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EPA
United States
Environmental Protection
Agency

Sustainable and Healthy Communities National Research Program

2015 ACCOMPLISHMENTS

Office of Research and Development
Sustainable and Healthy Communities National Research Program

EPA 601/R-16/004
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EPA Sustainable and Healthy Communities National Research Program

2015 Accomplishments

U.S. Environmental Protection Agency

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Planning. Partnership. Delivery.

The Sustainable and Healthy Communities (SHC) national research program is the largest and most diverse research program within EPA's Office of Research and Development. SHC researchers consider the full range of interactions between people and our environment, from providing technical support for oil spills and other environmental emergencies, to illuminating the myriad connections between healthy ecosystems and human well-being.

Program scientists—together with input from their partners from EPA program and regional offices, state environmental management agencies, community decision-makers, and the scientific community—are embracing a truly cross-disciplinary research portfolio to deliver the knowledge, data, and tools needed to meet the most pressing environmental challenges of the day. They are doing that work in innovative ways that simultaneously advance prosperous and healthy communities well into the future.

A common theme for the work is to present research results so that they support community decisions across the three components of sustainability: economics, society, and the environment.

To ensure our work is immediately relevant to support such decisions, SHC has embarked on a multi-year, strategic planning effort (see *Learn More* sidebar) that explicitly includes cultivating partnerships with EPA program offices, other federal and state organizations, public health officials, and community decision makers across the nation. Those partnerships create an atmosphere of exchange and feedback that continually inform the program, helping it remain responsive and nimble even as it advances a new paradigm of environmental and related public health research that advances holistic, long-term solutions.

This report highlights specific achievements and solutions delivered in fiscal year 2015 (October 2014 to September 2015). Collectively, they exemplify how EPA's Sustainable and Healthy Communities national research program is providing the technical support needed by its partners, and helping the Agency achieve its cross-cutting strategic goals of "working towards a sustainable future" and "making a visible difference in communities."

The results presented here represent critical milestones along the road to a healthy, prosperous future for all. Sustainable decisions start with what SHC scientists and engineers are learning and sharing.

Learn More:

With considerable input from its partners, SHC released the S*ustainable and Healthy Communities Strategic Action Research Plan* in late 2015. Download at: http://go.usa.gov/xY2ud

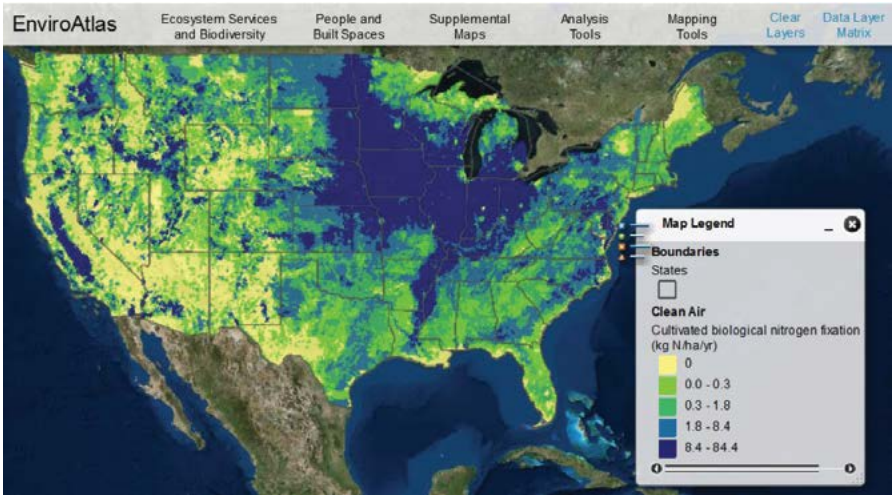
Ecosystem Research

Understanding and quantifying the many ways in which natural ecosystems contribute to human well being is a major focus of SHC research. Program scientists and engineers are exploring how aspects of the natural environment such as coastal and other wetlands, urban tree cover, and parks and other green spaces provide "ecosystem services," also known as nature's benefits. Working with communities, they are helping identify and measure specific local benefits, including natural flood control, cleaner air and water, heat mitigation, resiliency, and economic opportunity.

To ensure that work has impact, researchers are incorporating what they learn into tools that support decisions and inform long-term plans that better protect and sustain these ecosystem services. Built on robust databases, EPA tools provide accessible, easy-to-use resources for exploring complex questions and for contrasting the near-term costs of proposed actions with the long-term benefits of alternatives. By advancing the understanding of the links between healthy ecosystems and healthy people, SHC researchers are helping their partners make the best investments for their communities.

2015 highlights of SHC research illuminating the links between ecosystems and public health follow.

