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Green Infrastructure & Health Guide



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Health Challenges and Green Infrastructure Solutions

If you are a green infrastructure provider, you are a health provider—but in ways you might not expect. This guide provides information about new ways to connect green infrastructure and public health, and some tools to help achieve human health improvements from green infrastructure projects.

In the mid-19th century, public sanitation improvements led to the greatest improvement in life expectancy.¹ These infrastructure investments brought clean drinking water into people's homes and businesses, and also treated wastewater. They increased life expectancy from 35² to 80³ years, largely by reducing communicable disease such as cholera. Since then, public health efforts such as regular vaccination have decreased infectious disease rates, but not with as great an increase in life expectancy.⁴

Now, chronic conditions (such as heart disease, cancer, respiratory diseases, diabetes, depression, and others) are the most prevalent health issues in the United States, Canada, and other nations⁵, and preventing them is the public health challenge of our time. Green infrastructure can be part of the solution, but achieving health is hard work. It means being intentional about engaging community, locating green infrastructure, and selecting designs that improve physical activity, mental health, social cohesion, air quality, and other health factors.



BOX 1.0. GREEN INFRASTRUCTURE LEADERSHIP EXCHANGE

The Green Infrastructure Leadership Exchange is a practitioner network that supports communities seeking to grow green stormwater infrastructure programs by accelerating implementation through peer learning, innovation, partnerships, and advocacy. The Exchange develops, hosts, and shares resources to advance the benefits and viability of green infrastructure. This guide is a product of a collaborative grant program hosted by the Exchange that addresses the challenges of its member cities.

¹Hamlin, C., and Sheard, S. (1998). Revolutions in public health: 1848, and 1998? *BMJ: British Medical Journal*, 317 (7158), 587-591. doi:10.1136/bmj.i3769.

²Ibid.

³Ninde, C. (n.d.). 200 years of public health has doubled our life expectancy. Retrieved May 15, 2018, from <http://sjbpublichealth.org/200-years-public-health-doubled-life-expectancy/>.

⁴Helmuth, L. (2013, September 05). You Used to Get One Life. Now You Get Two. #NotDeadYet. Retrieved from http://www.slate.com/articles/health_and_science/science_of_longevity/2013/09/life_expectancy_history_public_health_and_medical_advances_that_lead_to.html.

⁵World Health Organization. (2002). *The world health report 2002: reducing risks, promoting healthy life*. Geneva: World Health Organization.



1.1. Using This Guideline

This guide provides some general principles, best practices, and experiences about how best to use green infrastructure to promote better health equity. It is designed for use by managers, engineers, community organizations, planners, and others who are siting, designing, building, and stewarding green infrastructure in urban areas and rural towns across Canada and the United States. The guide is a product of several Green Infrastructure Leadership Exchange cities coming together to build stronger partnerships between green infrastructure providers and health providers. The guide is organized in sections that can help green infrastructure providers and their partners answer important questions about how green infrastructure can improve health (Table 1.1.).

Not every city or community may be in a position today to implement all the recommendations in this guide for every green infrastructure project, but all can get started. See Section 7 for ideas on asking a neighborhood or particular parts of the community where and how to start.

TABLE 1.1. ORGANIZATION OF THE GUIDE

SECTION	QUESTIONS THIS GUIDE ANSWERS
II. Green infrastructure and health: What is the connection?	Why is the link between green infrastructure and health important?
III. Nature experiences and health: current evidence	What are the health benefits of green infrastructure and where is that evidence?
IV. Shared language	What are some basic terms from both the health and green infrastructure sectors that are needed to communicate better across sectors?
V. Identifying community health needs	How can health goals be incorporated into a green infrastructure program?
VI. Make the case: Business and more	How can the case be made for green infrastructure as a health intervention?
VII. Community engagement: Why and how?	How does community engagement promote health, and how can people engage meaningfully?
VIII. Green infrastructure siting and design: considerations for health	Where should green infrastructure projects be located for the most health benefit? What design elements should be included to maximize positive health impact?
IX. Evaluating health benefits of green infrastructure	How can progress on health improvement be measured and communicated?
X. Needs and next steps	What additional information, tools, partners, and resources are needed in the short- and long-term to further advance the connection between green infrastructure and health improvement?

Green Infrastructure and Health: What Is the Connection?

Throughout Canada and the United States, communities use green infrastructure to manage stormwater quantity and quality, reduce urban heat island effects, provide wildlife habitat, create park space, and create resilience to climate change. Cities, provinces, and counties around the world are investing in green infrastructure—both by protecting existing, natural green infrastructure, such as streams, wetlands, and trees, and by creating new green infrastructure that mimics natural systems.

At the same time, communities are also looking at upstream, or preventive, solutions to address the social and environmental factors that negatively impact health, especially for communities most impacted by poor health outcomes. Health care providers, health systems, and health insurers are focusing more on promoting health and preventing disease before it happens, not just treating disease. Promoting health—especially improving health equity—is key to reducing health care costs in the long term, and building livable communities that will thrive into the future.

BOX 2.0. CLIMATE CHANGE AND HEALTH ARE LINKED

Climate change (rising temperature, changes in precipitation, sea level rise, and storm severity) has health impacts. Climate change will directly affect clean air, clean water, and access to healthy food.⁶ Flooding and other disasters have health impacts, including stress, displacement, and death.⁷ Green infrastructure is a tool to make cities more climate resilient.⁸ This guide is explicit about the health benefits of green infrastructure for reducing heat and air pollution exposure. It does not address flood risk or water pollution reduction because those goals are often central to current city water management goals. The guide also does not articulate in detail the root causes of chronic disease or the magnitude of threats, including climate change. Future versions of this guide will more explicitly connect climate change and health. The World Health Organization,⁹ U.S. Climate Resilience Toolkit,¹⁰ Public Health Association of British Columbia,¹¹ Canadian Coalition for Green Health Care,¹² and the American Public Health Association¹³ have compiled data and resources for climate action and public health.

⁶ Oregon Health Authority. (2017). Oregon Climate and Health Resilience Plan. Retrieved from <https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Pages/resilience-plan.aspx>.

⁷ Du, W., Fitzgerald, G.J., Clark, M., and Hou, X.Y. (2010). Prehospital and Disaster Medicine, 25(3), 265-72.

⁸ U.S. Environmental Protection Agency. (n.d.). Green Infrastructure for Climate Resiliency. Accessed June 24, 2018 from <https://www.epa.gov/green-infrastructure/green-infrastructure-climate-resiliency>.

⁹ World Health Organization. (2018, February 1). Climate Change and Health. Retrieved from <http://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>.

¹⁰ United States Global Change Research Program. (n.d.). U.S. Climate Resilience Toolkit. Accessed June 24, 2018 from <https://toolkit.climate.gov/>.

¹¹ Public Health Association of British Columbia. (n.d.). Climate Action and Public Health. Accessed June 24, 2018 from <https://planh.ca/take-action/healthy-environments/natural-environments/page/climate-action-public-health>.

¹² Canadian Coalition for Green Health Care. (n.d.). Climate-related hazards can have significant implications for demand on health care services. Accessed June 24, 2018 from <http://greenhealthcare.ca/climate-change/>.

¹³ American Public Health Association. (n.d.). Climate Change. Accessed June 24, 2018 from <https://www.apha.org/topics-and-issues/climate-change>.

An extensive and growing body of research demonstrates that more time in and near natural and green spaces can measurably improve health. Both natural and built green infrastructure can provide clean air, clean water, and natural places to play while serving as health-improving green space. Protecting, enhancing, and expanding natural and open areas; planting street trees in paved areas; creating bioswales in road rights-of-ways and parking lots; adding eco-roofs and living walls to buildings; and increasing tree canopy—all elements of green infrastructure—can potentially move the needle on disease prevention, health promotion, equity, and ultimately, health care cost savings.



Nature Experiences & Health: Current Evidence

Much is known about how more time in and better access to nature contributes to health. More time in nature is strongly correlated with increased physical activity and improved mental health, social cohesion, and air quality.¹⁴ Figure 3.0. provides an overall framework linking time in nature and health.

Table 3.0. provides some of the research linking time in nature and health outcomes cited in the popular press and can be used as a template to communicate to local audiences. Other sources have compiled research and conducted reviews of the literature.¹⁵ In general, more time outdoors and nearby natural places (from wilderness to green streets) creates an exposure to the healing effects of nature. The dose of that exposure can be measured by duration, intensity, and other factors that determine how someone will respond from their time in nature. That response generates a health benefit, which in turn has a value (e.g., reduced disease, reduced health care cost, or improvement in a health factor). Hartig et al.¹⁶ define a **logic model** connecting nature contact and health. A sample logic model for connecting urban tree planting to health that is presented in Appendix C.

FIGURE 3.0. CONCEPTUAL FRAMEWORK LINKING CONTACT WITH NATURE TO IMPROVED HEALTH OUTCOMES.¹⁷



¹⁴Hartig, T., Richard, M., De Vries, S., and Frumkin, H. (2014). Nature and Health. Annual Review of Public Health, 35, 207-228. Retrieved from <https://www.annualreviews.org/doi/pdf/10.1146/annurev-publhealth-032013-182443>.

¹⁵ Ibid. (see also Green Cities: Good Health-http://depts.washington.edu/hhwb/Top_Resources.html and Children and Nature Network- <https://www.childrenandnature.org/research-library/collections-of-references>).

¹⁶ Ibid.

¹⁷ Frumkin, H., Bratman, G.N., Breslow, S.J., Cochran, B., Kahn, P.H., Lawler, J.J., Levin, P.S., Tandon, P.S., Varanasi, U., Wolf, K.L., and Wood, S.A. (2017). Nature contact and human health: A research agenda. Environmental Health Perspectives, 125 (7), 075001. Retrieved from <https://ehp.niehs.nih.gov/ehp1663/>.

TABLE 3.0. HEALTH BENEFITS OF NATURE CONTACT

HEALTH BENEFIT	POPULAR PRESS AND CASE EXAMPLES
Reduced stress	NBC News: How the Simple Act of Nature Helps You De-Stress
Better sleep	TIME Magazine: How Camping Helps You Sleep Better
Improved mental health (reduced depression, reduced anxiety)	New Yorker: How Trees Calm Us Down The Atlantic: The Nature Cure
Greater happiness, well-being, life satisfaction	TIME Magazine: How Just 15 Minutes in Nature Can Make You Happier Greater Good Magazine: How Nature Can Make You Kinder, Happier, and More Creative
Reduced aggression	The Brain Flux: Nature Reduces Teen Aggression
Reduced ADHD symptoms	CARE.com: 5 Benefits of Kids Playing Outside
Increased prosocial behavior (actions intended to help others) ¹⁸ and social connectedness	National Geographic: We Are Wired to Be Outside
Lower blood pressure	ScienceAlert: Just 30 Minutes of Nature a Week Could Reduce Your Risk of Depression and Heart Disease
Improved postoperative recovery	SHARP Health: 5 Ways Being Outdoors Can Make You Healthier and Happier
Improved birth outcomes	The Oregonian: The More Trees in a City Bring Surprising Benefit, Portland Study Finds
Improved congestive heart failure	U.S. News: Can Nature Help You Deal With Heart Disease?
Improved child development (cognitive and motor)	The Atlantic: The Push for Outdoor and Nature-Based Preschools
Improved pain control	Harvard Health: A Prescription for Better Health: Go Alfresco
Reduced obesity	NPR: To Make Children Healthier, A Doctor Prescribes a Trip to the Park
Reduced diabetes	The National: The Health Benefits of Being Outdoors
Better eyesight	NPR: The Telegraph: Time Spent Outdoors Linked to Better Eyesight
Improved immune function	Business Insider
Improved general health (adults, cancer survivors, children)	Harvard Health: A Prescription for Better Health: Go Alfresco
Reduced mortality	CNN: Living Near Nature Could Prolong Your Life
Asthma and/or allergies (studies show both improvement and exacerbations)	Plaid Zebra: Spending Time Outside Could Help Prevent the Development of Asthma
Improved Air Quality	Oregon Public Broadcasting: New Study Says Urban Trees Significantly Reduce Pollution

¹⁸ Eisenberg, N., and Mussen, P.H. (1989). *The Roots of Prosocial Behavior in Children*. Cambridge: Cambridge University Press. ISBN: 0-521-33771-2.



3.1. Outstanding Research Questions

There are important questions remaining about health and nature links. Some of these areas of inquiry include¹⁹:

- How exactly does nature improve health? There are strong correlations, but little is known about the mechanisms that create health improvement. Theories range from attention restoration to changes in immune system response.²⁰
- Is there a correct dose of nature? It is not known which types of nature are most effective or important, how much time in nature is needed and how often, and what the health response is to corresponding marginal increases in exposure to nature.
- How do different populations respond? For example, adult white men may respond differently to time in the woods than Latino families do, but how? How do differences in race/ethnicity, gender, age, culture, and other characteristics affect health responses to nature?
- How can the health values of nature be reflected quantitatively in decision-making tools? City green infrastructure providers often use tools to locate, design, and prioritize their capital improvements. These tools could help answer questions such as, “For every gallon of stormwater managed with bioretention, what is the dollar value of improved mental health?” Without more information on the dosage of nature needed to produce health improvements, it is challenging to develop a range of health values per unit of a particular type of green infrastructure. Some work is beginning to articulate the financial benefits of access to nature and health.²¹

¹⁹ Frumkin et al., note 7.

²⁰ Kuo, M. (2015). How might contact with nature promote human health? Exploring promising mechanisms and a possible central pathway. *Frontiers in Psychology*, 6, 1093. DOI 10.3389/fpsyg.2015.01093. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4548093/>.

²¹ Wolf, K. (2016). Nature’s Riches: The Health and Financial Benefits of Nearby Nature. Retrieved from https://www.naturewithin.info/New/2016.11.Economic_Benefits_of_Nature_in_Cities_KWolf.pdf.

Shared Language

Different professions have their own language and terms to describe their work and why they do it. Sometimes that language is unifying, but sometimes it can be exclusionary. To link green infrastructure and health, city and health partners need common language they can use to describe their work together and the reason for their partnership. This section describes some of the key terms used in the fields of green infrastructure and health.

Health can be a unifying organizing framework. Health is a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity.²² People care deeply about their own and their family's health. In polling on why people care about the environment, themes of clean air, clean water, and natural places to play emerge²³ regardless of location, race²⁴, or political philosophy.²⁵ These reasons are closely linked to health—to be healthy, people need clean air to breathe, clean water to nourish themselves, and natural places to be active and to relax.

BOX 4.1. A BROAD VIEW OF NATURE: HANDCYCLING AT THE RACEWAY

Each week in the summer months, about 35 individuals who use wheelchairs or other mobility devices participate in handcycling events at the Portland International Raceway. To people outside the disability community, cycling around a paved track built for cars might not seem very “outdoorsy,” but consider the perspective of participants: much of the raceway is lined with trees and is surrounded by natural areas. It is accessible for mobility devices, and can be reached by public transit. It is away from dangerous traffic and other stressors. For many participants, this is one of the best opportunities for physical activity in green space available to them. As one participant noted, sometimes “we have preconceived notions about what nature or green space is.”



Handcycling / Adaptive Sports Northwest

²² World Health Organization. (2006). Constitution of the World Health Organization (55th edition, Supplement). Retrieved from http://www.who.int/governance/eb/who_constitution_en.pdf.

²³ Metz, D., and Weigel, L. (2013). The Language of Conservation 2013: Updated Recommendations on How to Communicate Effectively to Build Support for Conservation. The Nature Conservancy. Retrieved from <https://www.conservationgateway.org/Files/Documents/2013%20Language%20of%20Conservation%20Memo.pdf>.

²⁴ Metz, D. and Weigel, L. (2009). Key Findings from National Voter Survey on Conservation Among Voters of Color. The Nature Conservancy. Retrieved from <http://www.cdeinspires.org/resources/>.

²⁵ Metz, D. and Weigel, L. (2012). Key Findings from a Survey of 800 Registered Voters Conducted June 16-19, 2012. The Nature Conservancy. Retrieved from <https://www.nature.org/about-us/june-2012-public-key-findings.pdf>.



4.1. Green Infrastructure, Nature, and Green Stormwater Infrastructure

Green infrastructure, as used in this guide, are the natural and built green spaces²⁶ that uses nature and natural processes to manage a variety of challenges, including improving water quality, reducing flood risk, providing wildlife habitat, improving air quality, and now, improving human health. Some groups, such as The Nature Conservancy, call these “nature-based solutions.” Green infrastructure can be narrowly defined as a stormwater management solution (see “green stormwater infrastructure”), but that definition limits the ability of cities, counties, and provinces to use nature and natural processes to advance human health.

