Urban Greenery and Public Housing

Brian Stromberg
Department of Housing and Urban Development

The views expressed in this article are those of the author and do not represent the official positions or policies of the Office of Policy Development and Research, the U.S. Department of Housing and Urban Development, or the U.S. Government.

Abstract

Urban greenspace has demonstrably beneficial impacts on mental and physical health. Greenspace and tree canopy also play a role in reducing local temperatures, which reduces heat-related mortalities. This is particularly important in cities that act as "urban heat islands." This short article reviews the research on these two topics and provides a simple analysis of the location of public housing buildings in Washington, D.C. in relation to tree canopy and greenspace.

Urban greenery in its various forms (urban forestry, city parks, urban agriculture, greenspace, and so on) has been shown to provide a wide range of physical and mental health benefits to urban populations (Beyer et al., 2014; Thompson et al., 2012). This evidence ranges from improved recovery of hospital residents with view of trees outside their windows (Ulrich, 1984) to stress reduction prompted by the Japanese practice of Shinrin-yoku (Park et al., 2007).

Research on the mental and physical well-being of HUD-assisted residents suggests they would benefit from increased access to greenspace. Helms, Sperling, and Steffen (2017) compared the physical and mental health of HUD-assisted adults to unassisted low-income adults and the general adult population. The results of this research indicate that HUD-assisted households tend to have poorer health than other households in the country. Almost 36 percent of adults in HUD-assisted housing reported their health as fair or poor, compared with 24 percent for unassisted low-income renters and 14 percent for the general adult population (Helms, Sperling, and Steffen, 2017). This self-reporting was supported by the fact that HUD-assisted adults suffered from higher rates of various physical health conditions such as diabetes, asthma, heart disease, and obesity. The mental health of HUD-assisted adults was also markedly worse than the two comparison groups; 12 percent of HUD-assisted adults experienced serious psychological distress, compared with 9 and 4 percent for unassisted low-income renters and the general population.

These increased rates of physical and mental stress in HUD-assisted adults could be reduced by expanded access to greenspace, according to the research that has been done. One of the earliest contemporary experimental analyses of the health impact of green space was Maas et al. (2006). The authors looked at the connection between health outcomes and the percentage of green space in individuals' immediate environment. More recently, Beyer et al. (2014) looked at the population of Wisconsin and found, quite simply, that "higher levels of green space correspond to better mental health outcomes" (p. 3466). This positive impact is comparable to the difference between individuals with and without private health insurance. The authors also suggested that the greening of neighborhoods could help offset the stress of high unemployment rates and residential segregation.

Simple access to green space was shown in Miami to reduce the incidence of chronic medical conditions in Medicare recipients (Brown et al., 2016; 2018). Those medical conditions included both physical and mental conditions such as diabetes, hypertension, obesity, Alzheimer's disease, and depression. A study in California found that the presence of tree canopy resulted in better self-reported health; a lower prevalence of obesity; stronger neighborhood cohesion; and lower rates of diabetes, high blood pressure, and asthma (Ulmer et al., 2016). Additional studies abound in the literature that connect greenspace to positive mental and physical health outcomes.

The presence of tree canopy can also help mitigate the health impacts of extreme heat events, which are in turn amplified by the urban heat island (UHI) effect that causes significantly higher temperatures in developed areas that lack vegetation (Mallen et al., 2020). For example, a 2017 analysis of temperature and vegetative land cover in Washington, DC, connects neighborhood-level variations in temperature with the presence of green land cover (McCo, 2018; see also Smith, 2017).

Extreme heat exacerbates existing health issues and can increase mortality (Bowler et al., 2010; Buchin et al., 2016). These temperature variations can have particularly significant consequences for low-income and minority communities, who tend to have higher mortality rates and higher healthcare costs during extreme heat events (Schmeltz, Petkova, and Gamble, 2016; Schwartz, 2005; Smith, 2017; Wondmagegn et al., 2019). HUD-assisted households can generally be described as part of these more vulnerable populations.