EPA's EnviroAtlas: Exploring Ecosystem Service from Your Desktop



EPA researchers and external partners have developed EnviroAtlas, a collection of online interactive tools and resources to help decision makers and other citizens explore the connections between people and the environment. The spatial decision-support tool provides access to ecosystem services-based data sets through a robust geographic information system (GIS), allowing users to view and analyze key aspects of the relationships between natural landscape features, human-built infrastructure, and public health.

In 2015 the EnviroAtlas team complemented the tool's watershed-scale data, already covering the entire conterminous U.S., with high-resolution landcover information and metrics focused on twelve communities. The community data emphasizes local environmental aspects that can have direct relevance to public health, such as: residential properties' proximity to major roadways, the percentage of residents living more than 500m walking distance from a park entrance, and the number of schools and daycare centers with less than 25% surrounding green space.

In addition, researchers completed the first two case studies for the tool uses library. The first explores the connection between tree cover and public health, illustrating how a planner could use EnviroAtlas to prioritize additional plantings to benefit children in the vicinity of Durham, NC; the second shows how to identify the amounts of near-road tree cover in relation to residential populations vulnerable to air pollution. It was conducted by examining communities in Durham, NC, Milwaukee, WI, Portland, ME, and Tampa, FL.

In December 2014, Secretary of the Interior Sally Jewel announced the release of EcoINFORMA, for which EnviroAtlas serves as the ecosystem services "resource hub." As a component to a Presidential initiative on understanding nature's benefits, EcoINFORMA is designed to facilitate assessments of the impact of climate change, pollution and other stressors on ecosystems, as well as assessments of management responses to such stressors.

EnviroAtlas is free and publicly at: www.epa.gov/enviroatlas.

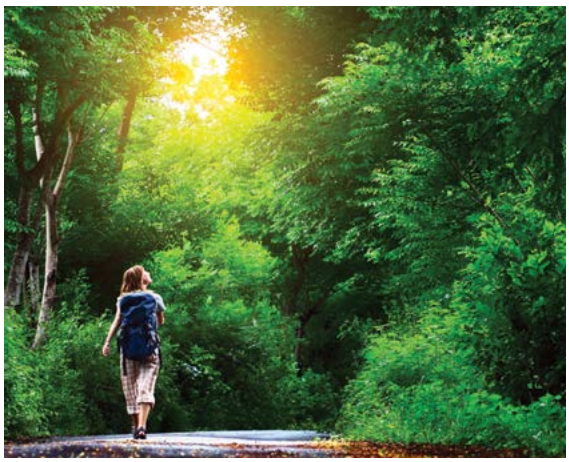
Novel Techniques Support Local Decisions

SHC researchers used high-tech satellite imaging and GIS to map land cover and use patterns in the 32,000-square-mile Muddy-Virgin River area of southern Nevada. They then combined those metrics with local water quality measurements to create a tool to help local decision-makers better understand ecological conditions and predict likely changes under different decisions and actions. Results of that work are featured in *An Ecological Characterization and Landscape Assessment of the Muddy-Virgin River Project* (download at http://1.usa.gov/1pKwajy).

Ecosystems and Human Well-Being: Developing Ways to Consider the "Goods and Services" of Nature in Environmental Decisions and Policies

Together with partners from the EPA Office of Water, in September 2015, SHC researchers released *National Ecosystem Services Classification System (NESCS): Framework Design and Policy Application*. The final report presents a standard framework for systematically identifying the components of nature that are directly beneficial to people, specifically the flow of "final ecosystem goods and services" from local environments into economies and other community and individual assets. The authors combined an analysis of the scientific literature of how ecosystems support human well-being, with reviews of standard national economic accounting practices. By reconciling natural and human systems, they developed a seamless method for supporting environmental decisions and policies that impact both. For example, NESCS (pronounced "nexus") can be used to explore exchanges from the "supply side" of nature to the "demands" placed on them by people through direct consumption or enjoyment.

The report is another significant milestone in SHC's effort to move ecosystems services from concept to implementation. It complements a 2013 Agency report, *Final Ecosystems Goods and Services Classification System (FEGS-CS)* as well as ongoing research focused on developing standard, scalable techniques for measuring, mapping, and quantifying the value of natural ecosystems. Additional Agency research delivered in 2015 will be presented in "The Beneficiary Perspective—Benefits and Beyond", a chapter in the forthcoming *Handbook on Ecosystem Services*. In the chapter, SHC researchers and their co-authors outline the importance of identifying specific beneficiaries of final ecosystem goods for making environmental measurements relevant for policy and decision makers.



National Ecosystem Services Classification System (NESCS): Framework Design and Policy Application is available for downloading at: http://go.usa.gov/xYTxY.