Green stormwater infrastructure is an approach to water management that protects, restores, or mimics the natural water cycle.²⁷ The U.S. Environmental Protection Agency adds, “Green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. While single-purpose gray stormwater infrastructure—conventional piped drainage and water treatment systems—is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.”²⁸ Green Stormwater Infrastructure (GSI) is a term often used to describe the subset of more engineered approaches, including bioswales and bioretention, rain gardens, depaving, green roofs and walls, tree canopy, and compost and mulch.

Nature is an area containing elements of living systems that includes plants and nonhuman animals across a range of scales and degrees of human management, from a small, urban park to relatively pristine wilderness,²⁹ together with abiotic elements such as sunset or mountain views. Multiple definitions of nature are appropriate, varying with the form of nature contact being studied and the ways that people relate to nature.³⁰

²⁶ U.S. Environmental Protection Agency (n.d.). What is Open Space/Green Space? Retrieved June 22, 2018 from <https://www3.epa.gov/region1/eco/uep/openspace.html>.

²⁷ American Rivers. (n.d.). What is Green Infrastructure. Retrieved June 22, 2018 from <https://www.americanrivers.org/threats-solutions/clean-water/green-infrastructure/what-is-green-infrastructure/>.

²⁸ US Environmental Protection Agency. (n.d.). Retrieved June 22, 2018 from <https://www.epa.gov/green-infrastructure/what-green-infrastructure>.

²⁹ Bratman, G.N., Hamilton, J.P, and Daily, G.C. (2012). The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences*, 1249, 118-136.

³⁰ Frumkin et al., note 7.

4.2. Social Determinants of Health, Health Equity, and Disparities

Health organizations know that health is mostly determined outside the clinic or hospital, in the communities where people live, work, learn, and play. To successfully partner with health organizations, green infrastructure providers must have an understanding of how social and environmental conditions impact the health of individuals and communities, and green infrastructure's potential to address those conditions and improve health. Social determinants of health, health equity, and health disparities are key terms for green infrastructure providers to understand (Figure 4.2.a.).

FIGURE 4.2.A. SOCIAL DETERMINANTS OF HEALTH³¹



The social, economic, and environmental conditions influencing human health of individuals and communities are referred to as the social determinants of health in the health and health care fields. Examples of social determinants include income level, education attainment, neighborhood safety, and housing status. Kaiser Family Foundation has produced another [social determinants framework](https://www.kff.org/disparities-policy/issue-brief/beyond-health-care-the-role-of-social-determinants-in-promoting-health-and-health-equity/).³²

³¹ Dahlgren, G. and Whitehead, M. (1991). Policies and strategies to promote social equity in health. Institute for Future Studies. Retrieved from <https://core.ac.uk/download/pdf/6472456.pdf>.

³² Artiga, S. and Hinton, E. (2018, May 10). Beyond Health Care: The Role of Social Determinants in Promoting Health and Health Equity. Kaiser Family Foundation. Retrieved from <https://www.kff.org/disparities-policy/issue-brief/beyond-health-care-the-role-of-social-determinants-in-promoting-health-and-health-equity/>.



Health equity means that everyone has a fair and just opportunity to be as healthy as possible. This requires removing obstacles to health such as poverty, discrimination, and their consequences, including powerlessness and lack of access to good jobs with fair pay, quality education and housing, safe environments, and health care.³³ Another important aspect of health equity is understanding structural inequity—where public policy, institutional practices, and other norms reinforce and perpetuate group inequity. Structural inequity is not something practiced by a few people or organizations, it is a feature of the systems in which people exist.³⁴ Structural inequality can be perpetuated along race, gender, age, class, sexual orientation, religion, ability, or at the intersection of several group characteristics.

BOX 4.2. THE PRACTICE OF REDLINING AND STRUCTURAL RACISM

“Redlining” in the United States included public policies that made it difficult to impossible for people of color to purchase homes in certain neighborhoods. Those decisions concentrated poverty and limited the ability to accumulate wealth.³⁵ That legacy is still creating inequity where formerly redlined neighborhoods are now gentrifying and displacing communities of color. For example, 87% of San Francisco’s redlined neighborhoods are low-income neighborhoods undergoing gentrification today.³⁶ Promoting health means addressing structural inequity, which includes how and where green infrastructure is located and designed.

³³ Braveman, P., Arkin, E., Orleans, T., Proctor, D., and Plough, A. (2017). What Is Health Equity? And What Difference Does a Definition Make? Princeton, NJ: Robert Wood Johnson Foundation. Retrieved from https://www.rwjf.org/content/dam/farm/reports/issue_briefs/2017/rwjf437393.

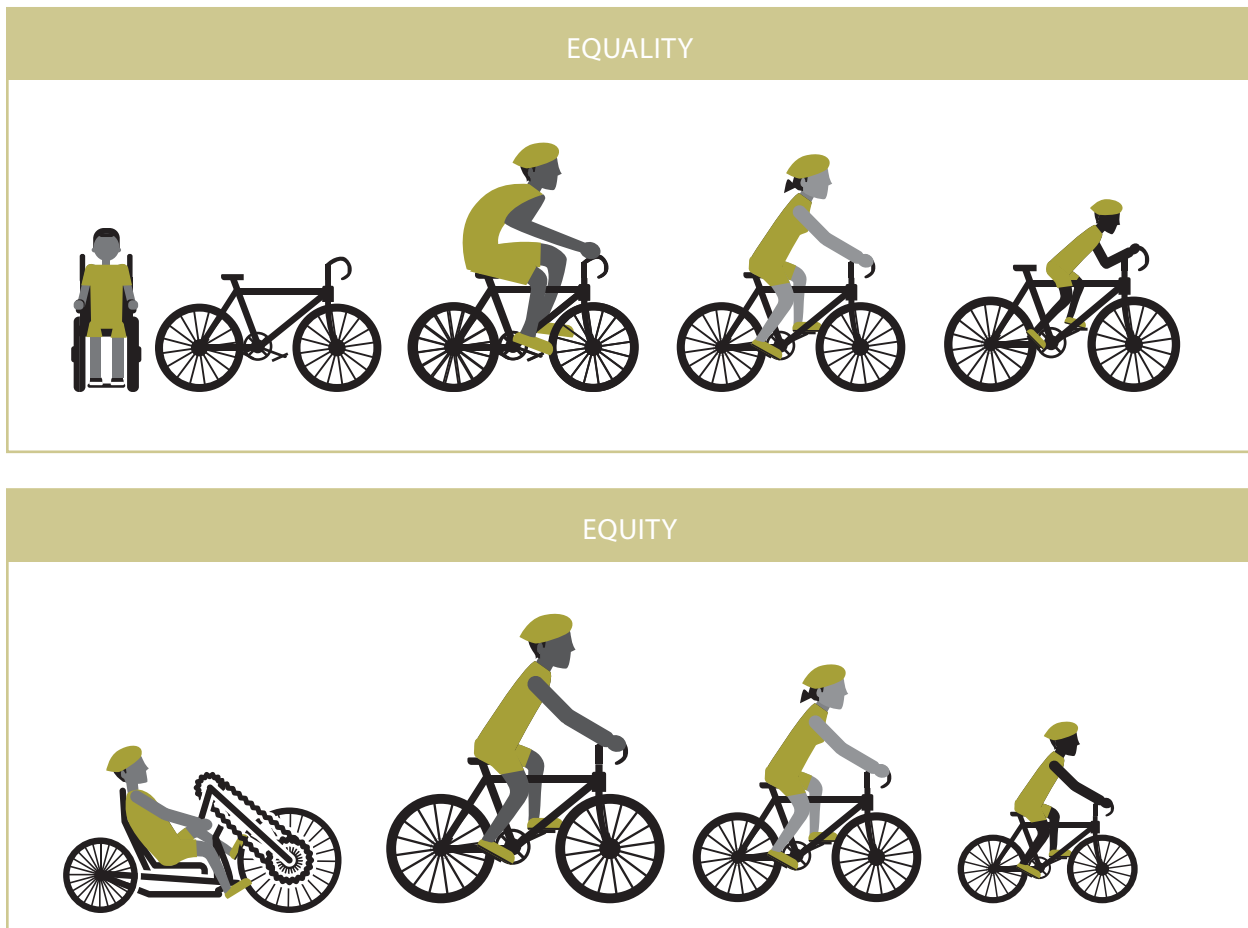
³⁴ Aspen Institute. (2016, June 11). 11 Terms You Should Know to Better Understand Structural Racism. Retrieved from <https://www.aspeninstitute.org/blog-posts/structural-racism-definition/>.

³⁵ Badger, E. (2017, August 24). SELF-FULFILLING PROPHECIES: How Redlining’s Racist Effects Lasted for Decades. Retrieved from <https://www.nytimes.com/2017/08/24/upshot/how-redlinings-racist-effects-lived-for-decades.html>.

³⁶ Urban Displacement Project. (n.d.). The Legacy of Redlining – Resources. Retrieved June 22, 2018 from <http://www.urbandisplacement.org/redlining>.

Equality is a similar but different term than equity. It means that everyone gets equal treatment or resources. Equity, on the other hand, means everyone has the opportunity to reach the same outcome—for the purposes of this guide, that outcome is health. Pursuing equity means that some groups may need more or special types of assistance or resources to achieve the same level of engagement or benefit as other groups (Figure 4.2.b).

FIGURE 4.2.B. DEFINING EQUALITY AND EQUITY³⁷



Health disparities and Health inequities are terms that public health providers often use interchangeably, but they have different meanings. Disparities are differences between groups in health outcomes, presence of disease, or health care access. Health inequities are differences between groups that are unfair, unjust, unnecessary, and avoidable.³⁸

³⁷ Culture of Health Leaders, 2016 Cohort. (2018). Defining a Culture of Health. Unpublished graphic.

³⁸ Boston Public Health Commission. (2018). What is Health Equity? Retrieved from <http://www.bphc.org/whatwedo/health-equity-social-justice/what-is-health-equity/Pages/what-is-health-equity.aspx>.



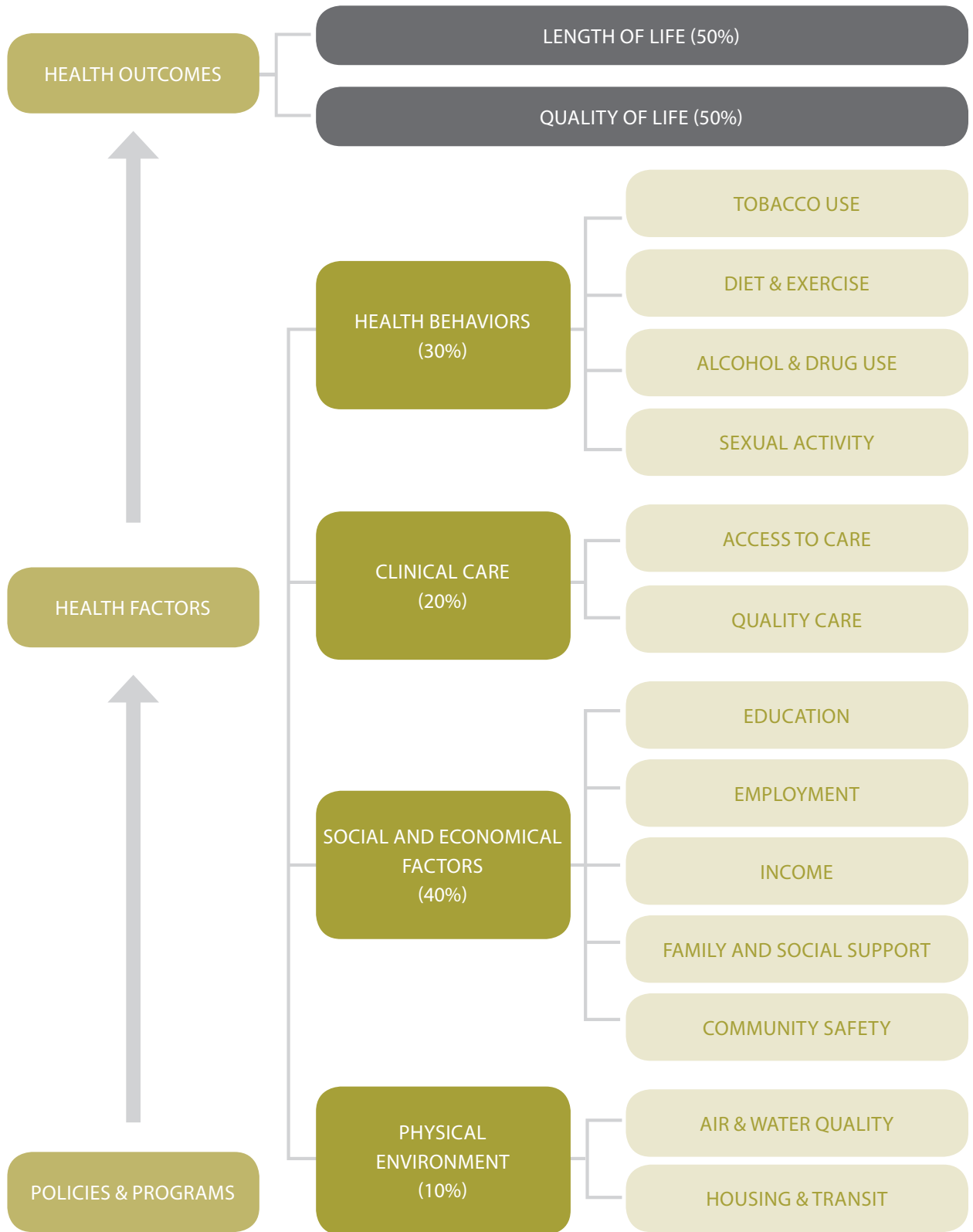
4.3. Conceptual Frameworks Linking Social Determinants and Environment

The existence of nature and open space within communities is an important social determinant of health. City green infrastructure providers now have the pieces they need to take action—the evidence of health benefits and the relationship of nature to other social determinants. Communities can now begin to think about how green infrastructure can be planned and designed to make communities and neighborhoods healthier.

A conceptual framework is a way to organize complex information in a meaningful, readily understood way, often presented as a graphic or visual model. This section presents several frameworks that link green infrastructure to overall health, in addition to the Dalhgren and Whitehead framework (see Figure 4.2.a.). County Health Rankings, a joint program of the University of Wisconsin and the Robert Wood Johnson Foundation, uses a social determinants of health framework to rank each county in the United States relative to other counties in the same state, using data on health outcomes (e.g., length of life) and health factors (e.g., social and economic factors) (Figure 4.3.a.). The framework recognizes that health status varies from place to place, and that the social and environmental context of where people live matters for health. The physical environment health factors account for 10% of the overall county health ranking score. Affecting 10% of someone’s health is significant, but the framework also recognizes that health is a combination of where someone lives, what they do, and the social and economic context in which they live. Adding time in green space is important, but so is a good job, education, and individual behavior.

