EPA

2014 Accomplishments

OFFICE OF RESEARCH AND DEVELOPMENT

United States Environmental Protection Agency

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Impact ***\'im-ˌpakt*** *n* 1 a. an impinging or striking; 2 the force of impression of one thing on another: an impelling or forcefull effect.

Impact. Every research project conducted or supported by the U.S. Environmental Protection Agency's (EPA) Office of Research and Development has a single, overarching goal: to support EPA's mission of protecting human health and the environment. The Office is well suited for embracing such an ambitious challenge. No other research organization offers the collective diversity of expertise uniting public health, environmental, social, and other scientists to address the most pressing environmental and related human health challenges, many of which are far more far-reaching and complex than before.

Together, this community of researchers has blazed a 40-year path toward science-informed actions that have led to cleaner air, safer water, and more prosperous lands. This progress has improved public health and well-being, having an impact on every American community and beyond.

These achievements have been quantified across a host of indicators, including: lower blood lead-levels in children, the population growth of peregrine falcons and other birds of prey moving from near extinction to complete recovery, the increase in the number of swimmable and fishable local water ways, millions of pounds and gallons of pollutants kept out of air and water, and acres of formerly contaminated and condemned industrial sites rehabilitated into parks and other community assets. Even the measurement of lifespans have increased—by five months—for those living in cities that have enjoyed the most dramatic improvements in air quality.

2014 accomplishments include tools, data, and models that are: protecting public health; improving air quality; helping communities become more resilient in the face of a changing climate; reducing emissions of carbon and other pollutants; ushering in new generations of safer, more sustainable chemicals; promoting homeland security and emergency response; and advancing safe and sustainable drinking water and water resources.

Air, Climate, and Energy Research

Improving air quality, reducing carbon and other greenhouse gas emissions, and developing strategies to help communities and individuals address the effects of a changing climate are central to EPA's mission to protect human health and the environment. Research by EPA's Air, Climate, and Energy research program and its partners has played a prominent role in protecting the air we breathe and providing new understandings about the relationship between air quality, climate change and energy production. Studies are advancing technology to better measure and monitor air quality, providing innovative modeling tools to help predict and respond to the impacts of climate change, and investigating the adverse health and environmental effects related to air pollution and a changing climate.

EPA air, climate, and energy research results have far-reaching impact, providing the scientific foundation for decisions and actions to protect public health and the environment.

Taking Action on Climate Change

More frequent heat waves. Spikes in coastal flooding. An increase in severe droughts and wildfires. How do we put such events into perspective, what might the future hold—and most importantly—how does the nation take collective action in response to the increasingly clear evidence that the effects of climate change are unfolding?

The first steps are rooted in science.

The U.S. Global Change Research Program, which coordinates scientific research across 13 Federal departments, recognizes the foundational role of science in understanding global change and its impacts: "Research, along with an array of increasingly sophisticated tools for collecting and analyzing data, can provide essential knowledge to governments, businesses, and communities as they plan for and respond to the myriad manifestations of global change, including sea-level rise and ocean acidification, heat waves and drought, and the severe storms, floods, and forest fires that pose an ever-growing risk to life, property, and agriculture."

EPA scientists and their partners are directly supporting President Barack Obama's "Climate Change Action Plan" to reduce carbon pollution, prepare the United States for the impacts of climate change, and lead international efforts to combat climate change and prepare for its impacts. The research results, knowledge, data, and tools Agency scientists produce help decision makers incorporate climate change into long-term strategies that promote sustainable, resilient, and healthy communities.

Working with partners from the U.S. Geological Survey and the U.S. Forest Service, Agency researchers published *Best Practices for Continuous Monitoring of Temperature and Flow in Wadeable Streams* (EPA/600/R-13/170F), a guide for collecting accurate, year-round temperature and hydrologic data at stream sites, an important component for monitoring climate change and its potential impacts over time.

EPA researchers also focus on helping communities mitigate the expected effects of climate change. "Urban adaptation can roll back warming of emerging megapolitan regions" (PNAS February 25, 2014 vol. 111no. 8 2909-2914), co-authored by EPA scientists, demonstrates important climate change mitigation techniques available for urban areas, specifically how three types of roofing (cool, green, and hybrid) can help reduce local temperatures.

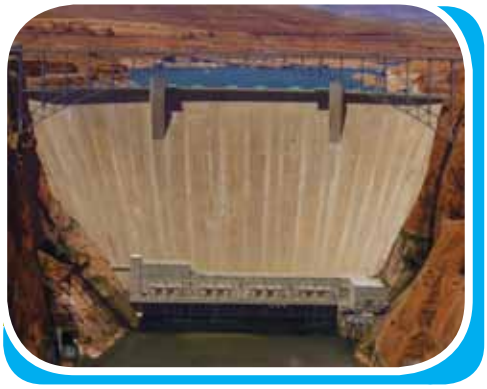
Evaluating roof designs and other technologies to help communities is part of Agency efforts to protect human health in the face of climate change. Agency researchers presented results of the first application of a model to support decision making in the journal *Urban Climate*: "Developing a model for effects of climate change on human health and health-environment interactions: Heat stress in Austin, Texas" (*Urban Climate* 06/2014). When complete, the model will have broad applications for identifying and supporting effective actions to protect health and the environment.

Agency researchers collaborated with colleagues from a number of different organizations within and outside government on the Climate-Smart Conservation Workgroup. The consortium released *Climate-Smart Conservation: Putting Adaptation Principles into Practice*. This key resource presents practical information for natural resources managers to integrate climate change into their planning, including assessing ecosystem vulnerability, identifying and prioritizing adaptation and implementation options, and monitoring the effectiveness of adaptation actions.

EPA scientists made significant contributions to the signature government climate change publication the *2014 National Climate Assessment*. The most comprehensive analysis to date, it documents current and expected climate change impacts and responses across different regions. The goal of the Assessment is to inform public and private decision-making at all levels.

In his remarks at the September 2014 United Nations Climate Summit, President Obama said, "We cannot condemn our children, and their children, to a future that is beyond their capacity to repair. Not when we have the means—the technological innovation and the scientific imagination—to begin the work of repairing it right now."

The scientific papers, model, tools, and contributions to such high-profile reports as the *2014 National Climate Assessment* illustrate how EPA researchers and their partners are at the forefront of the technological and scientific imagination President Obama spoke of during his speech.



Climate-energy and the Water-energy Nexus

EPA researchers are studying the effects that climate-change-driven drought might have on electricity generation. Using MARKet ALlocation (MARKAL), an energy trade-off model created by the Brookhaven National Lab, they are searching for potential ways to maximize electricity while minimizing water use and carbon dioxide emissions.

Results of their work are presented in two 2014 papers on MARKAL water-energy nexus modeling: "Strategic responses to CO2 emission reduction targets drive shift the U.S. electric sector water use" (*Energy Strategy Reviews, Volume 4, August 2014*), and "A review of water use in the U.S. electric power sector: insights from systems-level perspectives" (*Chemical Engineering, Volume 5, August 2014*).

Up In Smoke: Wildfires, Air Quality, and Public Health

Scientists expect climate change to lead to longer, more intense wildfire seasons. Research by EPA-supported scientists at the Harvard School of Engineering and Applied Sciences suggests that by the year 2050, wildfire seasons will increase in length by some three weeks, produce twice as much smoke, and burn a wider area in the Western States.

Other published research provides public health officials with a way to use smoke forecast models to reduce health and economic risks, and insights into how differences in wildfire smoke composition affect our health differently: "Cardiopulmonary toxicity of peat wildfire particulate matter and the predictive utility of precision cut lung slices" (*Particle and Fibre Toxicology, 2014: 11.29*). An EPA research team received support from the Joint Wildfire Science Program (FireScience.gov) to continue this important work through a study of the chemical composition of smoke from wildfires around the country.

NASA aircraft collects air samples from the sky.

Air Quality Monitoring From Space: DISCOVER-AQ

The final field component of an extensive, multi-year study to advance the measurement of ground-level air quality from space concluded in and above the metropolitan Denver, Colorado area in summer 2014 when scientists from EPA, NASA, and other federal partners collected data from satellites, airplanes and ground-level monitors. The study, called Deriving Information on Surface conditions from COlumn and VERtically or DISCOVER-AQ, has provided scientists a wealth of data to improve pollution measurements that will lead to better air quality forecasts and more accurate assessments of pollution sources and fluctuations.

As part of the project, EPA-trained teachers followed the action from Houston, where they led students in operating compact, ground-based air monitoring devices placed at eight local public schools. The schools then contributed the data they collected to the EPA research team.

Citizen Science Toolbox for Air Quality Sensors

There is a growing interest by citizens to learn more about what's going on in their community: What's in the air I breathe? What does it mean for my health and the health of my family? How can I learn more about these things and even be involved in the process? Is there a way for me to measure, learn, and share information about my local air quality? Thanks to EPA researchers, they now have a resource to explore those questions.

Released in 2014, EPA's Air Sensor Toolbox for Citizen Scientists provides information and guidance on new low-cost compact technologies now available for measuring air quality. The Toolbox includes: a guidebook to help citizens more effectively and accurately collect air quality data in their own communities; information on sampling methodologies; generalized calibration and validation approaches; options for measurement methods; data interpretation guidelines; education and outreach resources; and low-cost sensor performance information. The toolbox is available at: http://www.epa.gov/heasd/airsensortoolbox.

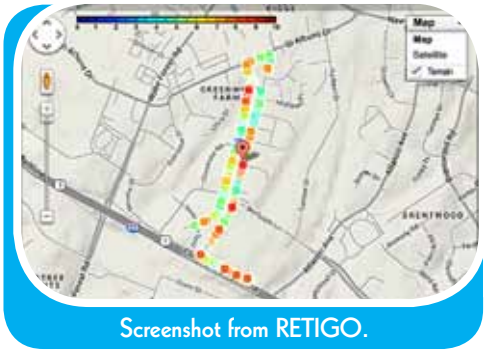
Air sensors in the back of an EPA research vehicle.

Advancing the Next Generation of Air Sensors

EPA is leading the implementation of a new generation of air sensors: portable, low-cost technologies that collect and transmit data in real time. The Agency's fourth workshop, held June 2014 at its campus in North Carolina, focused on the opportunities and challenges associated with the next generation of air quality monitoring technology and data.

The workshop brought nearly 500 interested parties together looking to improve sensor design, performance and usability, including community groups, sensor developers, state, local, and tribal officials, researchers, private industry and non-profit organizations.

The RETIGO Tool



Screenshot from RETIGO.

The proliferation of low cost, portable air sensors has meant that collecting real-time measurements from cars, bicycles, and other vehicles is an increasingly common method for investigating local air quality. Making use of the data, which includes geographical and time-based (geospatial) components, however, is still a technical challenge. EPA researchers are lowering the bar to meeting that challenge with the Real-Time Geospatial Data Viewer, or "RETIGO."

RETIGO is a free, web-based tool that allows users to visualize air quality data on a map. The tool helps users visualize, analyze, and understand geospatial air data, opening up a wealth of new capabilities to view and consider large sets of air quality data collected by citizen science groups, researchers, and others interested in local air quality. It is available at: www.epa.gov/retigo.

Air Pollution, Genes, and Our Health

EPA researchers and collaborators are investigating potential links between an individual's genetics and the way their body, particularly their cardiovascular system, responds to air pollution exposure. Their work was made possible by the sharing of an extensive clinical health database by Duke University Medical Center. Named CATHGEN, the database contains information from nearly 10,000 volunteers, most diagnosed with cardiovascular disease.

In initial studies using the CATHGEN database, researchers demonstrated a relationship between traffic-related air pollution and risk factors of diabetes and metabolic syndrome, a condition that contributes to cardiovascular disease. Another finding concludes that exposure to traffic-related air pollution is associated with diseases of the blood vessels and hypertension.

Understanding Local Air Quality with Fine-scale Modeling

The Community Multi-scale Air Quality Model

EPA scientists developed several innovative techniques for tapping the widely-used Community Multi-scale Air Quality model (CMAQ) to explore highly localized local air quality, down to the county, city, or even neighborhood levels.

Such fine-scale modeling helps states address areas where air pollution has been difficult to reduce, such as those that don't meet National Ambient Air Quality Standards. It can also be used to inform air quality assessments and improve exposure estimates for conducting health studies. The refinements support even more robust and accurate modeling capabilities.

