DESIGNING THE HEALTHY NEIGHBORHOOD:
DERIVING PRINCIPLES FROM THE EVIDENCE BASE

UNIVERSITY of VIRGINIA

HART HOWERTON

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in collaboration with
Hart Howerton

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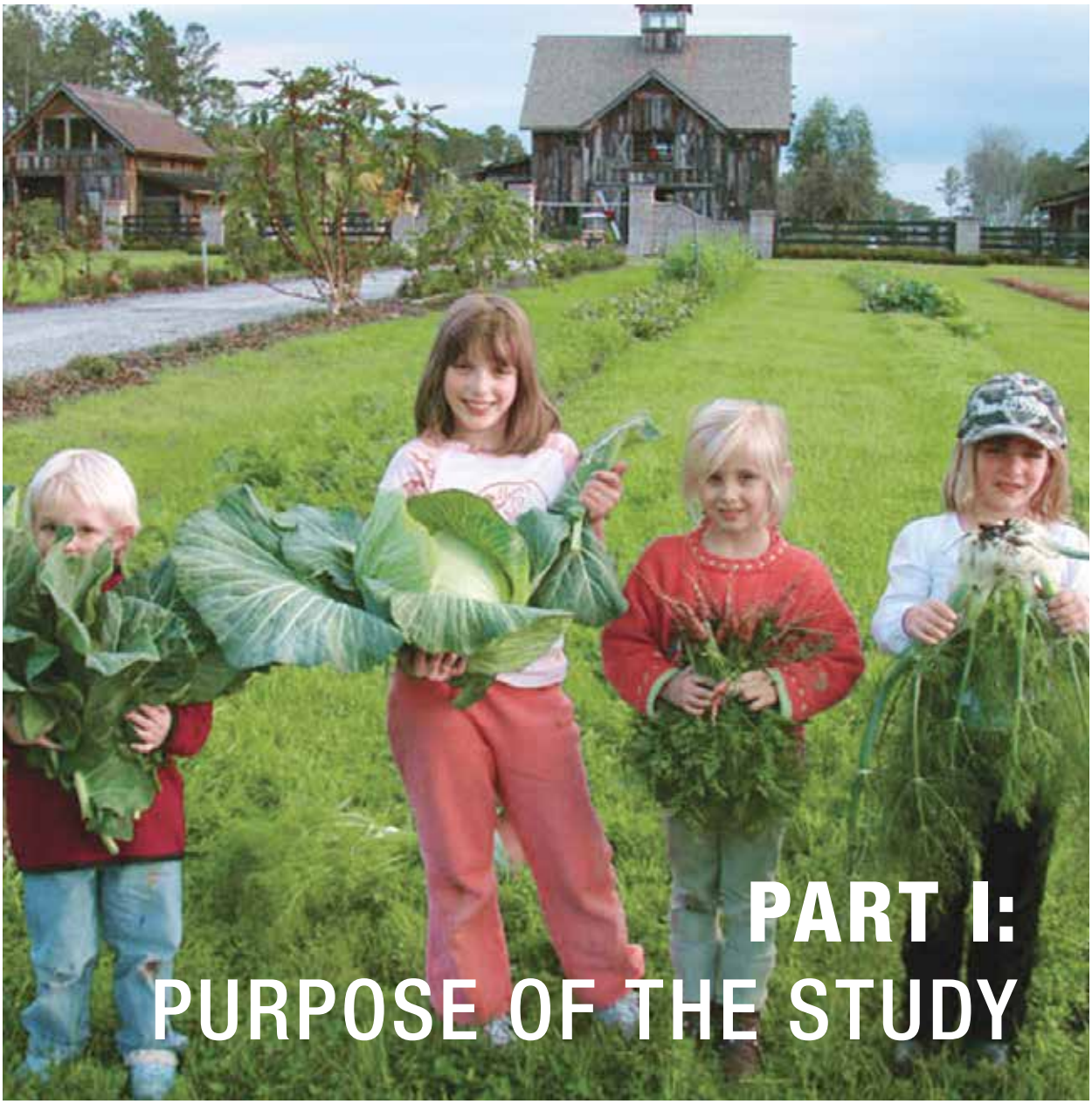