Excess nutrients sparked a toxic algal bloom in Lake Erie in 2011. Image: NASA Earth Observatory.

Integrated Nitrogen Management

Human caused nutrient pollution, primarily in the form of excess nitrogen and phosphorus, is one of America's most widespread, costly, and challenging environmental problems—threatening both human health and the continued delivery of ecosystem services. SHC scientists are working with partners from across the Agency to address those challenges and sustainably manage nitrogen and related co pollutants.

More specifically, SHC researchers are exploring the flow of nutrients into and across ecosystems, and how excess nitrogen and related co-pollutants are impacting and potentially disrupting ecosystem services. They are leading Agency research efforts under the context of informing sustainable decisions using an ecosystem services approach.

Examples of results from research using an ecosystem services approach to address nitrogen management during 2015 include the release of an EPA *Research Roadmap*, and the following publications:

In October, 2015, EPA released *Nitrogen and Co-Pollutants Research Roadmap*, a report outlining a highly collaborative, strategic plan to provide the scientific knowledge, data, and innovative solutions needed to sustainably manage reactive nitrogen and co-pollutants. The Roadmap can be downloaded at: https://www.epa.gov/research/research-roadmaps.

Hale, Stephan. (2015, August.) E*utrophication and hypoxia degrade ecosystem functions and services of benthic communities in a New England estuary*. Poster session presented at the 2015 Annual Conference of the Ecological Society of America, Baltimore, MD.

Fetscher E, Sutula M, Sengupta A, and Detenbeck NE. (2014.) *Linking Nutrients to Alterations in Aquatic Life in California Wadeable Streams.* U.S. Environmental Protection Agency, Washington, DC (NTIS EPA/600/R-14/043), 2014.

Community Health and Human Well-being

SHC researchers are working to identify the connections between our natural environment and human well-being. Their focus is on developing the knowledge, data, and tools that can be used in a decision-support context to help local communities compare and contrast different scenarios and take strategic action to build more sustainable, prosperous, and healthier communities for themselves and future generations.

2015 highlights of SHC work on developing a better understanding of the connections between the environment, community health, and human well-being follow.

Illuminating the Impacts of Contaminants on Communities

SHC researchers and their partners are working to better understand the true health, economic, and social costs that burden communities when their citizens are exposed to harmful chemicals and other contaminants in soil, air, and water. Their work is empowering public health officials and other community stakeholders with the knowledge they need to pinpoint actions that will lower exposure risks and advance public health.

Assessing Community Environmental Disease Burden Associated with Arsenic Exposure

Arsenic has long been known to be among the most toxic chemicals, causing bladder, lung, and skin cancers. It is also increasingly linked to other (noncancer) health effects, such as cardiovascular disease, reproductive effects, neurological malfunction, and diabetes. A main route of exposure can be drinking water, which is why the U.S. EPA Office of Water regulates arsenic at 10 ug/L in public water systems, a rule that is subject to review and reassessment every five years.

SHC researchers study the impacts of exposures to environmental contaminants, such as arsenic in drinking water.

The health effects of arsenic at low exposure levels, the interactions of the chemical with potential additional inorganic arsenic exposures from ingestions (from sources such as rice, wine, and apple juice), and the metabolic, genetic, and epigenetic differences that could impact susceptibility, are also largely unknown.

To address such concerns and better protect public health, SHC researchers and partners have been conducting research on human populations impacted by arsenic exposure in drinking water. Recently, they completed studies on two broad ranging populations: Inner Mongolia (chosen as a case study based on previous studies and known arsenic exposure risks) and Fallon, Nevada. Findings included: an association between well-water arsenic and cardiovascular disease, even at levels below 50 ug/L; and, variations in drinking water exposures (as measured in urine samples) along social and demographic features. The results are helping establish associations between arsenic and cardiovascular disease and a better understanding how arsenic exposures vary across different human populations—critical information for supporting the Office of Water's review of standards for arsenic levels in drinking water, which occurs every five years, as well as other efforts aimed at protecting communities from the impacts of arsenic.

2015 SHC publications and other outputs assessing environmental disease burden of arsenic include the following:

Antonelli R, Shao K, Thomas DJ, Sams R, and Cowden J. (2014). AS3MT, GSTO, and PNP polymorphisms: impact on arsenic methylation and implications for disease susceptibility. *Environmental Research,* 132, 156-167.

Calderon RL, Hudgens EE, Carty C, He B, Le XC, Rogers J, and Thomas DJ. (2013). Biological and behavioral factors modify biomarkers of arsenic exposure in a U.S. population. *Environmental Research*, 126, 134-144.

