EPA/600/RR-15/128

United States
Environmental Protection
Agency

Health Impact Assessment (HIA) & EnviroAtlas

Integrating Ecosystem Services into the Decision Making Process

Office of Research and Development
National Exposure Research Laboratory

Preface

This document was created to highlight the many ways that the U.S. EPA EnviroAtlas suite of ecosystem services tools can be used to aid in the Health Impact Assessment (HIA) process. Ecosystems provide numerous services and benefits to individuals, communities, businesses, and other entities. Changes in policies, plans, programs, or projects that alter natural elements of the environment may change the distribution of these services and benefits. Taking into consideration these natural components of the environment and their effects on public health during the decision making process can help mitigate unintended results or stimulate health promoting plans. HIA practitioners can use EnviroAtlas maps and tools to understand the role of ecosystem services and benefits in public health; to access watershed, census block group, and other scales of ecosystem services data for specific regions; and to visually assess these spatial data through a user-friendly interface.

The appropriate citation for this report is:

U.S. Environmental Protection Agency. 2015. Health Impact Assessment & EnviroAtlas: Integrating Ecosystem Services into the Decision Making Process. Office of Research and Development, National Health and Environmental Effects Research Laboratory, Research Triangle Park, NC. EPA/600/RR-15/128.

Acknowledgements

This document was developed by Leah Yngve, ASPPH Environmental Health Fellowship Program Participant hosted by EPA Office of Research and Development, and Pamela Barclay, EPA ORISE Fellow. Laura Jackson, Project Officer and EnviroAtlas Task Lead for Community Metrics Development, provided guidance and revisions throughout the development of this guide. Florence Fulk, a research biologist and Chief of the Ecology Research Branch within the Office of Research and Development's National Exposure Research Laboratory, provided internal review and contributed to discussions at various stages of development. Arthur Wendel, Team Lead for the Health Community Design Initiative at the CDC provided an external review. The cover page photo was taken at the Old Fourth Ward Park in Atlanta, GA by Riley Perszyk.

This publication was supported by Cooperative Agreement Number X3-83555301 between the U.S. Environmental Protection Agency and the Association of Schools and Programs of Public Health, and by Interagency Agreement Number DW-89-92298301 between the U.S. Environmental Protection Agency and the U.S. Dept. of Energy (DOE). The findings and conclusions of this report do not necessarily represent the official views of EPA, DOE, or ASPPH.

EnviroAtlas Contact Information

If you have questions or need additional information, email the EnviroAtlas Team at EnviroAtlas@epa.gov or go to the EnviroAtlas website (www.epa.gov/enviroatlas).

Table of Contents

Introduction to Health Impact Assessment and Ecosystem Services

What is Health Impact Assessment (HIA)?

Many organizations recommend the use of HIA to explicitly consider potential public health consequences of a pending decision. As described by the National Research Council, "HIA is a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects."[1]

The use of HIA to incorporate health into the decision making process from neighborhoods to multi-state regions is on the rise. HIAs generally consist of six steps: screening, scoping, assessment, recommendations, reporting, and monitoring and evaluation (Figure1).

For more information on HIAs, visit: http://www.cdc.gov/healthyplaces/hia.htm.

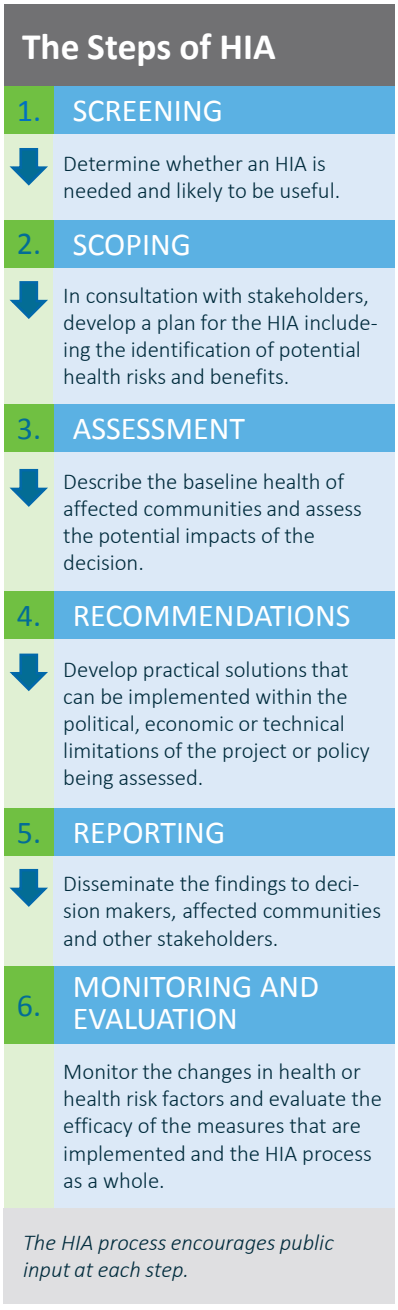


Figure 1. Steps of Health Impact Assessment; Health Impact Project [2]

What are Ecosystem Services?

Ecosystem goods and services, often shortened to just ecosystem services, are the benefits that humans receive from nature. These benefits underpin almost every aspect of human well-being, including our food and water, security, health, and economy. However, we are so accustomed to this natural provision of benefits that we are not always conscious of the links between our surrounding environment and our well-being, and thus may not always take the "true value" of ecosystems into account in our decision-making processes. Many of the decisions that we make, from how we develop the infrastructure in our communities, to the ways that we manage the land surrounding our communities, affect the provision of ecosystem services. Thus, considering the true value of ecosystem services in our policies and decision-making can help us better manage our resources in a way that may benefit us economically, environmentally, and socially.

For more information on ecosystem services, visit: http://www.epa.gov/enviroatlas/ecosystem-services-enviroatlas.

[1] "Improving Health in the United States: The Role of Health Impact Assessment". National Research Council. http://www.ncbi.nlm.nih.gov/pubmed/22379655.

[2] "HIA Process". Health Impact Project. http://www.pewtrusts.org/en/projects/health-impact-project/health-impact-assessment/hia-process.

Ecosystem Services as Health Determinants

Health determinants are "factors that contribute to a person's current state of health."[3] They range from biologic factors to the social environment, and can affect health positively or negatively. Natural ecosystems and even natural features in developed settings can function to improve the quality of the environment and its ability to support life. Vegetation and soils filter many pollutants and can buffer communities from extreme events. Additionally, the green space within and around our communities provides opportunities for physical activity, social interaction, and engagement with the natural world. Studies have found positive associations between exposure to green space and many aspects of physical and mental health. Multiple mechanisms contribute to the public health benefits derived from ecosystem services; these range from carbon sequestration in distant forests and oceans to highly local influences on personal behaviors and prenatal exposures (Figure 2).

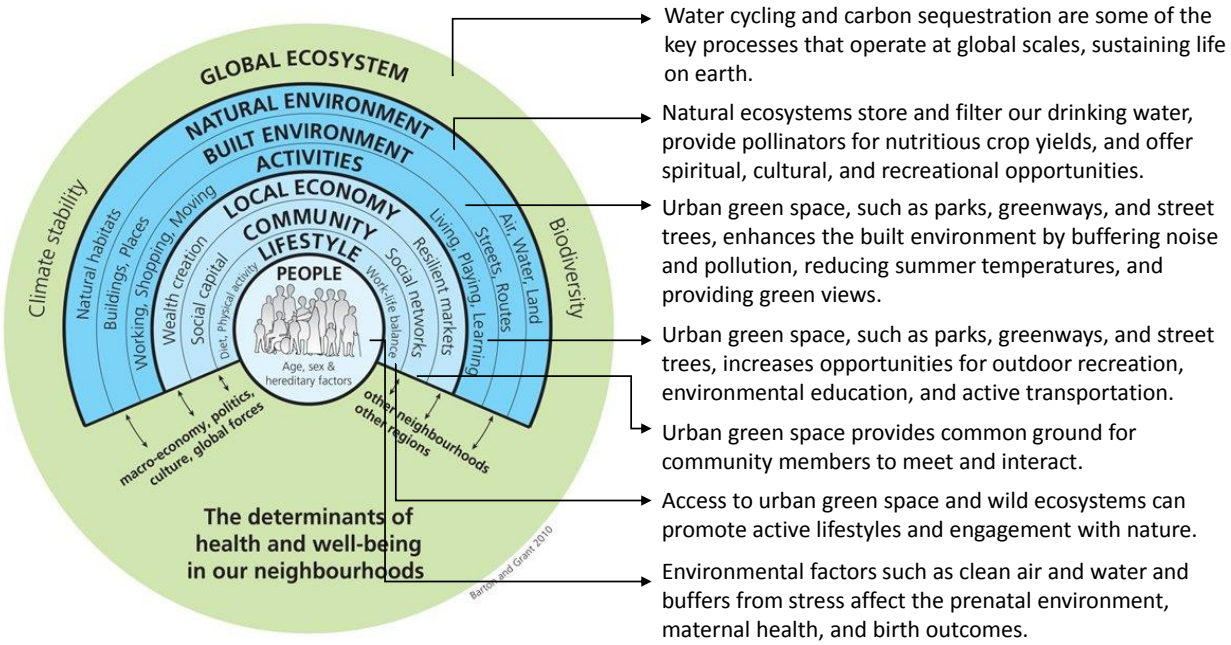


Figure 2. Ecosystem services are part of the Barton and Grant social, economic, and environmental determinants of health model.[4]