Urban Air Studies with the Smog Simulator

EPA engineers and scientists developed a novel mobile smog simulator they can use to produce customized air samples based on smog "recipes" for different parts of the country. Researchers can then use the samples to model and study the health effects of exposures to typical air mixtures found in cities across the country on laboratory animals, cell cultures, and even plants.

Using a unique temperature control feature built into the simulator, scientists are investigating the impacts of a warming climate on air photochemistry and physics, and the subsequent impacts on human and environmental health. The research is supporting EPA's evaluation of air mixtures for setting the National Ambient Air Quality Standards.

Supporting World-class Air, Climate, and Energy Research

To complement its own clean air, climate, and energy research, EPA supports some of the nation's leading scientists, engineers, and research organizations to conduct focused studies that address high priority science questions and advance solutions to today's more pressing health and climate challenges. Research grants announced during 2014 follow.

EPA Awarded $9 Million for Cleaner-burning Cookstove

EPA is a leader in the international effort to reduce the health and environmental threats related to the rudimentary cookstoves and open fires used by nearly half of the people in the world. According to the World Health Organization, cookstove smoke is a major contributor to indoor air pollution in developing countries, causing approximately four million premature deaths annually and a wide range of illnesses. The black carbon emitted from such cookstoves also contributes to climate change, disrupts weather patterns, and accelerates the melting of snow and ice.

In 2014, the Agency committed $9 million in grant funding for six universities to conduct research toward cleaner technologies and fuels for cooking, lighting, and heating homes. The research advances work to improve indoor air quality and positively impact the health of people living wherever cookstoves are used, including Native Alaskan communities and across the developing world. The research will also benefit efforts to reduce the impact of cookstove emissions on climate, and contribute to the ultimate goal-- development and widespread adoption of cleaner-burning stoves and fuels. The universities and their research projects are outlined below.

University	Research	Funding Amount
University of California, Berkeley	Researchers will explores the relationship between household and village-scale pollution, to better understand the effectiveness of cookstove interventions.	$1,495,454
University of Colorado, Boulder	Researchers will use small, inexpensive sensors to better monitor human exposure to pollution from residential burning. They will also collect data through health assessments and outdoor air quality measurements in Ghana.	1,500,000
Colorado State University, Fort Collins,	Researchers will use cookstove interventions in China, India, Kenya, and Honduras to explore the emissions, chemistry, and movement of indoor smoke. They will also conduct health assessments and model exposures to improve the understanding of climatic impacts of stove interventions.	$1,500,000
University of Illinois at Urbana-Champaign	Researchers will investigate how local resources affect community acceptance of heating stove interventions. They will also explore how measurements will improve the understanding of air quality and climatic benefits of cookstove interventions in Alaska, Nepal, Mongolia, and China.	$1,499,998
University of Minnesota	Researchers will measure changes in air quality and health outcomes from cleaner cooking and heating technologies. They will also model to assess a rural cookstove intervention in China.	$1,489,388
Yale University	Researchers will use socioeconomic analyses, emissions and pollution measurements, and global climate modeling to investigate the impacts of cookstove interventions in India.	$1,499,985

Safe and Sustainable Water Resources Research

Increasing demands for sources of clean water, combined with changing land use practices, population growth, aging infrastructure, and drought pose significant threats to the Nation's water resources. Failure to manage the Nation's waters in an integrated, sustainable manner can jeopardize human and aquatic ecosystem health, which can impact our society and economy.

It is the responsibility of EPA to conduct research and analyses that will ensure that the Nation's water resources are safe for use and can be sustained for future generations. In EPA's 40-year history, significant advances have been made in protecting the country's waters through the effective control of potable water treatment and point-source contamination. This has resulted in better protected and improved human and ecosystem health through reductions in waterborne disease organisms and chemicals.

Through innovative science and engineering, EPA's Safe and Sustainable Water Resources Research Program is developing cost-effective solutions to these current, complex water issues and proactively developing solutions to emerging concerns. Our research is helping to ensure that clean, adequate, and equitable supplies of water are available to support human health and resilient aquatic ecosystems, now and into the future.

Soaking It In: Green Infrastructure

Hopping over the small stream running down the side of the street and avoiding the spray of passing cars may be the only time most people focus on stormwater runoff, but it is just that kind of water that threatens the quality and integrity of local waterways across the nation. When rain hits pavement and rooftops, it mostly flows, picking up contaminants and excess nutrients before reaching storm drains that feed directly into sewer systems. During big storms and melting events, the sheer volume of that runoff often overwhelms such systems, leading to "combined sewer overflows" that dump mixtures of already tainted runoff and raw sewage directly into rivers and other local water resources.

In contrast, natural areas such as grassland, forests, and wetlands absorb and hold excess water in place, filtering out sediment and pollutants while also helping to recharge groundwater. EPA researchers are working to help local communities make their developed areas function more like those kinds of natural areas when it comes to stormwater management. Agency scientists and engineers, along with their partners, are advancing techniques and practices that tap or mimic natural habitats to reconnect the land to hydrologic cycles that absorb, hold, and cleanse stormwater.

Collectively referred to as "green infrastructure," these practices offer innovative, low cost ways to reduce stormwater runoff and associated problems, offering local communities opportunities to save money while having true impact improving water quality.

One tool that EPA researchers have developed to support the assessment and adoption of green infrastructure is the National Stormwater Calculator. This free, online tool provides decision-makers and others with information and analysis they need to assess the impact of incorporating green infrastructure practices, such as rain gardens, rain barrels, cisterns, and open parks, into their projects. It is designed to be used by anyone interested in reducing runoff from a property, including site developers, landscape architects, urban planners, and homeowners.

As part of the Climate Assessment Tool package announced in the President's Climate Action Plan, EPA researchers enhanced the Calculator with climate assessment capabilities, which will help communities incorporate green infrastructure into future climate scenarios. In addition, the Calculator is now a resource for LEED Project Credit 16 (Rainwater Management) certification by the U.S. Green Building Council for projects that are designed to reduce runoff volume and improve water quality of a site.

In addition to developing new tools such as the National Stormwater Calculator, EPA researchers are working directly with partners and communities across the nation to help them tap the benefits of green infrastructure. For example, in collaboration with the City of Omaha, the Nebraska Department of Environmental Quality, and the Nebraska Water Science Center (U.S. Geological Survey), EPA scientists are analyzing soils and preparing a monitoring network strategy to inform and better manage stormwater.

As part of the effort mentioned above, the Agency provided $100,000 in applied research funding for the City of Omaha to establish a water monitoring network built around the installation of green infrastructure systems.

Researchers will continue to monitor water sensors that were installed before the full implementation of green infrastructure for at least three years, allowing them to calculate how well green infrastructure performs with respect to water capture and

infiltration. By analyzing sample cores of both topsoil and subsoil, the scientists will be able to provide Omaha with key information on how best to realize the promise of green infrastructure to effectively manage stormwater. The impacts are expect to include better-informed decisions, lower cost stormwater management, and cleaner waterways.

Another EPA partnership was established with the City of Philadelphia, where officials are looking to advance the use of green infrastructure for urban wet weather pollution control. As part of that effort, in 2014, EPA provided nearly $5 million in grants to five universities to support research exploring the financial and social costs and benefits associated with green infrastructure as a stormwater and wet weather pollution management tool.

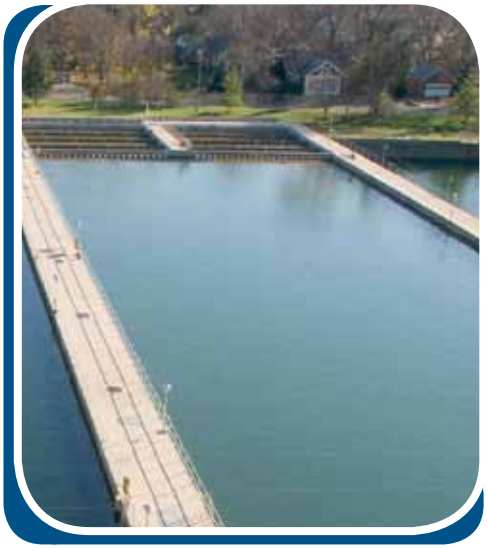
Research findings from the EPA-supported research teams will support efforts such as Philadelphia's *Green City, Clean Waters*, a 25-year plan to use innovative green infrastructure to protect and enhance local watersheds and make Philadelphia a more sustainable city. The project will help build municipal capacity to manage stormwater in a subset of the greater Philadelphia urban watershed through green infrastructure.

A major impact of incorporating effective green infrastructure techniques will be to reduce the number of "combined sewer overflows" that occur when runoff volumes exceed the capacity of wastewater treatment facilities. To facilitate that, EPA released *Greening CSO Plans: Planning and Modeling Green Infrastructure for Combined Sewer Overflow (CSO) Control* in March 2014. The free publication provides municipalities and sewer authorities with a single, science-based resource on available tools and techniques to help them calculate green infrastructure contributions to overall water management strategies.

Informed largely by EPA research on green infrastructure techniques, *Greening CSO Plans* will help communities make cost-effective decisions to maximize water quality benefits. The resource explains how to use modeling tools such as EPA's Storm Water Management Model (SWMM) to enhance green infrastructure and reduce sewer overflow.

The green infrastructure tools, partnerships, and resources that EPA researchers are delivering are ushering in a new generation of stormwater management practices. The results offer communities faced with upgrading and replacing obsolete, inadequate, and often neglected sewer and wastewater treatment systems with innovative, lower cost solutions. The impact will be measured in hundreds of millions of dollars saved, trillions of gallons of water conserved, and healthier, more sustainable water resources across the country.

Advancing green infrastructure is just one of many achievements made by EPA Safe and Sustainable Water researchers and their partners during 2014. Additional highlights follow.



Providing Information and Treatment Technologies to Small Water Systems

State and local officials across the Nation are faced with the challenges of effectively communicating information and overseeing training for small drinking water system owners and operators with a wide range of expertise, skills, and preferences for modes of communication. In addition, the large number of small systems makes it a challenge in itself – approximately 148,803 small public drinking water systems nationwide. To help ensure that these systems are in compliance with regulations enforced under the Safe Drinking Water Act, state and local officials need to stay up-to-date on treatment alternatives, regulations, health implications, and emerging contaminants. EPA researchers are committed to helping state and local personnel, as well as small system personnel, to deliver high quality drinking water to their customers by providing information, tools, and technical assistance. The highlights below are just some of many current EPA activities designed to assist with small system challenges:

- Treatment technologies from pilot- to full-scale: Researchers have helped small water systems by piloting an EPA developed and cost-effective biological treatment process that has demonstrated the ability to effectively remove ammonia and iron from the community's source water, while keeping nitrite and nitrate levels below their respective maximum contaminant level in the treated water. As part of a Housing and Urban Development Community Development's Block Grant, the community completed the construction of a full-scale water distribution plant that incorporated the technology. EPA is now investigating the opportunity to look at pilot systems that can be used by small community drinking water systems to remove nitrate from source water.
- The 11th Annual U.S. EPA Drinking Water Workshop: A collaborative effort between EPA and the Association of State Drinking Water Administrators, this workshop is held annually and has been hailed as one of EPA's best. With a goal of providing in-depth training and information on various solutions and strategies for handling small systems problems and compliance challenges, the 2014 workshop was attended by 225 people from forty states, tribal communities, and foreign countries. Although the workshop was primarily attended by state personnel, attendees were also from other federal and local agencies, academia, industry, and others.
- Small Systems Webinar Series for the States: As part of our long-term outreach efforts to the states, EPA will hold monthly webinars to communicate current research and treatment technologies in concert with Agency compliance priorities. The webinars will begin in January 2015, and will provide a platform for EPA scientists to communicate directly with state personnel, which will in turn help to foster collaboration and dissemination of information to small systems personnel.

Final Assessment on the Potential Effects of Large-scale Mining on Bristol Bay

Alaska's Bristol Bay watershed supports the largest sockeye salmon fishery in the world, is home to 25 federally recognized tribal governments, and contains large mineral resources. The potential for large-scale mining activities in the watershed has raised concerns about the impact of mining on the sustainability of Bristol Bay's world-class fisheries, as well as the future of Alaska Native tribes in the watershed who have maintained a salmon-based culture and subsistence-based lifestyle for at least 4000 years.

