands” rising from the water.

In all, we acquired some 500 tons of this stone. When it was delivered, the temporary traffic jam with many of the trucks showing up at once to disgorge their loads was really comical – a slice of chaos that lasted several hours. That's a lot of stone, of course, and the volume was increased a bit by virtue of the fact that I always order about 15 percent

more than I know I'll need.

This way, when I'm selecting and placing pieces later on, I won't run out of options and end up compromising the design somehow because there are no available pieces left to fill given spots. And the extra material never goes to waste: I'll use it later to dot the surrounding grounds with small outcroppings that tie the landscape more intimately to the water – all of which gives the entire scene a more natural appearance.

I typically stage the stone in a way that

lets me conveniently walk around it as I make selections. I place this area as close to the job site as possible, but only seldom can it be described as "nearby." That's not exactly ideal, but I wouldn't ever want the staging area to be so close by that I'd end up tripping over it as I tried to move around the job site.

However it happens to work out, I take all of this preparation very seriously, as I've always seen stone selection and placement as the most critical of all construction processes: This is where careful planning and design work meet up with intuition, visualization and creative improvisation.

Last month, I shared several rough sketches that express the basic design. These are extremely useful in setting everything up for the moments when the system takes form in natural stone, but because it's impossible to anticipate exactly what the stones will look like, sketches are only a gross approximation of what will eventually take shape.

In making my choices, I always walk around the staging area carrying a stick I make on site, notched so I can conveniently size up the rocks. On this project, the contractor's children were so intrigued that they made me a six-foot-long stick that they'd carefully notched and color-coded. They were delighted that I used it as we walked around making selections and saying things like, "Now we need a blue-and-a-half-sized piece!"

(I can't abide tape measures, by the way: They require two hands, get choked with mud, tend to break or jam at the least opportune times and require bending down to read the numbers. Great for carpentry but no good for rocks!)

As I move through the staging area sizing up the possibilities, I'll usually identify a handful of pieces of suitable size and then choose the one that best conforms to the immediate need with respect to shape, grain patterns, contours, fissures and other surface features.

## Spelunker's Delight

In the end, of course, the success of a naturalistic project of this or any other magnitude all comes down to intuition, experience and the quality of the available materials. You can plan all you like, but ultimately it's the rocks themselves that dictate how things will come together.

The situation is rather more complicated when you work on a grand scale, however, because you're creating as you go along and each placement depends on a whole string of placements that have gone before. It's even more difficult when you have to face something like a large waterfall. To make these things work, I refer steadily to my drawings and interpret the situation as I go along, knowing I can never precisely predict how things ultimately will look.

This is another reason I bring in 15 percent more stone than I know I'll need: The bigger the available selection, the quicker and better the job. Indeed, having enough to choose from is too im-

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## Mass Filtration

The filter pond mentioned in the accompanying text was designed to provide impeccable water quality throughout an extremely large system. This vessel, which sits near the top of the system, measures about 50 by 120 feet – and the entirety of its floor is dedicated to biological filtration.

With an overall system of this size, we wanted to provide ample surface area for filtration so that there would be no question of overburdening the system later on as it becomes more populated with fish and nutrient levels rise.

It's a very simple approach that I've relied upon since I started building filter ponds in the 1970s: We place perforated-pipe manifolds beneath 18 inches of gravel. Pumps pull water down through the gravel, where it's cleansed by aerobic and anaerobic bacteria. The pond also contains plant material of types that send out extensive fine roots that are greedy for food and further help to starve algae and purify the water.

It's a simple system, but it works beautifully – the proof being evident in the quality of the water it produces.

– A.A.W



Where we approached construction of the two lower ponds using the same method, the top pond was prepared in a different way to make it serve as the biofilter for the entire complex. These perforated pipes were ultimately buried under 18 inches of gravel to create a massive filtering bed capable of keeping a huge volume of water as clear as can be.





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portant to leave to chance, and I always try to avoid situations where I'm forced to rethink the design or a detail based on a shortfall in available material.

I could go on about rock selection and placement for countless pages, but it's time to move along and shift from the big picture to some of the smaller details and how decisions were made. As I was building the system, for example, I decided to create a cave that would let the children duck behind the waterfall: To that end, I fashioned a little passageway into the space that let them peek out across the water.

This improvisation worked so well that I decided to add another small cave nearby, giving the kids two places to hide. I've always known that children love hiding places, and these kids were no different: They were absolutely thrilled with the caves, and their howls of pleasure in turn made the clients very happy indeed.

They were so delighted, in fact, that the

owners asked if I could make a cave meant for adult use. I immediately thought of the high waterfalls at the top of the system and recognized that there would be a space for a much larger cave up there for adults. After a bit of discussion, the clients gave us the go ahead and we went forward with the processes that made up the second phase of the project.

Arranged so that adults could walk in comfortably without needing to get wet, the grotto is reached via a path that follows the water but then allows you to duck into an entrance that is almost invisible until you come upon it, inset into the stones in a deep chasm between rising rocks.

At about seven feet high and covering approximately 150 square feet, the interior space is organized so that it leads you around to a spot directly behind the waterfall. It's actually quite complicated inside: The cave includes stalactites and stalagmites, and there's a small

"ante-cave" that has a dripping stalactite with little stone benches. The whole space is wired with discreet LED lighting and, interestingly, works as a sort of micro-climate, staying cool in the summer and warm in the winter.

### Concealed Strength

The grotto/waterfall structure is absolutely sturdy, built more or less like a bomb shelter. Behind the waterfall, for example, the large rocks are pinned into a massive floor structure consisting of two mats of rebar encased in 7,000 psi glass-fiber-reinforced concrete two feet thick. We left scores of pieces of rebar sticking up, all around the perimeter and in middle spots where we were setting up the stalagmites as well as the interior columns.

Once this cage was ready, the whole thing was filled with sand that would act as a mold against which we would eventually pour concrete to form much of



the wall and roof structures. At that point, I crawled up onto the sand and, by hand, sculpted the interior contours of the grotto. We also inserted tubes for lighting as well as the plumbing for several small dripping-water effects.

It was all great fun: At this point, after all, we could do pretty much whatever we wanted to do.

Once those details had been attended to, we set rocks into the sand and built a rebar armature over the sculpted sand, drilling into the rocks and connecting them to the armature. We then poured fiber-reinforced concrete over the whole affair to a minimum thickness of 18 inches. After it cured, we removed the sand and walked in to inspect the space we'd crafted.