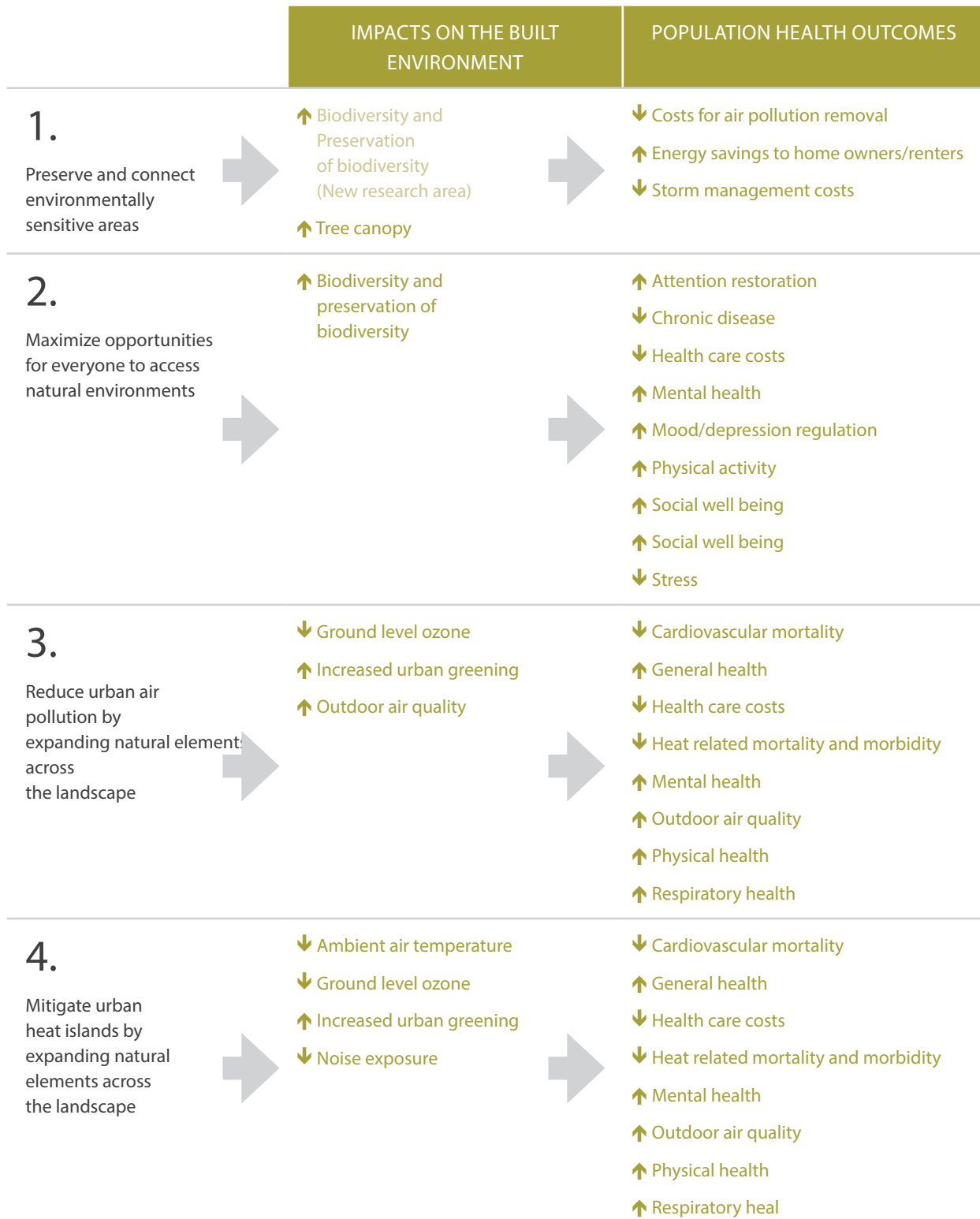
The British Columbia Provincial Health Services have also produced a conceptual framework for a healthy built environment that links neighborhood design, transportation networks, housing, food systems, and the natural environment. The framework provides a vision, planning principles, health impacts, and health outcomes for each of these themes. Figure 4.3.b. depicts the planning principles and health impacts and outcomes for the natural environment theme.

FIGURE 4.3.A. COUNTY HEALTH RANKINGS FRAMEWORK³⁹



³⁹ County Health Rankings. (n.d.). What is Health? Retrieved June 22, 2018 from <http://www.countyhealthrankings.org/what-is-health>.

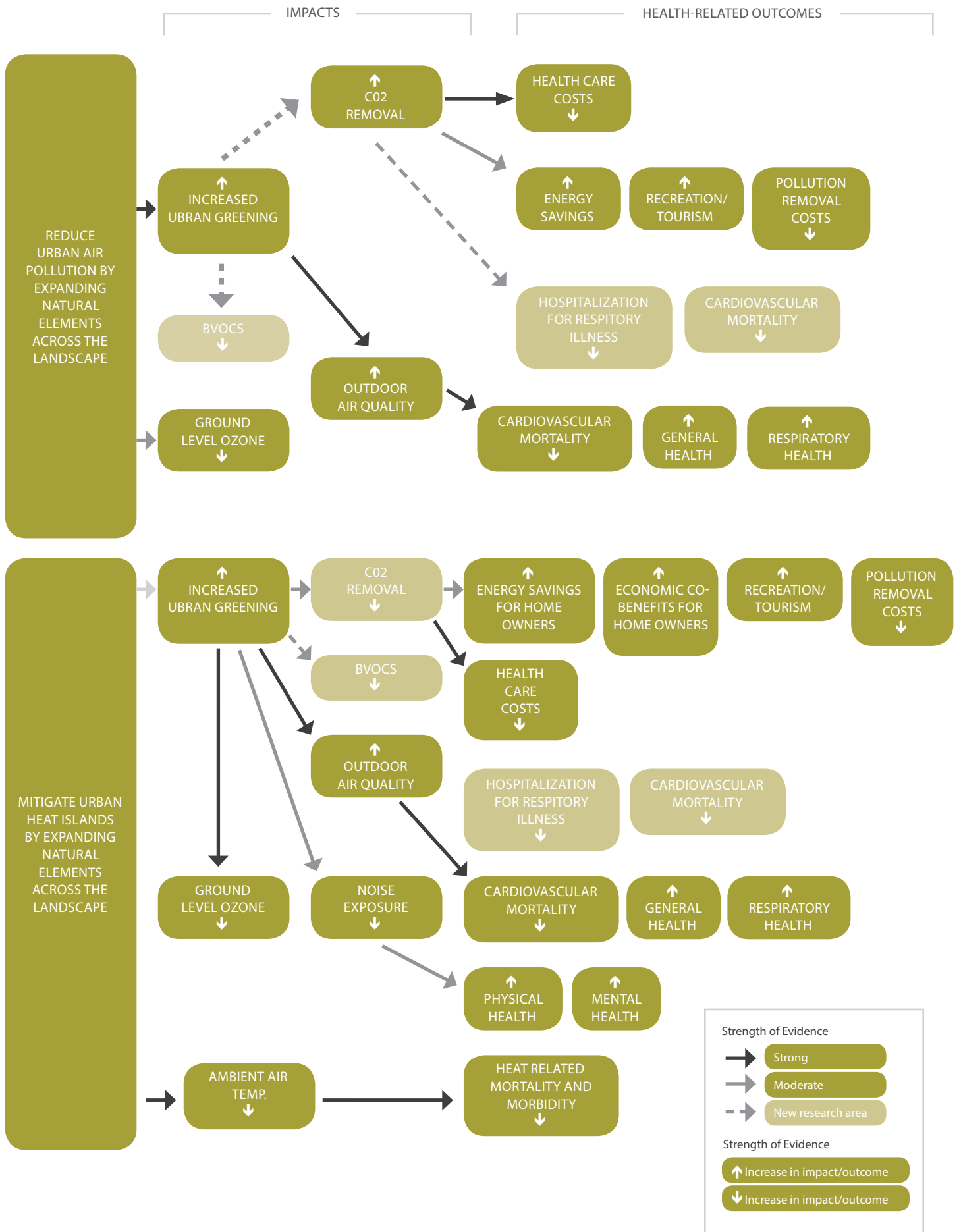
FIGURE 4.3.B. HEALTHY BUILT ENVIRONMENT FRAMEWORK⁴⁰



STRENGTH OF EVIDENCE: Strong/Moderate New research area

DIRECTION OF EFFECT: ↑Increase ↓Decrease

⁴⁰ BC Centre for Disease Control. (2018). Healthy Built Environment Linkages Toolkit: making the links between design, planning and health, Version 2.0. Vancouver, B.C. Provincial Health Services Authority. Retrieved from http://www.bccdc.ca/pop-public-health/Documents/HBE_linkages_toolkit_2018.pdf.



Identifying Community Health Needs

One of the easiest ways to start a conversation with a community health or health care partner is to link green infrastructure work to identified community health priorities. In the United States, the Affordable Care Act requires all tax-exempt hospitals to produce a report about the state of their community's health and their most important health priorities,⁴¹ and many county health departments are also undertaking assessments as part of accreditation processes. In Canada, provincial health authorities often gather information on public health priorities.⁴² The method below for creating a Health and Outdoors Opportunities Assessment draws heavily on the American context of publicly available Community Health Needs Assessments (CHNA) and Community Health Improvement Plans (CHIPs) in each county. Many regions are creating joint CHNAs and coalitions to implement priorities (e.g., [Activate Tucson](#)⁴⁴). [Community Commons](#) provides a toolkit for completing a CHNA that includes data and other resources for identifying community health needs. The County Health Rankings Framework mentioned above includes health data for every county in the United States.

BOX 5.0. OTHER USES FOR COUNTY HEALTH RANKINGS⁴³

County Health Rankings can give green infrastructure providers a snapshot of health in their county, and can also be helpful in making the case for green infrastructure as a health improvement strategy: the direct benefits of green infrastructure affect the Physical Environment category in Figure 4.3.a., and depending on siting and design, can also impact the Social & Environmental Factors category.

CAUTION—Assessing health needs at a countywide level can mask health inequities that exist in neighborhoods. County-level data is a good start, but applying an equity lens relies on disaggregating data to the smallest geography and by population to the extent possible.

County Health Rankings also offers [What Works for Health](#), a free database of health interventions that have been reviewed and scored based on evidence of effectiveness and likely impact on disparities. Some of the green infrastructure strategies in the database include rain barrels, rain gardens, permeable pavement, multi-component groundwater management, lead in soil abatement, and several agriculture management best practices. Green infrastructure providers can consult this tool to learn about the potential impact of these interventions on health and inequities, and to select strategies that are a good fit for their communities.

⁴¹ Association of State and Territorial Health Officials. (2018). Clinical to Community Connections: Community Health Needs Assessments. Retrieved from www.astho.org/Programs/Access/Community-Health-Needs-Assessments/.

⁴² Vancouver Coastal Health, Fraser Health, and University of British Columbia Faculty of Medicine. (2013) My Communities My Health. Retrieved June 25, 2018 from <https://www.myhealthmycommunity.org/>; Ontario Community Health Profiles Partnership. (2018). About Ontario Health Profiles Site. Retrieved from <http://www.ontariohealthprofiles.ca/>.

⁴³ County Health Rankings, note 39.

⁴⁴ Pima County Health Department. (2010). Activate Tucson. Retrieved June 25, 2018 from <http://www.activatetucson.org/>.



For example, Healthy Pima⁴⁵ in Arizona has identified reducing vehicle crashes as a health priority, which allows green infrastructure providers to initiate a conversation about the traffic calming benefits of green infrastructure (e.g., creating separation between cars and pedestrians). Vancouver, British Columbia has identified extreme heat risks for older adults, so the green infrastructure team can connect tree canopy goals in those neighborhoods to potential for reduced urban heat. Data on community-identified health priorities are increasingly available.

Below is a rapid opportunity assessment method that provides a quick way to collect important information to start partnership conversations.

5.1. Method for Creating a Rapid Health and Outdoors Opportunities Assessment

Step 1. Access the CHNA and CHIP documents for each county public health department and nonprofit hospital that serves a green infrastructure program area.

Remember that scale is important—county-level data can mask localized health inequities or different community health needs. CHNAs require community input and often use the best available local data, but they are a starting point and should be combined with other information, especially information gleaned from community engagement.

CHNAs can often be found easily online (try these search terms “YOUR CITY/COUNTY NAME” “Hospital” “Community Health Needs Assessment”). CHNAs must be informed through community engagement and existing data on community health needs. From the CHNA, Community Health Improvement Plans (CHIPs)⁴⁶ are created to describe how health care organizations, the health department, and community stakeholders will work together to address those needs. The CHIP is often very consistent with the CHNA. Both the CHIP and the CHNA are used to guide community health investments from hospitals and health departments.

In the United States, tax-exempt hospitals are required (by the Internal Revenue Service and some state statutes) to invest community benefit dollars in order to maintain a hospital’s tax-exempt status, and these investments will ideally reflect the priorities and goals set forth in the hospital’s CHNA and CHIP. Community benefits include providing free health care (often called “charity care” or “indigent care”), research, community health, environmental benefits, etc. Investment in green infrastructure would fall under community health and environmental benefits. Hospitals often produce reports⁴⁷ on their community benefit spending that are posted online (try these search terms: “YOUR CITY/COUNTY NAME” “Hospital” “Community Benefits Report”).

⁴⁵ Pima County Health Department. (n.d.). Healthy Pima. Retrieved June 25, 2018 from <https://www.healthypima.com/>.

⁴⁶ CHIPs will often be hosted on the same website as the CHNA, but not always. Two different searches may be needed.

⁴⁷ Community Benefit Reports are not required, and so may not be available online for all hospitals in all states.

Step 2. Read through the CHNA, CHIP, and Community Benefit Reports to identify actionable opportunities.

While reading through the documents, record the opportunities. Some of the most relevant information might include:

- Hospital/County name;
- Primary health priorities and needs;
- Relevant health indicators/metrics used;
- Green Infrastructure-relevant findings and recommendations;
- Possible green infrastructure connections;
- Relevant existing partners;
- Weblink to the document and page numbers for key pages; and
- Other notes.

Focus on themes. Do not get bogged down in details, but be specific about where important information is so it is easy to find those pages when there are more detailed or different questions to explore in the documents.

Step 3. Extract information about current community health investments.

Each nonprofit hospital typically produces a Community Benefit Report⁴⁸ summarizing annual investments meeting IRS and state requirements. Typical investment categories include charity care, research and education, and community health/programs. Investments in the social determinants of health are most often described in the “community health/programs” section. In the Community Benefit Reports, identify the total overall community benefit investment from a hospital and the total community health/programs investment. Community health investment is likely to be a small percentage of the overall community benefit investment. The reports will often identify examples of their investments. Identify the partnerships that are similar to green infrastructure program, or where access to green infrastructure could play a role.

Step 4. Identify patterns, links, and opportunities.

Compare what has been learned from the CHNA, CHIP, and Community Benefit Report to the general evidence on how green infrastructure improves health (see Section 3) to identify opportunities of how green infrastructure work links to health priorities. Brainstorm possible patterns linking science findings, local health priorities, and the environments created by green infrastructure. Note that if a City/Region has many hospitals (e.g., Los Angeles), health priorities may not be consistent across hospitals, and some of the hospitals may not be aware of opportunities for alignment.

Step 5. Write up something simple to use as a conversation starter.

The Green Infrastructure Leadership Exchange produced a 2-page template for a Health and Outdoors Opportunities Assessment and filled in the template for Vancouver, Seattle, Portland, Tucson, and Los Angeles. The analysis was rapid, and city staff could then use the practical handout to start conversations.

⁴⁸ See for example, Seattle Children's Hospital. (2017). Community Benefit Report 2016-2017. Retrieved from <http://www.seattlechildrens.org/about/community-benefit/>.

Make the Case: Business and More

There are many ways to make a health case for green infrastructure. The most effective appeals will speak to the hearts, minds, and wallets of the people who need to be convinced. This section provides talking points and suggestions for how to build arguments that make the case for different audiences.

Do you need a 30-second elevator pitch on why green infrastructure can be good for health? The templates in Table 6.0 provide a general pitch on the health and green infrastructure link, and a customizable pitch template, which can be filled out with information for specific communities, health needs, and audiences based on the information in Section 6.2.



TABLE 6.0. QUICK PITCHES FOR HOW GREEN INFRASTRUCTURE CAN IMPROVE HEALTH

GENERAL PITCH
<p>Did you know that your ZIP/postal code determines more of your health than your genetic code? Where we live and how we live our daily lives has more impact on health than going to the doctor, and that's especially true for communities facing inequities. We don't all live in equally healthy places: did you know that across the U.S., race is the most significant predictor of a person living near contaminated air, water, or soil? We need a way to create healthier places in the communities with the greatest need. Making these communities greener is a way to do that.</p> <p>The United States spent more than \$10,000 per capita on health care (18% of Gross Domestic Product) in 2016, and Canada spent \$4,700 per capita (12% of GDP).⁴⁹ We know health care costs continue to grow and we know access to green spaces improve health and can potentially reduce those costs. Studies show that kids who walk for 20 minutes in a park perform better in school,⁵⁰ that a 90-minute walk outdoors can significantly reduce stress and early stages of depression,⁵¹ and that street trees along busy streets can reduce the air pollutants we breathe.⁵² We MUST strengthen the link between more green space and better health, and act on it.</p> <p>Now imagine that we're getting ready to spend billions on our road, energy, and water infrastructure. What if we spent that money in a way that brings people together to plant trees, protect open space, create jobs, and advance health? It's not that difficult—we just need solutions that work for both nature and people.</p> <p>Our City is already greening neighborhoods in ways that improve health. Together, we can do more:</p> <ul style="list-style-type: none"> • Green infrastructure is health infrastructure—something we need to invest in and care for; • Engaging the community in design and implementation of green infrastructure builds social cohesion and better health; and • We can reduce health inequity by locating green infrastructure in the places that need it most and by designing it with communities to improve health.
CUSTOMIZED PITCH TEMPLATE (SUBSTITUTE RELEVANT DETAILS FOR BLUE LETTERING)
<p>We know that more green space and time outdoors in green and natural areas improves health: it leads to cleaner air, reduced stress, improved mental health, more physical activity, and stronger social connections. Health partners in CITY/UTILITY NAME have also identified the most significant health needs: HEALTH NEED 1, HEALTH NEED 2, HEALTH NEED 3.</p> <p>Our organization has an obligation to do MISSION AREA 1, MISSION AREA 2, MISSION AREA 3. We have an opportunity to use green infrastructure to meet those needs in CITY NAME/UTILITY AREA WHILE ALSO making progress on these health priorities, and we can do it in a way that creates an asset for the community, prevents disease, lowers health care costs, and protects the environment.</p> <p>If we want to do more to improve health through green infrastructure, we should:</p> <p>ACTION 1 (e.g., engage with communities experiencing inequity);</p> <p>ACTION 2 (e.g., Prioritize use of green infrastructure to achieve stormwater management goals while also increasing proximity and connectivity of green space);</p> <p>ACTION 3 (e.g., Remove physical barriers to accessing existing green space); and</p> <p>ACTION 4 (e.g., Remove perceived barriers to accessing existing green space).</p>

⁴⁹ Sawyer, B, and Cox, C. (2018, February 13). How does health spending in the U.S. compare to other countries? Kaiser Family Foundation. Retrieved from <https://www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries/>.