In response to these concerns, and stakeholder petitions both for and against agency action under the Clean Water Act, the EPA launched the Bristol Bay Assessment in February 2011. EPA conducted this assessment to characterize the biological and mineral resources of the Bristol Bay watershed, increase understanding of the potential impacts of large-scale mining on the region's fish resources, and inform future decisions by government agencies and others related to protecting and maintaining the chemical, physical, and biological integrity of the watershed. In January 2014, the Agency completed its study of the science and concluded that large-scale mining in the Bristol Bay watershed poses risks to salmon and Alaska Native cultures. For more information, visit http://www2.epa.gov/bristolbay.

Harmful algal bloom in Lake Erie.
(Image courtesy of NASA Earth Observatory.)

EPA Experts Help Restore Drinking Water to Half a Million

In early August 2014, residents in and around Toledo, Ohio awoke to an emergency "Do Not Drink" water advisory from their local water utility, due to cyanobacterial toxins detected in their treated drinking water. The City uses Lake Erie as their drinking water source, which, at the time, was experiencing a large cyanobacteria harmful algal bloom. Cyanobacteria is particularly tricky because toxins are released from the bacteria when they are damaged, so boiling the water only makes the situation worse.

Officials with the State of Ohio immediately reached out to EPA's Cincinnati-based research laboratory—a world leader in the evaluation and development of innovative drinking water testing, monitoring, and treatment technologies—for technical assistance, including water sample analysis and recommendations as to what treatment plant adjustments could be made to further reduce cyanotoxin levels in the finished drinking water. With that help, combined with the help of others, the City of Toledo was able to lift the advisory within a little more than two days, restoring safe drinking water to some half a million people. Agency researchers continue to advance ways for utilities to monitor and protect drinking water resources, such as the development and deployment of low-cost sensors that will help predict future algal blooms and minimize their impact.

National Wetland Condition Assessment

EPA led a multi-agency collaboration on the first-ever report on wetland ecological condition as part of its National Aquatic Resource Surveys. The new wetland condition assessment builds on the U.S. Fish and Wildlife Service's data on status and trends of wetland acreage to describe the ecological condition of the Nation's wetlands, to advance the science of wetland monitoring and assessment, and to help build State and Tribal wetland monitoring and assessment capabilities.

Assessing the Nation's Water

Protecting and sustaining the nation's rivers, streams, lakes, wetlands, and other water resources requires a detailed understanding of their current state, how they are changing, and how human activities are affecting the structure and function of aquatic ecosystems. To meet that challenge, EPA researchers are leading the development of standardized field and lab methods to ensure robust, comparable data and analysis that yield nationally-consistent, scientifically defensible assessments.

In 2014, they finished a two-year survey and field collaboration with partners from across EPA, other federal agencies, as well as from states, tribes, natural resource agencies, universities and other organizations to conduct wide-scale surveys of the nation's rivers and streams. Together, they collected samples from 1,800 sites across the lower 48 states to represent the condition of rivers and streams. The information collected is being shared as part of a national database, and will be analyzed to support the anticipated 2016 release of the report *National Rivers and Streams Assessment 2013-2014*. It will serve as a scientific report card on America's flowing water, and contribute to a series of EPA assessments that collectively represent the full breath of the nation's aquatic ecosystems (for more information, see www.epa.gov/aquaticsurveys).

EPA's Study of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources: Progress and Research

EPA is writing a draft assessment report to answer key scientific questions about the potential impacts of hydraulic fracturing for oil and gas on drinking water resources. The draft assessment will be released for public comment and peer review in spring of 2015, and will be the culmination of a comprehensive literature review, EPA independent research projects and stakeholder input. As a Highly Influential Scientific Assessment, the draft assessment will receive meaningful and timely peer review in accordance with EPA's peer review handbook, and undergo peer review by EPA's Scientific Advisory Board (SAB) to ensure all information is high quality.

The assessment will provide states, tribes and local communities around the country a critical resource to protect our drinking water resources.

Supporting World-class Water Research

To complement its own sustainable and safe water research, EPA supports some of the nation's leading scientists, engineers, and research organizations to conduct focused studies that address high priority science questions and advance solutions to today's more pressing water challenges. Research grants announced during 2014 follow.

Supporting Small Drinking Water Systems

EPA continued its commitment to improving America's drinking water by providing more than $8 million to create two national centers for research and innovation in small- to medium-sized drinking water systems. The grants support the development of "water innovation clusters," hubs of businesses, researchers, and others all devoted to developing and advancing innovative, new, and affordable technologies to protect and supply safe, sustainable water supplies.

The 2014 recipients of the grants were the University of Colorado Boulder, to support its Design of Risk Reducing, Innovative Implementable Small System Knowledge Center (DeRISK), and the University of Massachusetts Amherst's Water Innovation Network for Sustainable Small Systems Center. With EPA support, the two centers will develop and test advanced, low cost methods to reduce, control, and eliminate groups of water contaminants that present challenges to communities worldwide.

EPA is helping cities such as Omaha, Nebraska improve stormwater monitoring and management.

Supporting Green Infrastructure

(Also see "Soaking It In: Green Infrastructure" at the start of this chapter.)

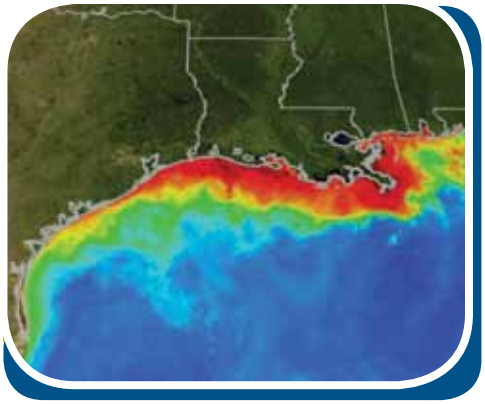
In May 2014 EPA provided $100,000 in applied research funding for the City of Omaha, Nebraska to establish a water monitoring network around the installation of green infrastructure systems. In collaboration with the City of Omaha, the Nebraska Department of Environmental Quality and the U.S. Geological Survey's Nebraska Water Science Center, EPA scientists are analyzing soils and preparing a monitoring network strategy. Both Omaha and the State of Nebraska asked EPA's Office of Research and Development and the Agency's Midwest Regional Office (EPA Region 7) to provide scientific research assistance.

Researchers will install monitors to conduct before-and-after studies around the green infrastructure implementation, including for at least three years after installations to quantify performance with respect to water capture and infiltration. Through this collaboration with community and state partners, the impact of the EPA research support will extend far beyond Omaha, showing other communities how they can approach green infrastructure.

EPA-Supported Researchers Develop Low-cost Water Filtration for Underserved, Rural Communities

EPA-supported researchers from the University of Texas, El Paso, together with a team of students and professors from there and New Mexico State University, have developed an innovative, low-cost "point of use" filtration system for underserved, rural communities in Texas, New Mexico, and elsewhere. The group built a filtration system that can be made with between $50 and $300 worth of common hardware supplies, and requires just $3 to$6 of monthly maintenance—replacing the need to haul water in to rural areas.

The work was supported by an EPA grant awarded in 2012 to support the study of different factors in the feasibility and sustainability of water filtration devices in communities (locally referred to as "colonias") around El Paso and Doña Ana counties. The impact of the newly developed filtration system, currently being field tested, will be access to clean, safe drinking water for underserved, rural communities in areas faced with well water contaminated with (naturally-occurring) arsenic and other metals.



EPA Awarded Almost $9 Million to Researchers Working to Improve Water Quality

On January 30, 2014 EPA marked the 14th National Conference and Global Forum on Science, Policy and the Environment with the announcement of grants to four research institutions to support innovative and sustainable research to manage harmful nutrient pollution. Nutrient pollution, caused by excess nitrogen and phosphorous in waterways, is one of America's most widespread, costly, and challenging environmental problems. It can increase human health risks (see "EPA Experts Help Restore Drinking Water to Half a Million" earlier in this chapter), spark low oxygen in water leading to large fish kills, and negatively impact the economy.

The grants will support sustainable water research and demonstration projects consistent with a comprehensive strategy for nutrient management and active community engagement throughout the research process. "These grants will go towards research to help us better manage nutrients and better protect our precious water resources from the dangers of nutrient pollution, especially in a changing climate," said EPA Administrator Gina McCarthy when announcing them.

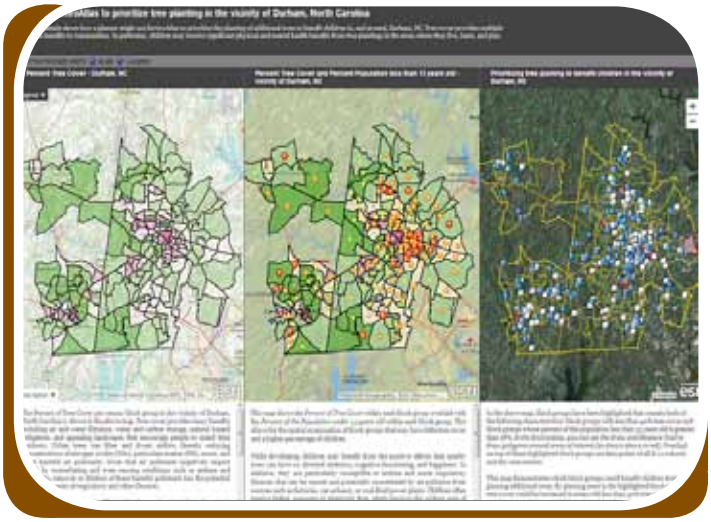
The institutions and their research follow.

Research Institution	Project	Funding Amount
Pennsylvania State University Center for Integrated Multi-scale Nutrient Pollution Solutions	Nutrient flows in Pennsylvania and the Chesapeake basin.	$2,220,649
University of South Florida Center for Reinventing Aging Infrastructure for Nutrient Management	Support Tampa Bay and similar coastal areas as they face problems of aging wastewater collection and treatment systems, and rapid population growth.	$2,220,649
Colorado State University, Center for Comprehensive, Optimal, and Effective Abatement of Nutrients	Linking physical, biological, legal, social and economic aspects of nutrient management in the Western and Eastern United States.	$2,200,151
Water Environment Research Foundation National Center for Resource Recovery and Nutrient Management	Innovative research in nutrient reduction through resource recovery and behavioral factors affecting acceptance and implementation.	$2,220,649

Sustainable and Healthy Communities Research

How can communities and individuals meet their current needs without compromising the ability of future generations to meet their own? And more specifically, how can they balance the protection of our shared environment—air, water, land, and natural ecosystem—in ways that sustain both human health and a stable economy? Providing the science and engineering to answer those questions is the focus of EPA's Sustainable and Healthy Communities research program.

EPA researchers engage community stakeholders, individuals, partner agencies, and other decision makers to help identify the long-term environmental and related health challenges they face. The scientists and engineer then use that insight to design and implement programs that provide the decision-support tools, information, and models needed to meet those challenges. The impact of their work is exemplified in a host of science-based strategies and models available to decision makers, and in the investments these EPA partners are making today for a healthy, sustainable, and prosperous future.



EPA Releases EnviroAtlas

Communities are often faced with difficult decisions, such as trade-offs between transportation, residential or commercial development and maintaining local wetlands, urban greenspaces, or urban forests. To help these decision makers, EPA released EnviroAtlas on May 7th, 2014. EnviroAtlas is a multi-scale (national to community), web-based, interactive mapping, visualization, and analysis tool that provides the first-ever picture of the distribution of ecosystem services for the mainland United States.

EnviroAtlas helps communities better understand the potential benefits and drawbacks of their decisions by providing tools to analyze relationships between nature, health and well-being, and the economy. Users can investigate land cover patterns, see how ecosystem services reduce pollution, and view closer to true scale data to compare them across selected communities.

EnviroAtlas can help people learn about ecosystems, and how they provide us with benefits such as clean air and water, opportunities for recreation, and protection from severe weather. EnviroAtlas also highlights how ecosystems provide habitats for plants, fish, and wildlife as well as the materials people need to produce food, clothing, shelter, and pharmaceuticals, and provides maps on all of these topics. It lets users generate customized maps and images that show the condition of their local community's air, water, and landscape; as well as population density and other demographic data.