We finished up by plastering the grotto's interior with a lime/mortar mix that looked similar to the rock in appearance, then combed and sculpted it while dyeing it with natural earth colors. Now it was the

adults' turn, and they loved their grotto as much as the kids loved their caves.

Once this was complete, we prepared the surface above the grotto for the project's third stage, placing a liner and installing rocks on top of the concrete to form the sides of the stream. (We pinned these in place following the same drilling procedure we'd used in shaping the grotto.) During this process, we drove directly over the structure with a loader – after all, it had to be tested! – then followed up by placing liners and rocks to complete the headwaters streams.

This was the final stage, and we completed the two streams at the top of the system before working through a list of finishing touches all around the property. As is always the case with such a wonderful project, we will anxiously follow the system as it ages and the plants grow and we might find some fine-tuning to do. As I mentioned last month, for example, I'd love to return someday to in-

stall some sort of visual connection between the bottom pond and the lakefront.


As it stands – and as you will see in an upcoming issue – the completed project involved both hard work and great fun in a beautiful setting. Best of all, the owners are delighted with what we've all accomplished in keeping with their vision of appropriately enhancing a beautiful, historic property.

**With its foundation set and boulders placed, we moved in to create what would be the grotto's open space. We started by building a steel cage complete with interior columns and, when all was ready, backed off and filled the cage with sand to establish a working form for the concrete. Once the concrete was applied, we cleared away the sand and began the unusual and interesting work of putting the finishing touches on a 'primeval' cave.**



# Radiant History

By Paolo Benedetti



On a recent trip to Spain, Paolo Benedetti and his family took a side-trip to Portugal and happened on some Roman ruins that opened his eyes to a whole new set of possibilities. Here, in a most unusual 'Solutions' piece, he describes his encounters with the technologies used to heat an ancient residential indoor swimming pool as well as a collection of pools that made up the public-bath system for a seaside outpost of the Roman Empire.

■ Solutions

As a pointed expression of the growing global concern over the earth's changing climate, lots of my clients these days are asking me about alternative methods for heating their pools. It's a reasonable concern, and I don't think it will be going away anytime soon.

Part of the problem in answering these questions is that neither I nor my clients want to go out on technological limbs and invest in leading-edge or green ideas that have yet to prove themselves. The rest of it probably has to do with the phenomenon of institutional momentum: People tend to want to do what people have done in the past because it reduces risk and provides acceptable levels of comfort with decisions.

All of this leads to the story of a trip to Spain I recently took with my family: While we were working our way through an area filled with remarkably well-preserved ruins dating back to the Roman Empire, we came across a remarkable solution to the pool-heating challenge.

## an unexpected find

I've long been fascinated by the ingenuity displayed by the architects, engineers and builders who assembled the infrastructure of the world's longest-reigning major empire, and my sense of this goes far beyond the obvious wonders of the Pantheon or the Colosseum in Rome itself.

In fact, almost everywhere I've gone around the Mediterranean Sea—Greece, Turkey and now Spain—I get caught up in the details that made daily life work across the entirety of the empire, from the aqueducts and the roads to the public forums and the private houses. Along the way, I've been pleasantly surprised

to encounter a number of sites that garnered little or no mention in travel guides or history books.

While I was in Spain with my family, for example, we took a daylong side trip across the border to Portugal with the coastal city of Faro as our destination. On the way to the shore, my GPS system identified some "ruins" ahead. Always up for an adventure, I took a detour despite the kids' protestations from the back seat.

As we navigated toward the ancient city of Algarve, we did a quick bit of research and learned that the ruins were of a palatial estate now known as *Palacio de Estoi*, which had once been the home of a wealthy Roman fish merchant. The large site boasted many intact features, including foundations, roads, paths and mosaics.

What intrigued me most, however, was the *cella natatoria* complex: The place actually had its own indoor swimming pool! As I examined the beautiful mosaics that remained on what had been the floors of the pool, I discovered something truly amazing: The pool had been heated—not with a boiler, but with a built-in radiant-heating system.

Not far from the site, we learned, was a cluster of geothermal hot springs. Apparently, these Romans were not particularly fond of the idea of sitting in sulfurous spring water, so what they did was fill their home pool with water diverted from a nearby freshwater stream. They had no filtration or sanitizing systems, so they added water to the pool, used it, drained away the water and then refilled the pool with fresh stream water—a classic fill-and-draw system.

What truly caught my eye was the series of clay pipes that trans-

It's encouraging to know that Roman designers, engineers and builders faced many of the same challenges we do today in choosing finishes for and heating the water in our water-shapes. It's also amazing to consider that these mosaics have endured for the best part of 2,000 years and that the low-tech, hot-spring-fed, radiant-heating system that ran through the coves at the bottom of pools did a great job – with absolutely no carbon footprint!



ferred the steaming-hot geothermal water to the pool complex. At the pool, these four-inch pipes had been set within coves around the perimeter of the pool, with plaster built up over them to diffuse the heat more evenly through the water. All was then topped with beautiful mosaics.

I can only imagine how luxurious this was all those years ago: Heck, a heated indoor pool is *still* a great luxury!

Close by this radiant-heated pool was a *frigidarium*, or what we now refer to as a “cold plunge.” It was another elegant vessel with its own collection of elaborate mosaics, and its water could be quickly exchanged with new, fresh water, too, merely by opening a series of gates. Even my kids were impressed.

### more discoveries

We left Algarve and continued on our way to Faro, where we stopped in a museum near the harbor and enjoyed its collection of Roman artifacts and pottery. As we exited through the rear door to wander through what I thought was going to be a garden space, I actually found myself face to face with an elaborate maze of Roman-era foundations.



Before long, I learned that what we were seeing was all that was left of an ancient *gymnasium* – that is, a sequence of classic public pools!

The entire complex had been fed by water from a nearby stream. This water entered via its own dedicated aqueduct, a small system that flowed freely only when it was time to flush the facility after some defined period of use. This water was only truly “fresh” in the first vessel – a beautiful indoor pool fed by a runnel leading from a fountain located in a grand banquet room reserved for use by the town’s governors, merchants and wealthiest citizens.

This first pool captured most of my attention, basically because of its foundation, which I couldn’t figure out at first although my kids had a suggestion: In seeing the brick arches for the first time, one of them said, “Look, Dad: pizza ovens!” Sidetracked by that observation, I wondered if there might have been some sort of subterranean bakery here, and that thought was reinforced by the soot staining that was evident.

I soon learned, however, that this foundation was actually the pool’s heating system – yet another example of Roman use of radiant water heating!

