

Health Impact Assessment (HIA) & EnviroAtlas



Integrating Ecosystem Services into the Decision Making Process

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.

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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 (<https://www.epa.gov/enviroatlas>).



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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 Health Impact Project, "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. The length of time to complete an HIA varies based on the context and decision-making timeline. HIAs generally consist of six steps: screening, scoping, assessment, recommendations, reporting, and monitoring and evaluation (Figure 1).

For more information on HIAs, visit:

<https://www.cdc.gov/healthyplaces/hia.htm>.

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:

<https://www.epa.gov/enviroatlas/ecosystem-services-enviroatlas-0>.



Figure 1. Steps of Health Impact Assessment; Health Impact Project²

¹ "Improving Health in the United States: The Role of Health Impact Assessment". National Research Council. <https://www.nap.edu/resource/13229/Health-Impact-Assessment-Report-Brief-Final.pdf>.

² "HIA Process". Health Impact Project. <https://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).

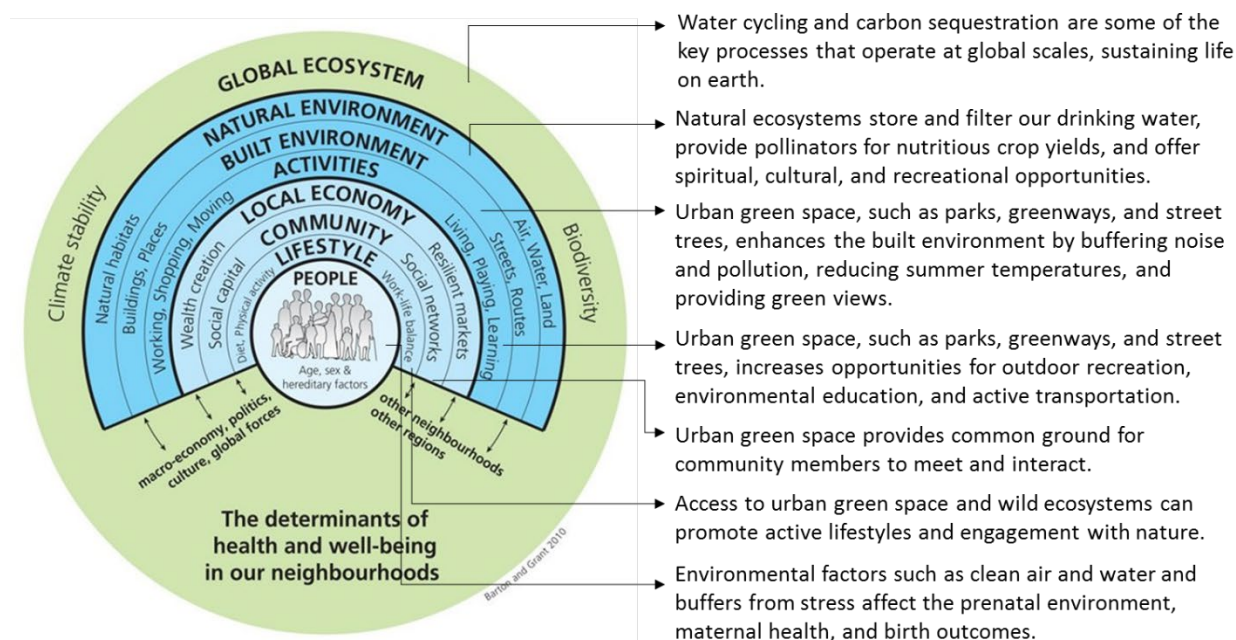


Figure 2. Ecosystem services are part of the Barton and Grant social, economic, and environmental determinants of health model.⁴

³ “Social Determinants of Health.” Centers for Disease Control and Prevention.

<https://www.cdc.gov/socialdeterminants/>.

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.

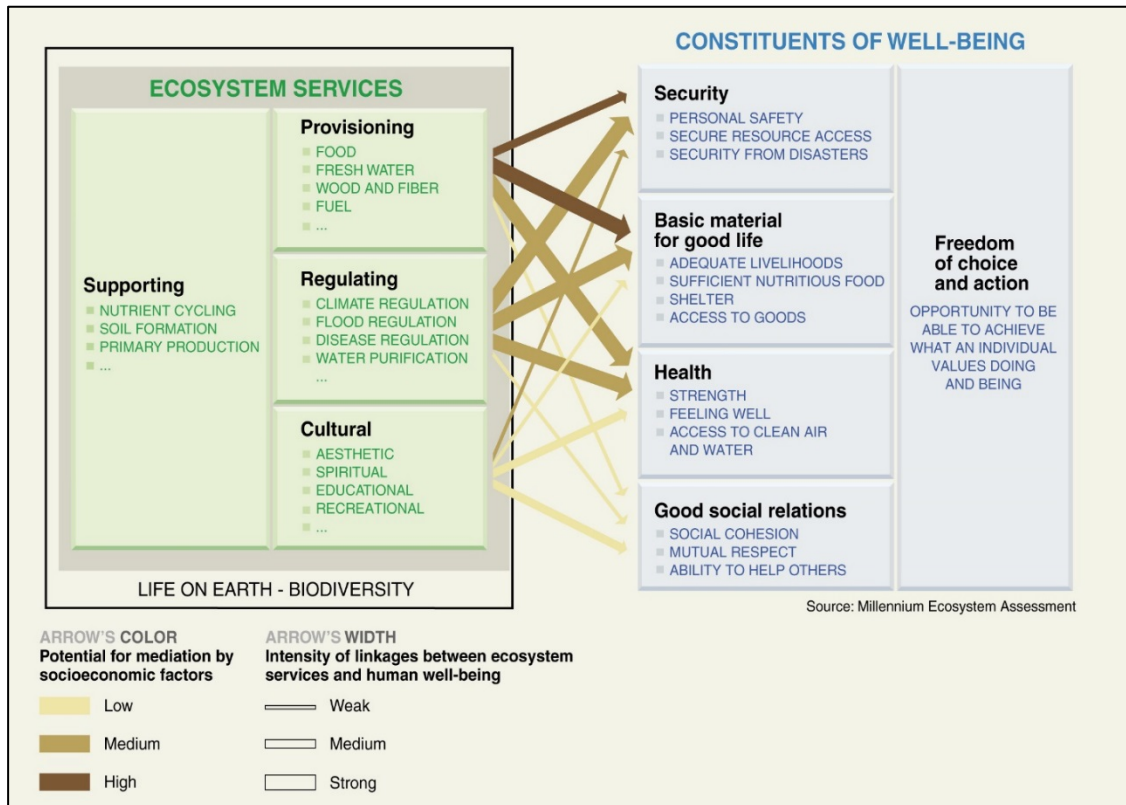


Figure 3. Model of the relationship between ecosystem services and human well-being.⁵

⁵ "Ecosystems and Human Well-Being: General Synthesis". 2005. Millennium Ecosystem Assessment. pp 15. World Health Organization. <https://www.millenniumassessment.org/en/Synthesis.aspx>.