[3] "Social Determinants of Health." Centers for Disease Control and Prevention. http://www.cdc.gov/nchhstp/socialdeterminants/definitions.html.

[4] Barton, H. and Grant, M. A health map for the local human habitat. 2006. The Journal for the Royal Society for the Promotion of Health, 126 (6). pp. 252-253. ISSN 1466-4240.

Why are ecosystem services relevant for HIA?

Ecosystem services, or societal benefits from nature, underpin almost every aspect of human well-being, including our food and water, security, health, recreational opportunities, and economy (Figure 3). Though critically important to human well-being, ecosystem services are often overlooked. They may not be directly observed, and can be difficult to quantify because of their complexity. For example, street trees can reduce natural hazards such as flooding or extreme heat, as well as filter air and water pollutants. Benefits may also depend on interactions among several natural features, or between natural features and built infrastructure.

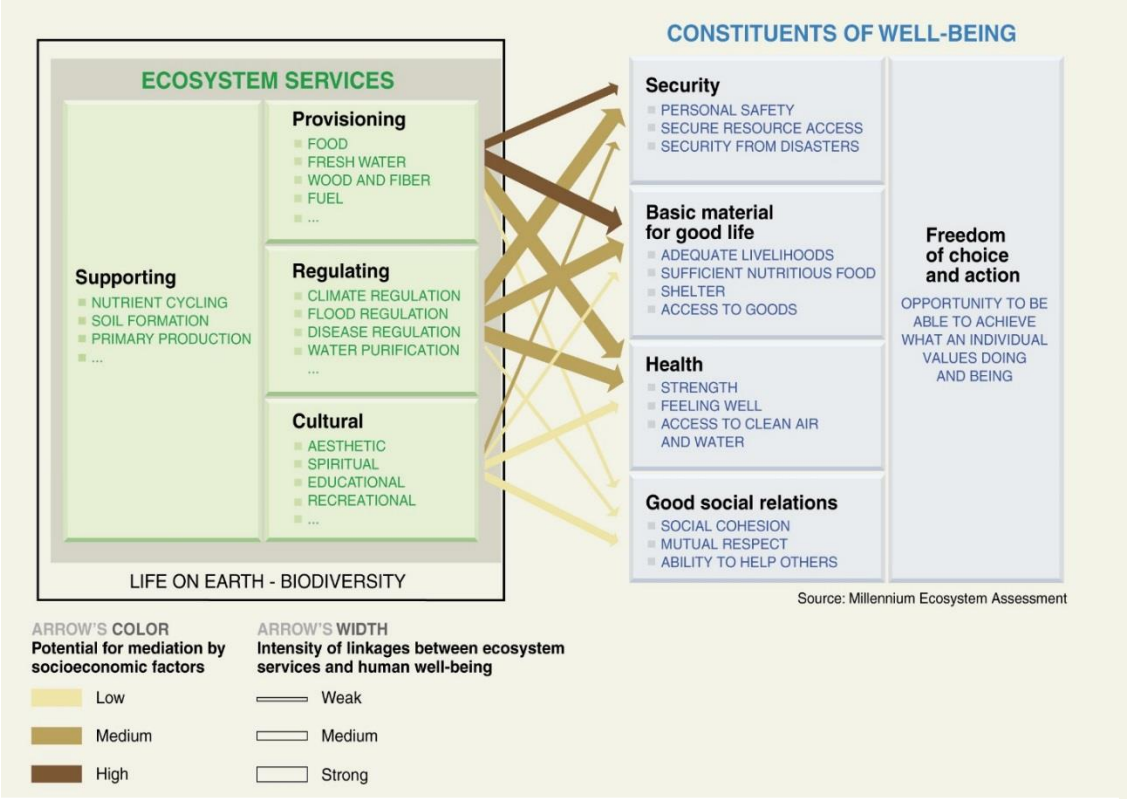


Figure 3. Model of the relationship between ecosystem services and human well-being [5]

[5] "Ecosystems and Human Well-Being: General Synthesis". (2005) Millennium Ecosystem Assessment. pp 15. World Health Organization.

Integrating EnviroAtlas and Health Impact Assessment

What is EnviroAtlas?

EnviroAtlas is a collection of interactive tools and resources that allows users to explore the many benefits people receive from ecosystem services. EnviroAtlas combines maps, analysis tools, fact sheets, and downloadable data into an easy-to-use, web-based resource. It also includes an interactive literature review, the Eco-Health Relationship Browser. A primary objective of EnviroAtlas is to assist stakeholders in the measurement and communication of the type, quality, and extent of the goods and services that families and communities receive from nature so that the true value of environmental assets can be considered in decision-making processes. Users can access, view, and analyze diverse information to better understand how various decisions can affect an array of ecological, health, and equity outcomes. The initial version of EnviroAtlas was released in May, 2014; however, continual additions are planned. This web-based tool is available to anyone with a computer and an internet connection; no special software is needed. EnviroAtlas was developed collaboratively by the U.S. Environmental Protection Agency, in partnership with the U.S. Geological Survey, Landscope America, the U.S. Department of Agriculture's Forest Service and Natural Resources Conservation Service, and other federal and non-profit organizations, universities and communities, including state, county, and community-level stakeholders.

For more information on EnviroAtlas, please visit: http://www.epa.gov/enviroatlas.

Incorporating EnviroAtlas Tools & Resources into the HIA Process

Click on topics of interest for more information.