The foundation actually included two floors separated by a series of closely spaced brick arches, with the lower floor just a few feet below the upper one. Just outside this structure was a large oven that was maintained by servants or slaves. Air was drawn in to the front of the oven, with superheated air and smoke dispersing through the archways and heating the bricks and masonry that made up the pool floor. The hot air and smoke then exited the space through a large chimney on the opposite side.

This radiant heat warmed both the water and the enclosed space above – yet another ingenious system for heating a swimming pool.

### pass it on

The Romans seldom missed a trick: They didn’t waste the heated water, instead letting it pass down to the next in a series of interconnected pools arrayed within the complex. The more “noble” you were, the fresher and warmer the

water you experienced – and all of that water had originated in the fountain at the end of the aqueduct.

We spent even more time there following the runnels and underground pipes trying to figure out where the water would flow next. There were spots where the pipes would disappear under a walkway and reappear 20 to 30 feet away in another pool. We also counted ourselves lucky not to be among those who had no alternative to using the last

pool in this long chain: Given the choice, I’d have jumped in the ocean instead.

My point here is not that we should all use these examples as reference points and start building with ancient technology, but instead that it may be time to think about answering questions from our clients in ways that aren’t limited by what we know about modern technology. There are indeed many ways to get things done, and sometimes we might need to break the mould to get there!



The look that reminded my kids of pizza ovens is actually an ingenious system for transferring the heat from the ceiling of a furnace to a pool of water placed above the furnace’s chamber. Once again, it’s an efficient, elegant solution to a common problem – one of many developed by Roman engineers centuries ago.



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# Refreshing the

By Eric Herman



# Supply

In January 2008, southern California's Orange County Water District unveiled its Groundwater Replenishment System, a treatment and reuse facility dedicated to producing water to resupply the county's beleaguered groundwater reserves. A year later, *WaterShapes* editor Eric Herman toured the facility, getting a behind-the-scenes look at a thought-provoking system that is setting new standards for water treatment, management and use.

# While

I was preparing our “True Green” issue for publication last summer, a friend invited me to tour the Groundwater Replenishment System, an advanced, 70-million-gallon-per-day water-purification facility located in Fountain Valley, Calif. The invitation to visit this joint project of the Orange County Water District and the Orange County Sanitation District came through landscape designer Brian Dong, whose college friend Tom Knoell conducts sophisticated studies of the various water-treatment processes used in the system.

At the time, my experience with our special October 2009 issue was sparking all sorts of thoughts in me about the preciousness of water as a resource. When the invitation came, I realized that all of us in the watershaping realm might benefit from understanding what’s happening with the water supply and the steps being taken to ensure its availability into the future.

Before I reached the facility, of course, I already knew that water was a precious commodity. Once the tour was complete, however, I had a new appreciation for the monumental stature of the challenges we all face as a species dependent on abundant supplies of fresh, potable water – and became especially concerned for people who make their livings by shaping water.

## Storied Background

As Knoell treated us to our tour, his enthusiasm for his work was obvious. It was clear that being part of developing and fine-tuning the largest and most advanced system of its kind was a source of professional pride. Furthermore, I perceived a sincere (and infectious) environmental idealism that would inspire anyone who consumes water or uses it for artistic or commercial purposes.

As we talked, it occurred to me that it made sense for Orange County to be on the cutting edge with this technology: It’s been one of the country’s fastest growing jurisdictions for more than 50 years, is now home to more than 3.2 million people and is expected to see that level increase by 20 percent between now and 2020. And this growth will come on top of established water needs for public irrigation, industry and agriculture.

A complicating factor is that this is an area subject to extended drought conditions, which means that ensuring an adequate water supply *always* requires planning, huge investments in infrastructure and tremendous levels of ingenuity.

Historically, the region has relied in part on water imported from the Colorado River and from northern California – as is true of much of southern California. Securing those water allocations is becoming both harder and more expensive, placing a greater premium on self-reliance and exploitation of local resources. In Orange County, that has long meant exploiting groundwater resources, a consumption that leads to obvious concern about how the supply is protected and maintained.

Orange County was once mainly a thriving agricultural region and had been sustained by the use of groundwater for more than 200 years. Consumption of this resource has spiked in the past 50 years, as the population grew and industrial operations displaced farmland and pastures.



**The scale of the Groundwater Replenishment System is truly grand, with each of the three treatment steps housed in its own facility and accompanied by pumping facilities, research laboratories – and an operating center so streamlined and automated that the entire process is managed by a staff of four.**

As Knoell explains, when water is pumped out of the ground, it leaves behind voids. In the case of coastal Orange County, this allowed for the intrusion of seawater into the groundwater supply, rendering huge volumes of water unsuitable for drinking. Adding to the problem, the region contains considerable petroleum deposits. As those resources have been extracted through the years, the voids left behind have also encouraged seawater migration.

The consequences of this seawater intrusion prompted the Orange County Water District (OCWD) to overcome the problem by injecting highly purified wastewater in the ground along the coast. The success of this effort led to continued injection and eventually will lead to effective recharging of the groundwater supply using water provided by the Groundwater Replenishment (GWR) System.

The 70 million gallons the GWR System generates daily, Knoell says, serve multiple purposes: producing an expanded barrier to seawater intrusion; increasing the amount of water available for public use; buffering shortages in times of drought; reducing reliance on the Colorado River and northern California

supplies; and ultimately reducing the amount of treated sewage dumped into the ocean.

## Tackling the Problem

In 1975, the district opened the now-famous Water Factory 21, an innovative system that purified treated sewer water from the Orange County Sanitation District (OCSD). This pioneering facility was the first to treat wastewater with reverse osmosis before it was pumped back into the ground through a system of injection wells along the coast as a means of slowing the infiltration of seawater into the groundwater supply.

Before long, Water Factory 21 was producing 15 million gallons of water per day and was so successful that it became a model for a whole generation of similar facilities throughout the United States and abroad – a real solution for jurisdictions facing similar problems with seawater intrusion.

As Knoell explains it, the concept is simple: OCWD took treated water coming out of an OCSD facility and, instead of allowing it to flow into the ocean, treated it to better-than-drinking-water standards using advanced membrane-filtration processes. The water would then be injected into the ground to maintain a barrier to prevent seawater intrusion.

(In the case of the recently commissioned GWR System, the capacity is such that half of the highly treated water is piped 13 miles inland to spreading basins located in the cities of Anaheim and Orange. There, the water is naturally purified through percolation into the aquifer. The groundwater is eventually available for extraction in residential, commercial and agricultural applications. In that sense, he says, the new system indirectly provides the county with a portion of its potable water.)