Integrating EnviroAtlas and Health Impact Assessment

What is EnviroAtlas?

EnviroAtlas is a free 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 and the website has been continually updated. As of 2020, the EnviroAtlas Interactive Map contains hundreds of data layers, including high resolution land cover and metrics for thirty U.S. urban areas. This web-based tool is available to anyone with a computer and an internet connection; no special software is needed. EnviroAtlas is 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: <https://www.epa.gov/enviroatlas>.

Incorporating EnviroAtlas Tools & Resources into the HIA Process

Click on topics of interest for more information (To return to this figure after clicking use ALT + ←).

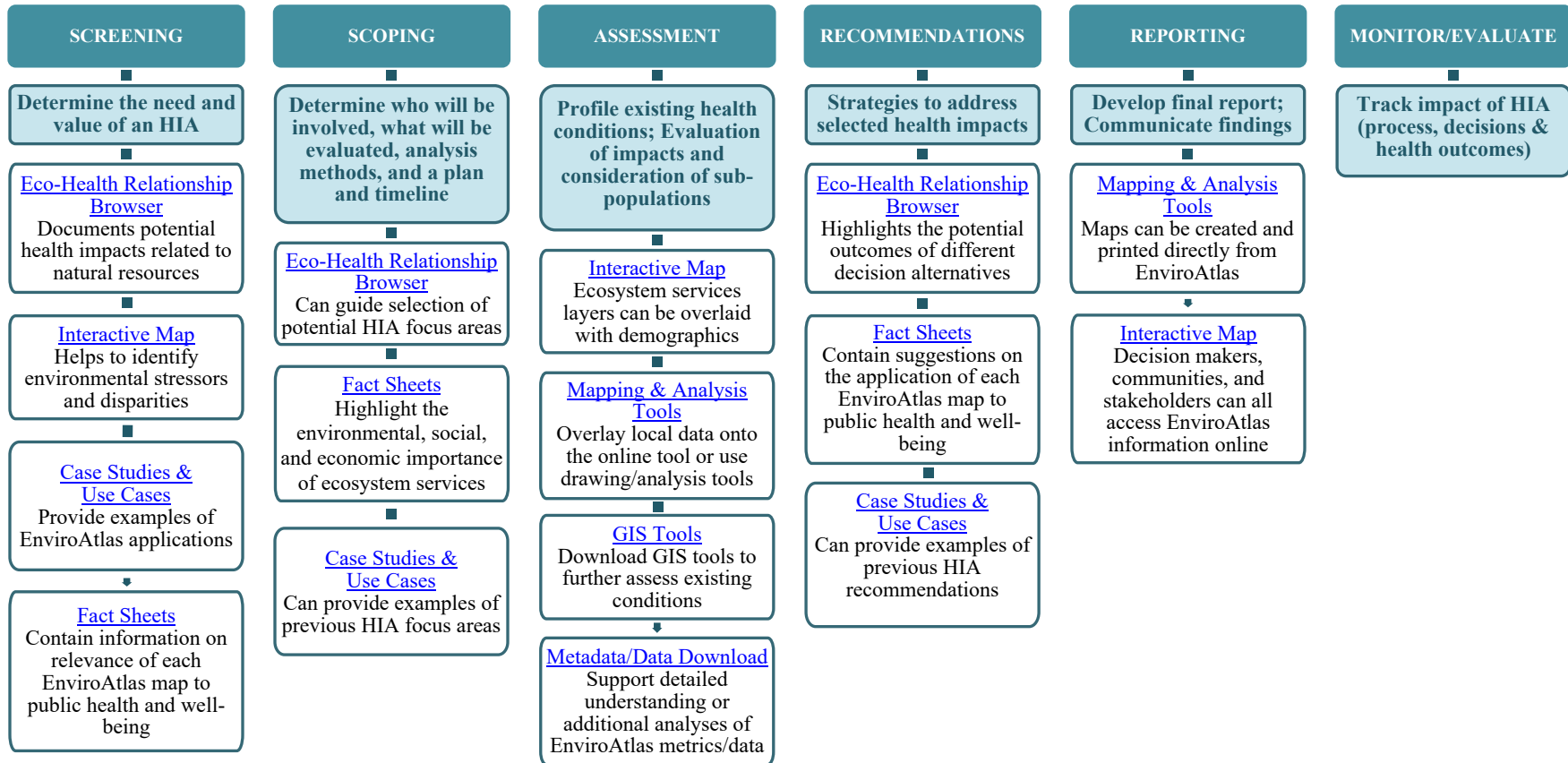


Figure 4. Recommended EnviroAtlas resources for the HIA process.

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. These 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 provided at various scales, including by 12-digit hydrologic watershed basin (12-digit HUC) and U.S. Census block group, and at the pixel level from one-meter to 30-meter resolution. In addition to data on ecosystem services, demographic and other relevant data are included to help users better understand the context of ecosystem services within specific populations, environmental conditions, and geographic areas. EnviroAtlas data layers 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 (Figure 5):

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

In the Interactive Map, data layers are grouped using an expandable topic menu. Designed to help users discover data of interest, this menu includes topics such as Land Cover: Near-Water, Land Cover: Type, Landscape Pattern, and Near Road Environments (e.g., Figures 6 and 7). Relevant ecosystem services benefit categories are indicated by colored icons underneath each data layer name. Some data layers are linked to multiple benefits and therefore may show icons for multiple benefit categories.