⁵⁰ Taylor, A.F., and Kuo, F.E. (2009). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorder*, 12, 402–9.

⁵¹ Bratman, G.N., Hamilton, J.P., Hahn, K.S., Daily, G.C., and Gross, J.J. (2015). Nature experience reduces rumination and subgenual prefrontal cortex activation. *Proceedings of the National Academy of Sciences of the United States of America*, 112 (28), 8567–572.

⁵² Islam M.N., Rahman, K.S., Bahar, M.M., Habib, M.A., Ando, K., and Hattori, N. (2012). Pollution attenuation by roadside greenbelt in and around urban areas. *Urban For. Urban Green*, 11, 460–64.



Powell Butte / NNA Landscape Architecture



Green infrastructure during the work day / Willamette Partnership



A day in a park / Willamette Partnership

6.1. The Business Case for Health and Green Infrastructure

Health care represents 18% of GDP in the United States,⁵³ or 8% of the average household's expenditures.⁵⁴ Time in green spaces has the potential to reduce health care costs.⁵⁵ Being healthy is a value that appeals to almost everyone, and it has the potential to lead to new partnerships and engage and support communities working on and/or interested in green infrastructure. These are all important reasons that more access to green infrastructure is important, and that green infrastructure providers should consider themselves public health providers.

People in many different roles will make and carry out decisions about green infrastructure investment for health. They have to weigh all sorts of variables, such as cost, political mood, and community acceptance. Table 6.1. lists examples of messages and appeals for decision makers and supporters.

⁵³ Sawyer and Cox, note 33.

⁵⁴ Bureau of Labor Statistics. (2017, August 29). Economic News Release: Consumer Expenditures 2016. Retrieved from <https://www.bls.gov/news.release/cesan.nr0.htm>.

⁵⁵ Wolf, K.L., and Robbins, A.S.T. (2015). Metro nature, environmental health, and economic value. *Environmental Health Perspectives*, 123 (5), 390-98. DOI: 10.1289/ehp.1408216.

TABLE 6.1. EXAMPLES OF MESSAGES AND APPEALS FOR DECISION-MAKERS AND SUPPORTERS

AUDIENCE	CASE	CASE STATEMENTS
<p>Utility ratepayers</p>	<p>1) Green infrastructure does more than collect and clean water—it can also have human health benefits.</p> <p>2) And that is why it is worth investing in green infrastructure, and having it in your neighborhood or close to your business.</p>	<p>Your zip code/postal code determines more of your health than your genetic code, so when you think about a green infrastructure project in your neighborhood, do not just think about captured and cleaned stormwater—think about your health, your kids’ health, your neighbor’s health, and what it means to be a healthy community. Green infrastructure projects bring more nature into our neighborhoods, and being in areas with trees, green space, and other natural elements can improve our health, even if it is just a few minutes each day. It eases stress and anxiety, encourages people to be more active, and can strengthen our relationships with friends and the greater community.</p>
<p>Elected officials</p>	<p>1) Broader audiences are engaged when the health and equity benefits of green infrastructure are talked about.</p> <p>2) Green infrastructure can offer health return on investment (ROI) as well as stormwater/infrastructure ROI.</p> <p>3) Investing in green infrastructure makes a city more resilient—able to withstand environmental, economic and social challenges.</p>	<p>1) People love clean water, clean air, and natural places to play—they love being healthy. When discussing green infrastructure projects, talk about what they will do for the health of the community, and how they can address health equity. More people will listen, and more people will show up to support green infrastructure.</p> <p>2) Green infrastructure costs money, but it’s an investment in more than just stormwater management. With the right design, siting, and community engagement, it can reduce health care spending and improve health equity—it is an asset that improves quality of life and builds opportunity. Additionally, the cost of green infrastructure is often less than for gray infrastructure when the full life cycle costs are considered.</p>

Continued on page 27

AUDIENCE	CASE	CASE STATEMENTS
<p>Community-based organizations; Public health officials and advocates; Health care; Foundations; Environmental groups</p>	<p>1) The greatest health impact comes with a focus on health equity.</p> <p>2) If there is interest in partnering to lead, fund, or support green infrastructure projects because of their potential health impact, then advocacy for equity impacts is also important.</p> <p>3) Cities might be looking for only a small cost difference (e.g., 10% cheaper) to select a green infrastructure alternative over a gray option. Frequently green is cheaper, but not always. City infrastructure projects might be looking for a small cost difference to select a green infrastructure alternative over a gray option.⁵⁶ Partner organizations could make a big impact if they are able to help fund the shift in city infrastructure strategies from grey to green strategies.</p>	<p>Reducing health inequity is the right thing to do, but it is also one of the most important strategies in reducing health care costs. If someone has a disability, is a person of color, has a low income, or lives in rural areas, they have a higher risk of chronic disease.</p> <p>When green infrastructure is a health strategy, green infrastructure needs to benefit the communities that need the most health improvement.</p> <p>When green infrastructure providers are explicit about advancing health equity and which populations they are serving, it becomes easier for health officials and community-based organizations to see their role as partners.</p> <p>This might mean adjusting who to work with, where green infrastructure is placed, and how it is designed—all exciting opportunities.</p>
<p>Hospitals; state Medicaid; Elected officials; Foundations; Environmental groups</p>	<p>1) Green infrastructure can increase access to nature, which can improve health and reduce health care costs.</p> <p>2) Cities might be looking for only a small cost difference (e.g., less than 10% more expensive) to select a green infrastructure alternative over a gray option. A small investment could leverage large infrastructure investments.</p>	<p>Green infrastructure projects bring green space to people and make nature more accessible—whether it is at a worksite, a school, a hospital, or in a neighborhood. There is evidence that time in nature can increase physical activity, improve mental health, and improve social cohesion—not to mention that trees clean the air that people breathe. These are benefits that address some of the top health issues: obesity, chronic disease, mental health, and respiratory conditions. There is potential to lower health care spending by investing in green infrastructure that is designed and sited to maximize health improvements.</p>

⁵⁶ Tracy Tackett, Seattle Public Utilities, personal communication, June 25, 2018.

Begin casemaking with what communities say is important to improving health (see Section 5 for getting data from Community Health Needs Assessments). With that anchor, link green infrastructure work to those needs (see Appendix C for sample logic model). This can be enough information to make a compelling case to ratepayers or city councils for changing how green infrastructure investments are made. Some other questions that can inform how to build the case include:

- Where is an agency or organization preparing to invest in a project where a health-nature lens could contribute to the same goals, at similar cost,⁵⁷ and with broader benefits (e.g., a new city combined sewer overflow plan; the state making a major investment in rolling back access to prescription opioids; significant transportation or other infrastructure investments; or a new hospital facility, merger, or foundation formation)?
- How can green infrastructure support other priority goals (e.g., housing stability, reducing opioid addiction, or reducing extreme heat exposure)?
- Who is best suited to deliver the case? Who are respected champions? A message usually has greater influence when delivered by the combined voices of business, health, community, and environmental groups.
- Who else is already doing similar work (e.g., public agency, nonprofit, or private sector)? And how can that work or project be leveraged to add value, rather than duplicate efforts and costs?
- Is it possible to form a coalition of organizations all working toward health goals to collectively pursue larger funding sources, rather than each organization competing for rare funds?

BOX 6.1. ACCESSING HEALTH CARE FUNDING FOR GREEN INFRASTRUCTURE

There are multiple ways that health care and cities can collaborate to share costs of green infrastructure programs. Capital expenses (e.g., trees and sidewalks) may be the most difficult for health care to fund. It may be easier for health care partners to support actions such as outdoor programming, acquiring data, conducting evaluation, doing community engagement, or even stewardship. These activities fall under utility operations and maintenance budgets, which are often limited by fund restrictions, so a health care partner may be quite helpful. There are examples of cities and health care funders co-investing for more time in nature to improve health. For example, Park Prescriptions,⁵⁸ and, Walk with a Doc,⁵⁹ are two programs with health care funding that get patients and clinicians out together in green spaces. There are some examples where hospitals have funded greenway and active transportation capital improvements (e.g., Seattle Children's Hospital Livable Streets investments in greenways and bike lanes⁶⁰).

⁵⁷ Tackett, 2018, note 52.

⁵⁸ <http://www.parkrx.org/park-prescription-programs>.

⁵⁹ <https://walkwithadoc.org/>.

⁶⁰ <http://construction.seattlechildrens.org/livablestreets/>.



The High Line / Willamette Partnership

6.2. Nesting Health Within Broader Organizational Goals

If a green infrastructure program is housed in an agency or department that manages stormwater or wastewater, or is in a parks department or utility, it is likely that public health improvement is already part of the agency’s mission statement. Managers and staff readily recognize the health contributions of their projects and sites. However, if the department is a drinking water or wastewater department, the mission statement’s health focus may still be on removing the direct risk of communicable disease (e.g. viruses and bacteria) or eliminating toxins, and may not include reducing chronic disease. Because these departments’ projects often create green spaces where nature experiences can happen—and thus where health benefits can be created—the understanding of their mission statements could be modified to include reducing chronic disease.

Some strategies for nesting the green infrastructure-health link within an organization’s broader mission or strategic focus are included in Table 6.2.

TABLE 6.2. STRATEGIES FOR NESTING HEALTH IN ORGANIZATIONAL GOALS

STRATEGY
When “health” already appears as an aspirational goal in an agency’s mission, use a social determinants of health framework to provide more detailed strategy or action area.
Use a health equity frame to make an organizational exploration of equity, diversity, and inclusion more explicit (see Section 7).
Include health factor/outcome metrics in annual reports to the public, capital improvement planning and prioritization, or organizational budgeting decisions.
Ensure voices for health equity are present in leadership (e.g., elected boards, advisory committees, staff job descriptions, and formal partnerships).

Community Engagement: Why and How

Engaging communities impacted by green infrastructure projects is essential. Bringing communities to the table early on in the process and sharing decision-making—especially with groups who have been underrepresented in decision-making and/or are experiencing inequities—is integral to a project’s success, especially when considering impacts on health and equity. Community engagement is one of the most important tools for advancing health equity. Appendix A includes detailed guidelines and principles of community engagement.

BOX 7.1. WHY COMMUNITY ENGAGEMENT IS ESSENTIAL

Affirming and including the wisdom, expertise, and experience of the community generates better project outcomes and increases social cohesion, which in turn has positive effects on community health.⁶¹ Those stronger social relationships provide capacity to solve future community challenges and increase community ownership of green infrastructure solutions.



Tualatin River stakeholders / Willamette Partnership

⁶¹ Clinical and Translational Science Awards Consortium Community Engagement Key Function Committee Task Force on the Principles of Community Engagement. (2011). Principles of Community Engagement (Second Edition). Department of Health and Human Services. NIH Publication No. 11-7782. Retrieved from https://www.atsdr.cdc.gov/communityengagement/pdf/PCE_Report_508_FINAL.pdf.

Not all external-facing activities classified as community engagement are meaningful. Sherry Arnstein's Ladder of Citizen Participation⁶² and the International Association of Public Participation (Figure 7.1.) provide conceptual frameworks that are useful for gauging meaningfulness of community engagement.

FIGURE 7.1. SPECTRUM OF COMMUNITY ENGAGEMENT⁶³

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities, and/or solutions.	To obtain public feedback on analysis, alternatives, and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

There are several practices and characteristics that identify meaningful community engagement:

- Leverage existing relationships—ideally, the relationships that already exist with communities, but also relationships partner organizations have built with communities;
- Plan and budget for meaningful community engagement throughout the project;
- Identify questions and commit to incorporating the community's answer;
- Practice dialogue, not direction;
- Listen and be consistent; and
- Meaningful community engagement produces some degree of positive change.

⁶² Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Planning Association*, 35 (4), 216-224.

⁶³ International Association for Public Participation. (2014). IAP2's Spectrum of Public Participation. Retrieved from https://www.iap2.org.au/Tenant/C0000004/00000001/files/IAP2_Public_Participation_Spectrum.pdf.

BOX 7.2. PORTLAND BUREAU OF PLANNING AND SUSTAINABILITY COMMUNITY LIAISONS

Portland Planning and Sustainability has paid, full-time community liaisons whose job is to network with community groups and form trusting relationships. These liaisons are able to assist other city departments as well. Although other departments may not fund the liaison positions, the arrangement makes key personnel and expertise available throughout the organization.

Equity and community engagement are not the same thing—solving equity issues requires much more than simply interacting with people in communities. However, equity should be a core principle when planning and executing community engagement. This means being attentive to the societal, economic, and political conditions that create inequity between groups, and understanding how these dynamics could affect an engagement process. Work with community members to develop engagement processes that go beyond simply removing barriers to participation, to actually building community capacity—an important part of improving health equity. Consider partnering with Community Health Workers or other local leaders with deep knowledge of the community and expertise in equitable engagement methods (e.g., Popular Education⁶⁴). A community health worker is a frontline public health worker who is a trusted member of and/or has an unusually close understanding of the community served.

Assessing your readiness for engagement

Before engaging communities, assess your own organization's readiness and capacity to do so meaningfully. Scan the environment or community to see what community groups are already working this and how to best support and partner. These steps will help provide important historical context, a better understanding of the extent to which power will be shared with the community, and reasonable expectations for engagement outcomes. In assessing readiness, consider the following:

- Are there teams or staff within the agency that have worked with the community before (what were the outcomes?) and do they have connections that can be leveraged?
- Is the agency or department experienced with regard to the community's culture, history, experiences? If not, are there ways to gain that experience?
- Are there disconnects between the agency's mission and the community's needs? Can the mission be changed? If not, what are the best ways to communicate the disconnect to the community?
- Not everyone will trust the agency at first. Go in ready to listen, not tell.
- Find supporters and leverage their support with the rest of community.
- Be aware of unintended consequences. For example, adding green infrastructure may increase property value and lead to gentrification. If this is a risk, start working on reducing that risk at the beginning by asking the community what they need and want in the long term. This may mean reaching out to other agencies and organizations to find solutions.

⁶⁴ Wiggins, N. (2011). Popular education for health promotion and community empowerment: a review of the literature. *Health Promotion International*, 27(3), 356-371. doi:10.1093/heapro/dar046. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21835843>.

Building the community's readiness to embrace and succeed in leadership roles

When planning an engagement project, “meet them where they are” is a useful principle both literally and figuratively. Literally speaking, this means conducting engagement activities in a location, time, and format convenient to a focus community in order to minimize transportation barriers and create a more comfortable environment. Figuratively speaking, it means engaging the focus community at the level that makes sense for the community. Be prepared to use funds to provide childcare, food, interpretation services, transportation, etc., and for compensating individuals for their participation. Be aware that many agencies ask communities (usually via the same culturally-specific and other trusted organizations) to participate in engagement activities that ask similar questions. Whenever possible, combine efforts with other agencies to minimize the burden on these organizations and community members.

Building relationships and trust with communities

Start engaging with community leaders who represent those who have the least capacity and power, then work up to those with the most power. If at first you don't succeed, try, and try again. If things do not work out the first time, reflect on the approach taken, and keep showing up, building trust, and finding key community members who can help communicate and build relationships. Do not disappear, but take time to invest in the connections that are working and re-strategize with community partners on the best way to increase buy-in.