Using the resounding success of Water Factory 21 as a foundation, OCWD moved toward expanding on the concept. In 2002, it released a crucial White Paper outlining the scope of the proposed GWR System and began accumulating funds from a variety of sources – federal, state, local and private – up to \$92 million of the ultimate \$480 million cost. (As proposed and realized, the facility is a joint financial venture between OCSD and OCWD, with the water district taking responsibility for its operation and maintenance.)

The water entering the new facility comes straight from OCSD as “secondary effluent” – meaning the wastewater has already passed through a primary treatment step in which clarifiers and sedimentation basins settle the sludge and a secondary treatment in which biological processes degrade the biological and organic material still found in the water.

This water, says Knoell, is relatively biostable at this point: It still contains a host of bacteria, organics and inorganic material when it enters the GWR System, but by the time the water leaves, it meets or exceeds drinking-water standards. As he put it, the output is near distilled-water quality – so much so that minerals must be added back to the water at the end of the process.

## Clinical Precision

The processes used first at water Factory 21 and subsequently in the GWR System were developed, in fact, using methods sim-



The microfiltration stage of the treatment process occurs in a set of 26 open cells containing more than 600 separate filters. These cells are challenged by so much material that each one is taken offline every 21 minutes for a brief backwashing operation. The water that emerges at the end of the process is much cleaner – but still not drinkable.

Reverse osmosis is the workhorse of the purification process, with its 15,750 units (each with 400 square feet of a special filtering membrane) removing all remaining contaminants and bringing 85 percent of the water that enters the system up to extremely high levels of purity.

ilar to those used in treating bottled water or water for use in preparation of baby food, fruit juices and sodas – and to sterilize medicines. The GWR System uses a three-stage process of microfiltration, reverse osmosis and, finally, a combined treatment with hydrogen peroxide and ultraviolet light.

The system is fully automated – so much so that operation of the facility can be accomplished by just four people. Beyond that, of course, the facility employs a large staff that supports the project in a variety of capacities. Knoell, for instance, heads up activities at the GWR System's test center, a facility dedicated solely to conducting applied research aimed at optimizing the processes used in the treatment system. (During our visit, for example, he was in the midst of conducting trials on a new filter material being considered for use in the microfiltration process.)

He explained to us that the technologies used in the GWR System have a huge range of other applications in everything from food processing and pharmaceutical manufacturing to treating the water in swimming pools. What makes the GWR System so special, he says, is the monumental scale of the facility and the combination of technologies it puts to use. Among other things, his studies have led to a planned expansion of the system that will take its capacity to 100 million gallons per day.

A combination of three treatment processes makes up the GWR System:

► **Microfiltration:** When water first reaches the facility, it's treated with a chemical familiar to many watershapers – sodium hypochlorite (that is, bleach) – at a level of three to four parts per million. As with swimming pools, the sole purpose of introducing bleach is to reduce the biological activity as the water moves through the system. The water then enters the microfiltration process.

The microfiltration operation features 26 cells (or basins) that contain more than 600 separate filters (or modules) in each cell. In turn, each of these modules contains more than 15,000 hollow polypropylene fibers with holes that are 0.2 microns – one-three-hundredths the diameter of a human hair and small enough to allow water molecules to pass through while removing larger molecular structures such as bacteria, protozoa and viruses. At the current full plant production capacity of 70 million gallons per day, the microfiltration process receives approximately 96 million gallons of water per day, with the difference



being attributable to the fact that the microfiltration process has an overall recovery rate of 90 percent.

As the microfiltration cells operate, debris and other contaminants are filtered out and onto the module fibers and eventually block the flow of water. To combat this, each cell is taken out of service for a few seconds approximately every 21 minutes for backwashing. In this process, the fibers are scoured by air and then backwashed with water that has already been through the microfiltration process; this backwash water is sent to waste.

As time passes, backwashing becomes ineffective as material builds up on the fiber surfaces. As a result, the microfiltration cells are taken off line every three weeks and chemically cleaned using caustic sodium hydroxide, a proprietary cleaner and citric acid.

When water emerges from this stage of the process, it is virtually free of bacteria, but still contains a wide range of organ-

ic and inorganic contaminants. The water, in other words, is much cleaner but is not yet drinkable.

Before it passes to the next step and into the reverse-osmosis process, the water is chemically treated with sulfuric acid to reduce its pH from 7.5 to 6.8. Another chemical is added as well to prevent salts from precipitating onto the membranes as the water passes through the reverse-osmosis process. Now the water enters banks of cartridge filters to ensure that any debris that might be lurking in the process stream is removed before the water enters the high-pressure feed pumps and encounters the reverse-osmosis membranes.

► **Reverse Osmosis:** Reverse osmosis (RO) is a filtration process that can remove particles down to an estimated 0.0001 microns – a level so small that some experts refer to it as “theoretical zero.”

This process removes viruses, inorganics and almost everything that isn’t water from the flow. (As Knoell states, it’s the workhorse of the GWR System and where the bulk of the filtration occurs.) In the GWR System, the reverse-osmosis array consists of 15 units, each with a capacity of five million gallons per day. Within each unit are 1,050 membranes – a total of 15,750 in all. On any given day, one unit is held out of the stream as a spare.



As a third and final step, the water is injected with hydrogen peroxide and passed through a bank including 4,000 high-intensity, 250-watt ultraviolet lamps. After this step, the water is of amazing purity – well beyond drinking-water standards and ready for injection along the coast to prevent seawater intrusion into the groundwater supply.

As with the microfiltration process, not all of the water entering the system is recovered. In this case, 85 percent of the water entering the RO system is actually transformed into pure water, leaving 15 percent of what is called “reject water” to be returned to OCSD. This means that, to meet the 70-million-gallon-per-day target, the microfiltration process must produce approximately 82 million gallons of feed water each day for feeding into the reverse-osmosis process.

Each of the reverse-osmosis filters contains 400 square feet of a polyamide membrane. As Knoell explains, it was the advent of this material that allowed this technology to become economically feasible on a large scale. Before polyamide came along, membranes were constructed of cellulose acetate and re-

quired much more pressure and power consumption to purify the water. Not only does the polyamide material function at lower pressure and require less power, but it also produces water of far superior quality.

The water goes through a three-stage, single-pass structure of reverse osmosis membranes – 78 in the first stage, 48 in the second and 24 in the third – with an overall recovery of 85 percent of the water. The remaining reverse osmosis brine (or concentrated mineral water) is returned to OCSD and disposed of through ocean outfall.