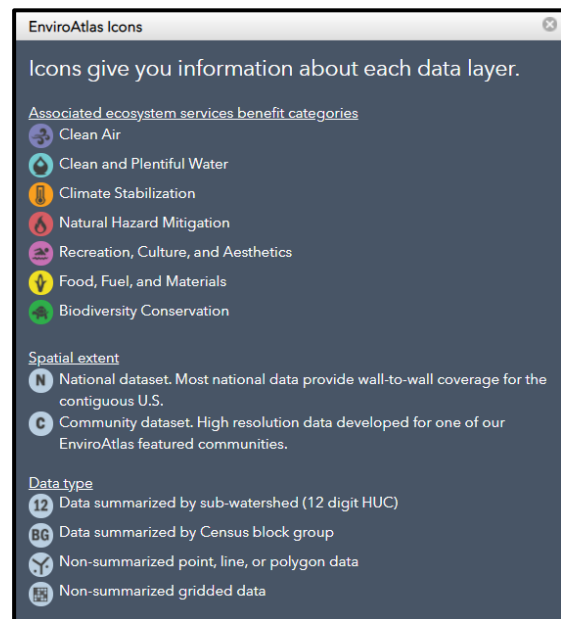


Figure 5: EnviroAtlas icons indicating benefit categories and other information for data layers in the Interactive Map.

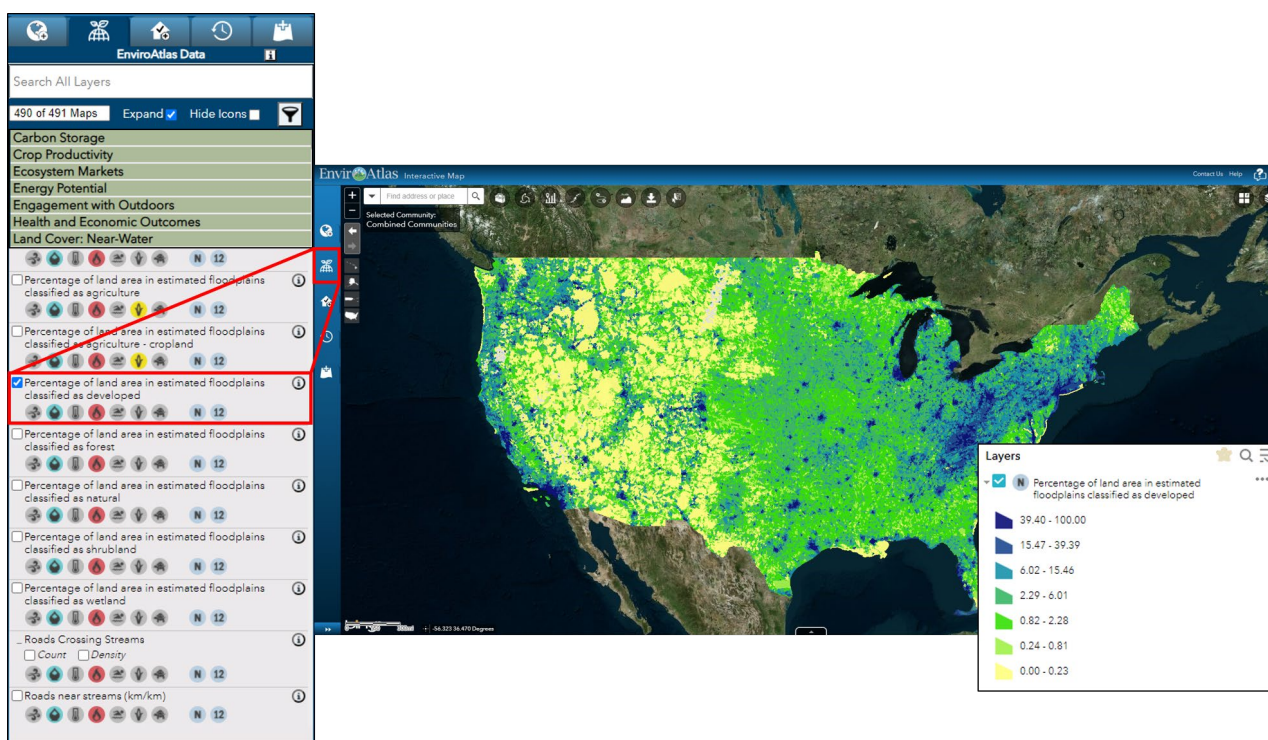


Figure 6. Screen capture of Interactive Map displaying percent of land area within floodplains that are classified as developed.

EnviroAtlas provides a large suite of very high-resolution maps for 30 U.S. urbanized areas (“communities”), encompassing more than 1,400 cities and towns. Based on Meter-Scale Urban Landcover (2010-2016), these maps emphasize potential health issues associated with each benefit category.

A few examples from approximately 100 community maps are:

- Proximity to green space (Figure 7) 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
- Potential of near-road tree cover and green space to increase shading and mitigate heat along walkable roads.

EnviroAtlas national data span the contiguous lower 48 states, with a subset of data for Alaska, Hawaii, Puerto Rico, and the US Virgin Islands. Some examples of fine-scale national datasets include:

- Downscaled population distribution ([dasymetric](#)), which represents the areas where people live and omits areas such as waterbodies and wetlands.
- Estimated floodplain data that fills in gaps in the FEMA flood hazard data. Communities in areas prone to flooding may be at greater risk of exposure to contaminants or other hazards.

- Potentially restorable wetlands on agricultural land, which are important for providing clean and plentiful water, along with other important ecosystem services.
- Facilities that have the potential to release chemical or microbial contaminants into surroundings.