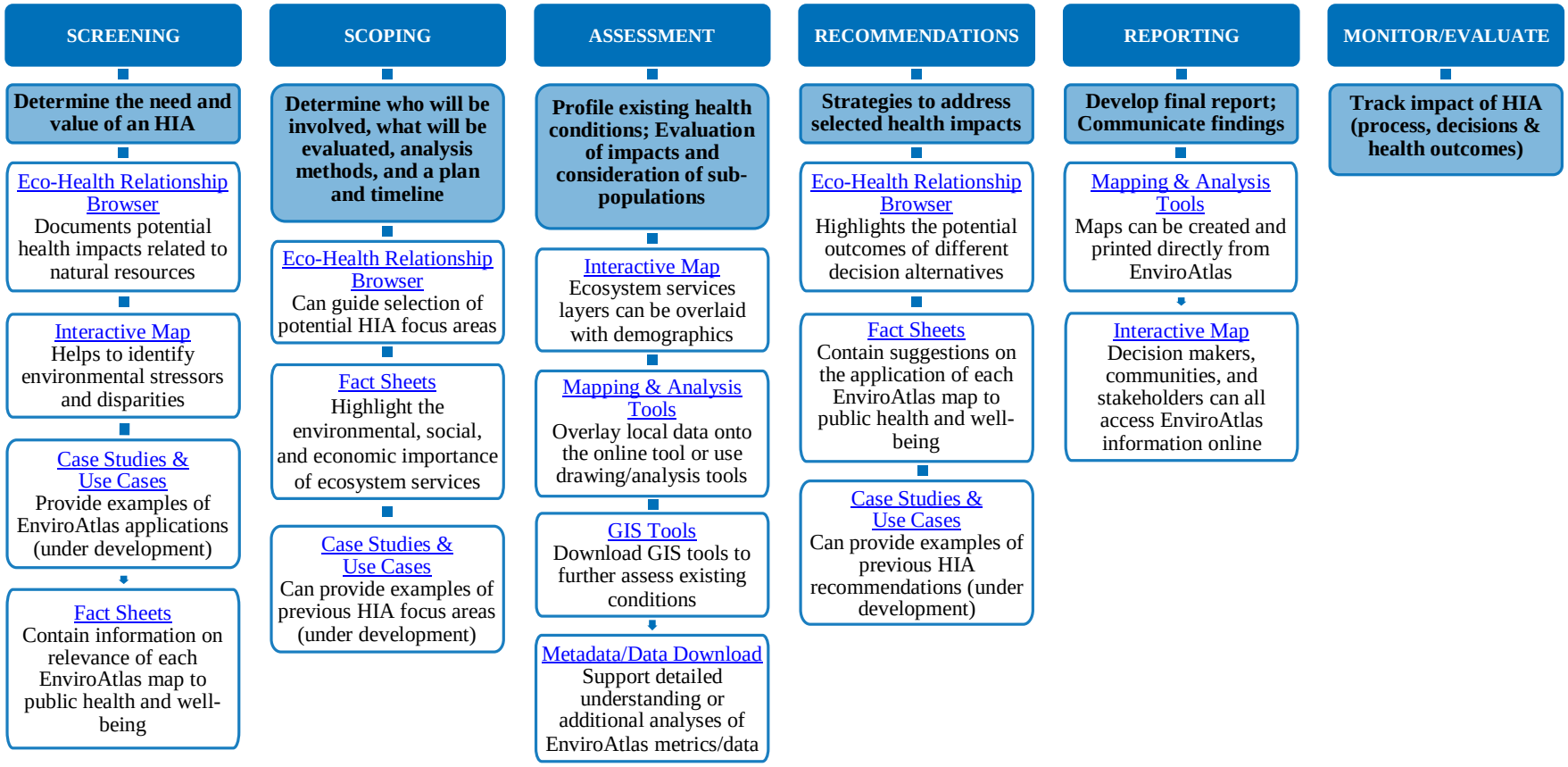


Figure 4. Recommended EnviroAtlas resources for the HIA process; adapted from Human Impact Partners, HIA Fact Sheet

Overview of the Interactive Map

The interactive map is a primary component of EnviroAtlas. EPA researchers and partners are developing and incorporating the best available science to map and analyze indicators of ecosystem services. Research efforts also focus on drivers that may change their production or demand; these include land use changes, point and non-point source pollution, ecosystem restoration, population growth, and transportation and energy development potential. Data are developed at two scales: 12-digit hydrologic watershed basins (12-digit HUCs) for the contiguous United States, and U.S. Census block groups for selected communities. In addition to data on ecosystem services, demographic and supplemental data, such as 1-meter resolution community land cover (circa 2010), are included to help users better understand the context of ecosystem services within specific populations, environmental conditions, and geographic areas. EnviroAtlas contains hundreds of data layers that can be viewed in the Interactive Map viewer, accessed through web services, or downloaded.

Ecosystem Services and Biodiversity data are organized into seven benefit categories:

- Clean air
- Clean and plentiful water
- Natural hazard mitigation
- Climate stabilization
- Recreation, culture, and aesthetics
- Food, fuel, and materials
- Biodiversity conservation

Some data layers are linked to multiple benefits and can therefore be found under multiple benefit categories.

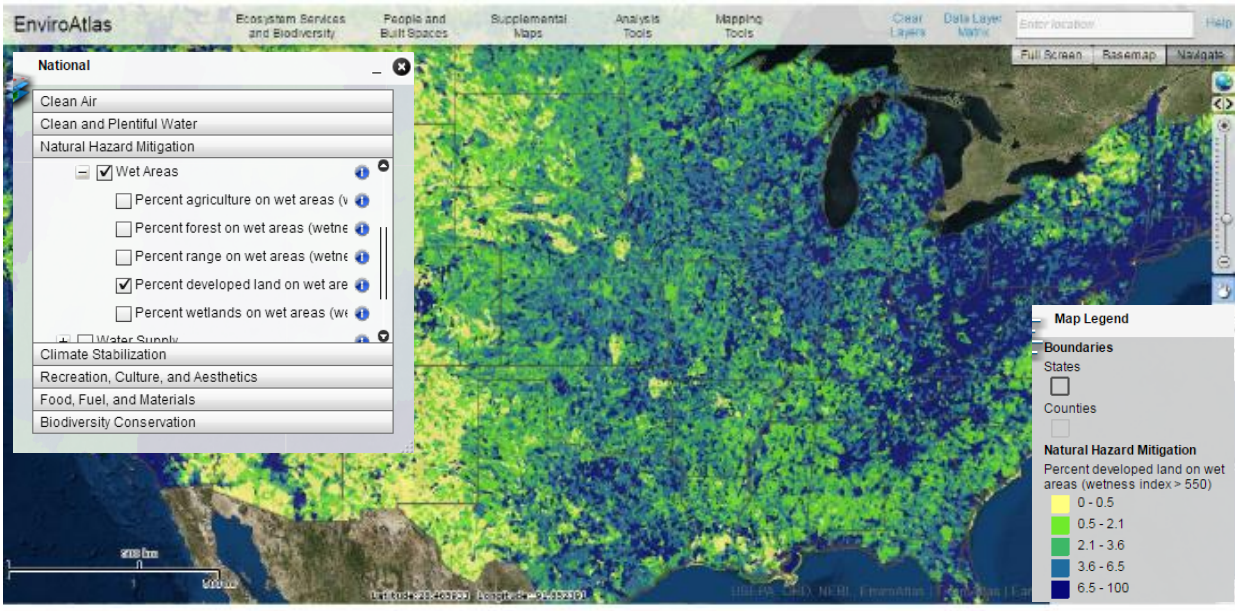


Figure 5. Screen capture of Interactive Map displaying Percent Developed Land on Wet Areas for the Nation

The community component includes high-resolution indicators of societal benefits and their spatial distribution across a featured community, and information on health issues associated with each benefit category.

A few examples of the topics included in the community component are:

- Residential proximity to green space and walking distances to parks
- Potential of near-road tree cover to buffer air pollution from traffic
- Capacity of natural vegetation to protect water quality and reduce urban heat-island effect
- Adverse health events avoided and dollars saved due to air pollutant removal by trees

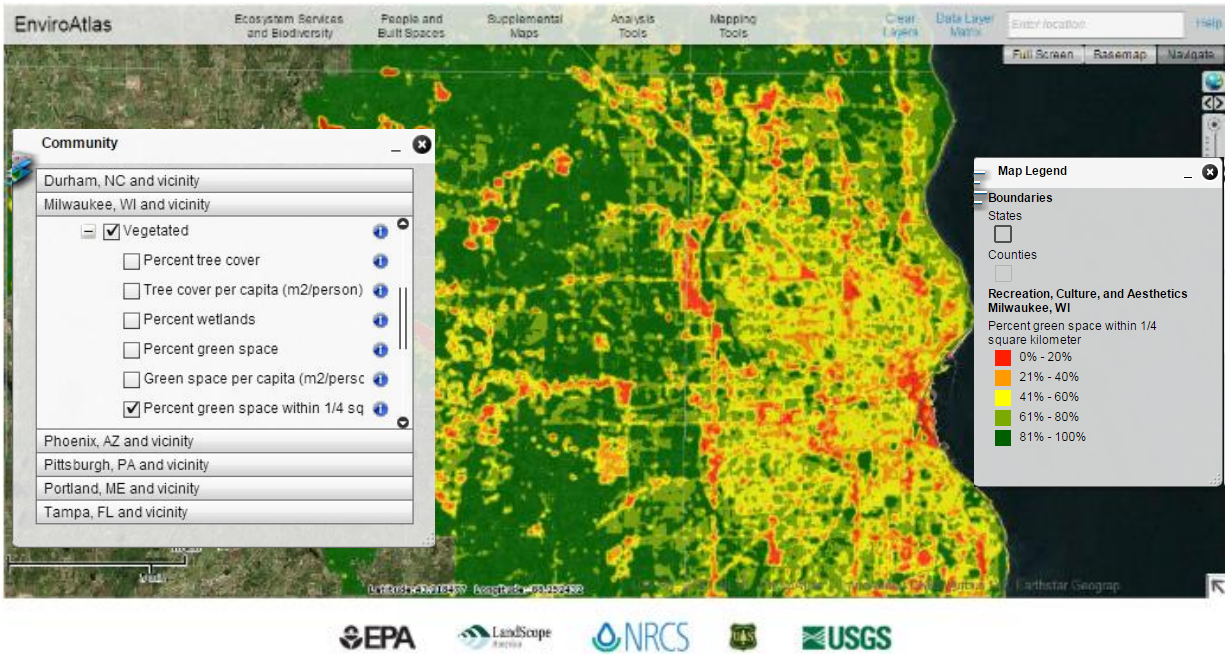


Figure 6. Screen capture of Interactive Map displaying Percent Green Space within ¼ square kilometer in Milwaukee, WI

A full list of community level map layers is listed following the national layers in the EnviroAtlas Data Layer Matrix online at: http://www.epa.gov/enviroatlas/enviroatlas-data-layer-matrix. Current and planned EnviroAtlas Communities are available here: http://www.epa.gov/enviroatlas/enviroatlas-communities.