The maps included in this article show the relationship between urban greenspace and tree canopy and public housing buildings in Washington, DC. The land cover data comes from the Chesapeake Conservancy, and provides 1-meter resolution coverage for the entirety of the Chesapeake Bay's watershed (Chesapeake Conservancy, 2020). This raster data was used to produce a series of maps that compare the distribution of public housing to tree canopy coverage.

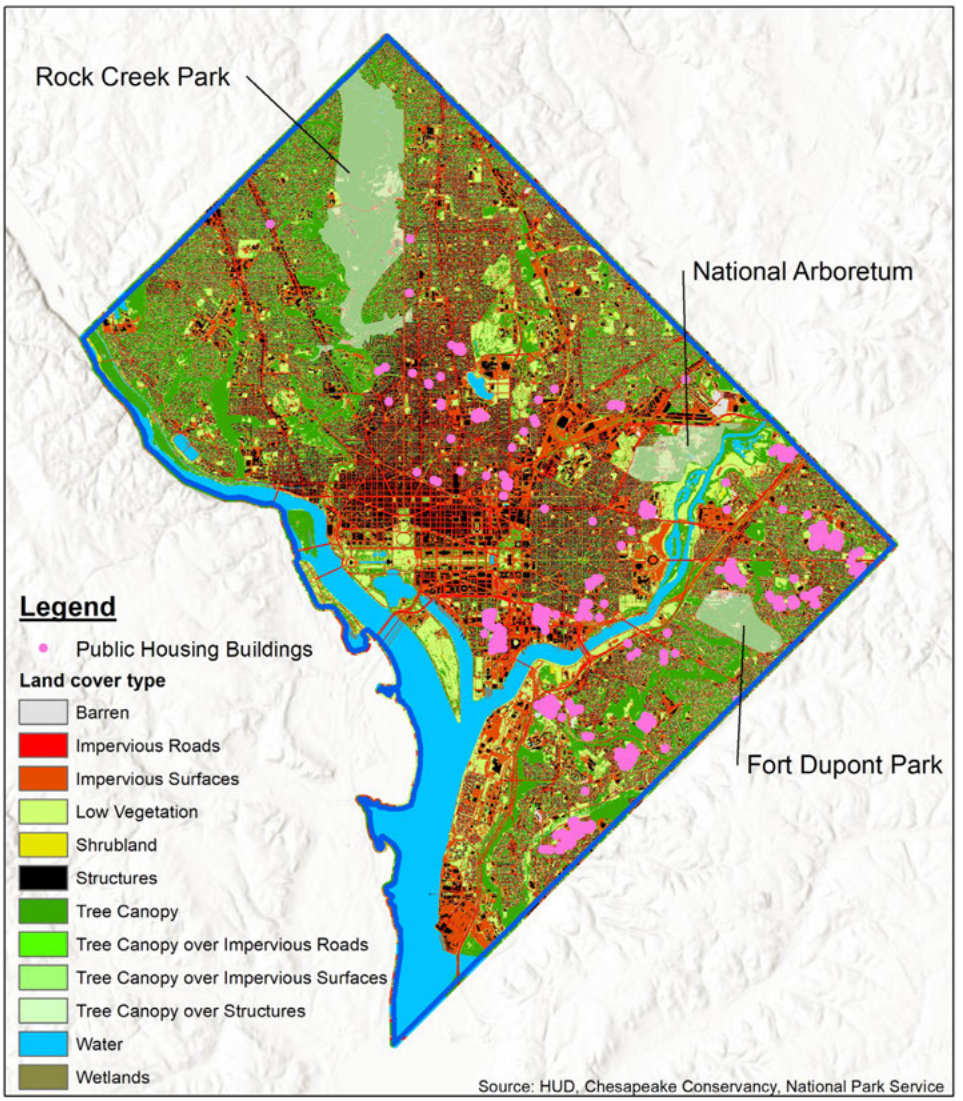
Exhibit 1 shows public housing building locations and the land cover raster data for DC classified according to specific types.[1] Exhibit 2 generalizes the raster according to whether the cells are classified as any type of tree canopy or some other type. Exhibit 3 further generalizes the raster data into hexagonal cells, shaded according to the total amount of tree canopy cells in each hexagon.