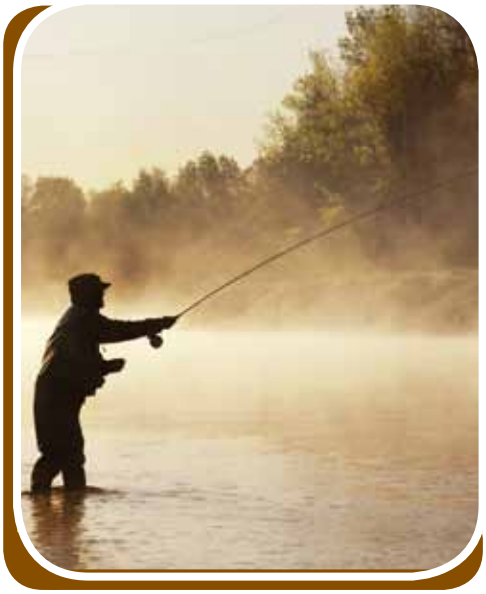
The tool integrates over 300 separate data layers developed through a collaboration between EPA, US Geological Survey US Forest Service, other federal, state, and non-profit organizations, and several universities. It is designed to help decision makers understand the implications of planning and policy decisions on our fragile ecosystems and the communities who depend on goods and services from these ecosystems.

People from all levels of government, professionals, researchers, educators, non-governmental organizations and anyone interested in considering the benefits or impacts of a decision, such as building a new road or city park can use EnviroAtlas. It is available to anybody with access to a computer and an Internet connection. No special software is needed. It is currently not optimized for smartphone or tablet use, but a mobile-friendly version is planned for the future.

By providing EnviroAtlas, EPA is helping to ensure that anyone making decisions that may impact ecosystems will have the best available knowledge to build prosperous communities while conserving our natural resources.

To learn more and use EnviroAtlas visit: http://enviroatlas.epa.gov/enviroatlas/.

EnviroAtlas is just one of the many achievements made by EPA's Sustainable and Healthy Communities research program during 2014. Additional highlights follow.



Integrated Environmental Modeling for Better Decision Making

EPA researchers are advancing a new paradigm of environmental assessment that uses sophisticated computer modeling to integrate a wealth of data, such as incorporating biological, wildlife, and fishery information with land use patterns, chemical and physical stressors, and human-caused impacts. That work is providing tools and information that paint a clearer picture of current baseline conditions, as well as the ability to forecast (model) potential future impacts and risks. This will better inform decisions for balancing short and long-term goals.

Using the framework outlined above, Agency researchers conducted a case study in the Kanawha Coal Field of West Virginia, focusing on watershed-based, cumulative impacts of land use (primarily mountaintop mining) on the abundance of smallmouth bass and brook trout. Because these two species are sought-after game fish, their population is a potentially important local economic resource, and an indicator of an ecosystem service that can be threatened by impacts associated with mountaintop mining. In addition, two papers were submitted from the work that document how to further the use of integrated environmental modeling to assess the impacts and stressors on landscapes and ecosystem services.

Literature Cited:

Fishing for Alternatives to Mountaintop Mining in Southern West Virginia (McGarvey, D.J. and J.M. Johnston. 2013. Ambio. 42: 298-308).

Daniel McGarvey, J.M. Johnston. 2011. A Simple Method to Predict Regional Fish Abundance: An Example in the McKenzie River Basin, Oregon, *Fisheries*, 36:11, 534-546.

McGarvey, D.J., Johnston, J.M., and M.C. Barber. 2010. Predicting fish densities in lotic systems: a simple modeling approach. 2010. *Journal of the North American Benthological Society* 29(4):1212-1227.

Assessing Long-term Solutions for Contaminated Sites

EPA researchers are advancing techniques and technologies to help communities remediate and rehabilitate Superfund and other contaminated sites. A major focus is to develop and assess solutions that will protect human health and reduce environmental risks associated with the flow of hazardous substances in groundwater. A common technique has been Permeable Reactive Barriers (PRB), low-cost technologies installed underground that absorb or convert hazardous materials into safe compounds. Because of their affordability and ease of use, these barriers offer an accessible, attractive technology for communities looking to reclaim areas for productive uses while also protecting public health. But their long-term, sustainable use has not been well documented.

EPA researchers are changing that. In 2014, they published *Fifteen-year assessment of a Permeable Reactive Barrier for treatment of chromate and tricholoroethylene in groundwater* ("Science of the Total Environment, v.468/469). The research presents an assessment of the longest available record of the performance of a Permeable Reactive Barrier, one installed to treat groundwater contaminants at the U.S. Coast Guard Support Center in

Elizabeth, New Jersey. Conducted to directly support partners in the Agency's Office of Solid Waste and Emergency Response and the local community, the study indicates that the barrier continues to remove contaminants after fifteen years of operation. The ongoing work not only informs such partners, but also serves as a case study to further the understanding of techniques and technologies to rehabilitate contaminated sites.

2014 EPA Report on the Environment Website Launched *(Draft)*

The Report on the Environment (ROE) presents the best available indicators of information on national conditions and trends in air, water, land, human health, and ecological systems. These indicators serve as a tool for EPA decision-makers, program planners, scientists, researchers, the public, and others interested in environmental science and policy to track changes in environmental condition. They allow EPA and the public to assess whether the Agency is succeeding in its mission, and they help alert EPA to new challenges that may need attention and action.

The ROE was first published in 2003 and released for review by the EPA Science Advisory Board. It was substantially revised in 2008 and 2014. The 2014 ROE, published exclusively on the Web, includes six new indicators and many new features. The web-version provides access to the information from the ROE report published in 2008 with a companion Highlights Document, which includes the underlying methodology, references, and sources of additional information, in an on-line searchable format. The ROE compiles, in one place, the most reliable indicators currently available to help answer 24 questions that EPA believes are of critical importance to its mission and the nation's environment.

This pre-1920 residential duplex is the site of an EPA study on vapor intrusion.

Advancing Vapor Intrusion Monitoring and Mitigation

EPA researchers and collaborators are advancing the science of monitoring and mitigating vapor intrusion, when radon, volatile organic compounds, or other hazardous gases move from contaminated groundwater through the soil and into the air of homes and other buildings, where exposures can lead to serious health risks. In 2014, they released a draft report for external peer review presenting the results of an extensive study conducted at a pre-1920 residential duplex outfitted with a suite of monitors to intensively measure and track changes in the composition of indoor air.

Comparing weekly measurements, real-time observations from continual monitoring of a host of variables (barometric pressure, air and soil temperature, heating and air conditioning operations, and others), and modeling scenarios allowed the researchers to perform one of the most in-depth analyses to date of the driving forces of vapor intrusion, building on several years' worth of data collected at the research house. Results provide science-based guidance to help partners in EPA's Office of Solid Waste and Emergency Response and elsewhere protect people and inform actions to improve indoor air quality. The final report is expected to be release in 2015.

Ecosystem Service Production Function Library

One of the major challenges that researchers, environmental managers, and community decision makers face is understanding the link between how today's actions and decision might impact the long-term sustainability of ecosystems, particularly the ability of such ecosystems to continue to provide the benefits that form the foundation of healthy, vibrant communities. To help, EPA researchers have created the EcoService Models Library (ESML).

The library compiles a host of different resources to serve as a single site for developing tools and models that illustrate the connection between healthy ecosystems and ecosystem services. ESML was designed for scientists and economists who provide advice to communities, businesses and conservation organizations. It was made available for beta testing in December 2014, and is scheduled for public release in 2016. EPA researchers will continue to build library content to reflect the state of science and address user needs.

Advancing Tools to Quantify and Explore Human-Well Being

EPA's Human Well-being Index (HWBI), released as a draft in 2012, was designed to help communities live more sustainably. This tool assists decision makers in characterizing and quantifying the potential positive and negative effects on human well-being when various decisions are made. The HWBI incorporates the multiple dimensions of sustainability—environment, economy, and society—while also allowing the results to be widely scalable from national to local levels.

The approach developed and used by the EPA to evaluate these influences was coined TRIO for Total Resource Impacts and Outcomes. The report goes into a detailed analysis of the development of HWBI and also helps identify the appropriate applications of the data. The web-based predictive model will help communities identify the links between long-term sustainability, understand the flow of ecosystem services, and prioritize the well-being of humans.

Installing green infrastructure in the Proctor Creek neighborhood of Atlanta, GA.

Health Impact Assessment on the Use of Green Infrastructure in Proctor Creek

The community surrounding Proctor Creek in Atlanta faces a host of challenges, including pervasive street flooding, repeated sewage backups, derelict properties, illegal tire dumping, and bacterial contamination (*e.coli* and other *fecal coliforms*) in the creek itself. Having limited resources, the community is identifying solutions that will address multiple problems at once.

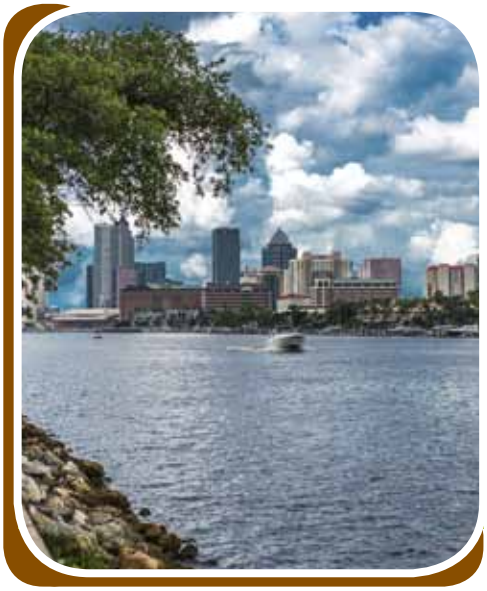
One promising solution, "Boone Boulevard Green Street Project," is incorporating green infrastructure elements such as permeable pavement, bioretention systems, and planter

boxes to reduce stormwater runoff and associated pollution. EPA researchers launched a Health Impact Assessment to support this work. Together with local and Agency partners, the researchers assessed green infrastructure options to identify those that minimize adverse health impacts and maximize environmental and public health benefits. The report, *Health Impact Assessment (HIA) of Proctor Creek's Boone Boulevard Green Street in Atlanta, GA.*: was released in 2014. Results of the study are informing the Boone Boulevard-Green Street design, led by the City of Atlanta's Department of Urban Watershed Management.

Tribal Science Supports Community Health and Sustainability

The Tribal-specific Health Index (previous story) is just one of many examples of how Agency researchers work for healthy and sustainable Native American and Alaskan communities. Working closely with the EPA-Tribal Science Council (composed of tribal representatives from each of EPA's nine regions across the country), they develop decision-support tools that incorporate traditional environmental knowledge with environmental, cultural, and health data. For example, one recently developed tool is the Tribal-Focused Environmental Risk and Sustainability Tool (Tribal-FERST), a web-based, geospatial resource developed specifically for federally recognized tribes.

Another major result of such collaboration is the 2014 report *Tribal Ecosystem Research Program Workshop, Proper Functioning Condition (PFC) Assessment for Management and Monitoring*. It presents results and recommendations from a gathering where participants worked to fuse traditional environmental knowledge with environmental science to advance ecosystem sustainability and resiliency, especially for streams and wetland riparian areas. Such areas are key considerations for meeting tapping ecosystem services to sustain tribal nutritional, cultural, societal, and economic needs



Ecosystem Services Research for Tampa Bay

Agency scientists have partnered with local governments, other research entities, planning organizations, and citizen and business groups to identify and assess the values the Tampa Bay estuary and other local environments provide to the surrounding community. Together, these experts and stakeholders are helping identify environmental information that decision makers can use when establishing plans to guide development and land use in the area.

For example, as part of the overall project, in 2012 researchers completed a two-year study of nine mangrove wetlands and 18 freshwater river and marsh sites, each with differing levels of human disturbance. The final demonstration results were delivered in the form of a website that provides robust, community-based mapping and visualization tools for exploring the impact of development on 8-key ecosystem services. This dynamic model illuminates how disturbances to such wetlands affect associated ecosystem services such as absorbing excess nutrients, a key factor related to water quality across the Tampa Bay and many other watersheds.