The Interactive Map and associated data layers may aid in HIA by:

- Identifying issues of concern for inclusion in an assessment
- Exploring existing or baseline conditions
- Enabling overlay of demographic, environmental, and built environment data
- Exploring metadata for information on data analysis and processing methods

More information on the Interactive Map can be found at: http://www.epa.gov/enviroatlas/how-use-enviroatlas.

Overview of the Eco-Health Relationship Browser

The Browser is a tool that visually illustrates linkages between ecosystem services, health determinants, and demonstrated health outcomes. A growing body of evidence suggests that ecosystems can provide protection from natural and man-made hazards, and promote healthy behaviors.[6] While developed from a broad selection of recent, peer reviewed evidence, the Browser is not exhaustive. Most of the included studies highlight statistically significant, plausible associations rather than cause-effect relationships. The scientific literature supporting the Browser is updated on an annual basis.

Ecosystems					
Agro-Ecosystems	Forests	Urban Ecosystems	Wetlands		
Ecosystem Services					
Aesthetics & Engagement with Nature	Clean Air	Clean Water	Heat Hazard Mitigation	Recreation & Physical Activity	Water Hazard Mitigation
Health Outcomes					
ADHD Aggression Anxiety Arthritis Asthma Birth Outcomes	Bronchitis Cancer Cardiovascular Disease Cognitive Function Confusion	COPD Depression Fatigue Gastrointestinal Illness Happiness Healing	Heat Stroke High Blood Pressure Hospital Admissions Kidney Damage Longevity Low Birth Weight	Mental Health Migraine Miscarriage Mortality Obesity Pre-term Birth	Respiratory Symptoms Self Esteem Social Relations Stress Thyroid Dysfunction

Table 1. Eco-Health Relationship Browser component categories as of 28 July 2014

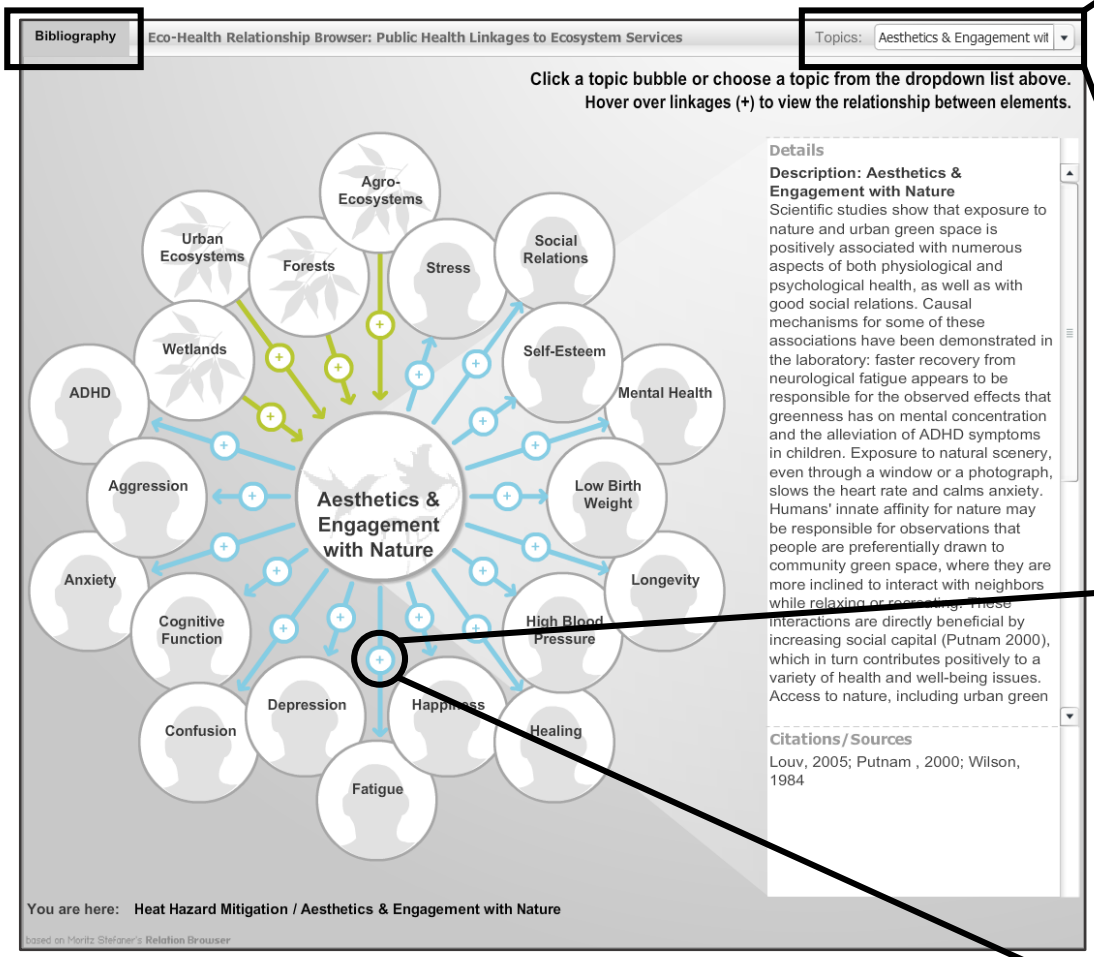
The Eco-Health Browser may aid in HIA by:

- Identifying issues of concern for assessment
- Illustrating the evidence-based connections between health and ecosystem services
- Highlighting the potential outcomes of different decision alternatives
- Providing rapid access to examples of how relationships between ecosystems, ecosystem services, and health have been previously assessed

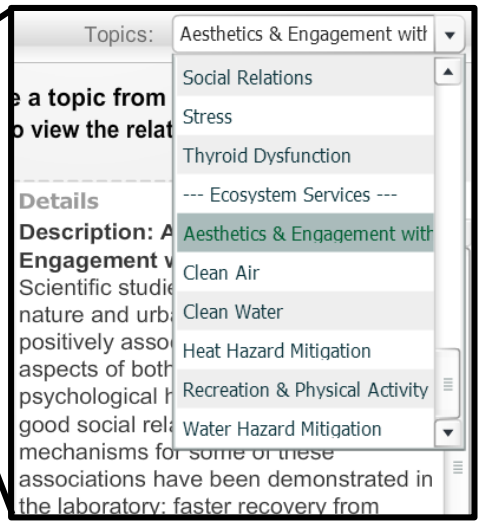
More information on the Eco-Health Relationship Browser can be found at: http://www.epa.gov/enviroatlas/enviroatlas-eco-health-relationship-browser.

[6] Jackson, L. E., Daniel, J., McCorkle, B., Sears, A., & Bush, K. F. (2013). Linking ecosystem services and human health: the Eco-Health Relationship Browser. *International Journal of Public Health, 58*(5), 747-755. doi: 10.1007/s00038-013-0482-1.