Wade TJ, Xia Y, Mumford J, Wu K, Le XC, Sams E, and Sanders WE. (2015). Cardiovascular disease and arsenic exposure in Inner Mongolia, China: a case control study. *Environmental Health*, 14(1), 35.

Assessing the Economic and Social Burden of Acute Respiratory, Gastrointestinal, and Skin Disorders Related to Environmental Exposures

SHC researchers and partners, including outside collaborators from the University of California, Berkley; the University of Illinois; and the Centers for Disease Control and Prevention, used data based on 50,000 records from previous large scale field work to better understand the health and economic burden posed by acute respiratory, gastrointestinal, and other health effects, primarily those associated with recreational swimming in contaminated natural waters.

Research results were presented in a number of scientific journal papers focused on a range of environmental health issues: trends in mortality due to gastrointestinal illness; the health and economic costs of swimming-associated ear infections; and estimates of the overall costs of swimming-associated illness.

2015 SHC publication on impacts related to environmental exposures include:

Collier SA, Wade TJ, Sams EA, Hlavsa MC, Dufour AP, and Beach, MJ. (2015). Swimming in the USA: beachgoer characteristics and health outcomes at US marine and freshwater beaches. *Journal of Water and Health*, 13(2), 531-543.

Assessing the Health Impacts of Cumulative Chemical ("Body Burden") Exposures

To protect public health, it is important for risk assessors and others to consider the complex dynamics of environmental chemical exposures: how people are exposed to different chemicals, how those chemicals interact with one another once inside the body, and how cumulative "body burden" exposures might spark different health effects in different groups, (by gender, race, life stage).

SHC researchers used a host of data sets, including the large-scale National Health and Nutrition Examination Survey (NHANES), and detailed

social, demographic, and genetic information from previously conducted research to assess how multiple and cumulative exposures have impacted health endpoints such as childhood asthma, chronic infection, and metabolic syndrome. A wide range of clinical, social, and demographic patterns were found to differ by race and ethnicity, demonstrating the importance of evaluating common, environmentally-driven health impacts in the context of cumulative exposures related to social, demographic, and clinical conditions.

2015 Sources and SHC publications on assessing the health impacts of "body burden" exposures include:

George BJ, Reif DM, Gallagher JE, Williams-DeVane CR, Heidenfelder BL, Hudgens EE, and Edwards SW. (2015). Data-driven asthma endotypes defined from blood biomarker and gene expression data. *PloS One,* 10(2), e0117445.

Krueger WS and Wade TJ. (2016). Elevated blood lead and cadmium levels associated with chronic infections among non-smokers in a cross-sectional analysis of NHANES data. *Environmental Health*, 15(1), 1.

Williams-DeVane CR, Reif DM, Hubal EC, Bushel PR, Hudgens EE, Gallagher JE, and Edwards SW. (2013). Decision tree-based method for integrating gene expression, demographic, and clinical data to determine disease endotypes. *BMC Systems Biology*, 7(1), 1.

New Models Developed for Assessing Soil Contamination

Toxic metals such as arsenic are a major target of mitigation efforts to clean up soils at Superfund and other contaminated sites. To support partners in EPA's Office of Land and Emergency Management, SHC researchers developed more rapid, less expensive tools to test the bioavailability of arsenic in soil and guide clean-up efforts. The results are highlighted in the EPA report, *Compilation and Review of Data for Relative Bioavailability of Arsenic in Soil and Recommendations for Default Value for Relative Bioavailability*. The report is now being used to guide national policy decisions and risk calculations that are resulting in effective, less costly remediation efforts—saving millions of dollars in clean-up efforts nationwide.

Helping Communities Breathe Easier: Exploring Local Environmental Drivers of Asthma

The prevalence of asthma in the U.S. has doubled since the 1980s. Today, some 26 million people struggle with the disease, at an economic impact of about $60 billion in yearly medical costs. SHC researchers are exploring the environmental, socio-economic, and public health dynamics behind asthma, and the causes behind the rate of increase experienced over the last several decades. What they are learning will help communities—especially low-income areas that have traditionally been disproportionately affected by the disease—take action. The ultimate goal is to ensure that everyone in the country has an equal opportunity to breathe easier.

Examples of those results follow.

A major priority of SHC asthma-related research is developing a better understanding of the role that race and social determinants play as factors in asthma and other health outcomes from environmental stressors. While the causes of asthma are clearly linked to poor air quality, genetics are also known to contribute to a predisposition for its development. The interaction of genes and environment, especially poor air quality, have long been thought to be related to asthma. Studies of these interactions, however, have not accounted for the higher asthma rates found in ethnic minorities and low income families.