Be intentional about where, how, and when to engage. For example, do not default to mid-day meetings or formal public comment periods if partner communities cannot get time off from work or have other barriers to engaging that way. It is likely that not all communities that are impacted will show up, so be mindful of the needs of communities not in the room when choosing green infrastructure locations and creating designs.



BOX 7.3. TRAUMA-INFORMED COMMUNITY ENGAGEMENT

Communities facing health inequity have often been subjected to interpersonal violence, structural violence, and historical harms—community trauma.⁶⁵ The Urban Institute built a model for trauma-informed engagement that includes principles around “do no harm” and “community power,” strategies, and practices that inform how to engage with communities with current and past traumas.

⁶⁵ Falkenberger, E., Arena, O., and Wolin, J. (2018, April). Trauma-Informed Community Building and Engagement. Urban Institute. Retrieved from https://www.urban.org/sites/default/files/publication/98296/trauma-informed_community_building_and_engagement_0.pdf.






Green Infrastructure Siting and Design: Considerations for Health

When it comes to health improvement, not all green infrastructure project locations or designs are created equal. Where should green infrastructure projects be located for the most health benefit? What design elements should be included to maximize positive health impact? Thinking through the details of location (siting) and design can help green infrastructure programs maximize the health benefits of green infrastructure projects.

Cities are composed of systems, such as housing systems and transportation systems. (Figure 8.0.). When green infrastructure is considered through a health lens and how it affects different parts of the built environment, decisions on policy and plans may shift. For example, city planners might sequence housing stability investment, then greening, then active transportation investments to promote health and combat gentrification.



FIGURE 8.0. PLANNING PRINCIPLES FOR HEALTHY BUILT ENVIRONMENTS⁶⁶

	SOCIAL WELL-BEING	ECONOMIC CO-BENEFITS	SMALL & MEDIUM SIZED COMMUNITIES
 <p>NEIGHBORHOOD DESIGN</p> <ol style="list-style-type: none"> 1. Create complete neighbourhoods through mixed land use 2. Build compact neighbourhoods through efficient planning 3. Enhance connectivity with efficient and safe networks 4. Prioritize new developments within or beside existing communities 			
 <p>TRANSPORTATION NETWORKS</p> <ol style="list-style-type: none"> 1. Use street designs which prioritize active transportation 2. Make active transportation networks safe and accessible for all ages and abilities 3. Design connected routes for active transportation and support multiple modalities 4. Consider the aesthetics of road, rail, and waterway networks 			
 <p>NATURAL ENVIRONMENTS</p> <ol style="list-style-type: none"> 1. Preserve and connect environmentally sensitive areas 2. Maximize opportunities for everyone to access natural environments 3. Reduce urban air pollution by expanding natural elements across the landscape 4. Mitigate urban heat islands by expanding natural elements across the landscape 			
 <p>FOOD SYSTEMS</p> <ol style="list-style-type: none"> 1. Increase equitable access to and affordability of healthy food options 2. Protect agricultural land and increase the capacity of local food systems 3. Support community-based food programs 			
 <p>HOUSING</p> <ol style="list-style-type: none"> 1. Prioritize affordable housing options through diverse housing forms and tenure types 2. Ensure adequate housing quality for everyone 3. Provide specialized housing options to support the needs of marginalized populations 4. Site and zone housing developments to minimize exposure to environmental hazards 			

The planning principles in Figure 8.0 are goals. How can green infrastructure help achieve them? Many studies from around the world show correlations between time spent in urban green space and improved health. The siting and design guidelines in the sections below are drawn from this evidence, in addition to examples from programs that link health and time in green spaces. The siting and design guidelines in this section are based to the extent possible on the available evidence, and beyond that they rely on the best professional judgement of the authors. The guidelines should be revisited regularly to incorporate the rapidly emerging science connecting health and nature.

⁶⁶ BC Centre for Disease Control, 2018, note 29.

⁶⁷ Communities are increasingly concerned about greening efforts exacerbating gentrification. Gentrification is a complex process tied to structural inequity (e.g., past redlining), city growth, and other forces. Reference for green gentrification from Haffner, J. (2015, May 6). The dangers of eco-gentrification: what's the best way to make a city greener? The Guardian. Retrieved from <https://www.theguardian.com/cities/2015/may/06/dangers-ecogentrification-best-way-make-city-greener>.

8.1. Siting Guidelines

Selecting locations, or siting, for green infrastructure installations that are co-designed for water, health, and other benefits involves both engineering feasibility and community engagement. The goal is to identify where different types of green infrastructure are possible, preferred, and will not exacerbate pressures from gentrification.⁶⁷

Green infrastructure planners prioritizing health will need accurate information about the health of various focal populations to identify inequities. County and provincial/state health departments may have fine-resolution spatial information on health. State and provincial departments of environmental quality may have local air quality data. Community members and community-based organizations also have a lot of information on where green infrastructure might generate health improvements. Remember, being meaningfully involved in the process by which green infrastructure is prioritized and located can itself improve health among engaged community members. Thus, how siting decisions are made may matter just as much as the final decision on where green infrastructure is placed (Table 8.1.).

TABLE 8.1. SAMPLE GREEN INFRASTRUCTURE SITING GUIDELINES FOR HEALTH, WITH A FOCUS ON EQUITY

HEALTH BENEFIT	LOCATION CONSIDERATIONS
Social and Economic Factors	<p>Prioritize postal codes/blocks where people may or do experience health inequities (e.g., high percentage of people of color, low-income, or direct health measures such as incidence of chronic disease). Work with government and community partners to avoid contributing to displacement and gentrification.</p> <p>Use an equity lens on siting and prioritization to consider how different cultures might engage with a siting prioritization process:</p> <ul style="list-style-type: none"> • Identify the populations most likely to use green infrastructure in different neighborhoods, and how to prioritize communities facing health inequity; • Incorporate community priorities articulated in the past relative to land use, environment, transportation, food, and housing into siting criteria; • Consider cultural preferences and expressions, such as how green infrastructure planting design can promote community identity; • Explore how a green infrastructure plan could help provide urban agriculture and healthier food; • Think about ways to plan and act at the same time. Many communities have articulated priorities without seeing action. To get engagement on green infrastructure siting, it may be important to demonstrate commitment by implementing an early community priority; and • Consider conducting a health equity impact assessment to better understand how the location of green infrastructure can impact health equity, and to generate neighborhood-level, qualitative data from stakeholders (which may not otherwise exist).

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HEALTH BENEFIT	LOCATION CONSIDERATIONS
Air Quality	<p>Prioritize filtering vegetation in postal codes/blocks with high air pollution exposure:</p> <ul style="list-style-type: none"> • proximity of people (especially people experiencing health inequities, low-income housing, and sensitive populations such as schools and senior care centers) to land uses correlated to air pollutants such as industrial, or high-speed and high-volume roadways and other transit; and, • modeled or measured exposure (e.g., to nitrogen dioxide, particulate matter, or heavy metals). <p>Prioritize filtering vegetation near heating, ventilation, and air conditioning (HVAC) intakes for buildings.</p>
Heat and Sun Exposure	<p>Prioritize shade-producing installations at south- and west-facing fronts of multi-family and other residential buildings (especially in areas with sensitive populations such as the older adults or children).</p> <p>Prioritize shade in/around ball fields and schoolyards to reduce UV exposure for children.</p> <p>Prioritize tree planting in areas with a high percentage of impervious surfaces (e.g., streets, parking lots and rooftops) but little tree canopy.</p> <p>Protect existing large stands of trees and large meadows from being converted to impervious surfaces.</p> <p>Prioritize tree plantings and living walls at south and west-facing fronts of multi-family and other residential buildings, as well as schools, libraries, community centers, churches, and other community facilities in areas with sensitive populations such as older adults or children.</p>
Mental Health	<p>Locate windows and green space to make green space more visible when looking out from inside places, like multi-family housing, hospitals, and school buildings.</p> <p>Create green space corridors (or large or well-connected natural spaces) to “get away from it all” (attention restoration).</p> <p>Identify areas along pedestrian routes where green infrastructure can also be used as rest areas to allow for breaks (attention restoration).</p> <p>Prioritize adding green infrastructure inside or outside employment centers, in locations where people are or could be taking lunch or midday breaks; and outside areas near larger employment centers to provide areas for relaxation and physical activity during the workday (especially employers with a high number of low income or community of color workers).</p> <p>Use vegetation to buffer loud noise or safety concerns (e.g., linear green space that separates cars from pedestrians) (stress reduction).</p>
Physical activity	<p>Prioritize greening pedestrian corridors that increase use of/access to trails, sidewalks, parks, and open space (e.g., Safe Routes to School). Consider further prioritization in high-density areas where there are lots of people that could be walking.</p> <p>Enhance green spaces along bike routes.</p> <p>Create loop trails around parks.</p> <p>Promote greater connectivity between existing parks and other green spaces by enhancing pedestrian connections with green infrastructure.</p>
Social cohesion	<p>Enhance areas where people already gather (e.g., schools, churches, big employer lunch areas, hospitals, etc.) with green infrastructure.</p> <p>Select areas large enough so that incorporating group activities in later design is possible.</p> <p>Select areas where community members have identified a lack of community gathering spaces (both indoors and outdoors).</p>

8.2. Site Design Guidelines

Where green infrastructure is located matters a lot for factors such as reducing air pollutant and extreme heat exposure. How green infrastructure is designed—how it facilitates the movement and feelings of people through and around green spaces—matters a lot for physical activity, mental health, and social cohesion. In general, the more green infrastructure can enable more frequent and deeper connections between nature and groups of people, the better.

Sometimes, residential stormwater detention facilities are surrounded by a chain-link fence to keep people out and make maintenance of that facility easier. The fence may allow for the health benefits of “seeing” the green space, but it removes the opportunities for people to come in contact with a more natural setting. Table 8.2. presents a full suite of nature design options, and the health benefits that might accrue. More information is available from a publication from The Nature Conservancy, *Cascading Benefits*.⁶⁸ In most green infrastructure projects there will be tradeoffs between design and safety, construction and maintenance costs, multiple desired outcomes, and requirements. Yet, if considered early in the green infrastructure project, a commitment to designing for health will expand experiences and benefits.



⁶⁸ Wolf, K.L. (2018). *Cascading Benefits: Designing Green Stormwater Infrastructure for Human Wellness*. Seattle: The Nature Conservancy. Retrieved from http://www.cityhabitats.org/wp-content/uploads/2018/05/tnc_gsi-report_2018_final-r1_digital.pdf.

TABLE 8.2. SAMPLE GREEN INFRASTRUCTURE DESIGN GUIDELINES FOR HEALTH

HEALTH BENEFIT	DESIGN GUIDELINE
Social and economic factors	<p>Use an equity lens on site design to consider how different populations (cultural groups, income levels, abilities, etc.) might engage with the design process.</p> <p>Identify the populations most likely to use the space, and how to prioritize communities facing health inequity.</p>
Air quality	<p>Maximize multi-story vegetation (trees, shrubs, and ground cover) and diversity of vegetation as a buffer/filter between air pollutant sources and people who use the green space or live/work nearby.</p> <p>Select tree species that emit lower concentrations of volatile organic compounds,⁶⁹ are better at filtering air pollutants (e.g., evergreens if air pollution exposure is highest in winter), and are more resilient to air pollution.</p> <p>In larger green spaces, locate high-use areas (e.g., play structures, or food prep facilities) farther away from air pollution sources (e.g., highways).</p> <p>Near heating, ventilation, and air conditioning (HVAC) intakes for buildings, select vegetation that A) filters pollutants, and B) does not create high pollen counts, volatile organic compounds, or other potential irritants for people with asthma or chronic respiratory disease.</p>
Extreme heat	<p>Balance sun and shade.</p> <p>Maximize taller and more shade-producing vegetation, especially to provide shade on buildings during the hottest part of the day during the hottest part of the year.</p> <p>Provide canopy cover/shade along pedestrian and bike corridors.</p> <p>Look to green/living roofs and green walls to mitigate extreme heat exposure and cool buildings.</p>
Mental health	<p>Where green space is designed to be viewed from inside, include a variety of vegetation structure and species. People should be able to see into the space.</p> <p>Create continuous corridors of green spaces that people experience as they move through the neighborhood (e.g., in rights of way along bike or pedestrian paths).</p> <p>Create spaces where someone can feel “immersed” and “safe” in the green space (e.g., benches tucked back from a path but in full view,⁷⁰ places to walk and sit where someone cannot see the built environment, outdoor “rooms,” opportunities for kids and families to “touch” nature (e.g. racing sticks down flowing water or crushing aromatic leaves).</p> <p>People prefer being near larger trees.⁷¹</p> <p>Water features can be restorative.⁷²</p> <p>Create paths that wind and do not have a visible end, creating a sense of safe adventure and exploration. People prefer landscapes that strike a balance between feeding curiosity and hanging together coherently.⁷³</p> <p>Create green rest areas along pedestrian routes that can allow for breaks for 3 or more people.</p> <p>Create areas for lunch and midday breaks near larger employment centers that can accommodate 3 or more people.</p> <p>Select vegetation that reduces noise. Occupational health limits call for 85 decibels, but human comfort level is closer to 4-60 decibels.⁷⁴</p> <p>Design for separation between transportation routes (vehicles, fast bicycles) and pedestrians.</p>

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⁶⁹ Ren, Y., Qu, Z., Du, Y., Xu, R., Ma, D., Yang, G., Shi, Y., Fan, X., Tani, A., Guo, P., Ge, Y., and Chang, J. (2017). Air quality and health effects of biogenic volatile organic compounds emissions from urban green spaces and the mitigation strategies. *Environmental Pollution*, 230, 849-861. DOI: 10.1016/j.envpol.2017.06.049.

⁷⁰ Prospect-refuge theory holds that people tend to stay near edges in landscapes (refuges), but with a view into the open space (prospect) (Wolf, 2018, note 50).

⁷¹ Wolf, K. L. (2005). Business district streetscapes, trees, and consumer response. *Journal of Forestry*, 103 (8), 396-400.

⁷² Grossman, P., Niemann, L., Schmidt, S., and Walach, H. (2004). Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of Psychosomatic Research*, 57 (1), 35-43.

⁷³ Gimblett, H. R., Itami, R. M., Fitzgibbon, J. E. (1985). Mystery in an information processing model of landscape preference. *Landscape Journal*, 4 (2), 87-95.

⁷⁴ Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. *Lancet*, 383 (9925), 1325-332. DOI: 10.1016/S0140-6736(13)61613-x.

HEALTH BENEFIT	DESIGN GUIDELINE
Physical activity	<p>Design green space that is universally accessible.</p> <p>Add appropriate trails and paths along existing streams and wetlands. Be mindful of sensitive fish and wildlife habitat and use trails to direct people away from sensitive areas.</p> <p>Create connections wherever possible, increasing proximity and connectivity for green areas.⁷⁵ Think about physical connections (e.g., continuous sidewalks) and visual connection (e.g., the ability to see progress to where someone is going).</p> <p>Use green spaces to increase route options. Commuters want the most direct path between Point A and Point B. Recreational walkers want to have choices or wander.</p> <p>Pay attention to integrated design of three sidewalk zones (building frontage, pedestrian, and planting strips)⁷⁶ (Wolf, 2018).</p> <p>A ¼ to 1 mile loop trails are great for increasing physical activity.</p>
Social cohesion and safety	<p>Benches and other seating should let 3 or more people use the space at the same time.</p> <p>Design picnic tables or other eating surfaces to be easily arranged for small or large groups.</p> <p>Incorporate drinking water and food prep facilities wherever possible.</p> <p>Provide restroom access.</p> <p>Create areas large enough to accommodate group activities, as gathering spaces are important to many communities. The opportunity to be in green space with a group may help some communities feel safer.</p> <p>Incorporate shared management/stewardship of green infrastructure and open spaces with institutions that gather people (e.g., schools, churches, neighborhood groups).</p> <p>Use design elements that show the green spaces are cared for, and not neglected (e.g., mown edges or ornamental borders show the wildness of natural area is intentional).⁷⁷</p> <p>Provide play areas for a range of ages.</p> <p>Use planting and other design choices that reflect the cultural and historic roots of a place.⁷⁸</p> <p>Create opportunities for leadership in stewardship of spaces (e.g., create a Friends of Main Street Bioswale).</p> <p>Within public spaces offer a variety of seating arrangements, particularly moveable chairs so that people can stop and rest, or engage with other people.</p> <p>Design green space to balance visibility for perceived safety (e.g., lighting, multiple lines of visibility) with the feeling of “getting away from it all.”</p>

⁷⁵ Sugiyama, T., Cerin, E., Owen, N., Oyeyemi, A.L., Conway, T.L., Van Dyck, D., Schipperijn, J., Macfarlane, D.J., Salvo, D., Reis, R.S., Mitáš, J., Sarmiento, O.L., Davey, R., Schofield, G., Orzanco-Garralda, R., and Sallis, J.F. (2014). Perceived neighbourhood environmental attributes associated with adults' recreational walking: IPEN adult study in 12 countries. *Health & Place*, 28, 22-30.