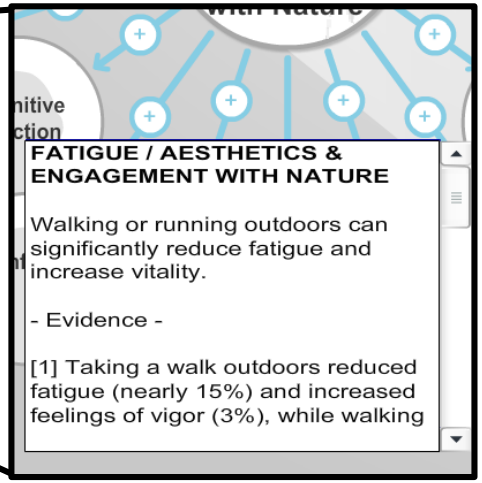
EnviroAtlas and HIA



Screen capture featuring the display of browser components and side bar description of central element



Navigate by either selecting a topic bubble or clicking the drop down menu



Hover over the "+" sign to explore evidence for the selected association

Figure 7. Screen captures of Eco-Health Relationship Browser components

How EnviroAtlas can support HIA

Many of the decisions that we make, from how we develop the infrastructure in our communities, to the ways that we manage surrounding land and resources, affect public health through their impacts on the provision of ecosystem services. Since the 2005 Millennium Ecosystem Assessment (MEA, Figure 3), local to national governments, non-profit organizations, and those in academia have been striving to incorporate the benefits of nature and urban green space into policies and decision-making. Numerous plans, policies, and projects evaluated by HIAs will affect health via their impacts on the provision of ecosystem services. Accounting for these impacts will result in a more complete picture of potential health effects. The following causal pathway diagram illustrates how a plan, policy, or project may affect ecosystem services and health. (Figure 8).

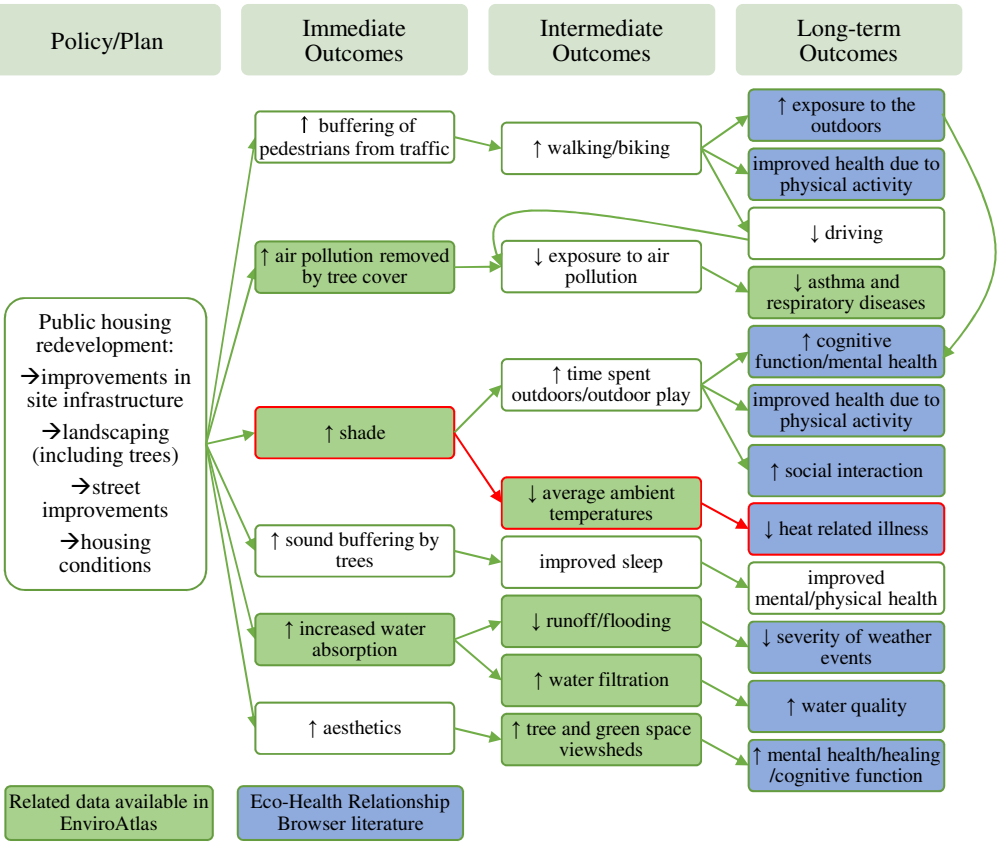


Figure 8. Causal pathway diagram for a hypothetical public housing redevelopment HIA

A baseline assessment of many of the above indicators are available online in the EnviroAtlas Interactive Map at the block-group scale for featured communities. For the example outlined in red above, current[7] levels of shade can be assessed for census block groups by entering the Interactive Map, selecting the community of interest, and following the sequence: Clean Air, Natural Hazard Mitigation, Land Cover, Vegetated, Percent Tree Cover (Figure 9). Under the same Hazard Mitigation menu heading, decreases in average ambient daytime and nighttime temperatures due to shade are under Ambient Temperature and Change Due to Tree Cover (Figure 9). Finally, the relationship between heat hazards and health outcomes can be explored in the Eco-Health Relationship Browser (Figure 10).

[7] Community land cover data was captured circa 2011.

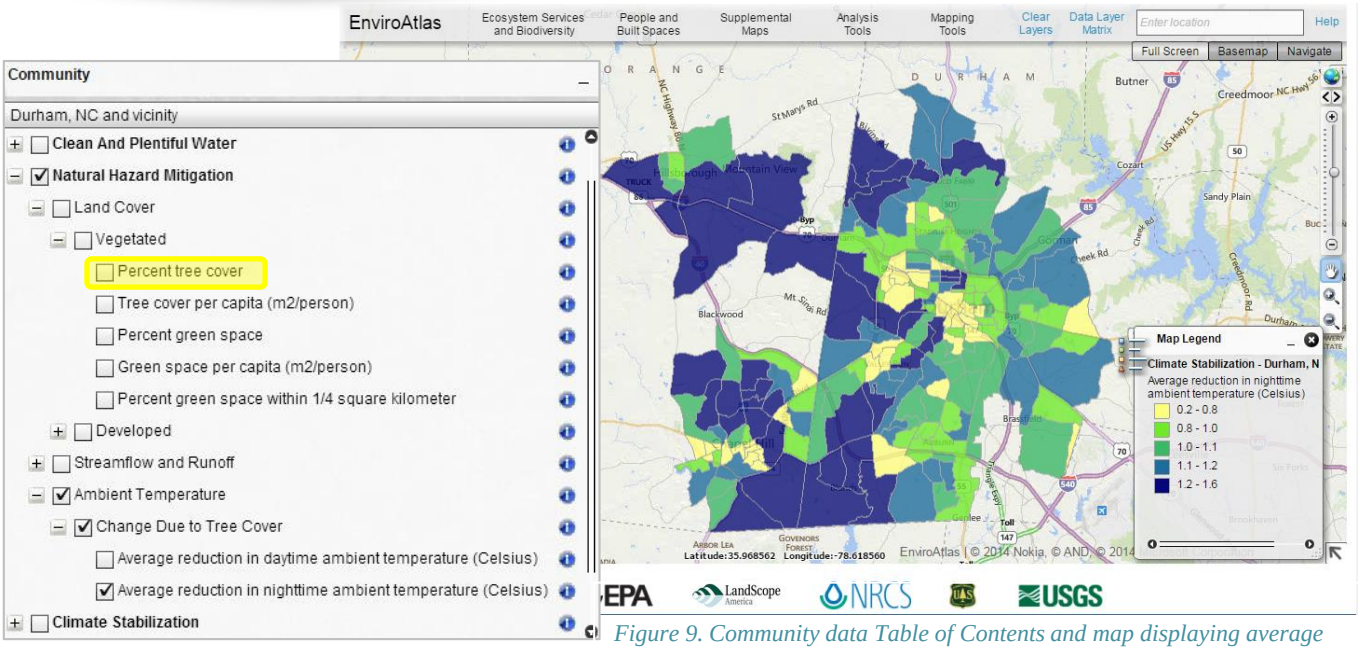


Figure 9. Community data Table of Contents and map displaying average reduction in nighttime ambient temperature for Durham, NC