Revitalizing Great Lakes Coastal Communities

Throughout the Great Lakes region, EPA and local partners are working to restore and enhance previously degraded areas ("Areas of Concern") to improve conditions for coastal communities. Traditionally, this work has unfolded as focused, site-specific activities with little coordination. To help change for the better, EPA researchers and colleagues from the Agency's Great Lakes National Program Office brought experts from across the area, including partners from the Great Lakes Commission, the U.S. Geological Survey, and state Sea Grant programs, to share success stories and further coordinate efforts to benefit local communities.

Results of the workshop were summarized in the report, *Past Successes, New Approaches and Emerging Needs for Remediation to Revitalization (R2R2R) projects: How Great Lakes Communities Benefit from Area of Concern (AOC) Delisting*. The researchers noted existing opportunities and future ways that the results of their work could support activities that improve economic, public health, and societal well-being for Great Lakes coastal communities. These include advancing geographic-based understandings of "ecosystem goods and services," developing measurable revitalization indicators, and sharing examples of success with workshop participants and others.

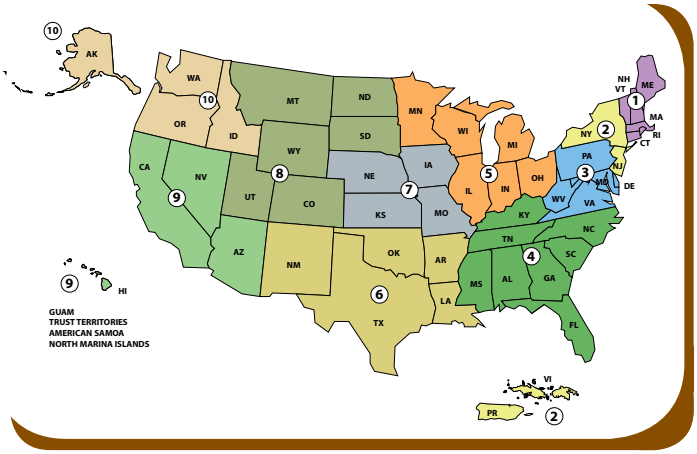
Tribal-specific Health Index

To extend the reach of EPA's Human Well-being Index, EPA-supported researchers are developing a set of indigenous health indicators to evaluate aspects of community health that are often left out of health impact assessments.

The indicator set encompasses community health priorities such as self-determination, natural resources security, and cultural use and practice. The indicators can be tailored to individual tribal communities and may be useful for a number of purposes, including baseline community health assessments, climate change impact assessments and planning, natural resource damage assessments, and health risk analyses.

Serving EPA Regional Offices

EPA has ten regional offices strategically located across the country to serve states and territories in protecting human health and the environment. These offices address local community needs to clean up and sustain land, air, water, and natural ecosystems. Agency scientists and engineers form partnerships with their colleagues from the regional offices to meet high-priority, near-term research needs of these regions.



Annually, the Agency's Office of Research and Development makes funds available through its Regional Applied Research Effort (RARE) program to each EPA region to develop research topics, and coordinates partnerships among scientists and other technical staff across the Agency. The partnerships: (1) provide the regions and communities across the nation with near-term research on high-priority localized needs; (2) improve collaboration between regions and Agency laboratories and research centers; (3) build the foundation for ongoing and future scientific interactions; and (4) develop useful, problem-solving tools and other resources for state, local and tribal governments to meet current and emerging environmental challenges.

Highlights from 2014 research results follow.

Investigating Brine Contaminated Ground Water

Traditionally, searching for the source of brine (salt) contamination in drinking water has taken on expensive, "drilling blind" techniques that involve installing monitoring wells in sometimes multiple locations to characterize site conditions and better understand where underground plumes are flowing from. However, EPA scientists and collaborators from Region 6 (South Central) have developed a considerably higher-tech approach that promises to be both less expensive and more accurate.

Using and comparing results from two different electrical resistivity imaging techniques and an electromagnetic survey, the scientists developed a way to document the source of brine contamination at a field test site in Oklahoma, where such contamination is a growing concern. Results of the project, completed in August 2014, demonstrated the efficacy of a lower cost, geophysical method for characterizing saline impacts. The research offers investigators a new, powerful approach to identifying possible sources of brine contamination. The technique also shows promise for investigating other types of ground water contamination.

Nail Salon Workers

For the more than 375,000 nail salon workers across the United States, using nail polish and similar products for long hours in inadequately ventilated spaces is suspected to be a health risk. Nail polishes and lacquers often contain chemicals which at high exposures have been associated with respiratory effects, and even cancer.

EPA scientists worked with local partners in California to identify ways to lower chemical exposures associated with health risks for nail salon workers. Their pilot study tested the efficiency of steps outlined in the California Healthy Nail Collaborative program. Results confirmed that workers in salons that had implemented steps outlined in the healthy nail program were exposed to lower levels of toluene and other volatile organic compounds. The impact of the work is expected to help these small businesses take action to protect their workers and their customers, staying in business while continuing to provide a welcome service.

Underwater autonomous glider.

Monitoring Dissolved Oxygen Using an Autonomous Glider

The measurement of dissolved oxygen concentrations in coastal ocean waters provides a key indicator of water quality and the health of the local ecosystem. However, rough seas can make gathering such coastal water quality data dangerous.

Collaborators from EPA (Region 2, New England), New Jersey's Department of Environmental Protection, and Rutgers University found a solution to minimize the risk: a robotic vehicle that travels beneath the waves to efficiently and safely capture coastal water quality data. The robotic vehicle, known as an autonomous underwater vehicle, even allowed EPA to take ocean samples beneath Hurricane Irene, one of the few such data collected during a powerful storm. The researchers completed six glider missions along the New Jersey coast, mapping the subsurface dissolved oxygen concentration in near real-time. A final report from the work was released in May 2014.

The Cicero Rail Yard Study

The impact of local sources of air pollution is a priority research area for EPA. Recent studies have focused primarily on the impact of major roads, but that work was expanded through a RARE project to investigate the local air quality impacts from a railroad yard. The Cicero Rail Yard Study was the second phase of an EPA Region 5 (Upper Midwest) RARE project.

Agency scientists used stationary and mobile air monitoring devices to investigate the impact of rail yard activity on a surrounding neighborhood in Dearborn, MI. The results showed that local, concentrated areas of higher diesel emissions activity adversely impact local-scale air quality, and that taking action may reduce such local exposure to air pollution. The study results made front page local news, and since their release the rail yard has joined forces with the Region to switch to newer, cleaner equipment.

Supporting World-class Research for Sustainable and Healthy Communities

EPA supports some of the nation's leading researchers to conduct focused studies that address local science needs and advance sustainable solutions to today's more pressing environmental and human health challenges. A major priority is to support and facilitate robust, science-based decisions by Agency partners, such as regional and program offices, public health officials, tribes, and environmental managers. Research grants announced during 2014 follow.

Protecting Children's Health for a Lifetime

EPA and National Institute of Environmental Health Sciences (NIEHS) have worked together for more than 15 years to protect some of our most vulnerable citizens—children—through the EPA/NIEHS Children's Environmental Health and Disease Prevention Research Centers program. Since its establishment, more than 20 multidisciplinary Children's Centers have received grants to engage leading scientists, pediatricians, epidemiologists, other research specialists, and local community representatives to reduce children's health risks, protect them from environmental threats, and promote health and well-being in the communities where children live, learn, and play.

Throughout 2014, Children's Centers researchers continued to add to a foundation of research they have built that is now represented in more than 1000 peer-reviewed journals. Examples include a study conducted by [Name of Center(s) to come], showing that [example to come]. Such results have led to innovative thinking about how to understand and address children's environmental health issues in ways that enable caregivers and health professionals to prevent adverse health effects. The Children's Centers program is an exemplary model of how collaborative, interagency federal research support can effectively improve community and public health for children and other vulnerable groups for real-world, positive impact.

When Students Compete for Sustainability, Everybody Wins!

On October 15, 2014, EPA announced Phase I winners of its People, Prosperity, and the Planet (P3) sustainability competition. Established in 2004, the two-phase competition is focused on supporting innovative designs that benefit people, promote prosperity, and protect the planet. Each of the 42 Phase I teams, made up of students and their faculty advisors, were awarded up to $15,000 and invited to showcase their prototypes at the National Sustainable Design Expo in Washington, DC.

At the National Design Expo, teams compete to move on to Phase II, which includes EPA's coveted "P3 Award" and up to $90,000 in additional support to further develop their design and potentially bring it to the marketplace. Previous P3 Awardees have used their winning ideas to establish small businesses and non-profit organizations. For example, Environmental Fuel Research, a 2008 P3 winner from Drexel University, incorporated their grease waste-trap biofuel technology into a business enterprise and won a $100,000 EPA Small Business Innovation Research Phase I award (See "Sparking Economic Growth Through EPA's Small Business Innovation Research Program" below). This woman-owned startup, headquartered in a historically underutilized business zone, has the potential to revolutionize domestic biodiesel capacity in the United States.

2014 EPA P3 Winners (Phase II)

Institution(s)	Project Title	Project Summary
Cornell University **Johns Hopkins University**	"Smart" Turbidimeters for Remote Monitoring of Water Quality	Cornell University and Johns Hopkins University's Water Quality team has designed a low-cost monitor for measuring water quality.

Institution(s)	Project Title	Project Summary
Embry-Riddle Aeronautical University	Develop a Concentrated Solar Power-based Thermal Cooling System via Simulation and Experimental Studies	Embry-Riddle Aeronautical University's team demonstrates an innovative air conditioning system that runs on solar power.
Iowa State University	Developing Sustainable Products Using Renewable Cellulose Fiber and Biopolymer Composites	Iowa State University's team is designing a new kind of fabric made with fibers from bacteria and yeast grown in tea and polymers (large molecules) of corn and soy.
Purdue University	Biowall's Impact on Indoor Air Quality and Energy	Purdue University's 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 Takeoff Mechanism	SUNY Stony Brook's team has 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	University of Tennessee Knoxville's green building team is exploring ways to use green oak or "heart centers," the low quality part of hardwood logs, in U.S. building construction.
University of Wisconsin-Madison	Exchange Network for Expanded Polystyrene Bio-Shipping Containers	University of Wisconsin-Madison's team has implemented a campus recycling program for Styrofoam packaging.

For a complete list of current and previous Phase I and P3 Award winners, as well as information on applying for future P3 sustainability competitions, please see: www.epa.gov/ncer/p3/index.html.

Environmentally-friendly packaging made by a former EPA-supported small business.

Sparking Economic Growth Through EPA's Small Business Innovation Research Program

EPA is one of 11 federal agencies in the Small business Innovation Research (SBIR) program, established by the Small Business Innovation Development Act of 1982. The Agency's participation is focused on supporting and facilitating the development of new technologies with potential to solve priority environmental problems while also sparking economic growth.

In 2014, EPA awarded 21 small businesses with "proof of concept" contracts (Phase I) totaling $2 million to conduct research on the scientific merit and technical feasibility of new technologies, including three businesses founded by members of winning teams from EPA's People, Prosperity and the Planet (P3) Student Competition for Sustainability (see previous story). Many of the SBIR recipient companies go on to leverage EPA's funding to bring their designs to reality, expand business, and create products that help protect human health and the environment. For example, ten years after winning its first SBIR contract, NanoMech won the Small Business Association's 2014 Tibbetts Award for its chemical-free, nanostructured coating used for industrial cutting and lubrication.

