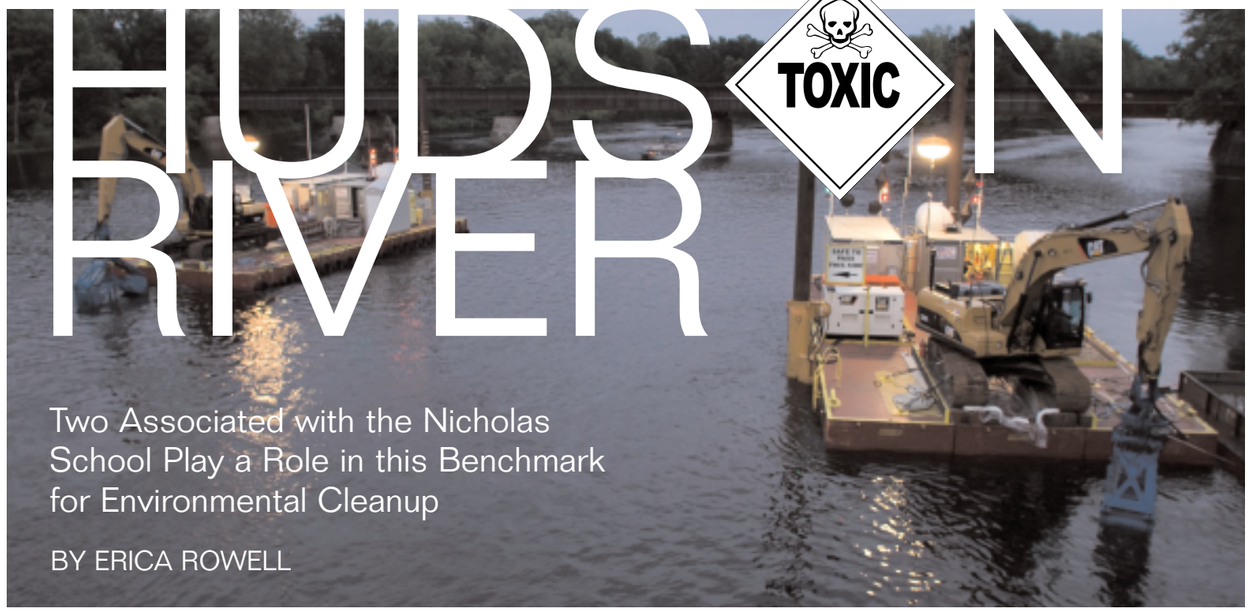
THE DREDGING OF THE HUDSON RIVER



Two Associated with the Nicholas School Play a Role in this Benchmark for Environmental Cleanup

BY ERICA ROWELL

The Hudson River's impact on American history is nothing short of stunning. For millennia, the Hudson has showered riches on the region in the form of bountiful food, scenic vistas, and an important transportation route. Today, a new chapter awaits the river. The mighty Hudson is poised to become the nation's biggest environmental cleanup story-or else a lesson in how not to clean a toxic waste site.

The removal of PCBs from the Hudson has been a long time coming. For decades, General Electric dumped contaminants into the river, fought long and hard against a cleanup, all the while denying health problems relating to the polychlorinated biphenyls, the collective name for the group of 209 synthetic compounds better known as PCBs. But then in 2002, 18 years after nearly two-thirds of the Hudson became a Superfund site, GE stopped balking.

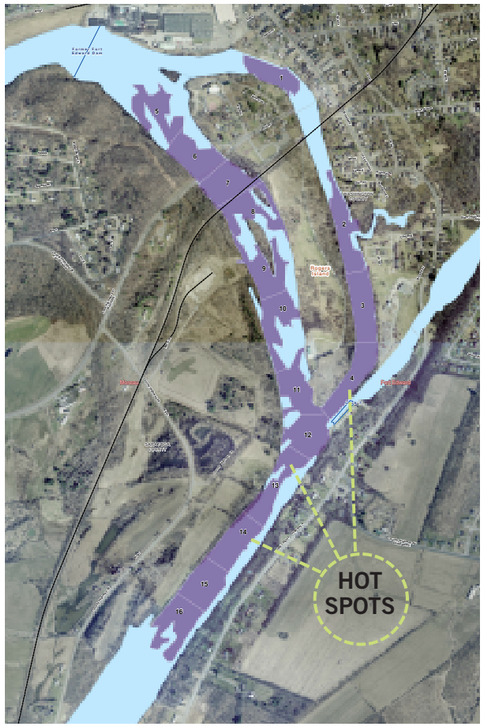
On May 15, 2009, the dredging of the Hudson River began.