► **Hydrogen peroxide/ultraviolet light treatment:** After leaving the reverse osmosis facility, the water moves to a final treatment stage – ultraviolet disinfection coupled with hydrogen peroxide – in a process called “advanced oxidation.” Here, water is injected with a small concentration of hydrogen peroxide and then passed through a series of reactors that expose the water to low-pressure, high-intensity ultraviolet lamps. This process, says Knoell, is designed as a multiple-barrier system to safeguard against any off-chance, trace organics that may have evaded the previous treatments.

As the treated water passes through this advanced-oxidation process, the ultraviolet light transforms a portion of the hy-



drogen peroxide into hydroxyl radicals that act as extremely powerful (but short-lived) oxidizing agents. After that, the water is ultra-pure and, as Knoell says, may well be the highest-quality water that can be produced using currently available technologies.

### On Further Reflection

Once the tour ended, my head filled with questions about how all of this information applied to the working lives of people who build swimming pools, fountains, ponds, streams and other watershapes, not to mention those who design and install the landscapes that accompany them.

Obviously, professionals whose livelihoods depend to an unimagin-

inable degree on the continuing availability of public water should know a thing or three about where that water comes from. Beyond that – and in the context of the package of “True Green” articles I was then compiling – I quickly began connecting the dots and recognizing just how well positioned watershape and landscape designers and builders are when it comes to working with a whole range of systems that can maximize efficient use of water.

There are the obvious ones, including the installation of rainwater harvesting systems, the assembly of constructed wetlands, the placement of floating islands and inclusion of systems that put gray water to use – to mention just a few. Indeed, what I began to see was that even modest residential projects could do more to mimic what Orange County’s Groundwater Replenishment System does by engaging every possible means of returning clean water to the groundwater system by letting it percolate into the soil instead of letting it flow to waste.

Obviously, there are issues of scale that must be recognized, but really, all Orange County’s system does is take water that would otherwise flow to waste, treat it and then put it to good use – in this case by putting it back in the ground. And it’s also being done with a smaller carbon footprint and costs less than ocean desalinization. Yes, this system cost half a billion dollars, but fractional versions could do the same work at a fractional cost.

I was struck as well by the fact that Knoell described his fa-

cility as a demonstration site and stressed the fact that the GWR System operates on principles of conservation and sound environmental management that can be applied (and *are* being applied) on much smaller scales in other applications. To be sure, it will be a while before these systems are ready to be strapped onto portable spas, but they’ll be with us soon enough – whether by choice or by mandate.

Moreover, people are taking notice of what’s happening here: In the two years since the GWR System came online, it has received an array of international engineering and environmental awards as well as lots of media attention. And in just its first year, more than 4,000 toured of the facility, including scores of high school and college students with a clear interest in water management and technology.

Having been through the facility myself, I know these young visitors are showing up and asking questions for good reason: Not only does this system represent a magnificent technical achievement, but it’s also a facility that is crucial to sustaining the quality of their lives and protecting the environment in which they and their children will live.

One last thought: You remember those spreading basins the water district operates about 13 miles away from the main facility in Fountain Valley? It bears mentioning that it’s a grand series of watershapes in the form of well-maintained, landscaped public lakes used for fishing and recreation.

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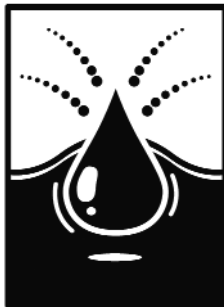
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# Covering the Traces

In 2008, the citizens of Boston were rewarded for nearly 50 years of tolerating urban blight when the raised highway that split their city was demolished and the Big Dig was completed. One of the side benefits of this project, note landscape architects Lynn Wolff and John Copley, was creation of a string of parks linking the waterfront with historic downtown areas. Here, they discuss their firm's involvement in developing these much-welcomed spaces.

By  
Lynn Wolff  
&  
John Copley

Boston's Big Dig was essentially a Big Fix. Officially known as the Central Artery Tunnel Project, it served to repair damage done to the heart of the city by the Interstate Highway program during the 1950s and '60s.

In Boston's case, the federal government had stepped in and inserted a primary traffic artery through what had been a downtrodden area near the waterfront. Its intentions may have been good, but the new I-93 ran north to south and separated the city's historic downtown area from its storied waterfront – a disastrous decision that did little more than create decades' worth of traffic nightmares.

Ultimately, it also required remediation on a scale seldom seen in the course of human history. Planning for the project began in 1982, initiating what would become the largest, most complex and most expensive highway project in the nation's entire history. It involved burying three-and-a-half miles of new highway beneath the raised highway's footprint. Once underground, the roadway would join up with the Ted Williams Tunnel and give the city more direct access to Logan Airport before resurfacing beyond the downtown area.

Construction finally began in 1991 and stretched on for 14 more years during which the project displaced tens of thousands of residents and businesses and cost several times the original projected amount. For all of the epic expense and inconvenience, however, the Big Dig's completion brought an immediate boost to the city, making it whole in ways that, since 2005, have rekindled a sense of community that cannot be measured in dollars.



## New Spaces

One of the significant outcomes of the project was its creation of new spaces atop the giant roof that covers the tunnel. That area, designated as the Rose Fitzgerald Kennedy Greenway, is essentially a massive green roof and has been dedicated as parkland and public spaces that link the downtown and waterfront areas.

It is with this greenway that our firm, Copley Wolff Design Group of Boston, enters the picture. In the early 1990s, both of us were engaged as citizens in providing our input through various public committees in the planning and pre-construction phases. Before long, the enormity of the project became clear, and the two of us, who until then had each been operating our own landscape architecture companies, joined forces as a single entity dedicated to going after this one huge job.

As designers who wanted to be involved in developing the new space, we felt a profound responsibility to advocate design solutions that were worthy of the historic setting. Our campaign was further based on the idea that it was time for a project that had been driven exclusively by engineers to be turned over to landscape architects. We knew that, eventually, at least part of the new space would take the form of parks, but the first stage of our involvement had to do simply with “surface restoration.”

This stage of the process was intensely practical: designing sidewalks, establishing a lighting system, selecting and placing street furnishings and organizing planting plans for all the spaces on the sides of the roadways – the essential framework of the greenway.