To better understand the roles of race and income in asthma risk, SHC scientists and partners conducted epidemiological studies quantifying home mold contamination in communities in New York, Ohio, Puerto Rico, and Scotland. Puerto-Rican Hispanic, African American, and Caucasian populations were considered.

The research resulted in findings that homes with higher scores on the Environmental Relative Mold Index (ERMI), a standard metric to assess mold contamination developed by EPA and the Department of Housing and Urban Development, were associated with increased asthma prevalence, regardless of race or income.

These significant findings mean that Agency partners can use the ERMI metric as a first line screening tool to help families and communities quantitatively assess—and ultimately reduce—mold contamination in homes with the expectation of lower asthma prevalence. Because asthma is so pervasive, these results might be used by families, physicians, and governments to reduce the prevalence of asthma.

2015 Related publications and for more information:

Kettleson EM, Adhikari A, Vesper S, Indugula R, Reponen T. Key Determinants of the fungal and bacterial microbiomes of homes. *Experimental Research*. 2015; 138:130-135.

Vesper S, Choi H, Perzanowski MS, Acosta LM, Divjan A, Bolaños-Rosero B, Rivera-Mariani F, Chew GL. Comparison of mold populations and dust mite allergen concentrations in house dust samples from across Puerto Rico. *International Journal of Environmental Health Research*. Accepted 7-22-2015.

Developing Standardized Tests for Mold-resistant Building Materials

To prevent the growth of mold and other microbial "bioaerosols" that can contaminate indoor air and threaten health, companies have developed a new generation of resistant wallboard, flooring, and other building materials. But how effective are these materials? To support the industry and improve indoor air quality SHC researchers developed a joint, antimicrobial-chemical testing method that industry can use to measures both the effectiveness of new fungal-resistant products as well as their release of volatile organic compounds.

The holistic, quantitative test method they developed establishes standard protocols and works for a diversity of different microbial resistant products and product classes. More information is in the report *Microbial Resistant Test Method Development*, available for download at: http://go.usa.gov/cGyXh.

EPA's Report on the Environment

EPA's Report on the Environment (ROE) is an interactive, web-based resource for tracking how national environmental and human health conditions are changing over time. These trends are captured in a set of 85 objective scientific indicators based on data from a variety of sources including EPA and other federal agencies, universities, and non-governmental organizations. The ROE indicators and the supporting contextual scientific content are each reviewed by scientific experts to ensure that they are based on valid and unbiased measurements.

Indicators are organized into five different themes —Air, Water, Land, Human Exposure and Health, and Ecological Condition—and address questions relevant to EPA's mission of protecting human health and the environment. The online format of the Report on the Environment allows agency researchers and others to frequently update the indicators as new information is made available, continually providing the latest data. New indicators are also added when relevant. By better understanding the condition and trends of the environment and human health in the United States, EPA can more effectively prioritize areas for action, and foster efforts that improve trends.

EPA's Report on the Environment is available at: https://cfpub.epa.gov/roe/.

Assessing Environmental Health Disparities

Advancing healthy and sustainable communities requires an understanding of the complex dynamics linking environmental and social factors to human health and well-being. SHC researchers and their partners are working to provide that understanding, combining explorations of both built and natural environments with social sciences to paint a more complete picture of how chemical (exposures in air, water, and soil) and non-chemical stressors (climate change, living in low-income versus more affluent communities, and lifestages, for example) impact human health and well-being.

Three research focus areas—(1) children's environmental health, (2) tribal communities, and (3) disproportionately impacted communities—provide critical information supporting the Agency's strategic goals to advance environmental justice and bring the benefits of environmental protection to every community and citizen across the country.

Advancing Children's Environmental Health Science

Pound for pound children eat, drink, and breathe more than adults. And because their bodies and internal systems are still growing and developing, the earliest stages of life are when the potentially harmful effects of environmental exposures can lead to long-term detrimental impacts. Behaviors such as picking food up from the floor, playing in dirt, exploring the world through touch and taste also contribute to increased environmental health risks.

SHC researchers and partners are leading the effort to provide the Agency's Office of Children's Health Protection, as well as state and local public health officials, pediatric health professionals, parents and other caregivers, and community stakeholders with the information they need to protect children's environmental health wherever the live, learn, and play.

- *The Children's Environmental Health and Disease and Prevention Centers*
  Together, EPA and the National Institute of Environmental Health Sciences have established a national network of university-based Children's Environmental Health and Disease Prevention Research Centers. The overall goal is to explore ways to reduce children's health risks from environmental exposures and other factors.

  Currently, 14 centers are funded, collectively addressing the most pressing questions related to children's environmental health, such as evaluating exposures from air pollutants and endocrine disrupting chemicals, and looking at causal relationships behind health outcomes such as asthma, autism, adverse birth outcomes.

