A Section 508–conformant HTML version of this article is available at https://doi.org/10.1289/EHP7050.

Unbalanced Burden? Potential Population-Level Health Risks and Benefits of Superfund Cleanup

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https://doi.org/10.1289/EHP7050

Between 2009 and 2015, a dredging operation funded by manufacturer General Electric removed approximately 2.75 million cubic yards[1] of contaminated sediment from the Hudson River Polychlorinated Biphenyls (PCBs) Superfund Site at a cost of $1.7 billion.[2] A study recently published in *Environmental Health Perspectives* used a population-level approach to balance the estimated health benefits of the cleanup with potential health risks.[3] The authors report that, for the subset of impacts they considered, the health benefits to local communities from remediation may not outweigh the health risks to more distant communities and cleanup workers.

The researchers used data on health effects[4,5] and fish consumption[6,7] to estimate the health benefits to local anglers and their families of reducing PCB contamination in fish consumed from the Superfund site. They estimated these benefits as avoided cancer and noncancer health effects resulting from the removal of PCB-contaminated sediment by dredging. They also estimated disability-adjusted life years (DALYs) based on inhalation of PCBs and fine particulate matter ($PM_{2.5}$) at the dredge site, inhalation of $PM_{2.5}$ among communities along rail transport routes to several dumpsites, and occupational hazards to workers.

Long-distance rail transport of contaminated sediment contributed the greatest estimated health risk. The authors estimated that the cleanup required 12 million gallons of fuel to transport 3 million tons of material by rail to landfills an average distance of 1,500 miles away. With more than 1 million total railroad miles traveled, this effort would have produced 73,000 kg of $PM_{2.5}$ emissions and 2.5 million kg of nitrogen oxide (NO_x) emissions. Ultimately, the authors calculated that the transport of sediment caused an estimated 32 DALYs of health burden, or 32 lost years of healthy life.

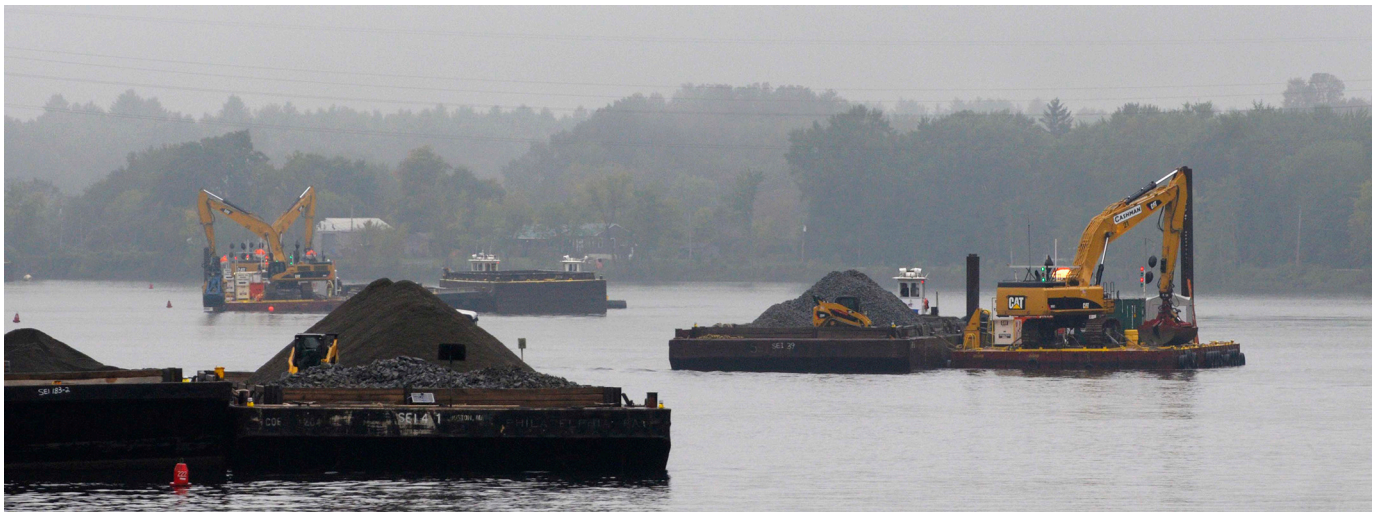
Dredging, on the other hand, resulted in an estimated net reduction of 15 DALYs compared with taking no action on the site beyond controlling the pollution source. "The best estimate of the benefits of fifteen DALYs avoided by dredging, even when multiplied by a factor of ten, is very restricted for [such an] investment," says senior author Olivier Jolliet, a professor of environmental health sciences at the University of Michigan.

The authors mention that future work could compare health risks of consuming local foods against their health benefits, such as the positive effects on early cognitive development and cardiovascular health from eating omega-3 fatty acids in fish.[8] Potential ecological, social, and economic effects of environmental dredging also could be addressed.

Before the Hudson River cleanup project began, the U.S. Environmental Protection Agency (EPA) conducted an air quality evaluation[9] for dredging, comparing estimated concentrations of air pollutants at the site to threshold-based regulatory standards[10] for protecting individual health. "EPA's selected cleanup approach—dredging and off-site disposal—considered air emissions from project equipment in terms of compliance with applicable standards," says EPA Region 2 Public Affairs Director Mary Mears. The agency concluded that the project "would not significantly impact air quality" based on assumptions including one locomotive running for 30 minutes during the day, twice per day.[9]

"This highlights the distinction between EPA's traditional framework for assessing individual risks versus a comparative, population-based approach taken by the present study," says first author Jacob Kvasnicka, a PhD candidate at the University of Toronto. "When we considered the actual data . . . on rail shipments and included long-distance transport in an overall evaluation of population health benefits versus risks for the dredging alternative, the findings painted a different picture."

That said, the study was limited by substantial uncertainties in estimating noncancer health benefits of reducing PCBs in fish.



In this 22 September 2011 photograph, barges are piled high with material used to backfill dredged areas and to protect caps in areas where PCBs remained. The U.S. EPA will survey the site every 10 years in perpetuity, along with special inspections after any flooding or other "high flow events," to ensure the caps remain intact. Image: © Albany *Times Union*.

Other limitations included uncertainty in estimating the local population's PCB exposures from eating fish. And the authors point out that as existing locomotives are gradually replaced by cleaner trains, rail-related emissions and associated health risks are expected to decrease considerably, highlighting the importance of such standards.[11]

"The authors clearly indicate that they are looking at a subset of risks and benefits involved with decisions about remediation of the Hudson River," says Donna Vorhees, Director of Energy Research with the Health Effects Institute, who was not involved with the research. "This limited scope may affect the utility of results because it is unknown how risks and benefits would compare if all were considered and, where possible, quantified."

Nevertheless, the study does raise new considerations for future cleanup projects. The study "highlights the need to minimize sediment transport distances and to assess health burdens and trade-offs affecting the overall population rather than just aiming to maintain individual risk below a given threshold," says Jolliet. "It raises the question of how to best use substantial financial compensations from polluters to benefit local communities and the environment."

Wendee Nicole is an award-winning Houston-based writer. Her work has appeared in *Discover*, *Scientific American*, and other publications.

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