[1] A live, colorized version of the same data can be found on the Chesapeake Conservancy's website here: https://chescon.maps.arcgis.com/apps/webappviewer/index.html?id=9453e9af0c774a02909cb2d3dda83431

Exhibit 1

Urban Greenery and Public Housing, Washington, DC

Classified land cover raster overlaid with public housing buildings and significant National Park areas.

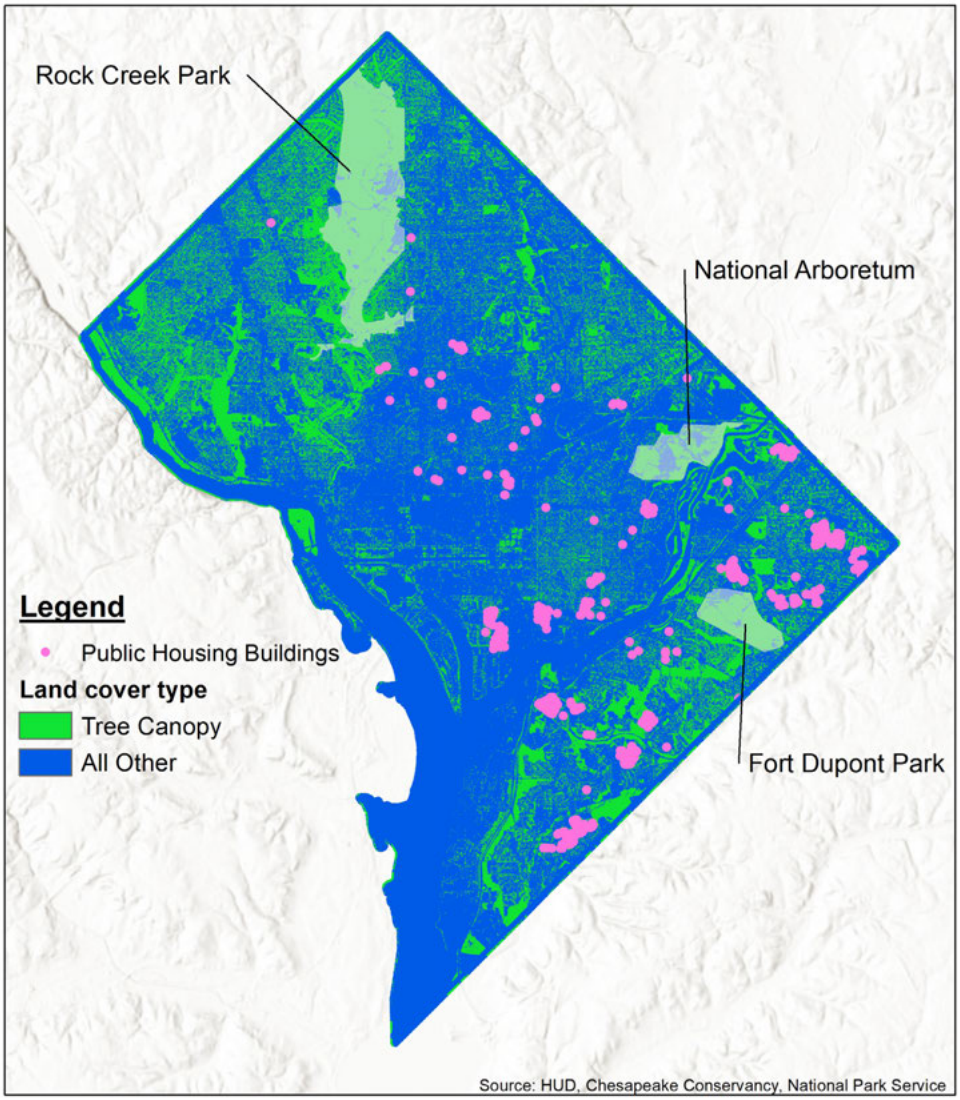


Sources: HUD, Chesapeake Conservancy, National Park Service

Exhibit 2

Urban Greenery and Public Housing, Washington, DC

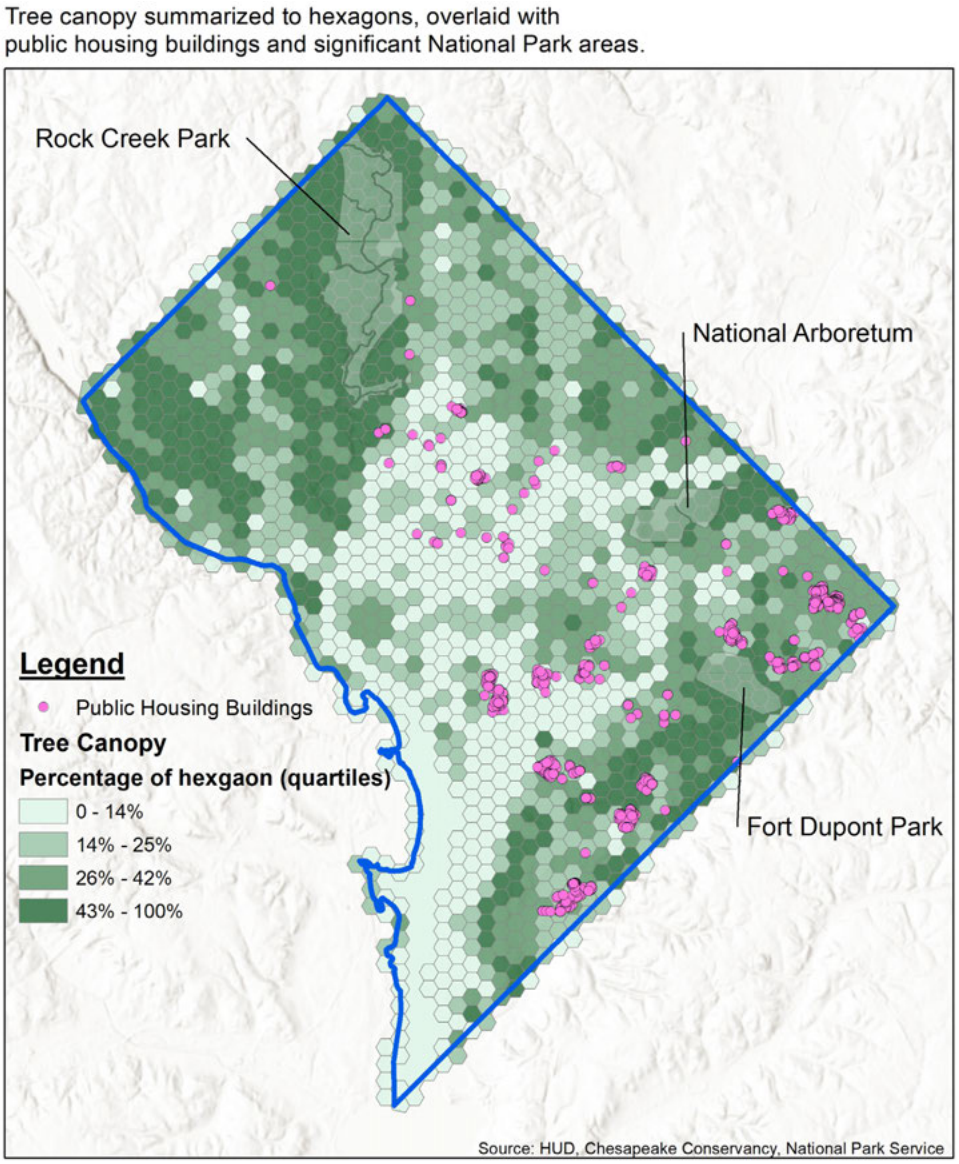
Tree canopy land cover raster overlaid with public housing buildings and significant National Park areas.