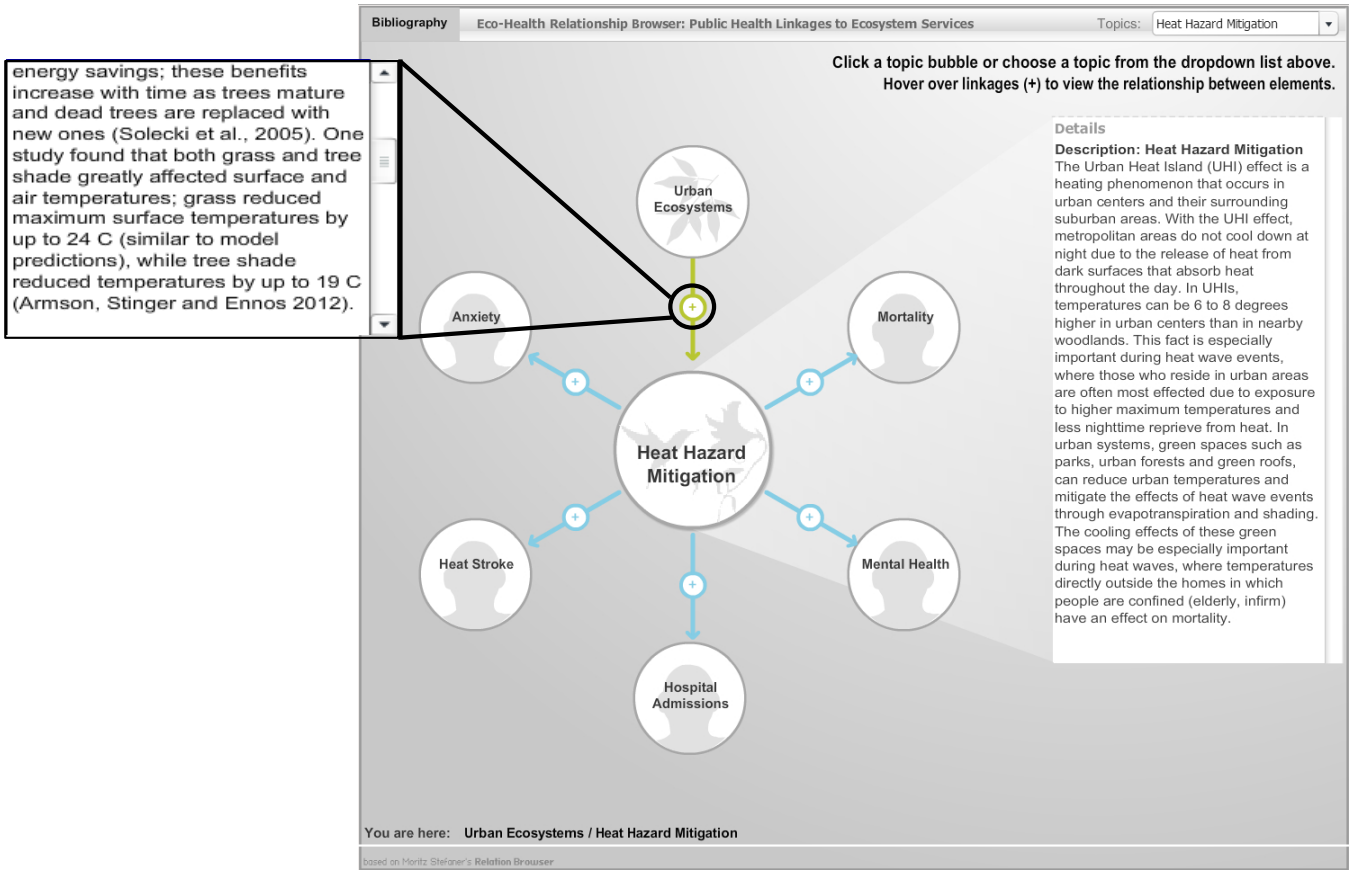


Figure 10. Demonstrated health effects of hazardous heat from the Eco-Health Relationship Browser, and the role of urban ecosystems in mitigation.

How EnviroAtlas can address HIA challenges

In the U.S., HIA is an emerging and growing field. Two recent reviews evaluating the use of HIA identified a number of challenges and areas for improvement[8, 9]. EnviroAtlas can assist with these through its resources and tools (Table 2).

IDENTIFIED CHALLENGE	ENVIROATLAS RESOURCES/TOOLS
Establishment of baseline conditions[7]	• Hundreds of data layers based on best available science • Two scales: Watershed (contiguous U.S.) and Census Block Group (selected communities)
Characterization of impacts[7]	• The Eco-Health Relationship Browser provides a broad selection of recent evidence that highlights statistically significant, plausible associations between ecosystem services and health outcomes. These can be used to guide assessment of the direction and magnitude of potential health impacts from proposed changes to green infrastructure. • The Interactive Map allows for incorporation and visualization of site-specific HIA data through the option to upload existing local data. • All EnviroAtlas data are free and available through web services and for download so can be integrated into site-specific HIA analyses via desktop mapping software or ArcGIS Online.
Broader utilization of existing tools & resources[7]	• Tools and data are publicly available for use online and as downloadable files. • Specialized software and/or applications are not necessary to use EnviroAtlas. • Links to other available resources and tools are provided.
Data gaps & access[7, 8]	• Contains hundreds of data layers based on best available science • User has ability to incorporate/upload additional data • National and community scale data are available
Incorporating equity & the inclusion of vulnerable populations[8]	• EnviroAtlas provides data on demographics and built spaces that can be overlaid with the data on ecosystem services and biodiversity to understand the distribution of ecosystem services and benefits relative to community needs. • The Interactive Map allows for spatial exploration and visualization of data. • User has ability to incorporate/upload additional data • Tools and data are publicly available and downloadable

Table 2. Identified HIA Challenges addressed by EnviroAtlas tools and resources

[8] Rhodus, J., Fulk, F., Autrey, B., O'Shea, S., Roth, A. 2013. A review of health impact assessments in the U.S.: Current state-of-science, best practices, and areas for improvement. U.S. EPA: Cincinnati, OH. EPA/600/R-13/354.

[9] Bourcier, E., Charbonneau, D., Cahill, C., & Dannenberg, A. 2014. Do health impact assessments make a difference? A national evaluation of HIAs in the United States. Seattle: Center for Community Health and Evaluation.

More Information about EnviroAtlas Resources & Tools

Integrated Mapping and Analysis Tools

A number of tools are available within the Interactive Map to assist users in exploring and evaluating EnviroAtlas data. These include:

- **Analyze Ecosystem Services Tool:** Displays index values for seven ecosystem services within one or more selected 12-digit HUC. The index values for each ecosystem service represent the degree to which certain ecosystem attributes within the HUC, when analyzed together, are able to mitigate stressors and maximize human health benefits. Multiple HUCs may be displayed simultaneously for comparison.

- **Raindrop Tool:** Generates a raindrop flow path (linear feature) from a selected location and returns the distance to the nearest water feature as depicted in the National Hydrography Dataset Plus V2 (NHDPlus V2). This tool is a prototype and does not yet account for buildings or engineered stormwater infrastructure. Turning on the National Hydrography Dataset (NHD) flowlines under Supplemental Maps may aid in visualizing these paths.

- **Elevation Data:** Provides the elevation at a selected point on the map or generates an elevation profile based on a user - drawn line.

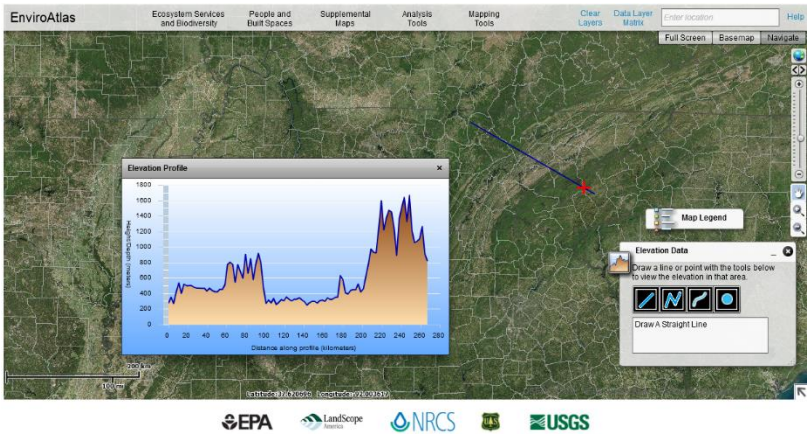


Figure 11. Screen capture of the elevation tool and a resulting elevation profile

- **Mapping Tools:** A number of tools including draw and measure, add shapefile, and print are available. These tools aid users in incorporating location specific data and analysis with existing data layers. Additional tools are under development.