  For more information, including a host of examples of research results that have made significant impacts improving the lives of children, please visit: http://go.usa.gov/c7kv9.

- *SHC Scientists Advance Children's Environmental Health*
  In addition to jointly funding the nation's leading pediatric public health scientists through the Children's Environmental Health and Disease Prevention Research Centers program, EPA's own researchers conduct highly-targeted investigations to help reduce environmental risks for those in the earliest stages of life.

  Their work includes looking at where, when, how often, and why young children might be exposed to contaminants in their environment and answering questions about chemicals commonly used in consumer products, pesticides.

  Recent research results include published papers contributing to what is known about the potential for certain classes of chemicals to disrupt the endocrine system, and the link between early life chemical exposures and increased risks for childhood obesity and related metabolic disorders (such as diabetes). EPA scientists are also advancing the science of how developmental or early life environmental exposures can lead to life-long health impacts through epigenetic effects, changes to the function or expression of genes.

SHC Publications include the following:

Gray LE, Furr J, Tatum-Gibbs KR, Lambright C, Sampson H, Hannas BR, and Foster PM. (2016). Establishing the "Biological Relevance" of *Dipentyl Phthalate* Reductions in Fetal Rat Testosterone Production and Plasma and Testis Testosterone Levels. *Toxicological Sciences*, 149(1), 178-191.

Rogers J. (2015, August). Epigenetics and the Developmental Origins of Health and Disease. *Environmental and Molecular Mutagenesis* (Vol. 56, pp. S46-S46).

Research to Advance the Clean-up and Rehabilitation of Contaminated Sites

Across the country, thousands of former industrial sites, waste operations, and other lands have been contaminated with harmful chemicals and other toxics, threatening human health, disrupting or diminishing ecosystem services, and limiting the productive use of the land. SHC researchers are providing the innovative solutions needed to clean up and rehabilitate such sites and help restore them back into community assets.

EPA's Engineering Technical Support Centers for Contaminated Sites

In 1987, EPA established three engineering Technical Support Centers to match Agency expertise with the needs of Agency Program and Regional Offices, as well as the states for assessing, cleaning up, and releasing contaminated sites for reuse.

The centers are strategically located in close proximity to the EPA Office of Research and Development research laboratories and are dedicated to serving the Agency and its clients by supplying high-quality, quick-response technical support services. Together, the centers respond to hundreds of technical support requests from contaminated sites across each of EPA's 10 Regions.

The three Technical Support Centers, their locations, and web sites for more information are:

- The Engineering Technical Support Center
  Cincinnati, OH.
  Web: www.epa.gov/land-research/engineering-technical-support-center-etsc
- The Ground Water Technical Support Center
  Ada, OK
  Web: www.epa.gov/water-research/ground-water-technical-support-center-gwtsc
- The Site Characterization and Monitoring Technical Support Center
  Athens, GA
  Web: www.epa.gov/land-research/site-characterization-and-monitoring-technical-support-center-scmtsc

The three centers listed above work closely with two other centers, the Superfund/Human Health Technical Support Center and the Ecological Risk Assessment Technical Support Center, which are supported by EPA's Human Health Risk Assessment national research program.

Sustainable Approaches for Contaminated Sites

In coordination with the work of the Engineering Technical Support Centers, SHC researchers also work with land managers, EPA Program Offices, communities, and other partners to characterize the complex interactions of contaminants, soil, groundwater, and air (vapor intrusion). The overriding goal is to provide innovative solutions and tools that lower risks, protect human health, and help rehabilitate contaminated sites.

Agency researchers are building sophisticated computer models and other tools to better understand the pooling, flow, and diffusion of contaminants and "contaminant plumes" between (to and from) groundwater aquifers and different types of underlying and surrounding substrates, and to and from surface waters. They are also developing, testing, and assessing technologies and techniques for monitoring contaminants in soil, water, and air.

Site managers and remediation specialists use research results and resources to monitor and assess clean up activities, and design long-term strategies for protecting public health. Such innovative tools are helping revitalize communities and advance sustainable waste and materials management.

Recent research results and publications include the following.

(Contaminated Groundwater Research)

Huang J, and Goltz MN. (2015). Semi-analytical solutions for transport in aquifer and fractured clay matrix system. *Water Resources Research*, 51(9), 7218-7237.

Brooks MC, Cha KY, Wood AL, and Annable MD. (2015). Screening-level estimates of mass discharge uncertainty from point measurement methods. *Journal of Contaminant Hydrology*, 177, 167-182.