Summary of 2104 EPA Small Business Innovative Research Contract Awards

Small Business	Technology Proposal	Contract Award
AquaNano LLC	Next Generation of High-Capacity Perchlorate-Selective Resins for Drinking Groundwater Treatment	$100,000
Aspen Products Group, Inc.	High Flux Nanofiltration Membrane for Emerging Contaminant Control	$100,000
Biopico Systems	Environmental Sensing System Enhanced With Nested Concentrating Electrodes (ESSENCE) for Safe and Sustainable Water Resources	$100,000
CLEW	Development of a Cost-effective, Nutrient-removal, Onsite Household Wastewater Treatment System for Environmentally Fragile Areas	$100,000
Enchem Engineering, Inc.	Enhanced Decontamination of Wetted Pipe Material	$99,920
Environmental Fuel Research, LLC*	Biofuel Production From Grease Trap Waste	$100,000
ETSVP-JV	Innovative Filters Using Nanomaterials for Removal of Gaseous Pollutants and Particulates from Contaminated Air Streams	$99,902
HJ3 Composite Technologies, LLC	Green Materials for Doubling the Life of Drinking Water Pipeline	$99,693
Grow Plastics, LLC	Process Development for Sandwich Core Structure PLA Thermoformed Objects	$98,812
Lucid Design Group, Inc.*	Software Framework for Enabling Innovation in Behavior-based Energy Conservation in Commercial Buildings	$99,584
MesoCoat	Development of Zinc Coatings on Steel by Cermaclad^{TM} to Replace Pickling Lines	$99,939
MetaMateria Technologies, LLC	Phosphorus Removal and Recovery From Municipal Wastewater Using Nano-Enhanced Media	$100,000
NEI Corporation	Lithium-ion Batteries Based on Aqueous Electrolyte: A New Generation of Sustainable Energy Storage Devices	$99,992
N5 Sensors, Inc.	Low-power, Small Form-factor Benzene Sensor for Mobile Devices-based Exposure Monitoring	$99,191
Precision Combustion, Inc.	Low-Cost, Regenerable Air Filter for Efficient Gaseous Pollutants Removal	$99,897
Reactive Innovations, LLC	Micro Channel Electrochemical Production of Dimethyl Carbonate	$99,999
SimpleWater*	ECAR- Electrochemical Arsenic Remediation for Affordable Water Security in America	$100,000

Small Business	Technology Proposal	Contract Award
Sustainable Bioproducts, LLC	Direct Conversion of Municipal and Agricultural Wastes to Biodiesel and Ethanol Utilizing a Unique Extremophilic Fungus	$99,944
UltraCell Insulation, LLC	UltraCell - Advanced Cellulose Insulation	$100,000
United Science, LLC	Field Deployable PFCs Sensors for Contaminated Soil Screening	$100,000
Vista Photonics, Inc.	Inexpensive High Performance Continuous Ammonia Monitor	$100,000

**Previous EPA P3 Award Winner*

Environmental Health Research Grants for Tribal Communities

In July 2014, EPA awarded $5 million in grants to six groups, including universities and tribes, to identify and reduce health risks associated with tribes' reliance on natural resources. Collectively, funded researchers will investigate specific, tribal-focused health risks linked to climate change, indoor wood smoke exposure, environmental asthma, waterborne diseases, and other unique tribal concerns, as well as work to find the most efficient methods of avoiding or addressing these risks.

The grants continue support provided over the past decade for impactful research that has helped tribes address health risks. For example, the funding has resulted in the creation of fish advisory maps that have helped various tribal fishing communities avoid mercury and other contaminant-laden fish. The funding has also led the states of Washington and Oregon to revise their water-quality standards to offer greater protection. In addition, a library of resources in the Mohawk language was created to enhance education about toxic substances and empower the community to protect the health of its citizens.

Grant Recipient	Research
Alaska Native Tribal Health Consortium, Anchorage, Alaska	Assess, monitor, and adapt to threats to the sustainability of food and water in remote Alaska native villages.
Swinomish Indian Tribal Community, La Conner, Washington	Examine coastal climate impacts to traditional foods, cultural sites, and tribal community health and well-being.
Yurok Tribe, Klamath, California	Identify, assess, and adapt to climate change impacts to Yurok water and aquatic resources, food security and tribal health.
Little Big Horn College, Crow Agency, Montana	Research climate change adaptation and waterborne disease prevention on the Crow Reservation.
University of Tulsa, Oklahoma	Improve indoor air quality and reduce environmental asthma triggers in tribal homes and schools.
University of Massachusetts, Amherst	Measure indoor air quality in tents as related to wood smoke exposures and identify potential health risks in remote communities in North America

Human Health Risk Assessment

EPA's Human Health Risk Assessment research program produces state-of-the-science research results that provide insight into the intricate and complex relationships between human health and our environment. The program plays a unique role in serving the needs of EPA programs and their partners by integrating and evaluating scientific information into assessments and other products that can be used as a foundation for regulatory decisions that positively impact human health.

Examples of products developed by researchers in EPA's Human Health Risk Assessment research program include: scientific assessments describing the human health effects of environmental chemicals and chemical mixtures; comprehensive assessments of the health and environmental effects of the six criteria air pollutants (the assessments are the scientific foundation for the National Ambient Air Quality Standards); tools and reports that help exposure assessors understand how and to what extent humans are exposed to environmental contaminants; and tools and methods to modernize human health risk assessment.

Advancing EPA's Integrated Risk Information System

EPA researchers enhance stakeholder engagement, increase transparency, and improve science throughout IRIS, the Integrated Risk Information System

EPA researchers provide leadership across the scientific and public health communities to assess the potential health effects posed by chemicals in the environment. A critical part of that work is accomplished through the Agency's Integrated Risk Information System, commonly known as "IRIS." Through IRIS, scientists evaluate and present comprehensive information concerning the human health effects that might result from exposures to contaminants in land, water, and air.

IRIS assessments are neither full risk assessments nor regulations, but they provide a major contribution to the scientific foundation that supports Agency decisions and actions taken to protect human health and the environment through the implementation of the nation's environmental laws. The quality and comprehensive nature of IRIS assessments make them a valuable resource, and they are widely used throughout the country and beyond to guide environmental cleanups, set health standards, and take other important actions.

EPA researchers have continued to advance a multi-year commitment consistent with recommendations made by the National Academies' National Research Council (NRC) to improve the IRIS program, making enhancements to strengthen the science of assessments, increase transparency throughout the program, and incorporate efficiencies in the process in order to produce more assessments each year.

In May 2014, the NRC released their review of EPA's progress. The NRC report applauded EPA's efforts to improve IRIS and found that the program had made significant, steady progress planning for and implementing changes in each element of the assessment process. While recognizing EPA is still implementing changes, they noted that, "overall, the committee expects that EPA will complete its planned revisions in a timely way and that the revisions will transform the IRIS program." Their report notes that the IRIS Program has made substantial progress in a short time, and the committee offered recommendations to build on the progress that EPA has already made. EPA is now embracing many of these recommendations to further improve the IRIS Program.

IRIS improvements include the release of preliminary materials and public meetings to discuss those materials early in the assessment development process. The preliminary materials transparently communicate EPA's early strategy and process for determining which studies are most important for incorporating into an assessment. This early public engagement helps Agency researchers ensure that important studies are not omitted from the assessment process. The improvements also include using a more systematic approach to review and select studies. Additionally, the Agency implemented new "stopping rules" so that IRIS assessments are not delayed by scientific debate after key milestones of the process have passed.

IRIS researchers also continued to implement design changes to the presentation of assessments, making the technical information they contain more accessible and understandable. The Agency revealed an improved, clearer, more concise and accessible document structure for IRIS assessments. Going forward, all IRIS assessments will include evidence tables that summarize the critical scientific literature and exposure-response figures that graphically depict biological responses at different levels of exposure for studies in the evidence tables.

Another major focus is improving transparency and public access throughout the process. Here too, the Agency has made significant progress. EPA hosted a public workshop to discuss recommendations from the NRC's 2014 report on ways to further improve the scientific quality of IRIS assessments, allowing researchers to gather specific input from the public and scientific community about topics related to the NRC's recommendations.

The workshop was open to the public and took place in Arlington, VA. Continuing a commitment to provide remote access for those who are unable to attend IRIS-related meetings in person, the workshop was fully accessible via webinar and telephone.

In October 2014, EPA announced that IRIS Bimonthly Public Science Meetings will be supplemented by scientific experts identified by the National Academies' National Research Council (NRC). These independent experts will provide valuable scientific input and broaden the range of perspectives represented at IRIS public meetings.

Science and scientific integrity are the backbone of every decision, policy, and action taken by EPA. The Agency's commitment to maintaining the highest standards for its IRIS program will ensure that its work continues to reduce health risks and protect public health.

Currently, IRIS contains information on more than 500 chemicals. For more information, including opportunities to attend workshops or engage in other IRIS-related opportunities, please visit the IRIS website at www.epa.gov/IRIS.

IRIS is just one of the many achievements made by EPA's Human Health Risk Assessment research program during 2014. Additional highlights follow.

Toxicological Review of Benzo[a]pyrene released for External Review

Benzo(a)pyrene (BaP) is one of a group of chemical compounds called polycyclic aromatic hydrocarbons that is a byproduct of incomplete combustion, and is ubiquitous in the environment. It metabolizes in humans and animals to form a number of metabolites that may elicit toxicity. EPA has found acute exposures to polycyclic aromatic hydrocarbons similar to BaP to potentially cause red blood cell damage (leading to anemia), and suppressed immune systems. Chronic, long-term exposures have the potential to cause developmental and reproductive effects, and there is some evidence that life-time exposures above certain thresholds have the potential to lead to cancer.

EPA researchers are conducting an IRIS risk assessment to better understand how exposures to BaP can affect human health. In September 2014, they reached a major milestone in that effort when they submitted the draft assessment to the Agency's Science Advisory Board (SAB) for peer review and comments. The draft incorporated comments received from a previous draft released for public comment and a public meeting, part of the Agency's commitment to incorporating transparency and public outreach in the IRIS process. Next steps include SAB-hosted public meetings, teleconferences, and external peer review. A final review will be conducted by EPA, other federal agencies, and the Executive Office of the President before the final assessment is added to the IRIS database.

EPA researchers are tapping robotic technology *(pictured)* and other advancements for protecting human health.

Next Generation Risk Assessment: Incorporating the Latest Scientific Advances to Protect Human Health and the Environment

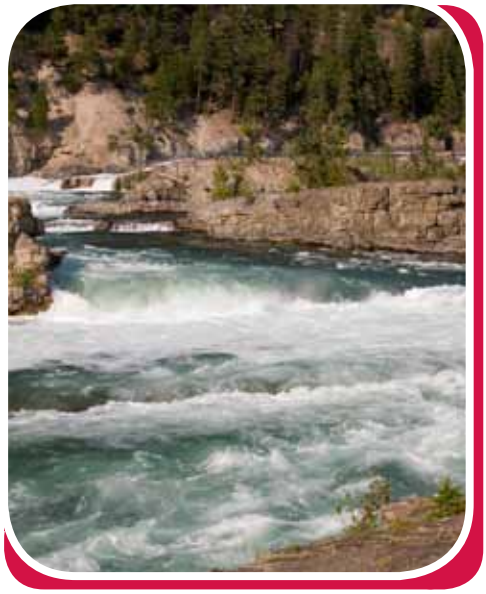
EPA researchers released the final report *Next Generation Risk Assessment: Incorporation of Recent Advances in Molecular, Computational, and Systems Biology*. The report describes how EPA researchers are tapping the rapid advancement of faster, less resource intensive (in both time and money), and more robust scientific methods. It outlines how the proliferation of emerging data and approaches in molecular, computational, and systems biology (together called "NexGen") can better inform risk assessment.

To complete the report, Agency researchers focused on the efficacy of incorporating new scientific advancements in ways that can help risk assessors, public health officials, and others meet the challenges they face keeping pace with the large numbers of chemicals introduced into the environment each year. By incorporating new techniques and technologies, new streams of toxicity data, and advanced understandings of such systems-biology factors as gene-environment interactions, EPA researchers are helping lead the way to a new generation of chemical safety assessment to protect human health.

Child-Specific Exposure Scenarios Example Final Report Released

EPA released the final report, *Child-Specific Exposure Scenarios Examples*, a companion document to the widely-used *Exposure Factors Handbook* (U.S. EPA 2011). The example scenarios were compiled from questions and inquiries EPA researchers received from risk assessors and other users of the *Exposure Factors Handbook* (EFH) on how to select data from the EFH to assess childhood exposures.

The purpose of the *Child-Specific Exposure Scenarios Examples* report is to outline scenarios for various child-specific exposure pathways and to demonstrate how data from the EFH may be applied for estimating dose. The handbook provides data on drinking water consumption, soil ingestion, mouthing behavior, inhalation rates, dermal factors (including skin area and soil adherence factors), consumption of fruits and vegetables, fish, meats, dairy products, homegrown foods, and human milk.



EPA Releases Final Toxicological Review of Libby Amphibole Asbestos

On December 8, 2014, EPA released its final Integrated Risk Information System (IRIS) health assessment for Libby Amphibole Asbestos (LAA). The assessment analyzes the potential cancer and non-cancer human health effects from inhalation exposure to LAA, and includes the final Toxicological Review of LAA. In addition, using the toxicity values as well as exposure data collected in Libby and Troy, Montana, EPA researchers and partners developed a draft, site-wide Human Health Risk Assessment for the Libby, Montana Superfund site, which quantifies the risks of exposure to LAA for residents and workers.