Designs for parks were years in the future at that point, but we knew there were to be three of them: North End Park, Wharf District Park and Chinatown Park. Each was to be the subject of a design competition. In making our case, we teamed up with EDAW, the large, international landscape architecture firm, and ultimately secured the contract to tackle Wharf District Park, the largest of the three.

This is, of course, a capsule version of a story that took all sorts of twists and



The parks that emerged atop the massive ‘green roof’ of the Big Dig are all about pedestrian traffic and reforging the links between Boston’s historic downtown and its storied waterfront. Our mission from end to end was to make the most of the reclaimed spaces while allowing them to express the unique character of the neighborhoods they traversed.

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# WATER SHAPES

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turns in the decade that led to our winning the job. Up to that point, there had been a broad, ongoing, contentious civic discussion about how the space should be used, with some voices advocating residential and commercial development and lots of streets and others, ours included, pushing long and hard for a pedestrian zone and fighting for the concept of open spaces and public amenities.

To make a long story short, these discussions resulted in a compromise in which 75 percent of the area was to be set aside for public parks and 25 percent for commercial development. Further discussions then ensued about what this all meant and in many ways are still ongoing. Overall, we were extremely satisfied with knowing that our city was to gain a “Great Park.” Although the total area amounted to only 13 acres, the planned parks would link key areas of the city in ways that could never be achieved with buildings and streets.

## Space Sensitivity

As we became involved with the project, we recognized that we needed to educate ourselves about the way the tunnel was being built and covered – and even more importantly saw the need to influence how the roof was to be completed in order to make it suitable for the

surface treatments and parklands we were considering. In those early stages, in fact, we were chiefly concerned about making the surface ready to support plants.

The project was huge, so it had been divided into sections with separate contractors and engineers taking responsibility for different parts of the entirety of the structure, including sections of the surface. It took some persuading, but we eventually convinced the project managers that there needed to be some consistency among those sections and that the entire surface area should be designed and coordinated by a single landscape architecture firm. Ours was the one selected.

In examining the plans, we saw that, in some places, the roof rose to levels just six inches below grade and that in others it was as far as 70 feet below grade. Keeping the needs of the projected open spaces in mind, we worked with the tunnel builders to coordinate locations of utilities, sub-grade structures and surface hardscape features.

This involvement positioned us as advocates for sidewalks, roadway interfaces and park areas, and the processes were all-consuming as we dealt with thousands of details that in many cases involved just millimeters – amazing tight

tolerances for a project of such gargantuan scale.

For all the drama and the vastness of scope, however, the overall program of surface restoration was relatively simple in concept: The idea was that, running north to south, the area would take the form of a tree-lined boulevard with broad sidewalk areas. East to west, the waterfront and downtown areas were to be connected by a series of cross streets.

The main boulevard moved through several different neighborhoods – the Bulfinch Triangle and North End neighborhoods to the north, the Waterfront, Leather and Financial districts in the middle and Chinatown on the south – each of which had its own history and character. Reflecting those distinctions, the greenway was subdivided to accommodate these neighborhoods, largely through selections of hardscape materials, fencing treatments, plantings and street furnishings that changed slightly from end to end of the space.

We changed the trees we used, for example, depending on the neighborhood, with ZelCovas in the Bulfinch Triangle, Maples in the North End, Gingkos in Chinatown and Oaks in the Financial District. All of the cross streets were lined in with Honey Locusts.

Our work in influencing the engi-



In addition to working with the overall program for the parks, we also specifically handled the design of Wharf District Park, the largest of the three that emerged as parts of the Rose Fitzgerald Kennedy Greenway. The heart of this park is a deck-level fountain that draws visitors together to watch (or play in) a choreographed water display with both day- and nighttime appeal.





Another key feature of Wharf District Park is the 'Fog Harbor' sculpture devised by Mark Miller. Not only does it use granite pieces harvested from the waterfront's original seawall, but it's also a subtly interactive feature that thematically ties its part of the park directly to the harbor beyond.

a deck-level fountain with vertical jets, while Chinatown has a rivulet feature with a small waterfall. For its part, our design for the Wharf District Park includes a pair of significant watershapes, the first a central deck-level, programmable fountain designed by WET Design (Los Angeles), the second a fog fountain created by artist Ross Miller.

The deck-level fountain features a series of leaping jets that function in a number of computer-controlled sequences. The structure's pavers are held on grade by a system of supports set in a large reservoir. The 100 square feet of deck space is organized in a pair of concentric circles.

Miller's "Harbor Fog" composition is a motion-activated system lit with LED lights and includes several granite pieces reclaimed from the waterfront's original seawall. Its maritime theme is perfectly suited to the space and does a wonderful job of linking the park space the-

neering of the roof included the use of "structural soil" and providing greater quantities of soil in restricted areas. Truth be told, some of our most significant victories in the entire process had to do with securing space between the tunnel's top and utilities for soil that would adequately support the full range of plantings we had in mind.

## Waters in the Park

The designs for the three parks were completed by different firms, but we all collaborated to the point of including common elements: While each has its own flavor and individual character, there is also a sense of order and continuity.

Among the common features were water elements: The North End Park has



matically to the waterfront.

As an organization, we never go into a design process assuming that we will necessarily be including water elements, but where they make sense we're more than eager to go in that direction. In this case, of course, the insertion of water was inevitable for a variety of practical and thematic reasons.

Indeed, water in this context yields multiple benefits: These features serve as destinations and gathering places within the space while also providing opportunities for interactive play as well as relaxation and contemplation. Moreover, it's just hard to imagine a waterfront park that isn't somehow tied directly to its backdrop.

The fact that these features "belong" is eloquently indicated by the fact that these areas are among the most popular of all the spaces in the greenway.

The challenge here, as was true with just about every landscape element within the whole scheme, was that we had to interlace these systems with the engineering of the tunnel's roof. To do so, we basically had to treat the entire Greenway as a gigantic sort of green roof, ensuring adequate drainage and irrigation as well as spaces for root systems and the plumbing, services and utilities needed to make the watershapes work.



The Greenway serves the community in a number of ways – as a place to exhibit public art, as the venue for a range of concerts and performances and as a source of information on local history. As important, the fact that the parks offer an expanse of open space where there was previously an ugly, elevated roadway now creates visual links from the Greenway to a range of historic features found in the area, including the city's old Customs House and its splendid tower.



In overall sophistication, the major achievement of these systems is not so much in their overall complexity; rather, it has to do with the fact that every millimeter of the design, every nut and bolt, each and every fitting and pipe, had to be carefully planned, communicated and advocated throughout what turned out to be a *very* long process.