Mapping and Analysis Tools may aid in HIA by enabling users to:

- Create and export images and graphics to aid in communicating findings
- Explore and interact with available data
- Upload or web-serve user developed or local data for further exploration and analysis

More information on Mapping and Analysis Tools in EnviroAtlas can be found at: http://www.epa.gov/enviroatlas/enviroatlas-interactive-map-users-guide.

Data Layer Fact Sheets

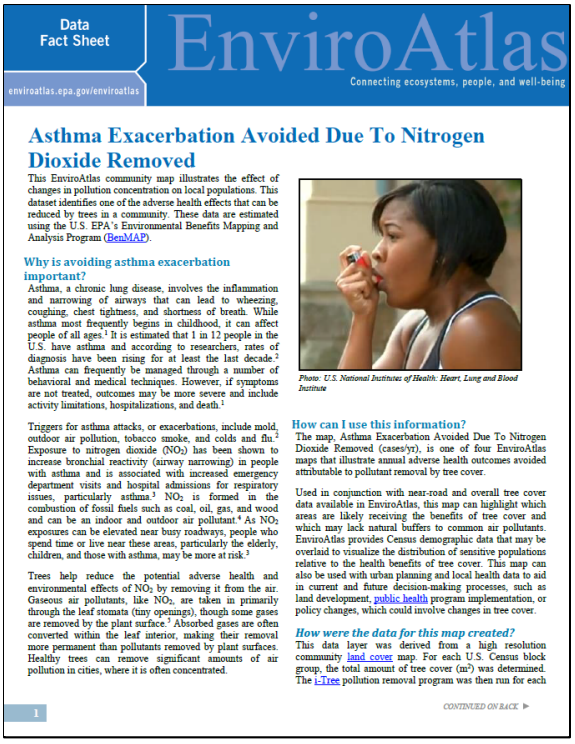
There are three types of fact sheets available: Project fact sheets, Community summary sheets, and Data fact sheets. Each community and data layer in EnviroAtlas has an accompanying fact sheet. These fact sheets include:

- Why the information/topic is important
- How the data was developed
- Limitations of the data
- How the information/topic could be used for assessment

The fact sheet content is linked to the EnviroAtlas glossary as well as to the primary sources of data used in creating the data layer.

The Fact Sheets may aid in HIA by:

- Providing brief methodology for data layer creation
- Highlighting the environmental, social, and economic importance of ecosystem service topics
- Offering examples of how data layers may be used and incorporated for analysis


Data Fact Sheet

EnviroAtlas

enviroatlas.epa.gov/enviroatlas

Connecting ecosystems, people, and well-being

Asthma Exacerbation Avoided Due To Nitrogen Dioxide Removed

This EnviroAtlas community map illustrates the effect of changes in pollution concentration on local populations. This dataset identifies one of the adverse health effects that can be reduced by trees in a community. These data are estimated using the U.S. EPA's Environmental Benefits Mapping and Analysis Program (BenMAP).

Why is avoiding asthma exacerbation important?

Asthma, a chronic lung disease, involves the inflammation and narrowing of airways that can lead to wheezing, coughing, chest tightness, and shortness of breath. While asthma most frequently begins in childhood, it can affect people of all ages.[1] It is estimated that 1 in 12 people in the U.S. have asthma and according to researchers, rates of diagnosis have been rising for at least the last decade.[2] Asthma can frequently be managed through a number of behavioral and medical techniques. However, if symptoms are not treated, outcomes may be more severe and include activity limitations, hospitalizations, and death.[1]

Triggers for asthma attacks, or exacerbations, include mold, outdoor air pollution, tobacco smoke, and colds and flu.[2] Exposure to nitrogen dioxide (NO_2) has been shown to increase bronchial reactivity (airway narrowing) in people with asthma and is associated with increased emergency department visits and hospital admissions for respiratory issues, particularly asthma.[3] NO_2 is formed in the combustion of fossil fuels such as coal, oil, gas, and wood and can be an indoor and outdoor air pollutant.[4] As NO_2 exposures can be elevated near busy roadways, people who spend time or live near these areas, particularly the elderly, children, and those with asthma, may be more at risk.[3]

Trees help reduce the potential adverse health and environmental effects of NO_2 by removing it from the air. Gaseous air pollutants, like NO_2, are taken in primarily through the leaf stomata (tiny openings), though some gases are removed by the plant surface.[5] Absorbed gases are often converted within the leaf interior, making their removal more permanent than pollutants removed by plant surfaces. Healthy trees can remove significant amounts of air pollution in cities, where it is often concentrated.

Photo: U.S. National Institutes of Health: Heart, Lung and Blood Institute

How can I use this information?

The map, Asthma Exacerbation Avoided Due To Nitrogen Dioxide Removed (cases/yr), is one of four EnviroAtlas maps that illustrate annual adverse health outcomes avoided attributable to pollutant removal by tree cover.

Used in conjunction with near-road and overall tree cover data available in EnviroAtlas, this map can highlight which areas are likely receiving the benefits of tree cover and which may lack natural buffers to common air pollutants. EnviroAtlas provides Census demographic data that may be overlaid to visualize the distribution of sensitive populations relative to the health benefits of tree cover. This map can also be used with urban planning and local health data to aid in current and future decision-making processes, such as land development, public health program implementation, or policy changes, which could involve changes in tree cover.

How were the data for this map created?

This data layer was derived from a high resolution community land cover map. For each U.S. Census block group, the total amount of tree cover (m^2) was determined. The i-Tree pollution removal program was then run for each

1

CONTINUED ON BACK ▶

Figure 13. Fact sheet for the community map Asthma Exacerbation Avoided Due to Nitrogen Dioxide Removed

More information on the Fact Sheets can be found at: http://www.epa.gov/enviroatlas/enviroatlas-fact-sheets.

Metadata and Data Download

EnviroAtlas metadata describe the analytical processes involved in creating each map layer. Metadata and data are accessed by entering the Community or National table of contents in the Interactive Map, identifying a map layer of interest and clicking t , then selecting "Metadata/Download" (Figure 14). This results in a summary data page with a link at the bottom to the data and metadata, which include a description of the layer and the process steps used to create it. All Interactive Map data are available for download in geodatabase format.

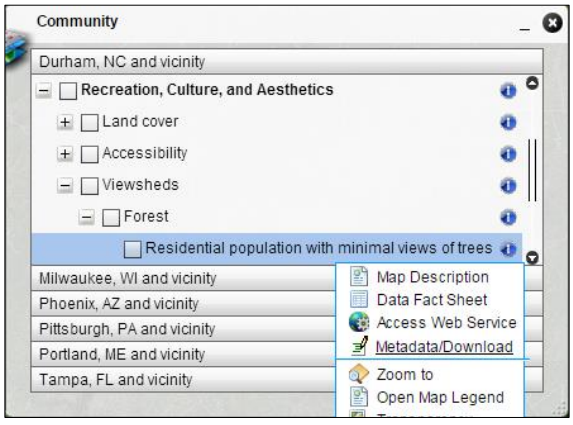


Figure 14. Interactive Map Community table of contents

The Metadata and data may aid in HIA by:

- Providing detailed methodology of data layer creation
- Supplying a framework for modified or additional analyses
- Describing data sources
- Allowing HIA practitioners to conduct their own analyses using EnviroAtlas data.

EnviroAtlas metadata are also available from the EPA Environmental Dataset Gateway at: https://edg.epa.gov/metadata/catalog/main/home.page.

Case Studies and Use Cases

EnviroAtlas is designed for staff from all levels of government, environmental and public health professionals, researchers, educators, non-governmental organizations, and anyone else with an interest in ecosystem services and their role in sustainable and healthy communities. Users can visually interpret ecosystem services and understand how they can be conserved and enhanced. EnviroAtlas provides a screening mechanism for understanding the implications of future planning and policy decisions, and provides information to help raise awareness of the importance, capacity, resilience, and fragility of natural systems.