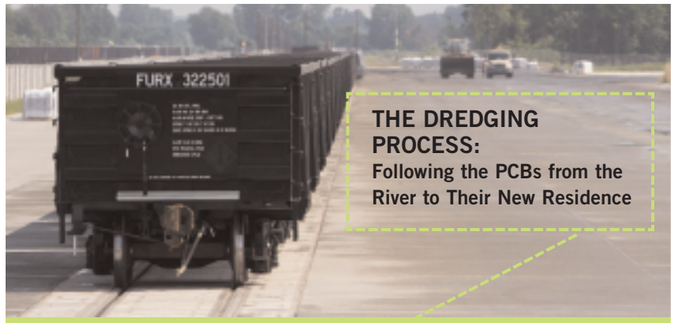
"It's the most challenging project I've ever worked on," says David Rosoff MS'90 (geology), the Hudson River on-scene field coordinator for the Environmental Protection Agency and one of two alums associated with the Nicholas School who are working on the project. "It's a challenge to work with the best people in this industry. … Technically, the challenges are immense-controlling re-suspension; dealing with quality-of-life issues; working six days a week, 24 hours a day, very close to residents; dealing with noise, lights, and odor complaints; the extensive amount of data that we have to look at every day."

OBJECTIVES OF THE PROJECT

- **Reduce the cancer risks** and non-cancer health hazards for people eating fish from the Hudson River by reducing the concentration of PCBs in fish.
- **Reduce the risks to ecological receptors** by reducing the concentration of PCBs in fish.
- **Reduce PCB levels** in sediments in order to reduce PCB concentrations in river (surface) water that are above surface water applicable or relevant and appropriate requirements.
- **Reduce the inventory (mass) of PCBs** in sediments are or may be bioavailable.
- **Minimize** the long-term downstream **transport of PCBs** in the river.

(from EPA's 2002 Record of Decision)





THE DREDGING PROCESS:
Following the PCBs from the River to Their New Residence

State-of-the-art dredgers remove sediment from pre-determined areas of the riverbed, and load it onto hopper barges. When full, the scows are sent via the Hudson River/Champlain Canal to the dewatering/processing facility in Fort Edward, a 120-acre site constructed for the project. The barges are off-loaded into a size-separation process. Coarser material goes to a staging area near the rail yard, which was constructed for the project. The finer silt, where most of the PCBs lie, is slurried with water and pumped to a dewatering building. There, filter presses squeeze out the water and press the material into filter cake. The water is cleaned at an on-site water treatment plant and eventually returned to the river. The filter cake is delivered to a storage area, where it is eventually loaded along with the coarse materials onto trains bound for a Texas landfill where the material will reside in a tightly controlled situation.

The cleanup covers the upper 40 miles of the roughly 200-mile contamination site that runs from Hudson Falls, N.Y., all the way to New York City. The pressure on Rosoff and his EPA team seems as intense as the project's scope is vast.

Says Rosoff, "This is going to be a benchmark for environmental dredging."

A Contaminant Runs Through It

The Hudson flows from its primary source high in the Adirondacks, the Lake Tear of the Clouds on New York's tallest peak, Mount Marcy, all the way to Manhattan. From Albany to the Battery, the river is a tidal estuary, something the Lenape sensed when they named the river Muhheakantuck, meaning "river that flows two ways."

Throughout, the Hudson teems with life, from the phytoplankton at the base of the marine food web to underwater plants that host invertebrates, and on up the chain. More than 200 fish species swim it-from important anadromous species such as sturgeon, shad and striped bass to mollusks, crabs, and shrimp.

Archeological findings indicate the Hudson's fish have fed humans for millennia. For bald eagles, peregrine falcons and snowy egrets the Hudson's environs serve as home and hunting ground.

A nexus of recreation, culture, and commerce, the Hudson journeys through landscapes that inspired the Hudson River School, passes by West Point-George Washington's "key of America"-and streams past the estates of industrial titans such as Vanderbilt, Morgan and Rockefeller. Dotting the riverbanks are industrial sites past and present-from foundries, paper mills and power companies to plants of corporate powerhouses like International Paper, General Motors and GE.

For much of the last century GE operated two capacitor-producing plants in Hudson Falls and Fort Edward, using the company's own blend of PCB oil-trademarked Pyranol-as an electrical insulator. In the eyes of companies making electrical equipment, PCBs were a miracle chemical because of their stability and inflammability-the very characteristics that make PCBs environmentally dangerous. From the 1940s through 1977 the two GE plants discharged about 1.3 million pounds of PCB-contaminated waste into the river.

"That was just the standard of the day back then," says Rosoff. "If you have waste, you put it in a river."

Part of the trouble with this waste stream is that it is highly persistent and likely carcinogenic.