## Historic Connections

At just under five-and-a-half acres, Wharf District Park is the largest of the three new parks. Given our deep involvement in all aspects of the Greenway, we knew that we needed a partner to assist us with the specifics of its interior design.

As mentioned above, we called on EDAW, which has tremendous capabilities and experience in large civic projects of this sort. Ultimately, they did the lion's share of the design work for the park, allowing us to continue our efforts as advocates for the overall design. That advocacy was, as mentioned above, all-

consuming: During one year of our involvement, for example, we conducted 133 community and committee meetings, each of which required preparation of a separate PowerPoint presentation!

We *did* manage to keep a hand in the design process, however, generating Wharf District Park's planting plan and consulting closely with EDAW on every other element. Nonetheless, we know we couldn't have gotten everything done without their support and give EDAW's staff tremendous credit for applying their expertise to key parts of the project.

The reason it's called the Wharf District Park is because there were originally five commercial wharfs that extended from the approximate location of the park into the harbor. The neighborhoods that now lie between the Greenway and the water came later, as parts of the harbor space were filled and settled in a key phase of Boston's development. While the original wharfs are long gone, the existing neighborhoods are still defined by that history.

With this in mind, segments of the

park and cross streets now correspond to the sequence of the five wharfs, including City Wharf, Long Wharf, Central Wharf, India Wharf and Rows Wharf, with each one carrying a historic theme. City Wharf, for example, is about land development, while Long Wharf is about the raw materials trade, Central Wharf is about the fishing industry, India Wharf concerns the spice trade and Rows Wharf is tied to immigration.

The cross streets divide our Wharf District Park into four distinct parcels. The northernmost, which is associated with City Wharf, is on a path called The Walk to the Sea and serves as a pedestrian route for people coming from nearby Faneuil Hall. It has become such a popular thoroughfare that the National Park Service is building a new visitor's center there.

The Central Wharf area, appropriately enough, includes the Central Fountain and is on an axis with the waterfront's New England Aquarium – the spot where the water comes closest to the Greenway.



Combined with the Long Wharf section just to the north, this space is about festivals and large gatherings, while the southern parcels associated with the India and Rows wharves are dedicated to smaller-scale performances and events.

These are relatively small spaces, but there's a lot going on in each.

While the cross-streets form four park parcels and follow the alignment of the historic wharves, for example, they also allow more permeability and pedestrian and visual access that now reach from the built fabric of Boston's downtown to the open skies and water of the harbor.

This dynamic created another layer of order within the park—on the downtown side in the form of an architectural and formalized promenade along the edge of the park and, on the harbor side, of a naturalistic, curvilinear pathway and plantings. This promenade was a common feature of all contracted segments of the Rose Fitzgerald Kennedy Greenway and allowed for continuity in pedestrian access in the north-to-south direction to counterpoint

the cross-streets' east-to-west orientations.

## Moving On

For all the progress that's been made since 1991, the Greenway is still very much a continuing story. As is true with all substantial parks, programming is an ongoing process, and the Rose Fitzgerald Kennedy Greenway Conservancy is currently working to make the most of this wonderful new public amenity.

As was suggested above, the entire Big Dig project has been the subject of vast controversy, both with respect to cost overruns and problems associated with certain aspects of its construction. The Greenway hasn't managed to avoid some guilt by association and has seen its fair share of criticism from those who initially supported filling the space with blocks of buildings. There are also those who just don't particularly care for the design.

We take that in stride as part of what happens with projects of this magnitude, but we've also been able to counterbalance the criticism with the sense of sat-

isfaction that has come with seeing the parks in use and perceiving what they already mean to the way the city flows and functions.

Where there was once a hulking, ugly raised highway that cut through the heart of the city, residents and visitors now walk through a series of thoughtfully designed spaces that reflect the city's history and character as they pass from the downtown district to the waterfront. In a very short time, the Greenway has restored a sense of unity and continuity that had been ripped away more than four decades previously.

All of this is why, as landscape architects who were involved in the project almost from the start and as citizens who will reap benefits of these spaces in the future, we feel only pride and excitement. There are very few cities in the Western Hemisphere with as much history as Boston. Through this wonderful project, we've been able to participate in restoring a significant part of its narrative, humbled by the experience.



Drawing people to the Greenway hasn't been a problem since the parks first opened, and in large measure that's due to the fact that the designers and artists who lent their talents to the project made it interesting and attractive on so many levels. From the shifting colors of the light panels that surround the fountain to the dancing waters of the fountain itself, there are features that appeal to visitors of all ages.

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**JANDY** (Vista, CA) has introduced the AquaLink RS TouchLink, a user interface that controls up to 32 separate circuits and features a homeowner-driven home screen that provides easy access to critical equipment. Available in wireless countertop or wired in-wall versions, the full-color touch screen not only offers easy pool/spa control, but also can be used to display up to 256 megabytes of photo files.

## Custom Metal Spas



**DIAMOND SPAS** (Frederick, CO) offers stainless steel spas in any imaginable size of shape for residential or commercial applications. Designs can include any number of jets and jet types; any form of lounge, seat or hydrotherapy/exercise area; any shoulder-cradling areas, grab bars or lighting arrays – all custom-fabricated in either stainless steel or copper with a virtually endless array of options and possibilities.

## 2010 Catalog



**HAYWARD POOL PRODUCTS** (Elizabeth, NJ) has published a 2010 Buyer's Guide. The 270-page catalog includes information on new products and energy-efficient design solutions as well as details on the company's full lines of pumps, filters, heaters and heat pumps, pool cleaners, sanitizing systems, automation/control systems, lighting products and a full array of pool/spa accessories.

## Sweeping Return Fitting



**PARAMOUNT POOL & SPA SYSTEMS** (Chandler, AZ) has introduced the Swingjet return fitting. Designed to fit into most 1-1/2-inch threaded wall returns, the device comes in eight standard colors and delivers an infinitely adjustable, three-step, 90-degree cleaning arc with an automatic reversing mechanism. It adjusts easily to target a particular area in the pool but also locks for tamper-resistant operation.

## Rainwater-Harvesting Systems



**BUSHMAN USA** (Temecula, CA) offers rainwater harvesting tanks and systems. Made with strong, durable polyethylene, the tanks are available in a variety of profiles in five colors (black, tan, green brown and red) and have capacities ranging from 130 to 2,825 gallons. The systems range from the very basic to one that includes a pump and fittings that facilitate use of stored water for irrigation and drip systems.