Figure 12. Sample Story Map examining near-road environments in communities

EnviroAtlas data and tools have been incorporated into a number of programs and projects:

- **Tree Planting:** As a part of the project Trees Across Durham, EnviroAtlas community data for Durham, NC, were used to aid in prioritizing planting locations that maximize the trees' environmental, social, and economic benefits.
- **Conservation of Natural Lands:** The Southeast Atlantic Landscape Conservation Cooperative has used the EnviroAtlas watershed-scale data layers to help develop a stakeholder driven conservation blueprint for the region.
- **Community Education:** EnviroAtlas community 1-meter land cover maps are included as a part of the Durham Neighborhood Compass. This website was developed to aid community members in identifying where their public service efforts may have the greatest impact.
- **Classroom Curriculum:** A teaching case study utilizing EnviroAtlas tools and maps is under development for use in high school and college classrooms. Students are challenged to support and defend their opinions on the proposed placement of a community greenway trail.

Case Studies and Use Cases may aid in HIA by:

- Highlighting the potential outcomes of different decision alternatives
- Providing examples of the types of decisions and projects that have integrated ecosystems, ecosystem services, and health
- Offering examples of communication and documentation tools and mechanisms

More information of EnviroAtlas Case Studies and Use Cases can be found at: http://www.epa.gov/enviroatlas/enviroatlas-use-cases.

Downloadable GIS Tools

EnviroAtlas includes information on the geospatial tools that helped with calculating some of the data layers that are available in the Interactive Map. Access to these downloadable geospatial tools and scripts is provided on the EnviroAtlas website. They can be used to conduct analyses at different spatial scales or using local data. Please note, these tools may require certain versions of commercial GIS software. Examples of tools available include:

ENVIROATLAS TOOL	HIA APPLICATION
Dasymetric Toolbox: Dasymetric mapping is a geospatial technique that uses additional information to more accurately distribute data that has been assigned to specific boundaries. For example: census block groups often encompass uninhabitable areas, such as open water or protected natural space, and fine-scaled landcover data can be incorporated to construct a more realistic model of population distribution. EnviroAtlas researchers use dasymetric mapping to calculate the distribution of: • ecosystem services • walking distances • viewsheds • resource use • exposure potential	HIA practitioners may find the dasymetric mapping tool useful to improve accuracy in the estimation of affected populations of place-based programs, plans, projects, or policies. For example, an HIA of a park redevelopment plan could use dasymetric mapping to more accurately calculate the percentage of people within 0.5 mile of the park entrances.
Analytical Tools Interface for Landscape Assessments (ATtILA): Calculates many commonly used landscape metrics including: • landscape characteristics (i.e. number and size of forest patches) • riparian characteristics (i.e. percent cropland within 30 m of streams) • human stressors (i.e. population changes) • physical characteristics (i.e. elevation and slope) It accepts data from a broad range of sources and is equally suitable across all landscapes, from deserts to rain forests to urban areas.	HIA practitioners can use this tool to understand the proximity and density of specific land characteristics such as: • percentage of forest within {n} map units of a sample point • percentage of cropland within {n} map units of a sample point • road density
Automated Geospatial Watershed Assessment (AGWA): Helps identify and prioritize potential problem areas at the watershed and subwatershed levels. AGWA can be used in many situations, including: • pre- and post-fire assessments • implementation of stream buffer zones • installation of retention and detention structures • land management evaluation • landscape assessments at a watershed- or basin-scale	HIA practitioners may find this tool useful in large-scale land-use change assessments at the watershed and sub-watershed level.
Ecosystem Rarity Toolbox: Allows users to calculate four measures of ecosystem rarity, a measure based on an ecosystem's rare or unique species, for their specific geographies of interest: • Ecosystem Relative Rarity (U.S. EPA Preferred) • Ecoform Relative Rarity • Macrogroup Relative Rarity • Macroform Relative Rarity	This tool could be used to assess ecosystem impacts of large-scale projects.

Table 3. Downloadable GIS tools descriptions and potential uses in HIA

More information on EnviroAtlas GIS and Analysis Tools can be found at:
http://www.epa.gov/enviroatlas/enviroatlas-tools

Additional Resources

- **Centers for Disease Control and Prevention: Designing and Building Healthy Places** - HIA is a key focus area for healthy community design topics. This site provides resources for completing HIA and provides "Stories from the Field": http://www.cdc.gov/healthyplaces/.
- **EnviroAtlas: Related Resources and Links -** Directs users to a selection of research projects, resource websites, and decision support tools relevant to EnviroAtlas topics: http://www.epa.gov/enviroatlas/related-resources-and-links.
- **Health Impact Project -** A collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts focused on promoting the use of HIA by policymakers across the nation. The Project offers resources on conducting HIA and funding opportunities, and tracks HIAs from across the nation: http://www.pewtrusts.org/en/projects/health-impact-project.
- **Human Impact Partners (HIP) -** A not-for-profit organization focused on improving health and health equality through the incorporation of health-based analyses in decision-making. A number of case stories and completed HIA projects and guides on completing HIAs are detailed on their website: http://www.humanimpact.org/.
- **Minimum Elements and Practice Standards for Health Impact Assessment** - A product of the North American HIA Practice Standards Working Group, this document details the elements necessary for a HIA and how best to conduct an assessment: http://www.hiasociety.org/documents/PracticeStandardsforHIAVersion2.pdf.

The following tools and models may also be used to understand and assess environmental conditions, environmental exposures, and their potential impacts.

TOOL/MODEL	DESCRIPTION	SOURCE
AirData	Provides access to the EPA's Air Quality System (AQS) Data Mart which is updated each weeknight with air quality data collected at outdoor monitors across the U.S. Criteria pollutant and air quality index (AQI) data are available in multiple forms, including reports, graphs, maps, and other visualizations.	U.S. EPA; http://www.epa.gov/airdata/
Benefit Mapping and Analysis Program (BenMAP)	A GIS-based computer program used to estimate the health impacts and associated economic value experienced with changes in air quality.	U.S. EPA; http://www.epa.gov/benmap
Co-Benefits Risk Assessment (COBRA)	A free tool that estimates the health and economic benefits of air quality policies. Allows users to estimate and map the air quality, human health, and related economic benefits (excluding energy cost savings) of clean energy policies or programs; and approximate the outcomes of clean energy policies that change emissions of particulate matter, sulfur dioxide, nitrogen oxides, ammonia, and volatile organic compounds at the county, state, regional, or national level.	U.S. EPA; http://www.epa.gov/statelocalclimate/resources/cobra.html
Community-Focused Exposure and Risk Screening Tool (C-FERST)	A one-stop community mapping, information access, and assessment tool designed to help assess risk and assist in decision making within communities. The addition of an HIA Roadmap to this tool will make C-FERST a very useful resource for those that are new to HIA.	U.S. EPA; http://www.epa.gov/healthresearch/community-focused-exposure-and-risk-screening-tool-c-ferst
Comparative Quantification of Health Risks	Quantifies risk factor exposure and effects for 26 major health risks and identifies population exposure distributions, evidence for causality, and estimates of disease-specific hazards associated with each level of exposure.	WorldHealth Organization; http://www.who.int/healthinfo/global_burden_disease/cra/en/
MyEnvironment	Integrates data from EPA and other sources, including air, water, energy, and health data, to provide a quick picture of local environmental conditions.	U.S. EPA; http://www3.epa.gov/enviro/myenviro/
National Environmental Public Health Tracking Network	The Tracking Network is a CDC led surveillance effort that provides data and information about environmental health exposures, health hazards, and health outcomes. County and state level data is publically available online in the form of maps, tables, and charts.	U.S. CDC; http://ephtracking.cdc.gov/showHome.action
ParkScore	Provides measures of how well the 60 largest U.S. cities meet their need for parks. Using advanced GIS, ParkScore identifies neighborhoods and demographics that are underserved by parks, and the number of people able to reach a park within a ten-minute walk. It also provides in-depth data to guide local park improvement efforts.	Trust for Public Land; http://parkscore.tpl.org/

Table 4. Additional tools and models useful to the practice of HIA (adapted from Rhodus et al, 2013)[10]

[10] Rhodus, J., Fulk, F., Autrey, B., O'Shea, S., Roth, A. 2013. A review of health impact assessments in the U.S.: Current state-of-science, best practices, and areas for improvement. U.S. EPA: Cincinnati, OH. EPA/600/R-13/354:pp 104.

EPA
United States
Environmental Protection
Agency

PRESORTED STANDARD
POSTAGE & FEES PAID
EPA
PERMIT NO. G-35

Office of Research and Development (8101R)
Washington, DC 20460

Official Business
Penalty for Private Use
$300