In 1966, a report in the British journal New Scientist gave rise to new concerns over PCBs, concerns that date back to the thirties, shortly after Monsanto began producing them. In studying DDT, Swedish chemist Soren Jensen happened upon the startling fact that PCBs are everywhere: "in his own, his wife's and his baby daughter's hair. As the baby is only five months old, her father concludes that she got her dose of PCB with her mother's milk." ("Report of a New Chemical Hazard," New Scientist 32 (1966), p. 612.) A flurry of reports followed.

As early as 1971 the New York Times cited "possible health hazards" associated with PCBs along with warnings by Nobel scientists that PCBs could damage ecosystems "irreversibly" on a global scale. Around the same time, PCBs started showing up in fish caught in the Hudson, and it was with fish that the first actions were taken to protect human health.

"Most people aren't in contact with PCBs in the riverbed," explains Rosoff. "However, the fish are, and the fish are consumed by people. As a result of heavily contaminated fish in the upper Hudson River, the Department of Health in New York State has issued a ban of all consumption of fish in the upper 40 miles of the Hudson."

That was back in 1976; the ban continues today. The destruction of the fisheries, so vital to the region's economy, was one of the first victims of the widespread PCB release.

Says Rosoff, "The hopes of this project are to return the Hudson to a usable resource and to eliminate the potential risk people have from consuming fish from the river."

By 1977 the federal government's concerns over the risks PCBs posed to human health reached a tipping point: the Toxic Substances Control Act essentially prohibited the U.S. manufacture and sale of PCBs.

But long after GE stopped using PCBs, the persistent chemicals are still around-and still leaking from the Hudson Falls plant into the river. (GE is conducting a separate cleanup under New York State's supervision to remove contamination from the plant site and plug the source.) The problem has spread downriver: each year about 300-500 pounds of PCBs cross over the Troy Dam into the lower river.

Back in 1984 when the river became a Superfund site, remediation wasn't seen as an option.

"The technology in the 1980s didn't exist to dredge the river without unacceptable levels of resuspension and redeposition," explains Rosoff.

Anatomy of Today's High-Tech Dredging Project

That was then. In 2002, EPA determined the widespread contamination must stop. And so began years of design work followed by construction, and a raft of sediment sampling to determine the most contaminated areas.

Flash forward to the quadricentennial of Henry Hudson's sail up the river that eventually took his name. In the spring of 2009 GE started dredging with "pinpoint" accuracy, using the satellite navigation network known as the Global Positioning System and a bucket-load of other cutting-edge technology, much of it custom-built for the project.

"This is the most state-of-the-art, advanced equipment out there," explains Rosoff.

Plugging some 50,000 data points into a Geographical Information System (GIS), General Electric created maps detailing dredge targets.

"Those maps [are] .... on the dredge barges … hooked into a GPS system which is used to position the bucket to do cuts," says Rosoff.

Sensors on each moving part of the bucket and excavator tell operators exactly where in space they are and how deep they must dig. Another mechanism prevents dipping beyond

SIDE PROJECT: Floodplains Work

The PCBs that were dumped into the Hudson River are not confined to its riverbed. They have grossly contaminated the two GE plants where they were used, and due to regular overflows of the river, PCBs have flowed over the Hudson's banks and onto people's properties.

"We have the dredging corridor where we're doing physical in-river work," explains Melanie Chapman MEM'06, who works on the floodplains with David Rosoff MS'90. "And then we have … the floodplains work."

The process for the two is very similar, but the floodplains work is still in its nascent stages.

"We go in and sample the sediment in people's yards, agriculture fields and in backwater areas," says Chapman, "and try to figure out if people are using this area of their yard, and what they're using it for. [Looking] at that and the results of the sample, we … do kind of a risk assessment."

From that, they determine which places require immediate action, which can wait for further assessment, and which are relatively clean.

"We're getting a much better idea on both sides of the river of where the hot spots are, where the sediments have settled," explains Chapman. "All along the river, we want to make sure people are safe today even though we'll still be dredging for a few years."

The Project by the Numbers

- **40 miles:** area to be dredged
- **200 miles:** rough area of PCB contamination site
- **$750 million:** EPA's estimated costs
- **$650 million:** amount GE claims to have spent already
- **$1 billion+:** projected costs if Phase II goes as planned

SIDE PROJECT: Minimizing Re-Suspension

Re-suspension-the disturbance and distribution of PCBs into new areas-is one of the project's biggest hurdles. Here are some of the measures being taken to limit this possibility.

- **Extensive monitoring -** Strict performance standards are in place for water and air quality. If these are exceeded, immediate action is taken. In addition, a number of quality-of-life parameters are in place.
- **Environmental clamshell dredge bucket -** Though the buckets are specially designed to clamp seal, riverbed debris such as branches and rocks are often scooped up, preventing the buckets from sealing completely.
- **Silt curtains** form a wall around each dredging area, which in project parlance is a Certification Unit.
- **Sheet piling** offer an even stronger buffer against PCBs distribution beyond their current containment area. Phase I has a test site using sheet piling to see determine its effectiveness.
- **Sorbent booms and carbon-impregnated containment** materials to contain and collect PCB sheens.

the pre-determined scoop specs. Thus they pinpoint the most contaminated areas.