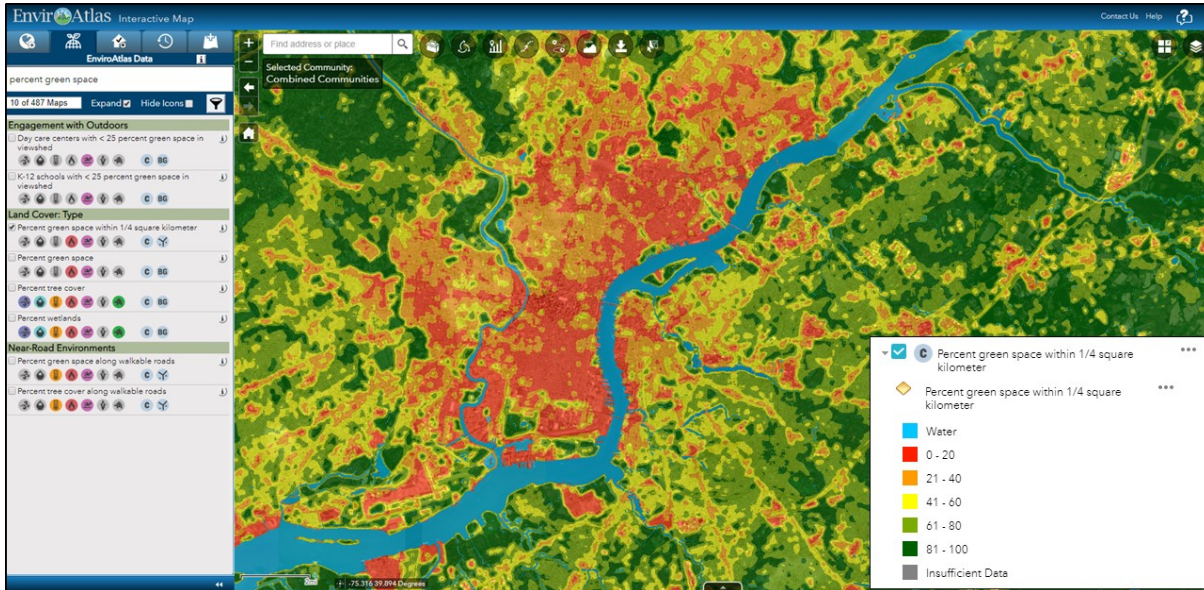


Figure 7. Screen capture of Interactive Map displaying Percent Green Space within 1/4 square kilometer in Philadelphia, PA.

A full list of map layers can be found in the EnviroAtlas Data Layer Matrix online at: <https://www.epa.gov/enviroatlas/enviroatlas-dynamic-data-matrix>. Current and pending EnviroAtlas Communities are shown here: <https://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

The [Compare My Area tool](#) in the Interactive Map allows users to compare local demographics, contamination, and health risks to surrounding county and state, offering powerful contextual information for HIAs.

More information on accessing and using the Interactive Map can be found at: <https://www.epa.gov/enviroatlas/how-use-enviroatlas>.

Overview of the Eco-Health Relationship Browser

The Eco-Health Relationship Browser is an interactive tool that visually illustrates published linkages among ecosystems, ecosystem services and more than 35 health outcomes (Figure 8). A growing body of evidence suggests that ecosystems can provide protection from natural and man-made hazards and promote healthy behaviors.^{6, 7} Most of the summarized studies highlight statistically significant, plausible associations that account for multiple key factors, rather than cause-effect relationships. The Browser is updated periodically to reflect the scientific literature.

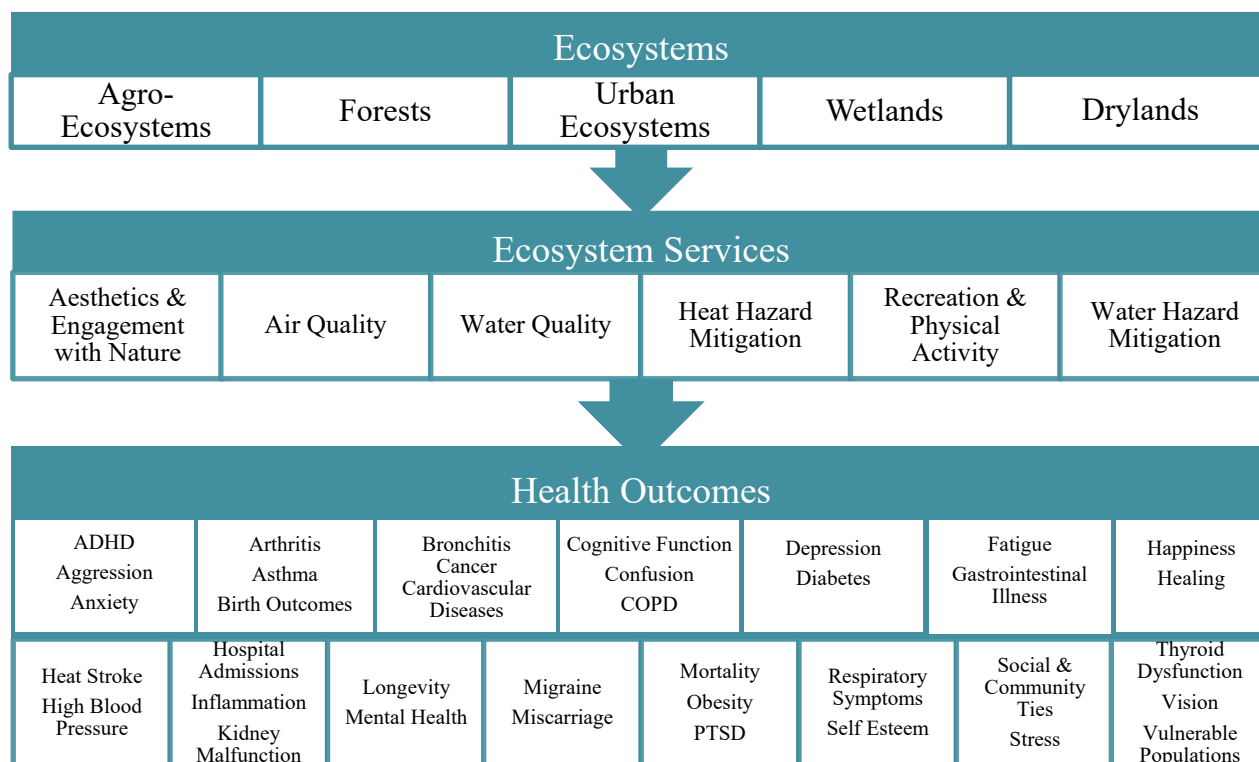


Table 1. Eco-Health Relationship Browser component categories as of December 2020.

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 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:

<https://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. <https://doi.org/10.1007/s00038-013-0482-1>.