(Contaminated Sediments Research)

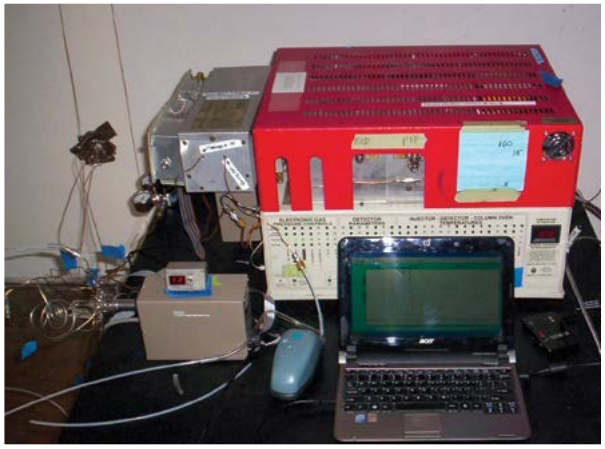
Lien Bob K, and Ford Robert G. (2014). *Quantifying Seepage Flux using Sediment Temperatures.* EPA/600/R-15/454. December 2014. Available at: http://go.usa.gov/cH4fJ.

Fernandez LA, Lao W, Maruya KA, and Burgess RM. (2014). Calculating the diffusive flux of persistent organic pollutants between sediments and the water column on the Palos Verdes Shelf Superfund site using polymeric passive samplers. *Environmental Science and Technology*, 48(7), 3925-3934.

Cantwell MG, Perron, MM, Sullivan JC, Katz DR, Burgess RM, and King J. (2014). Assessing organic contaminant fluxes from contaminated sediments following dam removal in an urbanized river. *Environmental Monitoring and Assessment,* 186(8), 4841-4855.

Sustainable Approaches for Vapor Intrusion

An additional challenge often related to cleaning up contaminated sites and protecting public health is that hazardous compounds are not confined to solids or liquids in soils and groundwater, but occur also in subsurface gases. Such gases, such as volatile organic compounds (VOC) and naturally occurring radon, can migrate upward and into buildings through a process known as vapor intrusion (VI), compromising indoor air quality and posing significant health risks to occupants.



Air monitor EPA researchers use to study vapor intrusion inside a former pre-1920 home.

EPA researchers have been conducting one of the longest-running and most in-depth studies on VI to date, conducted at a pre-1920 residential duplex outfitted with a suite of monitors to measure indoor air concentrations and continually monitor several independent variables that could influence VOC and radon concentrations, including barometric pressure, soil moisture, soil temperature, water level, heating and air conditioning operations, and air temperature.

In October, 2015, EPA released the latest results of that study: *Simple, Efficient, and Rapid Methods to Determine the Potential for Vapor Intrusion into the Home: Temporal Trends, Vapor Intrusion Forecasting, Sampling Strategies, and Contaminant Migration Routes*. The 332-page report provides the Agency's Office of Land and Emergency Management as well as other partners and stakeholders with a wealth of science-based information they need to better protect building occupants from vapor intrusion risks.

The report, the third in a series from the study outlined above, can be downloaded at: http://go.usa.gov/xYTGH.

Supporting Preparedness, Emergency Response, and Clean Up of Oil and Fuel Spills

Oil spill dispersant released in response to the BP oil spill in the Gulf of Mexico 2010.

The Deepwater Horizon oil spill of 2010 presented a tragic reminder of the enormous human and environmental toll that the accidental release of oils and fuels can take. Whether full-blown catastrophes or the many smaller, isolated releases that unfold across the nation, EPA is committed to finding new, innovative ways to better prepare emergency personnel and other responders, mitigate immediate and long-term impacts, and lower the environmental and related public health risks of oil and fuel spills.

That work includes exploring novel methods to spur the biodegradation of biodiesel and diesel blends of fuel, developing techniques and technologies to inform the Agency's National Contingency Plan Product Schedule (dispersants and other products available for use on oil spills), and advancing the monitoring and assessment of leaking underground storage tanks.

Recent accomplishments from EPA research include the following.

Wu S and Supply BW. (2014). *Anaerobic Biodegradation Patterns for Biodiesel* (Doctoral Dissertation, University of Cincinnati).

Koran KM, Venosa AD, Vyas S, and Sorial GA. (2005, May). Development of a Surface Washing Agent Effectiveness Protocol. In *International Oil Spill Conference* (Vol. 2005, No. 1, pp. 637-641). American Petroleum Institute.

Sustainable Materials Management

Even as EPA researchers advance novel techniques to help the cleanup of contaminated lands, monitor and mitigate vapor intrusion, and respond to releases of oil and fuel into the environment, they recognize that the ultimate solution to such challenges is to eliminate or prevent pollution at its source. They are leading the charge to usher in new a generation of cleaner, more sustainable materials management.