"Overall, the remedy is a mass reduction remedy," says Rosoff. "We're trying to remove a large volume of the PCBs from the river as opposed to trying to remove all the PCBs from the river, which is impossible."

This project's initial phase, to last through the fall, entails bank-to-bank dredging of the contamination site's upper six miles. A peer-review process will follow, after which GE and EPA will make adjustments according to the findings. Phase II, expected to last about six years, will tackle the remaining 35 miles.

Rosoff reports that the progress is going well, but not "without bumps in the road."

Three months in, 115,000 cubic yards of sediment had been removed but without meeting cleanup targets. That meant new cutlines had to be drawn, followed by residual dredging. (If PCB levels are too high after two rounds of residual dredging, GE can opt to cap the contaminants.) Such learning as they go makes Phase I a critical part of the project.

"I wouldn't call Phase I a test case," says Rosoff, "but it's certainly going to be evaluated heavily for the much longer and more voluminous Phase II."

Keeping the Community Safe and Informed

Whether one is a long-time resident of the area or someone just passing through, it's impossible not to notice something going on. While various tug, personnel, and monitoring boats run the river, dredgers work it, all day and all night, except for Sundays. Lights illuminate the night work. Monitors in bright-orange casing sit in the river and pepper its shores, measuring light and noise levels and air and water quality, and standing as visual reminders of the kind of safety and quality-of-life standards at the project's core.

"The project has a lot of parameters to keep the public safe and minimize disturbance to their daily lives," says Melanie Chapman MEM'06, an environmental scientist with Ecology & Environment (E&E), one of the consultants working with EPA. "There are a lot of things going on with the project, not only in the river but in people's backyards as we do floodplains work. (See sidebar.) There are also new people in the area. There's vehicular traffic."

As a check on GE's own monitoring and reporting, Chapman and her colleagues inspect the cleanup site and investigate potential disturbance issues: "Is the project too loud? Is there light shining on someone's house in the middle of the night? Is there an odor that's preventing people from being outside and enjoying their yards?"

While navigation and odor issues are relayed by the public, noise and light have specific numerical standards not to be exceeded.

More important are the air and water quality standards. If those are not met, action is swift.

In late July elevated levels of PCBs were detected in the air and water near one of the dredging sites. EPA responded immediately, cutting back on dredging and putting up wind-screens to catch the off-gassing of excavated sediment. Longer-term adjustments are also in the works.

"We're pushing GE harder to put more engineering controls in place to prevent these air conditions," says Rosoff, who notes that past projects have not had this type of monitoring or public involvement to this extent.

Daily updates and information about PCB levels are available through an EPA Web site (www.hudsondredgingdata.com). The locks hand out informational flyers to boaters. Community meetings are held regularly so that residents can learn directly about the project's many moving pieces.

Getting the community onboard with the project had been a tall hurdle. GE had spent years and millions spreading a PR campaign against any kind of cleanup and downplaying the hazards of PCBs. But when the tide turned and the public learned more about PCBs, the community largely came around.

It doesn't hurt that the influx of workers to the region seems to have jump-started the local economy.

Rosoff doesn't have hard numbers, but says, "We've spoken to several business owners who have related to us an increase in patronages."

Still, at times, the imposition to the sleepy hamlet is palpable. At a community meeting in mid-July, residents aired a number of grievances. Chief among them were noise and air quality complaints.

"We're dredging in some of the worst places in the river and the dredged sediment is off-gasing," says Rosoff, explaining the air issues.

"For air emissions," he continues, "the standards we use are for chronic exposure over a six-year time frame, so one day of an exceedance is not an issue from a health standpoint."

It's when there's a trend, he says, that big adjustments must be made.

With short-term engineering controls in place, EPA and GE are working on longer-term fixes and they are keeping the conversation going.

"We're talking to the entire community and entire world about what happens when you remove this type of gross contamination," says Rosoff.

If people recognize the disturbance aspect of project, many also recognize the importance of removing the PCBs.

Rosoff underlines the need to succeed.

"The local community … and future projects all over the country are depending on our success," says Rosoff, "So there is a heavy burden, not knowing whether or not the project is going to work the way it's been planned because we've never done anything at this scale."

He sees the restoration as a chance to return the historic area to its former magnificence, where its fish are plentiful and safe to eat.

"Perhaps down the road," says Rosoff, "Fort Edward and the upper Hudson River won't be known for PCBs but instead for the place of serenity and beauty that it is."

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