⁷ Twohig-Bennett, C., Jones, A. (2018). The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environ Res.*, 166, 628-637. <https://doi.org/10.1016/j.envres.2018.06.030>.

The screenshot displays the 'Eco-Health Relationship Browser: Public Health Linkages to Ecosystem Services'. The main interface features a central hub labeled 'Aesthetics & Engagement With Nature' with arrows pointing to numerous health and well-being outcomes, each accompanied by a small 'i' icon. A dropdown menu on the right is open, showing a list of ecosystem types and services, with 'Aesthetics & Engagement With Nature' selected. A callout window titled 'Linkages' provides detailed information for the 'Aesthetics & Engagement With Nature → ADHD' connection, including a summary of research and a specific study reference.

Aesthetics & Engagement With Nature

Many people around the world enjoy recreating, relaxing, and spending time outdoors. Scientific studies show that exposure to nature is positively associated with numerous aspects of both physiological and psychological health, as well as with good social relations. Causal mechanisms for some of these associations have been demonstrated in the laboratory: faster recovery from neurological fatigue appears to be responsible for the observed effects that greenness has on mental concentration and the alleviation of ADHD symptoms in children. Exposure to natural scenery, even through a window or a photograph, slows the heart rate and calms anxiety. Humans' innate affinity for nature may be responsible for observations that people are preferentially drawn to community green space, where they are more inclined to interact with neighbors while relaxing or recreating. These interactions are directly beneficial by increasing social capital (Putnam 2000), which in turn contributes positively to a variety of health and well-being issues. Access to

Aesthetics & Engagement With Nature

Ecosystem

- Agro-Ecosystems
- Drylands
- Forests
- Urban Ecosystems
- Wetlands

Ecosystem Services

- Aesthetics & Engagement With Nature
- Air Quality
- Heat Hazard Mitigation
- Recreation & Physical Activity
- Water Hazard Mitigation
- Water Quality

Health Outcomes

- ADHD
- Aggression
- Anxiety
- Arthritis
- Asthma
- Birth Outcomes

Linkages

Aesthetics & Engagement With Nature → ADHD

Several studies suggest that spending time in green settings versus other environments has a positive effect on children with ADHD. Children were able to function better overall, direct their attention, and perform concentration tasks more quickly following outdoor activities in green settings. Living in greener areas may also be associated with lower risk of ADHD.

Benefits for those with ADHD

[1] Children ages 5-18 with ADHD who played in a green setting experienced a significantly larger reduction of symptoms after the activity versus those who played indoors or in a built outdoor environment (Kuo and Faber Taylor 2004; n=452, USA).

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

Click on the "i" sign to explore evidence for the selected association.

Figure 8. Example screen capture from the Eco-Health Relationship Browser, highlighting key features of the tool.

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 causal pathway diagram in Figure 9 illustrates how a plan, policy, or project may affect ecosystem services and health.

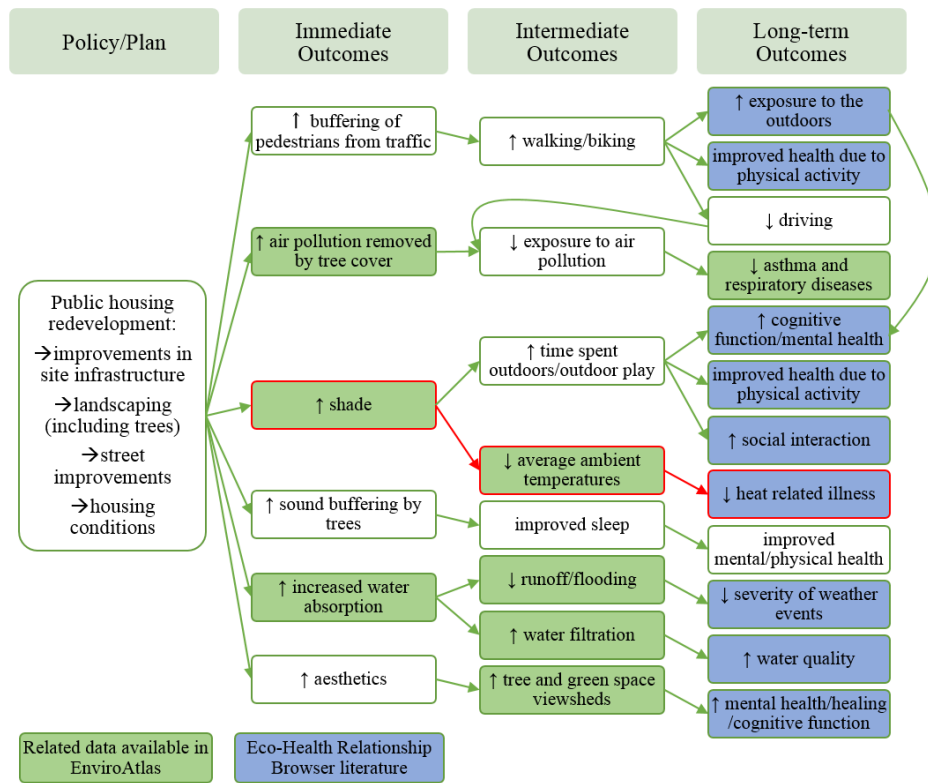


Figure 9. Ecosystem services-public health pathway diagram for a hypothetical public housing redevelopment HIA.

A baseline assessment of many of the above indicators is feasible using resources in the EnviroAtlas Interactive Map at the block-group scale for featured communities. For the example outlined in red above, current levels of shade can be assessed for census block groups by entering the Interactive Map, selecting the community of interest, and following this sequence: Land Cover: Type, Percent Tree Cover (Figure 10). Under the Weather and Climate heading, decreases in average ambient daytime and nighttime temperatures due to tree shade and evapotranspiration are represented by the Average Reduction in Ambient Temperature layers (Figure 10). Finally, the relationship of neighborhood greenery to extreme heat and related health outcomes can be explored in the Eco-Health Relationship Browser (Figure 11).