Working with partners and stakeholder throughout the Agency, other federal and state agencies, and private industries, SHC researchers are working to minimize environmental impacts associated with products, sparking new ways to reduce consumption and increase reuse and recycling.

This work includes developing and demonstrating new Life Cycle Assessment (LCA) paradigms to identify, monitor, and quantify the true environmental impacts of consumer products across the full spectrum of production, use, and disposal. Examples include a 172-page report (EPA, 2015) that provides greatly expanded access to data on construction and demolition debris, materials dominated by components such as concrete, asphalt, wood, drywall, and metal. Such materials represents both a focal point for many communities across the nation looking for opportunities to increase solid waste recycling and advancing sustainable materials management.

To further such efforts, Agency researchers updated The Waste Reduction Model (WARM), a tool that estimates greenhouse gas emission reductions from different waste management practices (including source reduction, recycling, combustion, composting, and landfilling), into an open source, international-standards-based format compatible with LCA studies and models. It is available for use (web-based) and downloading (via a spreadsheet) at https://www.epa.gov/warm.

In addition, Agency researchers are exploring ways to help communities turn the waste streams that result from high energy, resource intensive productions, such as secondary aluminum processing resources. Innovation applied to such industries and practices has the potential to dramatically reduce the consumption of water and non-renewable fuels, and spark economic growth.

Highlights from 2015 SHC research achievements in advancing sustainable materials management include the following.

U.S. EPA (2015.) *Methodology to Estimate the Quantity, Composition, and Management of Construction and Demolition Debris in the United States*. EPA/600/R-15/111. Accessed and downloadable at: http://go.usa.gov/ctBv.J.

Tolaymat T and Huang X. *Secondary Aluminum Processing Waste:Salt Cake Characterization and Reactivity*. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-15/109, 2015. Downloadable at: http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NRFR.txt.

Advancing Integrated Solutions for Community Sustainability

Advancing sustainable and healthy communities requires multidimensional, sophisticated investigations that integrate environmental, social, and economic parameters. SHC researchers and their partners, including grantees and supported small businesses, are at the forefront of those efforts, developing a suite of sophisticated decision-support tools and innovative solutions that seamlessly link environmental protection with human well-being.

Everybody Wins! EPA's People, Prosperity and the Planet (P 3) Competition

Since 2004, the Sustainable and Healthy Communities national research program has supported the next generation of environmental scientists and engineers through the People, Prosperity, and the Planet (P3) student design competition for sustainability.

The competition consists of two phases. In Phase1, student teams and their faculty advisors submit a research and design proposal for an innovative, marketable solution to an environmental and/or related public health challenge. Selected teams receive up to $15,000 in "seed" money to advance their solutions and are invited to present their results and prototypes to a panel of judges at the National Sustainability Design Expo each spring in Washington, DC. The best, most promising designs are awarded EPA's P3 Award, the second phase of the competition which includes up to $75,000 in additional funding to bring their designs to market.

Over the years, 645 funding awards have been made to 217 institutions in all 50 states and Puerto Rico, involving more than 4000 students. Twenty-six winning teams have gone on to start companies or commercialize their designs, and funded research has led to 186 publications and 16 patents.

2015 Phase Two Winners

Institution	Project Title	Description
Cornell University Johns Hopkins University	"Smart" Turbidimeters for Remote Monitoring of Water Quality	Designed a low-cost monitor for measuring water quality.
Embry-Riddle Aeronautical University	Develop a Concentrated Solar Power-based Thermal Cooling System via Simulation and Experimental Studies	An innovative air conditioning system that runs on solar power.
Iowa State University	Developing Sustainable Products Using Renewable Cellulose Fiber and Biopolymer Composites	A new kind of fabric made with fibers from bacteria and yeast grown in tea and polymers of corn and soy.
Purdue University	Biowall's Impact on Indoor Air Quality and Energy	Team is studying how to improve indoor air quality by installing plants in a home's HVAC system.
SUNY Stony Brook	Ocean Wave Energy Harvester with a Novel Power Take-off Mechanism	Designed and built Poseidon, an ocean energy harvester that infinitely converts wave motion into electrical energy.
University of Tennessee, Knoxville	Green Oak as a Sustainable Building Material	Exploring ways to use green oak or "heart centers", the low quality part of hardwood logs, in U.S. building construction.
University of Wisconsin	Exchange Network for Expanded Polystyrene Bio-Shipping Containers	Implemented a campus-wide recycling program for foam packaging.

For more information, including descriptions of past winning projects and how to apply, please visit: www.epa.gov/P3.

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