⁷⁶ Wolf, 2018, note 50.

⁷⁷ Wolf, 2018, note 50.

⁷⁸ Wolf, 2018, note 50.

Evaluating Health Benefits of Green Infrastructure

Program managers and decision-makers want to know whether green infrastructure investments are producing anticipated health outcomes. Evaluating health improvement is not easy. Measuring change in chronic disease for a specific population can take years, and measuring health is challenging because a person's health is shaped by many factors (e.g., individual genetics, race, where people live, their job, etc.). It can be hard to tie specific outcomes to particular program inputs, but it is important to measure what is feasible. Start thinking about evaluation early, and work with the community to define what success looks like and how best to measure that success. Even simple measures of health are important. If in a study or evaluation a subject says, "I am feeling better," that is important information, simple as it may be.⁷⁹ This section provides evaluation steps and ways of collecting data about both the healthy environments that result from green infrastructure and people's health responses.

9.1. Program Evaluation for Health Outcomes

Programs are a combination of the project leaders, project participants, processes and outcomes or outputs. The collection of decisions to locate, design, implement, and manage green infrastructure is a program. Often, program managers need to know how a program is performing to justify additional funding, grow the work, or adaptively manage a program for improvement. Many programs linking health and green infrastructure are new and may not be mature or large enough to create detectable change in all the health outcomes that are of interest. This section provides guidance on how to plan ahead for evaluation, indications that a green infrastructure or other community health program is ready to evaluate, and the steps for conducting an evaluation.

Some resources for health evaluation include:

- CDC's online Introduction to Program Evaluation for Public Health Programs: A Self-Study Guide⁸⁰;
- The CDC Parks and Trails Health Impact Assessment Toolkit⁸¹;
- Health Impact Assessments⁸²; and
- Robert Wood Johnson Foundation Program Evaluation Resource Library.⁸³

Program evaluation is a systematic method for collecting, analyzing, and using data to assess the effectiveness and efficiency of programs.⁸⁴ Programs evolve over time, and evaluation can be done at any stage of development for different reasons with different criteria (Table 9.1.). When is an evaluation useful? Who are the audiences who need convincing that green infrastructure improves health? These are questions that should be addressed at the very beginning of program development.

⁷⁹ Brody, K.K., Johnson, R.E., and Douglas, R.L. (1997). Evaluation of a Self-Report Screening Instrument to Predict Frailty Outcomes in Aging Populations. *The Gerontologist*, 37 (2), 182–191., doi:10.1093/geront/37.2.182.

⁸⁰ U.S. Department of Health and Human Services Centers for Disease Control and Prevention. Office of the Director, Office of Strategy and Innovation. (2011). Introduction to program evaluation for public health programs: A self-study guide. Atlanta, GA: Centers for Disease Control and Prevention. Retrieved from <https://www.cdc.gov/eval/guide/index.htm>.

⁸¹ U.S. Department of Health and Human Services Centers for Disease Control and Prevention. (n.d.). Parks and Trails Health Impact Assessment Toolkit. Retrieved from https://www.cdc.gov/healthypplaces/parks_trails/default.htm.

⁸² Pew Charitable Trusts. (2018, April 29). Health Impact Assessments in the United States. Retrieved from <http://www.pewtrusts.org/en/research-and-analysis/data-visualizations/2015/hia-map>.

⁸³ Robert Wood Johnson Foundation. (n.d.). RWJF Program Evaluations. Retrieved June 22, 2018 from <https://www.rwjf.org/en/library/collections/evaluations.html>.

⁸⁴ Healy, M.A. (2000). Knowing What Works: Program Evaluation. *New Directions for Student Services*, 2000 (90), 57-65. doi:10.1002/ss.9005.

TABLE 9.1. DEFINING THE PURPOSE OF PROGRAM EVALUATION

STAGE OF PROGRAM EVOLUTION	PURPOSE OF EVALUATION
Conception	Plan for community engagement; anticipate how to inform future monitoring and evaluation.
Program development	Improve practice to enhance success.
Operating program	Are objectives met? Did the program result in a change? What are the benefits? What are the unintended consequences? All informed by review of evaluation data.
Program completion	Inform program improvements; grow or spread the program.

9.2. Who Conducts Health Evaluations?

It is likely that there are great health evaluators nearby. Public health and health care have been doing robust evaluation work for some time. Health evaluators might work in universities, research institutions, nonprofits, consulting firms, county or state health departments, or within program delivery organizations. For many water utilities, it can be difficult to do robust program evaluations internally, so look to outside partnerships. Whether evaluations are done by internal staff or external consultants, it is important to budget for evaluation throughout the project, beginning as early as possible in the planning process. For example, the U.S. federal [Social Innovation Fund](#) recommends setting aside 10-15% of a project investment for evaluation.⁸⁵ Financial or in-kind loans of evaluation staff can be a resource the local public health agency or health care provider may be able to provide.

For projects linking green infrastructure and health, find an evaluator who is most familiar with the topic area and the dynamics at play. It may be hard to find a health evaluator who is knowledgeable about green infrastructure, but there may be some who understand health and the built environment, health and transportation, or other fields with similar health linkages.

9.3. Completing an Evaluation

Every evaluation starts with a clear objective about how evaluation information will eventually be used. If data or measures are collected without a clear purpose, money and community energy can be wasted. Appendix D provides some detailed steps to completing a health evaluation adapted from the U.S. Centers for Disease Control (CDC).

9.4. Measures and Data Collection Examples

Table 9.4. includes sample measures evaluators might use to track health outcomes and improvement. These measures are adapted from existing programs linking health and nature, most of which are measuring proxies for health and not the health outcomes themselves.⁸⁶ Data can be collected at the community (e.g., citywide, census tract, or neighborhood) or program/individual levels. Secondary data (e.g., census demographics and modeled air quality exposure) are often available at the community scale, but not at an individual or program scale. There may be literature and information from other areas where health benefits can be transferred from the studied situation to a local situation. Finally, primary data can be collected, but direct observation, self-reported data, or technology-collected data can be expensive and challenging to gather. In a review of health and nature programs, many programs used self-reported information for aspects of health and direct observation to capture aspects of nature.⁸⁷

⁸⁵ Zandniapour, L., and Vicananza, N. (2013, October). Budgeting for Rigorous Evaluation: Insights from the Social Innovation Fund. Retrieved from https://www.nationalservice.gov/sites/default/files/documents/Budgeting_for_Evaluation.pdf.

⁸⁶ Wood, L. (2017). Identifying Metrics for Health and Outdoor Initiatives: A Toolkit for Community Evaluators (unpublished masters thesis). Duke University, Durham, North Carolina.

⁸⁷ *ibid.*

TABLE 9.4. SAMPLE HEALTH OUTCOME MEASURES

ENVIRONMENTAL & HEALTH OUTCOME	SAMPLE MEASURES & METHODS
Overall connection to nature and overall health	Level of greenness: Normalized Difference Vegetative Index ⁸⁸ ; tree canopy cover; distance from urban center as a proxy for remoteness; proximity of green space to priority populations; Home to park distance scores; park accessibility score; Self-reported exposure through mobile device tracking; community level indicators toolkit ⁸⁹ ; Connection to Nature Index. ⁹⁰
Engagement with greening efforts	Type of engagement or activity; frequency and duration of participation; breadth of participation in other community and environmental events; plans for ongoing engagement/stewardship: distance and time traveled to events.
Air	NO ₂ & PM 2.5 exposure; Envi-met model. ⁹¹
Heat	Extreme heat exposure; Envi-met.
Physical activity	Body Mass Index ⁹² ; TRACK tool ⁹³ ; Pediatric Quality of Life Inventory ⁹⁴ ; System for Observing Play and Recreation in Communities ⁹⁵ ; CDC Division of Nutrition, Physical Activity and Obesity ⁹⁶ ; Community Park Audit Tool ⁹⁷ ; Active Neighborhood Checklist ⁹⁸ ; RAND 36-item short form survey. ⁹⁹
Overall mental health	How did participation in greening make you feel?; Perceived Restorativeness Scale ¹⁰⁰ ; Perceived Restorative Components Scale for Children (PRCS-C). ¹⁰¹
Depression and anxiety	RAND 36-item short form survey; 2-item Patient Health Questionnaire (PHQ-2) ¹⁰² ; 2-item Generalized Anxiety Disorder (GAD-2) scale. ¹⁰³
Stress	RAND short form survey; 4-item Perceived Stress Scale (PSS-4). ¹⁰⁴
Social cohesion	Peds QL; Nature Relatedness Scale ¹⁰⁵ ; attachment to neighborhood; perceived safety levels.

⁸⁸ Weier, J., and Herring, D. (2000, August 30). Measuring Vegetation (NDVI and EVI). NASA Earth Observatory. Retrieved from https://earthobservatory.nasa.gov/Features/MeasuringVegetation/measuring_vegetation_1.php.

⁸⁹ Community Level Tools. Retrieved from <https://ctb.ku.edu/en/table-of-contents/evaluate/evaluate-community-initiatives/community-level-indicators/main>.

⁹⁰ Bragg, R., Wood, C., Barton, J., and Pretty, J. (2013). Measuring connection to nature in children aged 8-12: A robust methodology for the RSPB. Essex Sustainability Institute. Retrieved from <https://www.rspb.org.uk/globalassets/downloads/documents/positions/education/measuring-connection-to-nature-in-children-aged-8-12---methodology.pdf>.

⁹¹ <https://www.envi-met.com/>.

⁹² Bell, J.F., Wilson, J.S., and Liu, G.C. 2008. Neighborhood greenness and 2-year changes in body mass index of children and youth. *American Journal of Preventive Medicine*, 35 (6), 547-53. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/19000844>.

⁹³ <http://www.kidsinparks.com/>.

⁹⁴ The Conservation Volunteers. 2009. School Green Gym: Evaluation findings: health and social outcomes 2009. Retrieved from <https://www.tcv.org.uk/sites/default/files/school-green-gym-evaluation-findings.pdf>.

⁹⁵ Cohen, D.A., Sturm, R., Han, B., and Marsh, T. (2014). Quantifying the Contribution of Public Parks to Physical Activity and Health: Introducing SOPARC. Rand Corporation. Retrieved from https://www.nrpa.org/uploadedFiles/nrpa.org/Publications_and_Research/Research/Papers/SOPARC-Report.pdf.

⁹⁶ <https://www.cdc.gov/nccdphp/dnpao/index.html>.

⁹⁷ Kaczynski, A.T., Wilhelm Stanis, S.A., and Besenyi, G.M. (2013). Community Park Audit Tool: User Guidebook. Active Living Research. Retrieved from <https://activelivingresearch.org/community-park-audit-tool-cpat>.

⁹⁸ Hoehner, C., and Brownson, R. (2011). Active Neighborhood Checklist. Active Living Research. Retrieved from <https://activelivingresearch.org/active-neighborhood-checklist>.

⁹⁹ Ware, J.E., and Sherbourne, C.D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*, 30 (6), 473-83. Retrieved from https://www.rand.org/health/surveys_tools/mos/36-item-short-form.html.

¹⁰⁰ Hartig, T., Korpela, K., Evans, G.W., and Gärling, T. (1997). A measure of restorative quality in environments. *Scandinavian Housing and Planning Research*, 14 (4), 175-194.

¹⁰¹ Bagot, K. L., Kuo, F. E., and Allen, F. C. (2007). Amendments to the perceived restorative components scale for children (PRCS-C II). *Children Youth and Environments*, 17 (4), 124-27.

¹⁰² Spitzer, R.L., Kroenke, K., and Williams, J.B.W., for the Patient Health Questionnaire Primary Care Study Group. (1999). Validation and utility of a self-report version of PRIME-MD: the PHQ Primary Care Study. *Journal of the American Medical Association*, 282, 1737-1744. Retrieved from <https://www.phqscreeners.com/sites/g/files/q10016261/ff/201412/instructions.pdf>.

¹⁰³ Spitzer, R.L., Kroenke, K., Williams, J.B.W., and Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine*, 166, 1092-1097. Retrieved from <https://www.phqscreeners.com/sites/g/files/q10016261/ff/201412/instructions.pdf>.

¹⁰⁴ Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385-396. Retrieved from <http://www.macses.ucsf.edu/research/psychosocial/pss4.php>.

¹⁰⁵ Nisbet, E. K. L., Zelenski, J. M., and Murphy, S. A. (2009). The Nature Relatedness Scale: Linking individuals' connection with nature to environmental concern and behaviour. *Environment and Behavior*, 41, 715-740. Retrieved from http://www.naturerelatedness.ca/Nature_Relatedness_files/Nature%20Relatedness%20Scale%20and%20scoring-Nisbet%20et%20al.pdf.

Needs and Next Steps

Locating, designing, and stewarding green infrastructure to advance health equity is still an emerging field of science and practice. It is known that there are important connections between nearby nature and health, but there are gaps between the rapidly growing evidence and the tools that cities, health care facilities, and partners need to apply the science with communities.

Version 1.0 of this guide is intended as a starting point—a place to begin compiling the information, tools, best practices, and lessons learned for green infrastructure providers. This guide will evolve and gain detail as time moves on.



Community meeting / Duwamish River Cleanup Coalition



Georgetown Green Wall / Just Health Action



Backyard green infrastructure / Tucson Water

10.1. First Steps

As federal and state agencies, city leaders, foundations, community-based organizations, and health care providers are looking to advance health through green infrastructure, there are some near-term actions that any city can take (Table 10.1).

TABLE 10.1. FIRST STEPS FOR LINKING GREEN INFRASTRUCTURE AND HEALTH

ACTION	WHY	WHO
Conduct a rapid assessment of community health needs and green infrastructure opportunity.	Easy seeds for conversation with health groups.	Green infrastructure providers.
Coordinate across cities to build evidence, develop tools, and innovate.	If one city builds a green infrastructure mental health model, another can focus on heat exposure model—and then share. Cities can also coordinate evaluation investments to build stronger, broader evidence.	Green infrastructure providers and researchers.
Engage community health advocates in green infrastructure planning and have green infrastructure advocates inform community health improvement plans.	Health equity begins with real engagement; and coordinated goals across health planning and green infrastructure planning opens future possibilities for more multi-benefit projects.	Community health organizations; Green infrastructure providers.
Incentivize the health benefits of stormwater and wastewater actions.	Infrastructure needs to provide multiple benefits, and investments cannot solve for one problem (e.g., nutrient runoff) by creating another (e.g., air pollutant exposure from lack of tree canopy). Water and wastewater are public health, safety, and welfare issues for all public service/utility agencies.	Federal and state regulatory agencies and infrastructure funders.
Provide access to health care funding for social determinants of health.	Improving health means preventing disease and creating overall well-being. State Medicaid programs and hospitals can create dedicated funding for social determinants work.	State Medicaid, hospitals, insurers, and other health care providers/funders.

10.2. Future Needs

To further advance the connection between green infrastructure and health improvement, additional information, tools, partners, and resources are needed in the long-term. Members of the Green Infrastructure Leadership Exchange and reviewers of this guideline identified these priorities:

- Research specific to the health benefits of green infrastructure, with an ability to extrapolate per-unit health benefits
- Community-scale measurement tools and data to inform location and design considerations
- Partners that can help weave together the objectives of health care providers and insurers with the knowledge and capacity of community-based organizations
- Funding sources that are compatible across sectors to achieve the multiple benefits required of infrastructure to improve the social determinants of health
- Educational and technical resources for infrastructure planners and managers to help introduce health topics, as these are typically not available in traditional education and training situations;
- “Health in all policies” guidelines and models so that health is widely considered to be a must have in all green infrastructure resources (including woodlands, parks, gardens, living wall and roofs, etc.) rather than being local one-off efforts
- A network, organization, or agency that is familiar with both green infrastructure technologies and public health practices to standardize design and measures, collect and elevate good examples and best practices, and serve as an identifiable and creative advocate for co-design for health co-benefits
- Digests of research and technical resources about linked nature and health programs
- Strategies for avoiding gentrification and displacement when green infrastructure is installed in low-income neighborhoods



APPENDIX A: DETAILED COMMUNITY ENGAGEMENT GUIDELINES

This Appendix builds on Section 8 with more detail on community engagement.