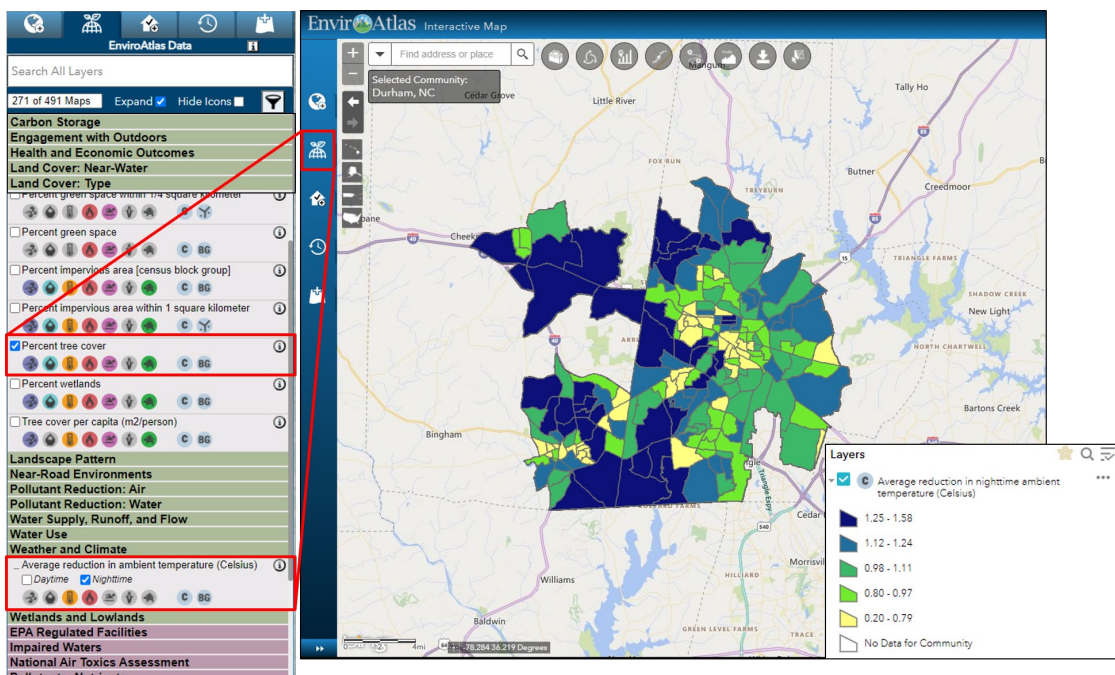


Figure 10. Table of Contents and map displaying Percent tree cover and Average reduction in nighttime ambient temperature for Durham, NC.

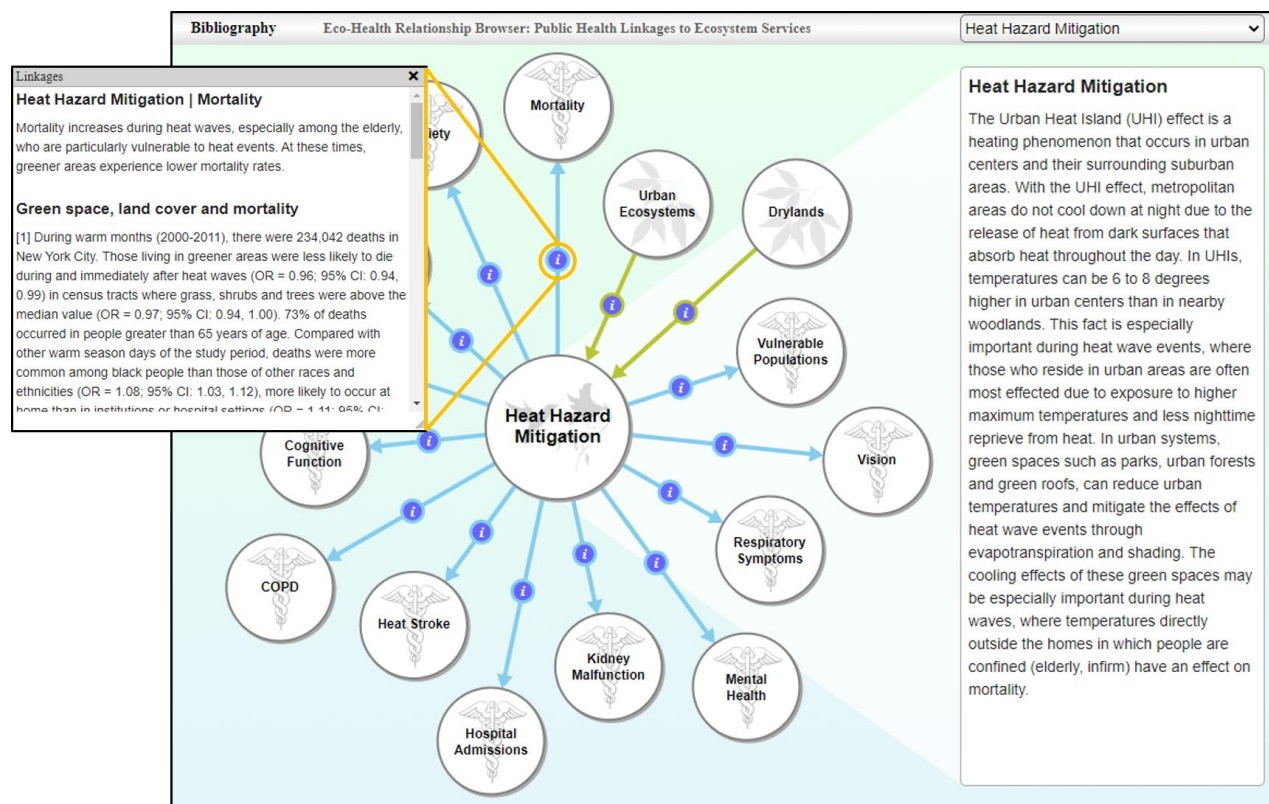


Figure 11. Health links to extreme heat as shown in the Eco-Health Relationship Browser, highlighting the Mortality Outcomes summary.

How EnviroAtlas can address HIA challenges

In the U.S., HIA is an emerging and growing field. Two reviews evaluating the use of HIA have identified challenges and areas for improvement.^{8,9} EnviroAtlas can assist with addressing these challenges through its resources and tools (Table 2).

