

# Physicians for the

Civil and environmental engineers at Temple address some of the world's most pressing issues.

Story by Betsy Winter Hall, SCT '01  
Photos courtesy of Michel Boufadel



Department of Civil and Environmental Engineering Chair Michel Boufadel conducting research in Alaska.



# Planet

ON MARCH 24, 1989, the Exxon Valdez tanker ran aground in Alaska's Prince William Sound, spilling nearly 11 million gallons of crude oil into an area of water that sustained otters, seals, salmon, seabirds, whales and other wildlife. While not the largest such spill in terms of volume, it was—and remains—the largest-ever oil spill in the United States.

Cleanup efforts began almost immediately, and early progress inspired experts in 1994 to predict that the oil would dissipate naturally within a few years. Remediation efforts on Prince William Sound's beaches were discontinued.

But oil continues to cling to the sound's rocks, sand, soil and wildlife, leaving residents, officials and environmentalists to ask what changed, and what can be done to remove the remaining oil. For this task, the Exxon Valdez Oil Spill Trustee Council enlisted Temple University researchers with a \$1.2 million grant in 2007 and renewed funding in 2009.

Over three summers, Department of Civil and Environmental Engineering Chair Michel Boufadel and a group of students representing hydrology, chemistry, microbiology and other specialized areas of environmental engineering traveled to the beaches of Prince William Sound to collect oil and sediment samples and to place year-round sensors for temperature and other measures. They came to realize that a complex interplay of geology and water dynamics in the region have been contributing to the oil's resistance to natural degradation.

"Most other studies have focused on inland aquifers and do not account for tides, temperature and salinity variation, and other factors that make things so complicated," Boufadel explains. "Our work focuses on what happens in the field, not just in the lab."

This summer, the Temple team's focus shifted from identifying the probable cause to determining a proposed remediation plan. Beyond informing a civil reopener claim currently brought against Exxon Mobil Corp. by the United States and the State of Alaska, their findings could provide a model to help reduce damage from future oil spills.

According to Boufadel, projects like this can be successful only with input from and collaboration among the right experts.

"As engineers, we are trained to communicate with other sciences," he adds. "What sets us apart is an ability to see the big picture, call in the right expertise and synthesize the resulting information into workable solutions."

This approach, Boufadel points out, is common to projects undertaken in the Civil and Environmental Engineering Department, from improving water quality to finding new uses for recycled material.

Today's civil engineers are designing more than infrastructure; they are bridging the gaps between our development and manufacturing needs and the planet's long-term environmental health.

### Protecting Our Water

In the increasingly global pharmaceutical industry, environmental laws that differ from country to country can challenge even the largest companies to meet regulations. For a growing number of small, recently established companies, meeting even one country's requirements can be daunting.



To support this vital industry in Pennsylvania, the commonwealth has awarded wastewater treatment expert Rominder Suri a two-year, \$1.6 million grant to create a research center focusing on the "green" manufacture of medicines.

"Pharmaceutical companies are looking for more cost-effective ways to meet varying national laws and to further reduce the amount of chemicals entering their process wastewater," explains Suri, an associate professor in Temple's Department of Civil and Environmental Engineering. "In addition, each new drug contains a mix of chemicals that requires new cost- and energy-efficient treatment methods."

Faculty members involved in the Center for Pennsylvania Environmental Technologies for the Pharmaceutical Industry represent the many aspects of drug manufacture: pharmacy, biomedicine, microbiology, biology and chemistry. They also consider the governmental, technological and cultural factors that affect companies' environmental impacts. The cost-saving and environmentally beneficial methods developed through the center not only are expected to draw additional business to Pennsylvania; like the findings from Prince William Sound, they also are being designed to serve as global models.

The Pennsylvania center is part of an even bigger initiative: In February, the National Science Foundation awarded Temple and two other universities \$1.24 million to establish a new Water and Environmental Technology (WET) Center. In collaboration with industry advisors representing fields such as defense and manufacturing, the researchers are determining what threats to water quality are most pressing and the best ways to address them.

One new approach to wastewater treatment uses ultrasound waves to selectively destroy contaminants so small they are measured in parts per trillion—the equivalent of one grain of sand within an Olympic-size pool.



Left to right: Michel Boufadel's students at Prince William Sound, where they traveled to further investigate the 1989 Exxon Valdez oil spill.

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“Some contaminants can affect water quality even in such trace amounts, and targeting them is very much like picking needles from a haystack,” Suri says. “We started working with ultrasound about eight years ago and believe this is its first implementation in wastewater.”

Ultimately, the technology could benefit municipal, medical and other water treatment plants, which often are not designed to treat the trace levels of antibiotics, cosmetics and other agriculture- and consumer-generated contaminants that enter streams and drinking water, he adds.

### Beyond the Surface

Some of the department's undertakings address those most traditional areas of engineering, roads and bridges. In fall 2008, the department entered into a five-year, \$5 million grant with the Pennsylvania Department of Transportation (PennDOT) to assess the state's infrastructure and the possible impacts of new, proposed bridges.

The main focus of the project is on issues such as bridge and highway repair and maintenance needs as well as best practices. Faculty and students from Temple's departments of Community and Regional Planning, Economics and Archaeology provide expertise regarding material and other cost efficiencies, and whether certain sites should be examined for archaeological significance, Boufadel says.

“Temple is the clearinghouse for new ideas for PennDOT, hearing the agency's concerns and recommending locations, new technologies and other vital information.”

One of these new technologies uses recycled plastic bottles to strengthen the ground beneath asphalt and pavement. PlastiSoil, developed by Assistant Professor of Civil and Environmental Engineering Naji Khoury, is a mix of soil and plastic heated to a uniform consistency. Used as a base, the substance improves drainage and stability for roads, sidewalks, airport runways and other surfaces, making them safer, longer-lasting and better for the environment.

Even localized projects can improve people's well-being. Aided by Heidi Grunwald, director of Research Development and Financial Planning at Temple, the department recently entered into an agreement with Friends of the Wissahickon, an organization that protects and maintains trails and wildlife in Philadelphia's Wissahickon Valley Park.

As part of the organization's Sustainable Trails Initiative, faculty and students will help address some of the ongoing challenges to trail development and maintenance such as flooding washouts and erosion through use.

“We are bringing the science by suggesting the least intrusive ways to establish trails that last from season to season,” Boufadel says.

For those improving the park, the work is more than an assignment; it is a passion for finding economically and socially feasible solutions that enhance people's quality of life and sustain natural resources.

“There is a calling for most people who do civil and environmental engineering,” Boufadel says. “In many ways, they consider themselves to be physicians for the planet.” ♦