Sources: HUD, Chesapeake Conservancy, National Park Service

Exhibit 3

Urban Greenery and Public Housing, Washington, DC



Sources: HUD, Chesapeake Conservancy, National Park Service

A simple summary of land cover types suggests that public housing buildings have less tree canopy and more impervious surfaces in their immediate area than the District has as a whole. Exhibit 4 compares the percentage of land cover types across DC to the percentage of land cover in a quarter-mile radius around public housing buildings. The area around public housing also has a much higher percentage of low vegetation and barren land cover.

Exhibit 4

Percentage of Land Cover Types Across DC and Within a Quarter-Mile of Public Housing

Land Cover Type	Districtwide Percentage (%)	Public Housing Percentage (%)
Tree canopy	30.36	23.49
Impervious surfaces	16.71	21.60
Low vegetation	16.43	17.87
Structures	15.42	21.27
Impervious roads	10.68	14.72
Water	10.00	0.51
Barren	0.24	0.39
Shrubland	0.14	0.13
Wetlands	0.03	0.00

Source: Author's calculations using Chesapeake Conservancy data

This analysis is basic and could be significantly improved in several ways. Potential improvements include dimensions of population density and other socioeconomic characteristics and the distribution of impervious surfaces throughout the neighborhoods would give a better sense of where tree canopy is found across the city. Spatial regression analysis would also provide a more detailed sense of how tree canopy is distributed. These more advanced methods may be pursued in future research.

This article focuses on tree canopy, but greenspace in general is the main focus of a large part of the literature on the benefits of urban greenery. A broader analysis of greenspace is complicated by questions of access. A project that includes remote sensing imagery with on-the-ground data collection would provide a better sense of where greenspace is located and how accessible it may be.

Acknowledgments

The author would like to thank John Huggins, Dylan Sweeney, Michael Early, Veronica Helms, and Alexander Din for their participation in the project that produced this article.

Author

Brian Stromberg is a Social Science Analyst in the Office of Policy Development and Research at HUD.

References

Beyer, Kirsten M. M., Andrea Kaltenbach, Aniko Szabo, Sandra Bogar, F. Javier Nieto, and Kristen M. Malecki. 2014. "Exposure to Neighborhood Green Space and Mental Health: Evidence from the Survey of the Health of Wisconsin," *International Journal of Environmental Research and Public Health* 11 (3): 3453–3472.

Bowler, Diana, Lisette Buyung-Ali, Teri M. Knight, and Andrew S. Pullin. 2010. "Urban Greening to Cool Towns and Cities: A Systematic Review of the Empirical Evidence," *Landscape and Urban Planning* 97 (3): 147–155.

Brown, Scott, Tatiana Perrino, Joanna Lombard, Kefeng Wang, Matthew Toro, Tatjana Rundek, Carolina Marinovic Gutierrez, Chuanhui Dong, Elizabeth Plater-Zyberk, Maria I. Nardi, Jack Kardys, and José Szapocznik. 2016. "Health Disparities in the Relationship of Neighborhood Greenness to Mental Health Outcomes in 249,405 U.S. Medicare Beneficiaries," *International Journal of Environmental Research and Public Health* 15 (3): 430.

Brown, Scott C. Tatiana Perrino, Joanna Lombard, Kefeng Wang, Matthew Toro, Tatjana Rundek, Carolina Marinovic Gutierrez, Chuanhui Dong, Elizabeth Plater-Zyberk, Maria I. Nardi, Jack Kardys, and José Szapocznik. 2018. "Health Disparities in the Relationship of Neighborhood Greenness to Mental Health Outcomes in 249,405 U.S. Medicare Beneficiaries," *International Journal of Environmental Research and Public Health* 15 (3): 430–441.