IDENTIFIED CHALLENGE	ENVIROATLAS RESOURCES/TOOLS
Establishment of baseline conditions⁸	<ul style="list-style-type: none"> • Hundreds of data layers based on best available science. • Two scales: Watershed (contiguous U.S.) and Census Block Group (selected communities).
Characterization of impacts⁸	<ul style="list-style-type: none"> • 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 & resources⁸	<ul style="list-style-type: none"> • 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^{8,9}	<ul style="list-style-type: none"> • 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 populations⁹	<ul style="list-style-type: none"> • 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 variety of tools are available within the Interactive Map to assist users in exploring and evaluating EnviroAtlas data. These include:

- **Compare My Area:** Generate a report for census tracts or watersheds to compare environmental indicators and relevant demographic information to the surrounding county and state. These reports are interactive and shareable and include numerous air toxics of concern. An example report for a census tract in Durham, NC, can be found here: <https://enviroatlas.epa.gov/enviroatlas/interactivemap/widgets/CompareMyArea/TractReport.html?tract=37063002200>.
- **Select Tool:** Select and highlight multiple block groups, watersheds, or other geographic areas and export the accompanying data for other applications (Figure 12).

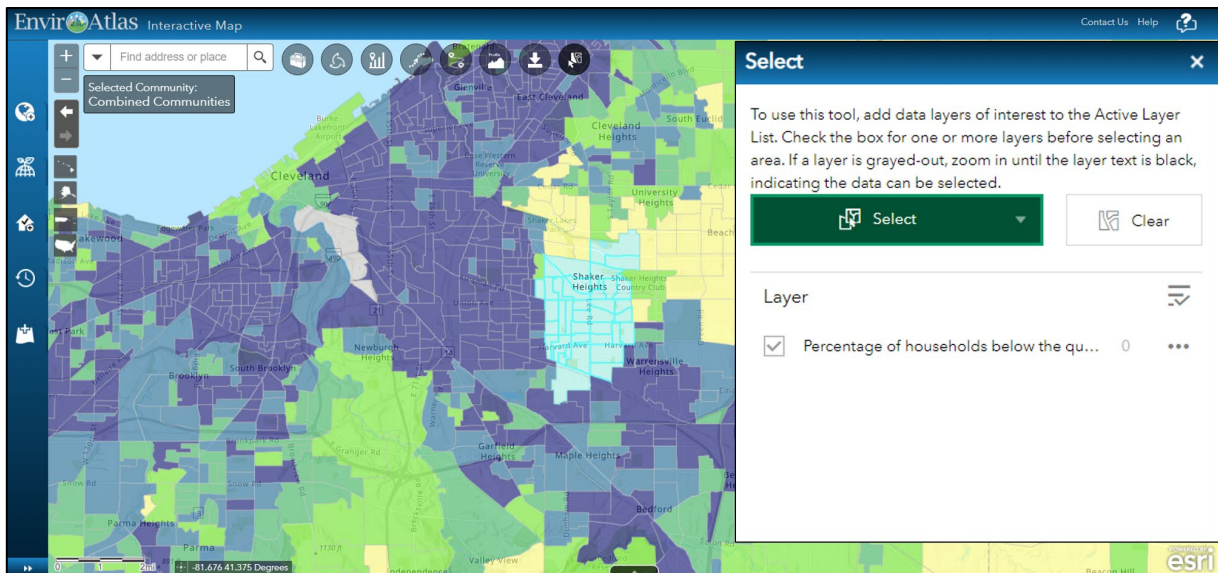


Figure 12. Using the Select Tool to select data summarized at the block group level.

- **Watershed Navigation:** Click on any location in the conterminous US to identify its watershed (Hydrologic Unit Code [HUC]), and upstream or downstream watersheds, including headwaters.
- **Change Analysis Tool (ECAT):** Users can select a climate variable (maximum temperature, minimum temperature, potential evapotranspiration, or precipitation) and compare it between two time periods. Watch a demonstration of ECAT: <https://www.youtube.com/watch?v=ojFtoL1NoSM&feature=youtu.be>.

- **Raindrop Tool:** Generates a raindrop flow path (linear feature) from a chosen location and returns the distance to the nearest water feature as depicted in the National Hydrography Dataset Plus V2 (NHDPlus V2). This tool does not account for buildings or engineered stormwater infrastructure. Turning on the National Hydrography Dataset (NHD) flowlines found in Hydrologic Boundaries adds landscape context to these paths.
- **Elevation Data:** Find the elevation at a selected point on the map or generate an elevation profile based on a user-drawn line.

Mapping Tools: Standard Geographic Information System (GIS) tools include Draw and Measure, Add Shapefile, and Print. These tools help to integrate user data and analyses with EnviroAtlas data layers.

Watch demonstrations to learn how to use EnviroAtlas tools:

<https://epa.maps.arcgis.com/apps/MapJournal/index.html?appid=c9016dba6b304eec974c1dd4611e9775>.

Mapping and Analysis Tools may assist with 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 and local data for further exploration and analysis

More information on Mapping and Analysis Tools in EnviroAtlas can be found at:

<https://enviroatlas.epa.gov/enviroatlas/InteractiveMapEntrance/InteractiveMap/AboutEnviroAtlas.pdf>.

Data Layer Fact Sheets

Each data layer in EnviroAtlas has an accompanying fact sheet (Figure 13). These fact sheets include:

- Why the information/topic is important
- How the data were 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 technical documentation for the data layer's creation (metadata).

The Fact Sheets may aid in HIA by:

- Providing brief methodology for the data layer
- Highlighting the environmental, social, and economic importance of the relevant ecosystem services
- Offering examples of how data layers may be used and incorporated into overlays and other analyses

More information on the Fact Sheets can be found at:

<https://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 clicking the ellipse **⋯** next to the layer in the active layer list, then selecting "Metadata" (Figure 14). This action leads to a summary metadata page with a link at the bottom to the complete metadata, including a description of the layer and the process steps used to create it. All Interactive Map data are available for download in geodatabase format from the EnviroAtlas website:

<https://www.epa.gov/enviroatlas/forms/enviroatlas-data-download>,

which also provides metadata links. The EnviroAtlas Dynamic Data Matrix is another useful way to search for data layers and access fact sheets and metadata; it is accessible at:

<https://www.epa.gov/enviroatlas/enviroatlas-dynamic-data-matrix>.