A.1. Community Engagement Principles to Live By

Not all external-facing activities classified as community engagement are meaningful. Meaningful engagement means more than getting the right people at the table—it requires a deep commitment to involve the communities served throughout engagement processes, elevating their voices in decision-making wherever possible. Without partnering with and empowering communities, community engagement is simply ticking off a box and potentially perpetuating a cycle of inequity. Sherry Arnstein’s Ladder of Citizen Participation¹⁰⁶ and International Association of Public Participation (Figure A.1.) provide diagrams that are useful for gauging meaningfulness of community engagement.

FIGURE A.1. SPECTRUM OF COMMUNITY ENGAGEMENT¹⁰⁷

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

¹⁰⁶ Arnstein, 1969, note 45.

¹⁰⁷ International Association of Public Participation, 2014, note 46.

There are several characteristics that identify meaningful community engagement:

- The best relationships are existing relationships: Whenever possible, build relationships with the communities served before something is needed from them. Sponsor and attend community events, host culturally-specific “meet-and-greet” events, learn about other community projects, and support efforts to build community capacity.
- Plan and budget for meaningful community engagement: Engagement should not be an afterthought. When planning a project budget, include the cost of both initial engagement (before a decision or project) and continued engagement throughout the project and during post-project assessments. Budget for costs such as meals during meetings, childcare, translation, transportation, and stipends for participants. Consider budgeting for a community partner organization that is trusted by the community to conduct engagement for or with you. When writing a budget, remember that the community members are experts who should be compensated for their time and expertise whenever possible. Recognize that it may take significantly more time than planned to answer community engagement questions.
- Identify questions and commit to incorporating the community’s answer: Before engaging the community, identify what specifically needs to be known from them. Develop questions where answers are needed, and build an engagement strategy around answering them. Be transparent and communicative about the level of influence the community’s feedback will have on decisions, and make good on this commitment.
- Dialogue, not direction: Listen to what the community’s needs are, and share your needs with them. Do not prescribe solutions based on a perception of the community’s needs—co-create solutions based on what is heard from them.
- Listen and be consistent: Keep showing up to demonstrate commitment, and do not disappear when the initial engagement phase is over. Make sure someone is checking in regularly to update the community on progress, and listen during implementation to make sure the community is on board with how things are going.
- People learn and engage differently: Some people will engage with visuals (e.g., future design concepts), and others will engage with story. Community engagement provides different modes for learning and connecting with people and can flex to meet the needs of people interested in participating.
- Meaningful community engagement produces some degree of positive change: Not all engagement will lead to funded projects, but building relationships between communities and agencies has other positive outcomes: namely increased trust and improved working relationships; and improved social cohesion and community health. Remember to evaluate the effectiveness and impact of community engagement and seek to continually improve.

A.2. The Importance of Equity in Community Engagement

Equity and community engagement are not the same thing—solving equity issues requires much more than engaging communities. However, equity should be a driving principle when planning and executing community engagement. This means being attentive to the societal, economic, and political conditions that create inequities between groups, and understanding how these dynamics could affect the engagement process. No one understands these nuances better than focus communities. Work with community members to develop an engagement process that goes beyond removing barriers to participation and builds community capacity. Consider partnering with Community Health Workers or other leaders with deep knowledge of the community and expertise in equitable engagement methods (e.g. Popular Education).

BOX A.2. GREEN INFRASTRUCTURE CAN'T SOLVE ALL STRUCTURAL INEQUITY

Many of the problems causing inequity in communities are large, societal issues that are the result of unjust policies dating back decades and even centuries. Many current policies are also unjust. While trying to address equity issues, it is also important to understand that a green infrastructure project or program will not solve every problem that contributes to systemic issues. However, by working meaningful community engagement into green infrastructure, programs can help advance larger, societal change.



Green Infrastructure Leadership Exchange / Willamette Partnership

A.3. Assessing Your Readiness for Engagement

Before engaging communities, assess your (individual) and your organization's readiness to do so meaningfully. This step will help walk into the room with important historical context, a better understanding of the extent to which power will be shared with the community, and reasonable expectations for engagement outcomes.

- I. Know what has come before: Find out which groups have worked with the community before and what challenges arose out of that engagement (e.g., reports or other outcomes generated). It is especially important to learn your organization's history with the community in question.
- II. Assess your cultural experience: Ensure team members are culturally competent and able to establish respectful relationships with people of different backgrounds. Consider setting a goal that your agency staff and board looks like the community served. Make cultural competency training an ongoing part of your team's professional development, and consider being explicit about training for institutional racism and white privilege.
- III. Be prepared for a mismatch in your agency's charge and the community's needs: For example, your agency may be charged with reducing stormwater pollution, but the community might rather work on traffic calming. How flexible can your agency be in shifting course in order to meet the community's needs? Work out answers to these questions ahead of time so you can be upfront and honest with community members. Be transparent about your goals, the limits to what you can do, and areas where you may be at odds with one another.
- IV. You may face pushback or animosity from some community members when you start working with a new group: Do not give up if there are people who seem to be against you. This is potentially an opportunity to build trust. Listen to and acknowledge the concerns of individuals who voice opposition. Record and integrate their feedback where possible, and constructively redirect the conversation if it veers off topic. Hang on to those community members who understand and support you. They can help others see the benefits of working with you, and they will be the ones who can help push the ball forward.
- V. Set your community partners up for success: Once you understand the capacity the community has for change, make sure you have the capacity to give them the support and tools they need to be successful. Do not ask community members to spend their time and resources as a partner with you if you are not able to assist them in achieving success.

A.4. Building the Community's Readiness to Embrace and Succeed in Leadership Roles

When planning an engagement project, “meet them where they are” is a useful principle both literally and figuratively. Literally speaking, this means engagement activities should be conducted in a location convenient to the focus community, in order to minimize transportation barriers and create a more comfortable environment. Figuratively speaking, it means engaging the focus community at the level that makes sense for the community. For example, if the community has low capacity for engagement, the expectation probably should not be to form an advisory committee that meets on a semi-weekly basis.

Engagement also requires time and resources that communities experiencing inequities may not have readily accessible, so learn in advance about the challenges that may prevent community members from showing up. Be prepared to spend your agency's resources to ensure these issues do not present barriers to participation. Compensate partners or community members for the expertise they bring via their involvement. This can mean providing child care, food, translation services, transportation, etc., and compensating individuals for their participation.

It is important to understand that your agency is likely not the only one attempting to engage a focus community. Many agencies ask communities (particularly culturally-specific and other trusted organizations) to participate in engagement activities that ask similar questions. Conserve the resources of the focal community and your agency by combining engagement efforts with other organizations, or piggybacking off existing community meetings. This can be anything from town halls to dance classes. This also removes pressure from having to organize and facilitate a meeting all on your own.

A.5. Beginning the Relationship with Communities (Who is in the Room? What if There is Not One Voice for the Community)

I. Getting Started with Engagement

Before diving in to any engagement project, do research to learn what information is already available.

- A good starting point is to take a survey of existing community-based groups (nonprofits, faith-based, ethnicity-based) to see what organizational structures already exist. Then, work on meeting them where they are.
- Talk to your agency partners and contacts to see if anyone has worked with this community before and what information may be useful in planning a project.
- Use crowd-source information. Find community leaders, then ask them for connections to help navigate a way through community groups. Word of mouth comes in handy here, and having a personal connection when to reach out to someone (e.g., “so-and-so told me you'd be a great person to contact”) makes things easier and increases the likelihood of getting the right people at the table. It also ensures that no matter your position in your home organization (ex. director, staff, etc.), community members see you as having the cache to be effective.

Once the research is done, involve the community and identified, trusted organizations in crafting a research question. Engaging at this step is critical to make sure hard work later is in line with community needs and reflective of/respectful toward community culture.

A.6. Walking in Relationship with Communities

I. Engagement Moving Forward

Be aware of how groups identify (e.g., Pacific Islanders may identify as Tongans or Samoans), and understand if there are different voices and opinions within groups. Acknowledge those differences, and set clear expectations for when answers/consensus is needed and when next steps need to be taken.

Also, know that engagement can be outsourced if your agency has the resources to do so. Make business connections with people who are already engaged in these communities to speed things up, or follow the example of the City of Portland and leverage your networks to develop specific trusted community engagers who can then be borrowed across departments.

II. If at first you don't succeed, try, try again.

Even with all the preparation in the world, there will inevitably be unforeseeable challenges that require quick thinking and adaptive response.

BOX A.6. TIMING IS IMPORTANT

Sometimes the political environment may present additional challenges to engagement, so projects may need to be put on hold. For example, The Oregon Health & Outdoors Initiative was ready to work with a latinX hiking group in the Columbia River Gorge, and just before the pilot launched, Donald Trump won the presidency. Anti-immigrant sentiments were a central part of campaign rhetoric, and much of the focus population of the pilot did not feel safe participating in outdoor activities.

When things do not work out the first time, keep showing up, building trust, and finding key community members who can help you succeed in the future. Do not disappear, but take time to invest in the connections that are working and re-strategize with community partners on the best way to increase buy in.

Appendix B: Sample Tree Planting Health Survey (Jade District, Portland, OR)

This survey was built to capture self-reported improvement in physical activity, depression, stress, and social cohesion for participants in a community tree planting effort. The survey was produced by [Providence Center for Outcomes Research and Education](#), adapted from a similar survey built to measure similar health outcomes from outdoor recreation.

Jade District Tree Planting: Baseline Survey Instructions: This survey will help us learn more about the benefits of community tree planting events. For each question, please fill in the box that best represents your answer. Your results are completely private, and you can skip any question. When you are finished with the survey, please give the survey back to a Friends of Trees staff person.

Part 1: Tree Planting with Friends of Trees

1. How did you hear about Friends of Trees? Mark all that apply.

- Facebook/Social Media/NextDoor
- Email
- Flyer
- From a friend
- Friends of Trees yard sign
- Friends of Trees tree tag
- Someone spoke to me at my home
- Other: _____ (please tell us)

2. What type of volunteer are you? Mark all that apply:

- Tree planter
- Crew Leader
- Tree recipient
- Tree pruner
- Part of a volunteer group

3. How many tree planting/care events have you participated in?

- This is my first one
- 1-2 total
- 3-6 total
- I volunteer Once/twice a month
- I volunteer Every week
- Other: _____ (please tell us)

4. Do you participate in other community and environmental events (i.e. clean up, invasive species removal, etc.)?

- Yes (If so, what types of events:) _____
- No

5. How did the tree planting/care event make you feel? _____

6. Do you plan to care for the trees you helped plant?

- Yes
- No
- N/A

7. Do you want to participate in more tree planting events in the future?

- Yes
- No

Part 2: Being Out in Nature and Opinions Regarding Trees in Cities

8. For each of the following, please rate the extent to which you agree with each statement

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Trees are important because they shade and cool their surroundings.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees in cities help people feel calmer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees are a problem in cities because they cause allergies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees should not be planted in cities because they are messy and drop leaves and residue.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees should not be planted because they are too costly to maintain.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees should be planted in cities to attract wildlife.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees should be used in cities because they reduce noise.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees should not be planted because their roots crack sidewalks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trees should be planted in cities because they help clean our air.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Thinking about the neighborhood that this tree planting event occurred in, please rate the extent to which you agree with each statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I love living here in this neighborhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would find it a great pity if I had to move away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My neighborhood is very special to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would recommend this neighborhood to my friends as a living place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel very attached to my neighborhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My neighborhood means a lot to me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do not want to live in another place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Part 3: Your Health and How You're Doing Now

10. During the past 2 weeks, about how often have you been bothered by the following problems:

	Not At All	Several Days	Over Half the Days	Nearly Every Day
Little interest or pleasure in doing things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling, down depressed or hopeless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feeling nervous, anxious, or on edge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Not being able to stop or control worrying	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. In the past month, how often have you:

	Never	Almost Never	Sometimes	Fairly Often	Very Often
Felt that you were unable to control the important things in your life?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt confident about your ability to handle your personal problems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt that things were going your way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt difficulties were piling up so high that you could not overcome them?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reflected on episodes of your life that you should no longer concern yourself with?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spent a great deal of time thinking back over your embarrassing or disappointing moments?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Part 4: About You

12. What year were you born?

13. Which of these describes you?

- Male
- Female
- Transgender or gender non-conforming
- I prefer to self-describe _____

14. How do you describe your race/ ethnicity? Mark all that apply.

- White
- Hispanic, Latino, or Spanish origin
- Black or African American
- Asian
- American Indian or Alaska Native
- Middle Eastern or North African
- Native Hawaiian or Other Pacific Islander
- I prefer to self-describe _____

15. What language do you speak best? Mark only one

- English
- Spanish
- Mandarin
- Vietnamese
- Other: _____

16. What is the closest major intersection to your house? _____

17. We will ask participants to take a follow-up survey in a few months. Please provide us with an email or text-capable cell phone. We would greatly appreciate your participation in our follow up survey.

Cell phone (include area code): _____

E-mail: _____

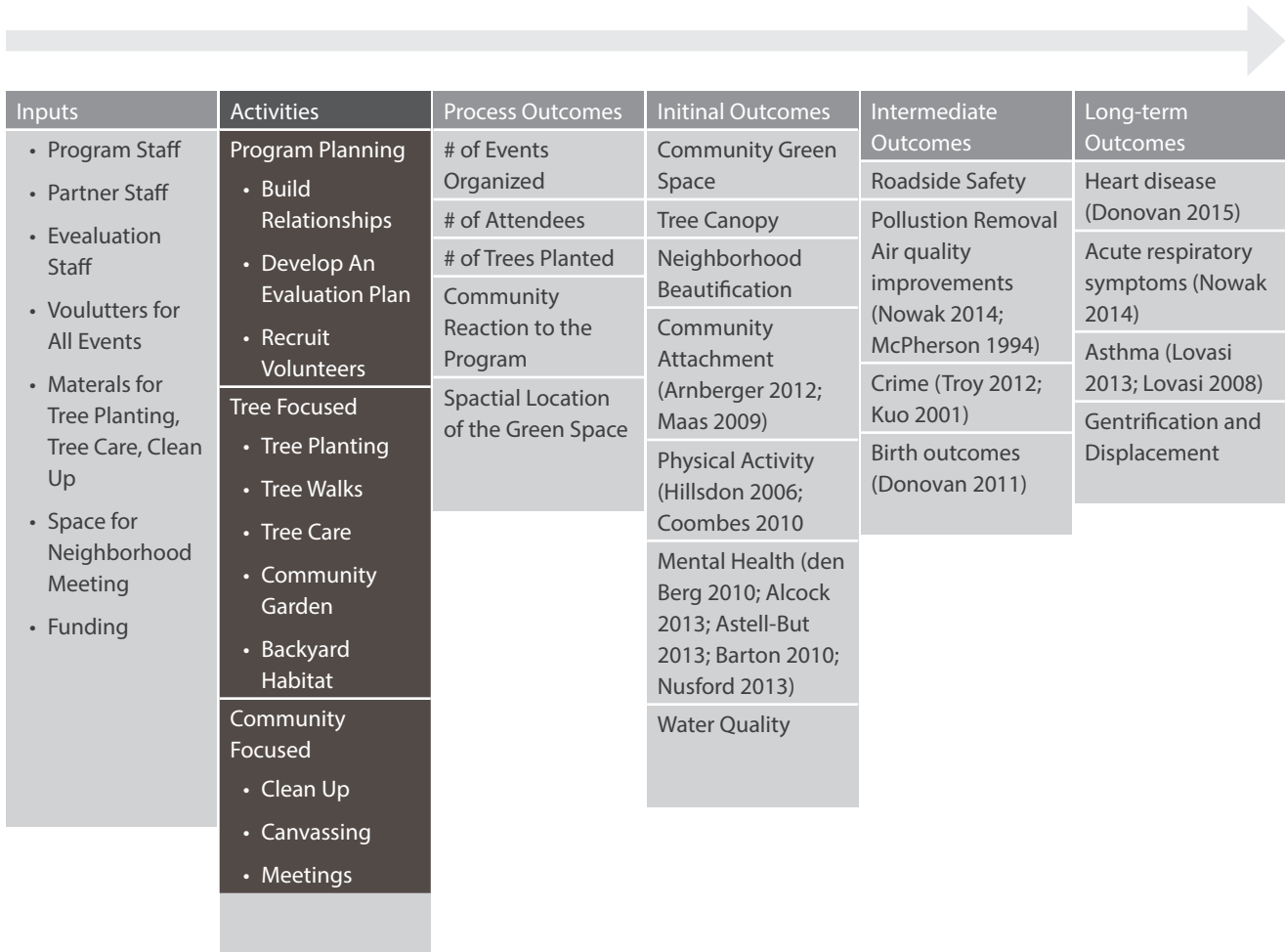
Participant Name: _____

Appendix C: Sample Logic Model Linking Tree Planting and Health

This logic model was built to design evaluation for health improvement in physical activity, depression, stress, and social cohesion tied to community greening efforts. The logic model was produced by [Providence Center for Outcomes Research and Education](#)

Neighborhood Greening Project

Question: impact of a community greening/revitalization project on residents' health



Key:

Inputs: What are the resources needed for the program?