Buchin, Oliver, Marie-Therese Hoelscher, Fred Meier, Thomas Nehls, and Felix Ziegler. 2016. "Evaluation of the Health-Risk Reduction Potential of Countermeasures to Urban Heat Islands," *Energy and Buildings* 114: 27–37.

Chesapeake Conservancy. 2020. Land Cover Data Project. Annapolis, MD: Chesapeake Conservancy. https://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project/. Accessed on 7/25/2020.

Helms, Veronica, Jon Sperling, and Barry Steffen. 2017. *A Health Picture of HUD-Assisted Adults, 2006-2012*. Washington, DC: U.S. Department of Housing and Urban Development.

Maas, Jolanda, Robert A Verheij, Peter P Groenewegen, Sjerp de Vries, and Peter Spreeuwenberg. 2006. "Green Space, Urbanity, and Health: How Strong is the Relation?" *Journal of Epidemiology and Community Health* 60 (7): 587–592.

Mallen, Evan, Joshua Bakin, Brian Stone, Ramachandra Sikavumar, and Kevin Lanza. 2020. "Thermal Impacts of Built and Vegetated Environments on Local Microclimates in an Urban University Campus," *Urban Climate* 32.

McCoy, Terrence. 2018. "'I Don't Want to Die': As the Country Bakes, Studies Show Poor City Neighborhoods Are Often Much Hotter Than Wealthy Ones." *Washington Post*. September 2. https://www.washingtonpost.com/local/social-issues/i-dont-want-to-die-as-the-country-bakes-studies-show-poor-city-neighborhoods-are-often-much-hotter-than-wealthy-ones/2018/09/02/21d-cf796-abd8-11e8-b1da-ff7faa680710_story.html?utm_term=.53ec2e09361b.

Park, Bum-Jin, Yuko Tsunetsugu, Tamami Kasetani, Hideki Hirano, Takahide Kagawa, Masahiko Sato4) and Yoshifumi Miyazaki. 2007. "Physiological Effects of Shinrin-yoku (Taking in the Atmosphere of the Forest)—Using Salivary Cortisol and Cerebral Activity as Indicators," *Journal of Physiological Anthropology* 26 (2): 123–128.

Schmeltz, Michael T., Elisaveta P. Petkova, and Janet L. Gamble. 2016. "Economic Burden of Hospitalizations for Heat-Related Illnesses in the United States, 2001-2010," *International Journal of Environmental Research and Public Health* 13 (9): 894–905.

Schwartz, Joel. 2005. "Who Is Sensitive to Extremes of Temperature?: A Case-Only Analysis," *Epidemiology* 16 (1): 67–72.

Smith, Randy. 2017. "DC's Heat Islands." Washington, DC: D.C. Policy Center. https://www.dcpolicycenter.org/publications/urban-heat-islands/.

Thompson, Catharine Ward, Jenny Roeb, Peter Aspinall, Richard Mitchell, Angela Clowd, and David Miller. 2012. "More Green Space Is Linked to Less Stress in Deprived Communities: Evidence From Salivary Cortisol Patterns," *Landscape and Urban Planning* 105 (2012): 221–229.

Ulmer, Jared M., Kathleen L. Wolf, Desiree R. Backman, Raymond L. Tretheway, Cynthia J.A. Blaine, Jarlath PM O'Neil-Dunne, and Lawrence D. Frank. 2016. "Multiple Health Benefits of Urban Tree Canopy: The Mounting Evidence For a Green Prescription," *Health & Place* 42 (2016): 54–62.

Ulrich, R.S. 1984. "View through a window may influence recovery from surgery," *Science* 224 (4647): 420–421.

Wondmagegn, Berhanu Y., Jianjun Xianga, Susan Williams, Dino Pisaniello, and Peng Bi. 2019. "What Do We Know About the Healthcare Costs of Extreme Heat Exposure? A Comprehensive Literature Review," *Science of the Total Environment* 657: 608–618.