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 data and metadata are also available from the EPA Environmental Dataset Gateway at:

<https://edg.epa.gov/metadata/catalog/main/home.page>.



Figure 13. Example fact sheet for a community map.

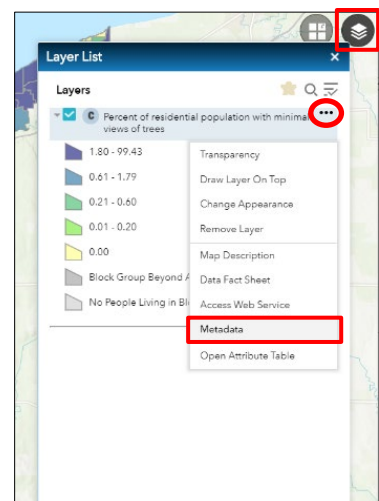


Figure 14. Accessing metadata for each dataset from within the Interactive Map.

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 in the context of the population to evaluate where they may most usefully be conserved and enhanced (Figure 15). Access the Figure 15 Use Case at: <https://epa.maps.arcgis.com/apps/MapSeries/index.html?appid=771581d9b2bf481c9bf06c19d599f812>. EnviroAtlas provides a screening mechanism for assessing the implications of future planning and policy decisions, and provides information to consider the importance, capacity, resilience, and fragility of natural systems.

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:** Several fine-scale EnviroAtlas community 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 Lesson Plans:** A teaching [case study](#) uses EnviroAtlas tools and maps to challenge students to support and defend their opinions on the proposed placement of a greenway trail to benefit diverse community members.

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 about EnviroAtlas Case Studies and Use Cases can be found at:

<https://www.epa.gov/enviroatlas/enviroatlas-use-cases>.

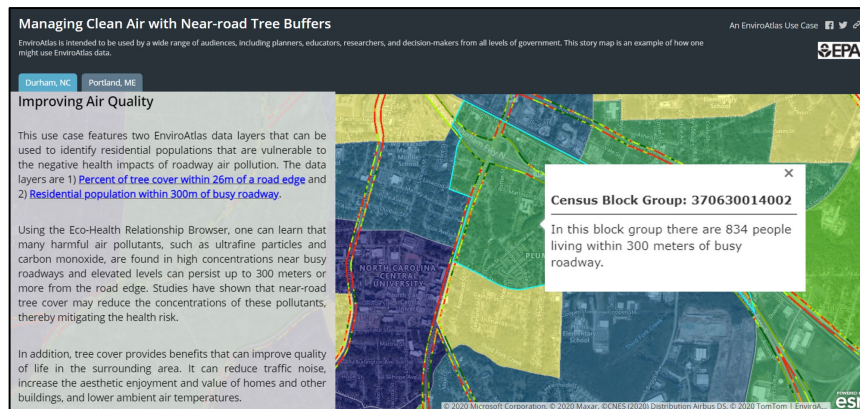


Figure 15. Excerpt from Story Map examining near-road environments in communities.

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. The downloadable tools are shown in Table 3.

ENVIROATLAS TOOL	HIA APPLICATION
<p>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:</p> <ul style="list-style-type: none"> • ecosystem services • walking distances • viewsheds • resource use • exposure potential 	<p>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.</p>
<p>Analytical Tools Interface for Landscape Assessments (ATtLA): Calculates many commonly used landscape metrics including:</p> <ul style="list-style-type: none"> • 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) <p>It accepts data from a broad range of sources and is equally suitable across all landscapes, from deserts to rain forests to urban areas.</p>	<p>HIA practitioners can use this tool to understand the proximity and density of specific land characteristics such as:</p> <ul style="list-style-type: none"> • percentage of forest within {n} map units of a sample point • percentage of cropland within {n} map units of a sample point • road density
<p>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:</p> <ul style="list-style-type: none"> • 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 	<p>HIA practitioners may find this tool useful in large-scale land-use change assessments at the watershed and sub-watershed level.</p>
<p>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:</p> <ul style="list-style-type: none"> • Ecosystem Relative Rarity (U.S. EPA Preferred) • Ecoform Relative Rarity • Macrogroup Relative Rarity • Macroform Relative Rarity 	<p>This tool could be used to assess ecosystem impacts of large-scale projects.</p>

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

More information on EnviroAtlas GIS and Analysis Tools can be found at:

<https://www.epa.gov/enviroatlas/geospatial-toolboxes>

Additional Resources

- **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. The Health Impact Project maintains the Cross-Sector Toolkit, which is an interactive webtool useful for exploring recent and historic HIAs from around the United States.
- **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.
- **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.
- **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”: <https://www.cdc.gov/healthyplaces/>.
- **Society of Practitioners of Health Impact Assessment (SOPHIA)** – This association of individuals and organizations supports the community of researchers and practitioners that perform HIAs. The organization facilitates networking of practitioners, highlights existing and ongoing HIA work in newsletters and other published materials, and disseminates HIA research.

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 week night with air quality data collected at outdoor monitors across the U.S. One can get criteria pollutant and air quality index (AQI) data in multiple forms, including reports, graphs, maps, and other visualization forms.	Environmental Protection Agency; https://www.epa.gov/outdoor-air-quality-data
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.	Environmental Protection Agency; https://www.epa.gov/benmap
Co-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool	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 (PM2.5), sulfur dioxide (SO2), nitrogen oxides (NOX), ammonia (NH3), and volatile organic compounds (VOCs) at the county, state, regional, or national level.	Environmental Protection Agency; https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool
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.	World Health Organization; https://www.who.int/healthinfo/global_burden_disease/cra/en/
EJSCREEN	A web-based application that provides a means for combining demographic and environmental indicators in order to assess potential environmental injustices. Users can also access pre-derived EJ indices that combine these data. Socioeconomic status and minority population are combined with other indicators in the EJ indices. Other community and environmental data can also be added to the mapping tool.	Environmental Protection Agency; https://www.epa.gov/ejscreen
MyEnvironment	Integrates data from EPA and other sources, including air, water, energy, and health data, to provide a quick picture of local environmental conditions.	Environmental Protection Agency; https://www3.epa.gov/myem/envmap/find.html
ParkScore	Provides measures of how well the 40 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

Table 4. Additional tools and models useful to the practice of HIA (adapted from Rhodus et al. 2013⁸).

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