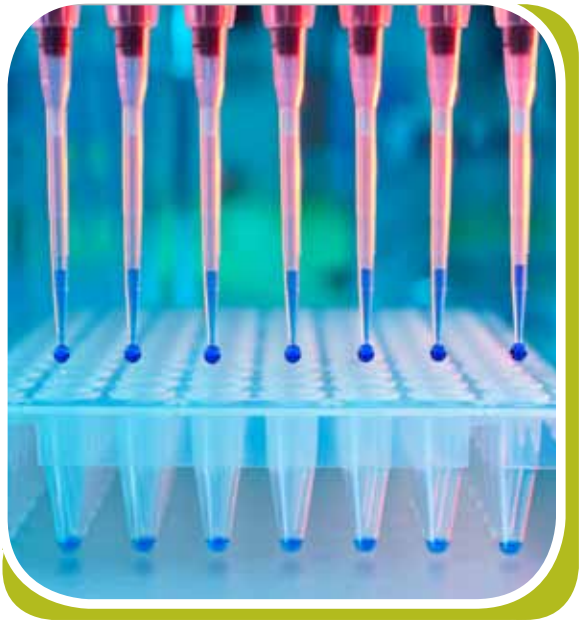
The risk assessment shows that EPA's indoor and outdoor cleanups have been effective in reducing both the cancer and non-cancer risks in Libby and Troy. The asbestos air concentrations in Libby today are about 100,000 times lower than when mine and processing facilities were in operation, making the air quality in Libby similar to other Montana cities. The information will be used to identify how exposures can be reduced to protect human health now and in the future.

Mouse Lung Tumors: Advancing the State-of-the-Science to Protect Human Health

In 2014, EPA researchers hosted a two-day workshop to advance the state-of-the-science of chemically-induced mouse lung tumors, an important tool for gaining insights into the mechanisms and links between exposures to certain chemicals and human health risks. Through the gathering, "State-of-the-Science Workshop on Chemically-induced Mouse Lung Tumors: Applications to Human Health Assessments," leading researchers collaborated to intensely examine a host of topics related to mouse lung tumors, continually referring back to the human relevance of data from animal and in vitro studies.

Together, participants covered a broad range of evidence from human, animal, and in vitro studies with a focus on specific chemicals (ethylbenzene, naphthalene, and styrene) that cause lung tumors in mice and are implicated in a proposed species-specific mode of action based on metabolic and physiological susceptibility. The workshop was sponsored and organized by EPA with input from (1) a volunteer committee of outside experts (including representatives from academic institutions, State agencies, other Federal organizations, nongovernmental organizations, and industry), and (2) an internal working group of experts from EPA and other Federal partners. A summary report of the workshop is available at: http://go.usa.gov/e8Xd.

Chemical Safety for Sustainability Research



Chemicals are a lynchpin of innovation in the American economy. Moving toward sustainable innovation requires designing, producing, and using chemicals in safer ways. New information and methods are needed to make better-informed, more-timely decisions about chemicals, especially since many chemicals have not been thoroughly evaluated for potential environmental and human health effects.

EPA's chemical safety for sustainability research program is leading the development of innovative science to support the safe, sustainable design and use of chemicals and materials needed to protect human and environmental health. The research prioritizes protection of vulnerable species and populations, including children and endangered species.

Applying Scientific Advances to Evaluate Chemicals for Potential Endocrine Disruption

EPA researchers are developing rapid and efficient methods to screen chemicals for potential toxicity and to estimate chemical exposure and dose. These methods—called high-throughput—are being used to evaluate thousands of chemicals for potential endocrine disruption. Endocrine disrupting chemicals can interfere with the endocrine system and lead to problems with reproduction (i.e. egg and sperm production) and development (i.e. healthy fetal growth). EPA's Endocrine Disruptor Screening Program (EDSP) is congressionally mandated to evaluate chemicals for potential endocrine disruption. The current EDSP methods used to evaluate chemicals are thorough but costly and time consuming (50-100 chemicals per year at a cost of approximately $1 million per chemical).

In comparison, EPA's high-throughput toxicity research effort (ToxCast) screened approximately 1,800 chemicals for potential estrogen activity in three years for ~$30,000 per chemical. EPA researchers also published high-throughput exposure estimates (ExpoCast) for 8,000 chemicals. Integrated together, toxicity and exposure information provide the scientific data needed to quickly and cost effectively evaluate thousands of chemicals for potential estrogen activity.

To facilitate access to and use of these new data, EPA researchers developed and made publicly available an interactive dashboard interface called the EDSP21 Dashboard. This research has also been published in several high impact journals, including *Environmental Science and Technology* (Wambaugh, et al., 2014), *Nature Biotechnology* (Kleinstreuer, et al., 2014) and *Basic and Clinical Pharmacology and Toxicology* (Judson, et al., 2014).

Literature Cited:

Wambaugh, et al., 2014. "High Throughput Heuristics for Prioritizing Human Exposure to Environmental Chemicals." *Environmental Science and Technology*. 48 (21): pp 12760-12767.

Kleinstreuer, et al., 2014. "Phenotypic Screening of the ToxCast Chemical Library to Classify Toxic and Therapeutic Mechanisms. *Nature Biotechnology*. 32, 583-591.

Judson, et al., 2014. "*In Vitro* and Modelling Approached to Risk Assessment from the U.S. Environmental Protection Agency ToxCast Programme. *Basic and Clinical Pharmacology and Toxicology*. 115: 69-76.

The above methods are just a few of the many achievements made by EPA's Chemical Safety and Sustainability research program during 2014. Additional highlights follow.

Pushing the Frontier of Exposure Science

In 2014, CSS scientists continued to drive the leading edge of science related to chemical exposures. EPA developed new exposure prediction models, designed a new database capturing information about chemicals found in various consumer products and awarded research grants to academic institutions to collect much needed exposure information.

EPA researchers developed a new exposure prediction model called SHEDS-HT (Stochastic Human Exposure and Dose Simulation- High-Throughput). SHEDS-HT produces exposure estimates for thousands of chemicals in a more rapid and cost-effective manner. The *Environmental Science and Technology* journal published "SHEDS High-Throughput: An Integrated Probabilistic Exposure Model for Prioritizing Exposures to Chemicals with Near-Field and Dietary Sources" (Isaacs et al., 2014) and it reports on the analysis and results from the model for 2,507 organic chemicals associated with consumer products and agricultural pesticides.

A major challenge in exposure science is estimating exposures to chemicals in consumer products, homes, the workplace, food, soil and the air. "Exploring Consumer Exposure Pathways and Patterns of Use for Chemicals in the Environment" (Dionisio et al., 2015) describes the Chemical/Product Categories Database (CPCat), a new, publicly available database of information on chemicals mapped to "use categories." The database uses a controlled vocabulary to capture and streamline descriptors of chemical use for over 40,000 chemicals.

These investments in exposure science are allowing EPA to make more informed decisions that help protect the health of Americans, in particular children.

Literature Cited:

Isaacs et al., 2014. "SHEDS High-Throughput: An Integrated Probabilistic Exposure Model for Prioritizing Exposures to Chemicals with Near-Field and Dietary Sources." *Environmental Science and Technology*. 48 (21): 12750-9.

Dionisio et al., 2015. "Exploring Consumer Exposure Pathways and Patterns of Use for Chemicals in the Environment." *Toxicology Reports*. V2: 228-237.

Developing Improved Research Tools to Ensure Healthy Babies

EPA conducts innovative research on the complex interactions of chemicals with both embryonic and early childhood developmental processes to better understand how these interactions may lead to adverse health effects in unborn children and babies. In 2014, the EPA used two testing platforms—zebrafish and high-throughput screening assays—to develop new methods for screening chemicals to determine if chemicals have the potential to affect healthy development.

Zebrafish are ideal test systems because they develop to the point that they freely swim and eat in less than a week and have most of the same genes as humans do. EPA researchers were able to perform sophisticated locomotor and behavioral learning tests to assess how chemicals impact their development. As a result, EPA researchers developed

a rapid chemical test (six days) and have used it to screen chemicals for potential developmental vascular toxicity. This research has been published in *Reproductive Toxicology* (T.L. Tal, et al., 2014) and presented at numerous scientific conferences including the Society of Toxicology, Society of Environmental Chemistry and Toxicology and the 9th World Congress on Alternatives and Animal Use in the Life Sciences, to name a few.

EPA also developed and used high-throughput screening to assess the effects of chemicals on brain development. This new method allows researchers to rapidly photograph chemically-exposed brain cells and analyze synapses through a detailed photograph, taken by a high-throughput automated microscope. This research has been published in *Neurotoxicology* and *Applied In Vitro Toxicology*.

Both the zebrafish testing and high-throughput screening are now evaluating chemicals of interest such as flame retardants. Used together, the new methods allow researchers to quickly and inexpensively test chemicals in the environment to see if they affect important processes in development, including formation of blood vessels and the brain. This research contributes directly to better protection for children during critical windows of growth and development.

Literature Cited:

T.L. Tal, et al., 2014. "Immediate and Long-term Consequences of Vascular Toxicity During Zebrafish Development." *Reproductive Toxicology*. 48: 51-61.

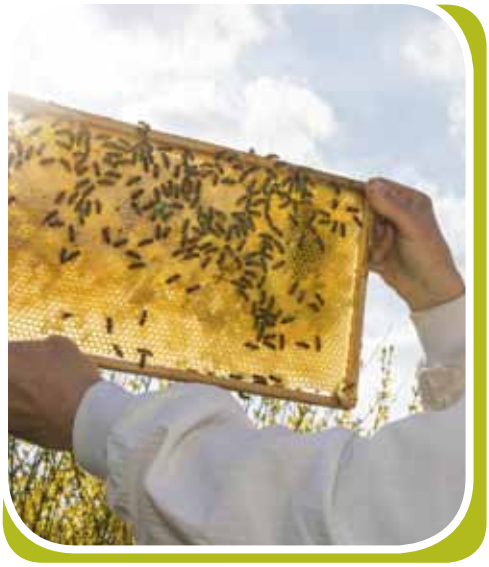
Valdivia, et al., 2014., "Multi-well Microelectrode Array Recordings Detect Neuroactivity of ToxCast Compounds." *Neurotoxicology*. 44: 204-217.

Radio, et al., 2014. "Use of Neural Models Proliferation and Neurite Outgrowth to Screen Environmental Chemicals in the ToxCast Phase I Library. *Applied In Vitro Toxicology* (available only online at the time of printing at: http://online.liebertpub.com/doi/abs/10.1089/aivt.2014.0009).

Research Supporting Improved Sustainability Analysis and Decisions

Rare earth elements (REE) are a group of 17 chemical elements that are vital to many modern technologies, including consumer electronics. The ubiquity and value of these elements places a significant stress on the environment, from the impact of mining and extracting of precious resources to end of life recycling and disposal. EPA researchers analyzed the production of televisions with liquid crystal displays (LCDs) and light emitting diodes (LEDs) using a Sustainable Materials Management (SMM) approach. The SMM approach reviewed and commented on the process (re)design, recovery and reuse, material substitution, and technology substitution to improve the sustainability of using REEs in televisions. The review revealed that a more holistic, material-centric philosophical shift towards LCD and LED televisions could incentivize more efficient REE usage within all levels of production.

These research efforts will lead to a better understanding of the impacts and will help to make more sustainable decisions related to which chemicals to use in products.



Estimating the Impacts of Pesticide Exposures to Improve Ecological Risk Assessments

Under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA), EPA evaluates the impact of pesticide use on wildlife, including threatened and endangered species. In 2014, EPA researchers investigated whether interspecies toxicity estimation models could be used in ecological risk assessments to estimate species sensitivity to pesticides by extrapolating information from where data were available to where toxicity data were absent.

EPA researchers demonstrated in the scientific paper "Augmenting aquatic species sensitivity distributions with interspecies estimation models" (Awkerman et al., 2014) that interspecies toxicity estimation (ICE) models used to augment datasets do not greatly affect uncertainty of the estimates. Using these models to supplement available data with extrapolated toxicity values will provide stronger and more protective risk estimations.

