Percent Impervious Area

This EnviroAtlas national map estimates the percentage of land within each 12-digit hydrologic unit (HUC) that is classified as impervious by the 2011 National Land Cover Dataset (NLCD) Percent Developed Impervious Surface Layer. Impervious surfaces are materials that do not allow the penetration of water, such as buildings, roads, and parking lots.

Why is impervious area important?

Impervious surfaces prevent rainwater from entering the soil. Pollutants from aerial and terrestrial sources accumulate on impervious surfaces until runoff from a precipitation event carries sediment, nutrients, metals, and pesticides into stormwater drains and directly to local waterbodies. As impervious surfaces increase, stormwater runoff increases in quantity, speed, temperature, and pollutant load. When impervious surfaces reach 10–20% of local watershed area, surface runoff doubles and continues to increase until, at 100% impervious surface coverage, runoff is five times that of a forested watershed.[1,2] Excessive stormwater runoff also increases the potential for flooding.

These factors can significantly reduce water quality downstream, affecting neighboring communities as well as aquatic wildlife. Excess nitrogen in urban runoff creates algal blooms and abundant aquatic plant growth (eutrophication). The breakdown of decomposing aquatic plants can create an oxygen deficit that negatively affects the health and productivity of aquatic animal species. Sediment and suspended solids reduce water clarity and light penetration, smother or retard the growth of beneficial aquatic plant life, and bury streambed gravel habitats essential for the sustainability of aquatic insects and fish spawning sites.[3,4] Poor water quality can also affect aesthetic enjoyment, recreational opportunities, and the potential development of tourism or fishing.

Impervious surfaces affect the quantity, as well as the quality, of water resources. Normally, rainwater entering the soil recharges groundwater aquifers. Water percolates slowly through the soil to enter streams and rivers, contributing to base flows and regulating stream flow after precipitation events. Excessive runoff greatly reduces rainwater percolation and groundwater recharge, thus contributing to potential shortages in water supply for both surface and ground water.[4]

Impervious surfaces exacerbate the effects of natural hazards, poor air quality, and climate change. Presently, 39% of the population lives in coastal counties on 10% of the nation's land area.[5] The increase in impervious surfaces from continued development in coastal areas and the concurrent decline in coastal wetlands have increased the impacts of coastal storms in recent decades.[6] In addition, impervious surfaces have been associated with increases in ambient temperatures. Impervious surfaces store heat during the day and slowly release it at night, preventing cooling after a hot day. In urban areas, elevated daytime and nighttime temperatures from this urban heat island effect can increase heat-related health effects and the production of ground-level ozone and smog.

Trees growing along roadways, in parking lots, retention basins, or riparian buffers can help mitigate the effects of impervious cover and benefit watersheds and communities by slowing surface water runoff and reducing the influx of pollutants into local waterbodies. Trees reduce air pollutants by intercepting gases and fine particulates on leaves and bark. Tree cover also helps reduce ambient temperatures through shading and evapotranspiration.

How can I use this information?

This map, Percent Impervious Area, gives a national and regional perspective of the distribution of impervious cover. Users can compare this map to other national EnviroAtlas maps such as Percent Developed Area, Percent Forest and Woody Wetlands in Stream Buffer, or the annual atmospheric deposition maps such as Annual Oxidized Nitrogen

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Deposition. One might identify hydrologic units that may be improved by additional tree cover to filter urban runoff, cool urban temperatures, or capture air pollutants.

By increasing the transparency of this map layer in the interactive map, users can view the landscape in an aerial imagery base map beneath it and overlay the impervious areas layer with select EnviroAtlas data layers, such as streams and waterbodies (NHD), wetlands (NWI), or impaired waters, to identify possible sources of impairments and remediation needs. Comparison with EPA impaired waters data may assist in planning to maximize filtration capabilities when implementing Total Maximum Daily Loads in streams. Wetlands or riparian areas restored alongside or upstream of impaired stream segments may help reduce pollutant, sediment, and nutrient loads to streams. Mitigation efforts may help local conditions upstream or downstream of developed areas with high concentrations of impervious surfaces.

How were the data for this map created?

These data were generated by using the 2011 National Land Cover Dataset (NLCD) and Esri ArcGIS 10.2.2. Landcover classified as impervious by the 2011 NLCD Percent Developed Imperviousness Layer was used for this map. Landcover data were summarized by 12-digit HUC boundaries from the NHDPlusV2 Watershed Boundary Dataset (WBD Snapshot).

What are the limitations of these data?

Though EnviroAtlas uses the best data available, there are limitations associated with the data. The landcover classes found in NLCD are created through the classification of satellite imagery. Human classification of landcover types that have a similar spectral signature can result in classification errors. As a result, NLCD is a best estimate of actual landcover. Periodic updates to EnviroAtlas will reflect improvements to nationally available data. Updates may improve accuracy as data and classification methods improve. Each version of NLCD is released several years after the date of the satellite imagery, meaning that the land cover patterns may have changed. Accuracy information for the NLCD can be found on its website.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. The 2011 NLCD Percent Developed Impervious Surface Layer is available at the MRLC website.

Where can I get more information?

A selection of resources on impervious cover and water quality is listed below. Information on section 303(d) of the Clean Water Act can be found at the EPA Office of Water website. For additional information on the data creation process, access the metadata found in the drop-down menu for each community map layer listed in the EnviroAtlas table of contents and click again on metadata at the bottom of the metadata summary page for more details. To ask specific questions about these data, please contact the EnviroAtlas Team.

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Selected Publications

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