Activities: What activities will the program implement?

Process outcomes: What is produced?

Initial outcomes: Outcomes that occur within the first year of the program. For the most part, these outcomes will continue into intermediate and long term outcomes.

Intermediate outcomes: outcomes that occur 3-5 years after the start of the program. For the most part, these outcomes will continue into long term outcomes.

Long-term outcomes: Outcomes that occur 5+ years after the start of the program.

Appendix D: Steps for Program Evaluation¹⁰⁸

Evaluation steps are interdependent and can occur simultaneously. The steps are not prescriptive and can be adapted and revisited as a program evolves or evaluation needs change.

TABLE D.0. PROGRAM EVALUATION STEPS

PROGRAM EVALUATION STEP	THINGS TO ASK AND DO
Engage stakeholders	Who is the audience for the evaluation? How will it be used? Stakeholders include the population the program serves, who will use the findings, and people running the program. Bring these stakeholders in early!
Describe the program	<p>What are the program activities and goals?</p> <p>What is the need/problem to be solved? Some examples:</p> <p>Anticipated health and environmental outcomes from proposed greening;</p> <p>Another way to prioritize locations and types of green spaces;</p> <p>A way to track and communicate progress over time; and</p> <p>Addressing community concerns.</p> <p>What is the focus population/community?</p> <p>What is the logic model connecting inputs/activities to outcomes (see Appendix C for sample logic model for tree planting)?</p>
Focus the evaluation design	<p>What is important to learn most given the resources available for evaluation?</p> <p>Prioritize the activities most important to evaluate (e.g., green space in the right-of-way or urban tree planting) and consider how to address stakeholders' needs and interests.</p> <p>What are current conditions before the program begins? It is hard to measure change and improvement without a good baseline description.</p> <p>Use existing evidence to show connections to health; make use of existing data resources from government (federal, state and county), hospitals, or NGOs.</p> <p>Make sure the project partners have the capacity to implement and use the evaluation (e.g., do not expect community organizers to help distribute surveys if it is not built into their job; anticipate that some activities may not happen because of lack of staff availability in summer).</p>

Continued on page 37

¹⁰⁸ Centers for Disease Control. (1999). Framework for Program Evaluation in Public Health. Morbidity and Mortality Weekly Report, 48 (RR-11). Retrieved from <https://www.cdc.gov/mmwr/PDF/rr/rr4811.pdf>.

PROGRAM EVALUATION STEP	THINGS TO ASK AND DO
Gather credible evidence	<p>Data may come from multiple sources, such as program measures, partner data, public sources, or primary data collection. Decide whether data is needed at the community level (e.g., postal code obesity rates) or the individual level (e.g., my own physical activity). For health data (primary or secondary) clearance to access data gets challenging as evaluation needs data closer to the individual scale. The Health care Insurance Portability and Accountability Act (HIPAA) strictly protects privacy for medical information and individual health records. Other useful sources may be the U.S. E.P.A. EnviroAtlas,¹⁰⁹ or the Trust for Public Land’s ParkScore rankings.¹¹⁰</p> <p>Potential data needs:</p> <ul style="list-style-type: none"> • Inputs (money, staff, time, materials); • Outputs/Process (number of people served, activities completed, consistency across subgroups); and • Outcomes (changes in health, social cohesion, community engagement)—These can be broken down into initial, intermediate, and long-term outcomes in a logic model. <p>Qualitative and quantitative data are complimentary. Avoid numbers without a story, or a story without numbers. Each speaks to the hearts and minds of different audiences.</p> <p>Choose data sources carefully. For example, administrative crime statistics are a better measurement of where police are active, not necessarily the changing levels of crime. Also, peer-reviewed journal articles do not publish evaluations where there is no (or a null) effect. So if a tree planting effort showed no change in asthma, that result might not get published even if very relevant for city decision-making around asthma and urban forestry. People who have done similar evaluations before may have such information on activities that have not been effective.</p> <p>Be aware that a detected change in outcomes may have nothing to do with program activities. When crime rates dropped in the 1990s, was it because of tough on crime laws? There remains broad disagreement over the causes of crime rate drops.¹¹¹</p> <p>The strongest evidence comes when an evaluation can contrast outcomes with a comparison group not served by the program, measuring change against benchmark and toward a target health outcome. Wait lists for program participation can be a creative way to find a control group. At the City scale, neighborhood comparisons can be useful.</p>
Justify conclusions	Analyze data and work with stakeholders and health experts (if available) to understand the meaning.
Ensure use and share lessons learned	Report to relevant partners and officials. Improve the program. Extend or spread the program. Make recommendations. Leverage the results to access more funding.

¹⁰⁹ <https://www.epa.gov/enviroatlas>.

¹¹⁰ <http://parkscore.tpl.org/>.

¹¹¹ Roeder, O., Eisen, L.B., Bowling, J. (2015). What Caused the Crime Decline. Brennan Center for Justice at New York University School of Law. Retrieved from <https://www.brennancenter.org/publication/what-caused-crime-decline>.

Appendix E: Sample City Health and Outdoors Opportunities Assessments



Photo of Seaside Greenway in Vancouver, B.C. / City of Vancouver



Vancouver, B.C.

Health and Outdoors Opportunities Assessment

More Access to Green Space, Better Health

Did you know that your environment (socio-economic, cultural, and physical) determines more of your health than your genetic code? Where and how we live in and around Vancouver makes a difference in how long we live and the cost of our healthcare. When more people have access to trees, trails, parks, and other natural areas, there are measurable improvements in mental health, physical activity, social cohesion, air quality and other social determinants of health (See Fig. 1). **This document is meant to stimulate discussion and collaboration on the topic of green space and health with the ultimate goal of working together to plan, build and maintain green spaces in ways that promote better health.**



Figure 1. Social determinants of health refer to the conditions in which we are born, grow, live, and work. Health organizations are increasingly looking upstream to these determinants to create community wellness, prevent chronic disease, and increase health care effectiveness.

COMMUNITY HEALTH NEEDS RELATED TO GREEN SPACES FOR VANCOUVER

Green spaces can provide places for physical activity, stress reduction, community connectedness, urban agriculture, and reprieve from noise, poor air quality, and excessive heat^[1]. Accumulating evidence shows the beneficial effects of green space on mental health, cognitive development, cardiovascular morbidity, type II diabetes, pregnancy outcomes, and mortality^[1]. Research suggests that access to quality green space can be particularly beneficial for the lowest socioeconomic groups, pregnant women, and children^[1].

- At the national level, the Chief Public Health Officer highlighted obesity, diabetes, and mental health issues as a concern for Canadians^[2].

[1] World Health Organization (WHO). (2016). Urban green spaces and health [Review]. Retrieved March 8, 2018 from http://www.euro.who.int/__data/assets/pdf_file/0005/321971/Urban-green-spaces-and-health-review-evidence.pdf?ua=1

[2] Public Health Agency of Canada. (2017). The Chief Public Health Officer's Report on the State of Public Health in Canada 2017: Designing Healthy Living [Report]. Retrieved March 8, 2018 from <https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/health-officer-reports-state-public-health-canada/2017-designing-healthy-living/2017-designing-healthy-living-eng.pdf>

- Vancouver Coastal Health's *My Health My Community* survey reported^[3]:
 - 18% of Vancouverites have experienced mood or anxiety disorders
 - Only 46% of Vancouverites are partaking in 150+ minutes of weekly physical activity
 - 54% of Vancouverites have a strong sense of community belonging
- A [review](#) commissioned by the BC Centre for Disease Control found that green space may have a stronger positive influence on the health of lower socioeconomic status individuals, and may help narrow some health disparities between higher and lower income groups^[4].

OPPORTUNITIES TO LINK GREEN INFRASTRUCTURE TO HEALTH

A number of activities are already being conducted by the City of Vancouver, Vancouver Coastal Health and other key stakeholders to improve access to, and the quality of, green space in the city:

- Vancouver Coastal Health's Healthy Built Environment team works to collaborate with local government and key partners to create environments that promote and protect health.
- The B.C. Centre for Disease Control released a [fact sheet](#) highlighting the importance of protecting and improving equitable access to healthy, natural environments to support physical and mental health^[5].
- The City of Vancouver and Vancouver Coastal Health have been working together in partnership through the [Healthy City Strategy](#) to provide opportunities for Vancouverites to live actively and get outside, and to create environments to thrive in^[6].
- The City of Vancouver's [Greenest City Action Plan](#) and long-term [Climate Change Adaptation Strategy](#) emphasize investment in green space and trees and green infrastructure to manage stormwater flows and quality and to mitigate heat stress experienced by residents^{[7],[8]}.
- The City of Vancouver has already invested in 190 green infrastructure practices in the public realm, with more than 60 additional planned future projects.
- GreenCare's [Climate Resilience & Adaptation Program](#)^[9] works collaboratively to co-develop adaptation options for reducing extreme heat and flood risks on and around health campuses. Key resources, such as design guidelines with resilience principles and practices, are informed by and shared with all BC health authorities to reduce and better prepare for the risks and impacts linked to, for example, increasing temperatures, wildfire exposure, and sea levels.

[3] My Health My Community. (2014). Vancouver Community Health Profile. Retrieved March 8, 2018 from http://www.myhealthmycommunity.org/Portals/0/Documents/Community%20Profiles/Vancouver_Final.pdf

[4] BC Centre for Disease Control (BCCDC). (2017). FACT SHEET: Supporting Health Equity Through the Built Environment [Fast Sheet]. Retrieved March 8, 2018 from http://www.bccdc.ca/resource-gallery/Documents/Educational%20Materials/EH/BCCDC_equalityfactsheet_web.pdf

[5] BC Centre for Disease Control (BCCDC). (2016, June). Working with local governments to support health equity through the built environment: A scoping review [Review]. Retrieved March 8, 2018, from <http://www.bccdc.ca/resource-gallery/Documents/Educational%20Materials/EHEquity%20BE%20scoping%20review.pdf>

[6] City of Vancouver. (2018, February 02). Healthy City Strategy: our goals. Retrieved March 08, 2018, from <https://vancouver.ca/people-programs/healthy-city-strategy.aspx>

[7] City of Vancouver. (2012). Greenest City Action Plan. Retrieved March 09, 2018 from <http://vancouver.ca/files/cov/Greenest-city-action-plan.pdf>

[8] City of Vancouver. (2012, November 07). Climate Change Adaptation Strategy (Strategy). Retrieved March 8, 2018, from City of Vancouver website: <http://vancouver.ca/files/cov/Vancouver-Climate-Change-Adaptation-Strategy-2012-11-07.pdf>

[9] Vancouver Coastal Health, Fraser Health, Provincial Health Services Authority and Providence Healthcare each have a [sustainability policy and framework](#) for increasing and improving green infrastructure, among other strategies, in a changing climate. The Climate Resilience & Adaptation program is a part of a consolidated department, *Lower Mainland Facilities Management*, that underpins health organizations' services delivery to over 62% of BC's population.

Continued work and improved collaboration have the opportunity to enhance quality green space and improve health outcomes. Some recommended actions could include:

- Work collaboratively across sectors between the health authority, City of Vancouver, and other interested parties to incorporate the planning principles listed in the Provincial Health Services Authority's [Healthy Built Environment Linkages Toolkit](#)^[10].
- Work to expand and improve accessible and connected green spaces in underserved and disadvantaged areas to support physical and mental health⁴ using vulnerability assessments to identify neighbourhoods in need.
- Incorporate Vancouver Coastal Health's clinics, hospitals, community centres and other health campuses in discussions about improvements to green space and incorporation of green infrastructure.
- Incorporate community input into the planning, design, and implementation of green spaces in neighbourhoods.
- Identify indicators and monitoring programs that could be used to evaluate the benefits of green infrastructure to reduce the urban heat island effect.

[10] BC Centre for Disease Control (BCCDC). Healthy Built Environment Linkages Toolkit: making the links between design, planning and health, Version 2.0. Vancouver, B.C. Provincial Health Services Authority, 2018, from http://www.bccdc.ca/sites/bccdc-public-health/Documents/HBE_Linkages_Toolkit_2019.pdf

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Photo of the Loop in Tucson, Arizona. / Visit Tucson



Tucson

Health and Outdoors Opportunities Assessment

More Access to Green Space, Better Health

Did you know your zip code determines more of your health than your genetic code? Where and how we live in and around Tucson makes a difference in how long we live and the cost of our healthcare. When more people have access to trees, trails, parks, and other natural areas, there are measurable improvements in mental health, physical activity, social cohesion, air quality and other social determinants of health (See Fig. 1). **This report summarizes how partners in Tucson can plan, build, and maintain green spaces in ways that promote better health.**



Figure 1. Social determinants of health refer to the conditions in which we are born, grow, live, and work. Health organizations are increasingly looking upstream to these determinants to create community wellness, prevent chronic disease, and increase health care effectiveness.

PRIORITY HEALTH NEEDS FOR PIMA COUNTY

Since 2010, the Pima County Health Department has collaborated with nonprofit organizations, governmental entities, tribal governments, local hospitals, community health workers, and other key community stakeholders to develop health needs assessments for Pima County. The county's 2015 Community Health Needs Assessment identified the following as health priorities for the county:

- Anxiety and Depression
- Substance Misuse and Mental Health
- Injuries and Accidents
 - Youth violence prevention

- Fall prevention among older adults
- Road safety for drivers, cyclists, and pedestrians
- Diabetes

To address the priority health needs of the County, a community-based initiative called Healthy Pima was launched. The initiative leverages support from a wide array of over 400 diverse community partners to improve health outcomes through collaboration and collective impact.

OPPORTUNITIES TO LINK GREEN INFRASTRUCTURE TO HEALTH

In 2016, Tucson’s nonprofit hospitals spent an estimated \$11,448,675 on community health improvement. Hospitals and the county health department are already spending money on activities such as:

- The Healthy Pima Initiative supports improvements to local infrastructure that promotes the health and wellbeing of drivers, cyclists, pedestrians, and other roadway users.
- Pima County recently completed The Loop, a 131-mile multi-use trail that spans the metropolitan area, allowing cyclists, pedestrians, joggers, and equestrians an opportunity to enjoy the beautiful Sonoran Desert on paved, vehicle-free pathways.
- The City of Tucson recently adopted a Complete Streets policy. The Pima County Health Department and the Healthy Pima Initiative are currently supporting measures to adopt and implement a Complete Streets policy for Pima County.
- In 2016, Tucson’s nonprofit hospitals spent an estimated \$11,448,675 on community health improvements. These investments in the community are contributing to a variety of programs focusing on health promotion and community wellness.
- A new Community Health Needs Assessment for Pima County is currently underway. A major focus of this assessment will be exploring the social determinants of health, which will include the upstream factors that influence the health of residents in Pima County.

Rank	Hospital	Total Allocated for Community Health Improvement
1	Tucson Medical Center	\$5,552,765
2	Carondelet St. Mary’s	\$2,947,955 (Estimate*)
2	Carondelet St. Joseph’s	\$2,947,955 (Estimate*)

* Carondelet hospitals’ dollar figures are based on 2014 reports regarding their three hospitals, one of which is not in Tucson.

With some adjustments to existing programs, more and better access to green space could create improved health outcomes. The following are some examples of recommended actions:

- Expand partners with multi-sector organizations when exploring the impact of green stormwater infrastructure investments on population health.
- Begin to frame green stormwater infrastructure through a public health lens.
- Conduct health needs assessments to examine health disparities and health issues that affect green stormwater infrastructure.
- Engage in participatory planning that includes community members to design and implement green stormwater infrastructure that ensures physical and cultural accessibility.

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