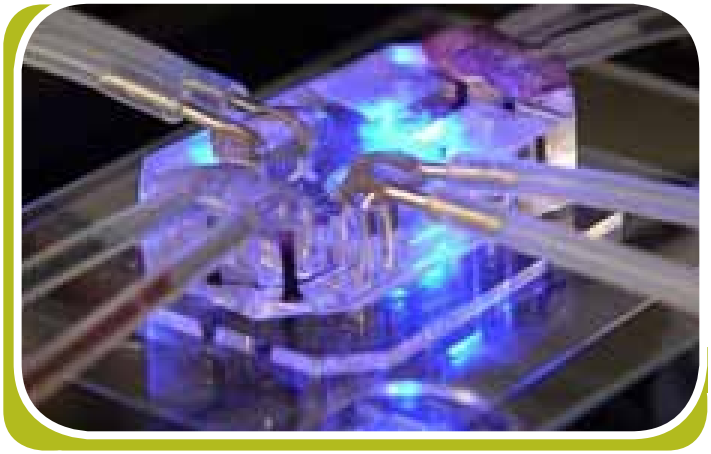
EPA researchers also developed an approach to rapidly explore how a pesticide or other chemical intended for use on a specific species might present risks to other, "non-target" species. The Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) enables rapid qualitative assessments of protein similarities across different species. Agency researchers conducted case studies using SeqAPASS to explore the potential impact that neonicotinoid pesticides have on honey bees. Results confirmed that molecular targets of the pesticides are similar across different insects, but most importantly, confirmed the conceptual approach behind using model organisms as representatives of other species in risk assessments. This research has been published in *Aquatic Toxicology, Philosophical Transactions of the Royal Society B,* and *Environmental Toxicology and Chemistry*.

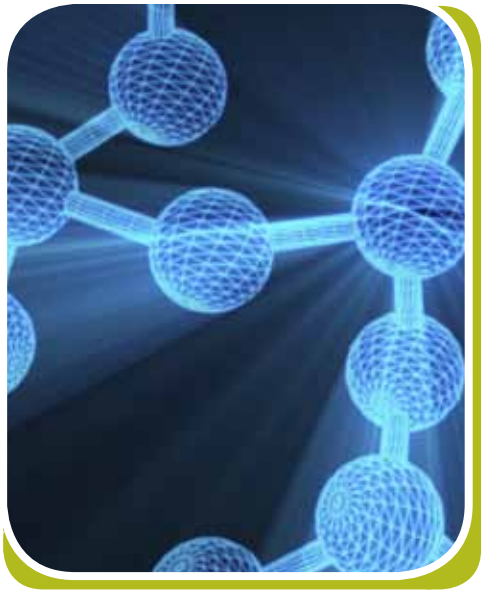
Literature Cited:

Awkerman et al., 2014. Augmenting aquatic species sensitivity distributions with interspecies estimation models. *Environ Toxicol Chem*: 33(3):688-95. doi: 10.1002/etc.2456. Epub 2014 Jan 24.

Supporting World-class Chemical Safety Research

To complement its own chemical safety for sustainability research program, EPA supports some of the leading chemists, chemical engineers, and other scientists to conduct focused studies that advance high priority science questions. Research grants announced during 2014 follow.





$9 Million Awarded to Support Research Advancing Chemical Sustainability

EPA awarded more than $9 million to Arizona State University and the University of California, Santa Barbara to support research to better understand the impacts of chemicals and nanomaterials throughout their entire life cycle—from design and manufacturing through use and eventual disposal. The grants are a continuation of a partnership launched in 2012 with the National Science Foundation to support collaborative work applying the principles of sustainability to chemical design and management.

Arizona State University researchers will evaluate the potential risks and benefits of using nanomaterials to improve the functionality of consumer products. Those at the University of California, Santa Barbara will develop an online tool for decision makers from industry, academia, and elsewhere to use to evaluate the impacts of chemicals over their entire life cycles, thereby improving chemical and product design. What the two research teams learn will lead to the design and use of safer, more sustainable chemicals.

EPA Awarded More Than $3 Million to Study Chemical Exposure, Brain Development Links

In February 2014, EPA announced awards of more than $3 million in grants to four research institutions conducting studies to better understand how chemicals interact with biological processes, and how these interactions may lead to altered brain development. The studies are focused on improving EPA's ability to predict the potential health effects of chemical exposures.

The grants focus on developing better adverse outcome pathways (AOPs), which are models that predict the connection between exposures and the chain of events that lead to an unwanted health effect. EPA expects to use the knowledge gained from the funded research to develop efficient and cost-effective models to better predict if and how exposure to environmental chemicals may lead to developmental neurotoxicity.

University	Research Project	Funding
North Carolina State University and Duke University Medical Center	Establishing an AOP for the Role of the Vitamin D Receptor in Developmental Neurotoxicity	$799,496
The University of Georgia, Athens	Human Neural Stem Cell Metabolomic, Cellular and Organ Level Adverse Outcome Pathway Relationships for Endocrine Active Compounds	$ 799,938
University of California, Davis	Identification and Scientific Validation of AOPS Involving Genomic and Nongenomic Intracellular Thyroid Hormone Signaling in Neurodevelopment	$ 800,000
Sanford-Burnham Medical Research Institute	Human Stem Cell-Based Platform to Predict Selective Developmental Neurotoxicity	$800,000

$4.5 Million Awarded for New Methods in 21st Century Exposure

EPA awarded a total of $4.5 million to five universities to support the innovative research needed to usher in a new generation of tools and methods for characterizing indoor exposures to chemicals associated with common consumer products, such as cleaners, cosmetics and other personal care products, and electronics. The funds support research continuing EPA's commitment to realize the call to modernize exposure science outlined in the National Research Council report "Exposure Science in the 21st Century: A Vision and A Strategy."

Advances in exposure science will provide EPA and other public health organizations with the tools they need to accurately and efficiently assess the potential impacts of chemicals in consumer products, enhance the capability to safely manage human health risks, and generate information that individuals and communities can use to make informed choices about safe chemical and product use.

The five universities each received grants of $900,000. Their research projects are outlined below.

University	Project Title	Anticipated Research Result
University of California, Davis	*Tracking Semivolatile Organic Compounds Indoors: Merging Models and Field Sampling to Assess Concentrations, Emissions, and Exposures*	A new analytical tool to measure multiple semivolatile organic compounds in indoor dust and the refinement of exposure models.
Duke University	*Residential Exposures to Young Children to SVOCs*	The first data source of SVOC levels from indoor air in homes, as well as advancements to: the understanding of exposures to mixtures; the links between specific products in the home and children's exposure levels; models for predicting indoor SVOC exposures.
University of California, San Francisco	*A Non-targeted Method for Measuring Multiple Chemical Exposures Among a Demographically Diverse Population of Pregnant Women in Northern California*	A pioneering screening method for more than 700 environmental chemicals, the identification of chemicals previously unmeasured in biological samples, and novel data on the extent to which pregnant women are potentially exposed to chemicals.
University of Michigan	*3-dimensional Micro-gas Chromatography Device for Rapid and Sensitive Indoor Chemical Exposure Analysis*	A portable automated device for rapid, sensitive and in-situ analysis of hundreds of semivolatile organic compounds for indoor human exposure assessment. The project addresses the urgent need for technologies and methods to characterize the presence of hundreds of semi-volatile chemicals.
Virginia Polytechnic Institute and State University	*Rapid Methods to Estimate Exposure to SVOCs in Indoor Environments*	A validated single-source model that can be used to make rapid estimates of exposure to SVOCs released from specific products used indoors; and a validated single-phase model that can be used to make rapid estimated of exposure to a wide range of SVOCs, based only on the average concentration of SVOCs found in indoor air.

Homeland Security Research

EPA is the lead federal agency for decontamination operations and for protecting water systems following incidents involving chemical, biological, and radiological substances. Scientists and engineers in the Homeland Security research program provide the knowledge, data, and tools that form the scientific foundation for meeting those responsibilities.

EPA homeland security research results help communities across the country advance their emergency response and remediation capabilities and to become more resilient in the face of natural disasters, acts of terrorism, or other large-scale disruptions. Results provide water utility managers, laboratory technicians, emergency personnel, risk assessors, and other Agency partners with the information, protocols, and techniques they need to take action.

Ready and Resilient: Advancing Decontamination Techniques for Buildings

In 2001, shortly after the 9/11 terrorist attacks, letters tainted with anthrax-causing Bacillus anthracis spores were mailed to two U.S. Senators and a handful of major television network newscasters. Although that mail never reached its intended targets, 22 people who came into contact with the envelopes were infected; five died.

Adding to the toll, at least 17 buildings were confirmed to have been contaminated with anthrax spores, requiring extensive and expensive clean up and decontamination efforts.

Today, the nation stands significantly better prepared to respond to acts of bio-terrorism than it did just over a decade ago. As the lead federal entity for responding to biological, chemical, and radiological contamination events, EPA has played a major role in that achievement.

On February 12th, 2014, EPA announced the results of a multi-year project called *Bio-Response Operational Testing and Evaluation* (BOTE), a two-phase demonstration project to test and advance decontamination methods that can be used after anthrax spores have been released into a building.

Researchers tested three technologies: (1) fumigation with vaporized hydrogen peroxide, (2) fumigation with chlorine dioxide, and (3) a bleach spraying technique. To advance the research from the laboratory to real world conditions, they released a nonlethal, anthrax surrogate (*Bacillus atropeus*) in a two-floor test facility they designed to mimic typical living and workspaces, with rooms set up like office spaces or small apartment dwellings.

The researchers tested all three decontamination methods under varying conditions, and evaluated the potential for recontamination risks that might occur due to spores reentering the air during cleanup activities. They also examined costs including the damage they might cause to the facility or to computers and other electronic equipment and waste management operations from related cleanup activities.

In the second phase of the BOTE study, partners from several government agencies conducted a joint exercise testing the coordinated response of health officials, law enforcement personnel, and decontamination (environmental) responders.

The study results found that the effectiveness of each decontamination method varied based on certain conditions, such as the amount of humidity and temperature in the room. The information gained during this exercise will help guide future decontamination decisions and help to ensure a more effective response to biological incidents. Findings have already been used as a guide to help decontaminate other incidents, including decontamination following the 2013 ricin events.

The results of this research will help provide state and local leaders, on-scene coordinators, waste managers and others with a guideline for effective decontamination in the event of a biological threat. Because BOTE included partnerships among several government agencies, the methods developed and lessons learned have been shared throughout the homeland security community, continuing to expand the impact of EPA research efforts.

BOTE was just one of many accomplishments achieved by EPA's Homeland Security researchers during 2014. Additional highlights follow.

I-Waste

Reducing environmental risks and restoring environmental services are essential components of bouncing back after a community has been impacted by a natural or human-made disaster. EPA's homeland security research program provides tools to help communities understand and shape their own resilience.

EPA's I-WASTE is a flexible, web-based, planning and decision-making tool to address disaster waste management issues. I-WASTE offers emergency responders, industry representatives, and responsible officials reliable information on waste characterization, treatment, and disposal options, as well as guidance on how to incorporate waste management into planning and response for natural disasters, terrorist attacks and animal disease outbreaks.

International Decon Conference

EPA held the International Decontamination Research and Development Conference at the Homeland Security Research headquarters in Research Triangle Park, North Carolina. The conference was designed to facilitate presentation, discussion, and further collaboration on research and development focused on an all-hazards approach to cleaning up contamination, especially chemical, biological, and radiological (CBR) threat agents. This year's conference focused on research around the decontamination of indoor and outdoor areas, and materials contaminated with biological, chemical, and radiological agents.

Provisional Advisory Levels for Emergency Response

EPA researchers are leading the development of health-based emergency exposure advisory levels to help inform and advise communities and emergency response professionals while they recover from a chemical incident or attack. Researchers have developed an approach to identify and communicate health-based emergency reference levels—Provisional Advisory Levels (PAL)—on the health dangers associated with exposures to high-priority hazardous chemicals and warfare agents.

While a number of exposure limit reference values exist for some of the chemicals of concern, they do not address all of the exposure scenarios and durations in question to inform recovery operations. In the event of a deliberate or accidental discharge of hazardous chemicals, PALs will provide emergency responders and managers with critical information to support site-specific decisions and actions, such as how to address the nature and extent of clean-up operations, and to inform decision-making to allow re-entry into an area, such as a contaminated office building, to claim personal possessions.

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