## LED Pool Lights



**FIBERSTARS** (Pleasanton, CA) offers PAL-Treo, a totally retrofittable even-glow LED optics system for use in swimming pools and other watershapes. The unit fits into standard wall fittings, has three available trim colors and is easily serviceable with a bright, replaceable, 100,000-hour LED lamp. It also has a wide beam spread, and the LED color array is self-synchronizing with other units in a lighting array.

## Heavy-Duty Waterfall Unit



**ATLANTIC WATER GARDENS** (Mantua, OH) has introduced Pro Series FastFalls to its line of heavy-duty products. Designed for use in pond-free waterfall systems, the rugged units offer strong, one-piece construction, rear liner attachments, reinforced spillways, internal baffling systems to ensure even water distribution and molded support cones that diffuse the flow across the spillway.

## Sanitizing Systems



**DELTA ULTRAVIOLET** (Gardena, CA) offers sanitizing systems for residential and commercial pools, spas, waterfeatures and ponds. The environmentally friendly systems use ultraviolet light to destroy harmful bacteria, viruses and algae as well as chloramines, allowing for dramatic reduction of watershapes' chemical consumption and bringing water to near drinking-water standards for purity.

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### Shell-Infused Pavers



**ARTISTIC PAVER MFG.** (North Miami Beach, FL) offers Shellock Pavers as an alternative to the brick-paver look. Ideal for applications around pools, the product consists of actual shells bonded together in a precision manufacturing process. It comes in two series: The Florida Series in ivory, buff, beach, tan and café and the Desert Series in cool white, beige, sand, cappuccino and old-world bronze.

### Gunite-Spa Jets

**WATERWAY** (Oxnard, CA) offers PowerSeat, a three-jet manifold designed for installation in gunite spas. The easy-to-install, moderately priced, pre-plumbed system features one two-inch spigot connection for water and an inch-and-a-half slip fitting for the air connection to power all three jets, which are designed to accommodate the company's wide array of Poly Storm and Power Storm jets.



## Change From Within

By Mike Farley

**S**o much has been written and said about our current economic situation that it can get pretty depressing. One thing I hear and read over and over is that many people are just stuck, waiting and hoping for things to change.

I can't help noticing that, for lots of people in government and major industries as well as in small businesses and sole proprietorships, this approach means doing the exact same things they were doing when their days were fat with opportunities. Personally, I think that's crazy!

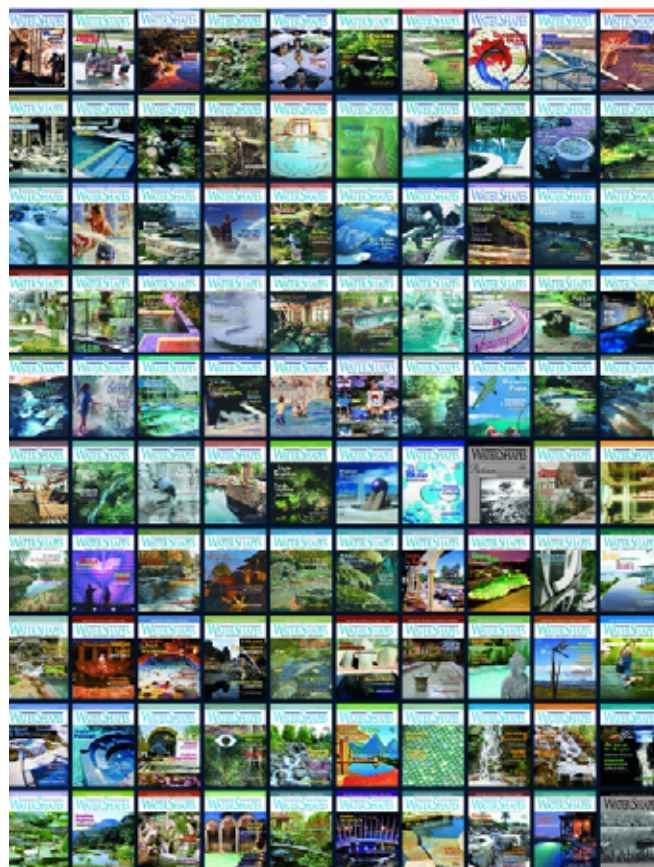
I believe if I want my situation to change, good times or bad, I must change myself from within and can't afford to wait for external forces to push me toward prosperity – especially not these days, when nobody really knows what's coming on the macro-economic scene and none of us can do much about it anyway.

This brings me to *Success* magazine and the compact disks they enclose to offer readers bonus information from their staff writers and outside contributors. I recently listened to an extended interview with one of the magazine's regulars, John Maxwell, who bowled me over by saying, "You shouldn't just read: You should *study* if you want information to have an impact."

That started me thinking about my column in *WaterShapes* and the magazine as a whole, and it reminded me that, years ago, I was one of those who constantly bemoaned the fact that there were no real resources to help me become a better watershaper. But now, with the magazine entering its twelfth year of publication, I think most of us have recognized that we have that long-needed support structure in our hands.

Anyway, I took Maxwell's advice and started studying *WaterShapes*, going through my complete set of back issues and re-discovering their content. I read carefully and slowly, taking notes and using highlighters. I also consulted the indexes the magazine has published and was glad to have several ways of digging more deeply into this immense treasure trove.

What I found is a whole list of ideas, processes and techniques that didn't apply to my work five or ten years ago that definitely *do* apply to what I'm doing now: Not only have I grown as a professional, in other words, but my needs have changed and my ability to put the information *WaterShapes* gives me to good use has increased by leaps and bounds. My



"studies" have been energizing, to say the least.

And *WaterShapes* is just one example of the broad array of resources we can use to improve our skills as designers, engineers and builders. There are other magazines, lots of great books and fantastic educational opportunities, and I see them all now in a fresh light as resources to advance my career as well as my business and personal lives.

It's inevitable that good things flow from ingesting good information. And if you're at all like me, you'll find that the opportunities you have to *apply* this new thinking and information are rising sooner rather than later: These opportunities are here for the asking, but if you don't have an open mind and the right attitude, it's almost impossible to recognize them.

So now I'm a true believer: Study, reflection and deep examination are the surest pathways to beneficial change. Better yet, those avenues are open to everyone, and all it takes is the desire to get moving and find out what's there! **WS**

**Mike Farley** is a landscape architect with more than 20 years of experience and is currently a designer/project manager for Claffey Pools in Southlake, Texas. A graduate of Genesis 3's Level I Design School, he holds a degree in landscape architecture from Texas Tech University and has worked as a watershaper in both California and Texas.



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