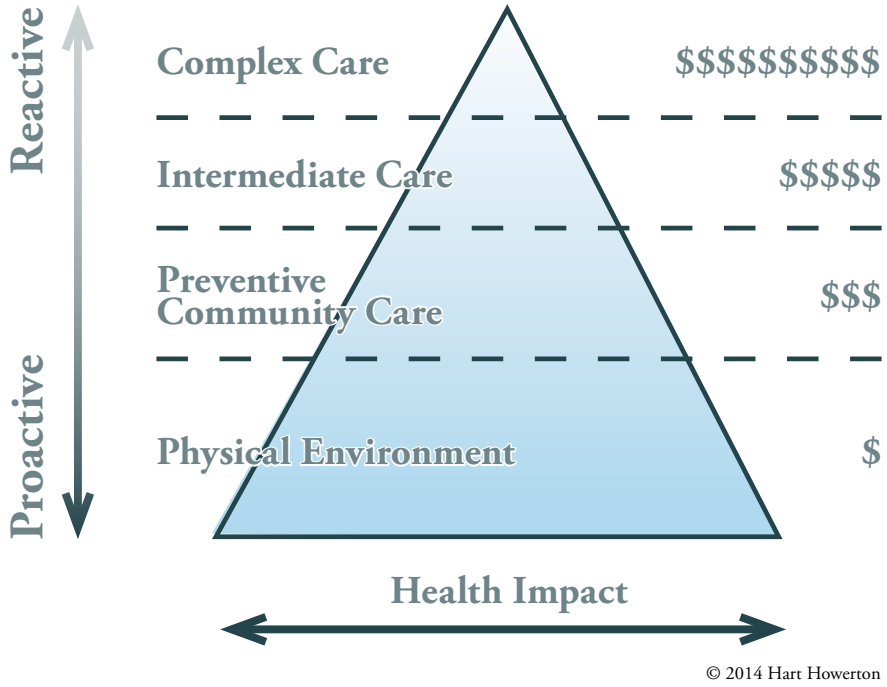
PART I: PURPOSE OF THE STUDY

INTRODUCTION: HART HOWERTON

Dear Reader:

At Hart Howerton, we have been participating in the increasingly vigorous discussion surrounding wellness and Healthy Living. As a leading design firm we have established a partnership with the University of Virginia's Center for Design & Health to help lead the collective Healthy Living conversation.

Many active contributors to the dialogue focus on healthy communities because they help reduce critical and acute care costs; they focus on models where "treatment" is transformed to a preventive care-based model passively facilitated by the design of a built environment, places that include a wider variety of—and more access to—choices about how we live.



Our initial research efforts, enclosed, benchmark design principles that have guided our Firm's work for nearly five decades, and the illustrations you'll see are ours. In "rolling up our sleeves" and more deeply engaging this topic with the help of UVa and their academic research teams, we came to recognize certain realities. Chief among them is that, while a vast amount of research has been done, it has been done in isolation from the stakeholders, end users, tools and processes that lead from design inception to development and delivery of complete, healthy places.

With ample, singular data available, our research led us to the realization that we need to define this topic in its broadest terms—and, with such a definition of Healthy Living in place, we can in turn begin to measure it.

Why measure it? We want the Healthy Living conversation to be as culturally productive and financially sustainable as possible and, to achieve that, we need various stakeholders to "buy in" to the principles and premise. Its benefits can then be tracked and future success measured. Importantly, that moment in the design discussion will help make this endeavor in to a commercially viable approach to real estate development.

As we seek to transition our academic research in to an actionable set of criteria and metrics that ultimately result in more attractive real estate development proformas (and in turn facilitate a paradigm shift in how we design and execute buildings and communities), we need your help. What follows is our research to date: please read it carefully. When finished, we'll look forward to enlisting your help as we improve the ways we design and develop.

Sincerely,

J. Timothy McCarthy II, AIA, LEED AP
Principal

INTRODUCTION: UNIVERSITY OF VIRGINIA

The built environment is a critical factor in human health outcomes. In the late 19th and early 20th centuries, for instance, poor urban environments were a great threat to city residents from all walks of life. Rapidly growing cities experienced severe epidemics of infectious diseases, including tuberculosis, cholera, typhoid, and yellow fever. These epidemics were effectively mitigated through investment in public infrastructure and better urban planning. Sewers were built to manage human waste, public parks were created give access to fresh air, building standards were changed to ensure safe shelter, and development regulations served to reduce traffic congestion and relieve urban overcrowding. **Importantly, visionary architects and planners of the time recognized the role of urban design as a tool for improving health.** Some of the earliest American suburbs—like Riverside, Illinois, planned by Vaux and Olmstead—were created as havens from the industrial city and designed in a way that incorporated nature and health-giving open space throughout the model community. In reaction to heavily polluted London, Ebenezer Howard envisioned the "garden-city" which strove to integrate the best of the city with the benefits of rural life. His iconic vision informed the thinking of other leading 20th century designers and urbanists who created places like the New Deal-era Greenbelt towns—practical but utopian communities designed to provide decent housing, strong community life, and nearby employment and amenities to its residents.

Our triumph over the acute diseases of the city provides important lessons for today since communities across the United States now face a different type of health threat—namely the spread of chronic diseases, such as asthma, Type-2 diabetes, cancer, and heart disease.[1] Of particular concern relative to the rise of chronic diseases is the global rise in levels of obesity. The prevalence of obesity or extreme obesity for adults aged 20 to 74—conventionally measured as a Body Mass Index exceeding 30 for obesity and 40 for extreme obesity—has risen from 14.3% in 1960-62 to 41.9% in 2010-2011 (Fryar, et al.(a), 2014). Child and adolescent (aged 2 to 19) obesity now measures at 16.9%, up from 5.2% in 1971-1974 (Fryar, et al.,(b), 2014). At the same time that obesity has risen, average rates of physical activity have fallen for both adults and children. In the US, only 48% of adults meet the Surgeon General's Guidelines for physical activity, namely 150 minutes of moderate intensity aerobic activity like brisk walking every week (http://www.cdc.gov/physicalactivity/data/facts.html). Physical inactivity amongst children is also a concern. For instance, in 2009, 13 percent of children five to 14 years old usually walked or biked to school compared with 48 percent of students in 1969. The concern with obesity and physical inactivity is so pronounced in our public health conversations because of the known link between these factors and chronic diseases such as diabetes, heart disease and various forms of cancer.

To address issues of obesity, physical activity and chronic disease, increased attention is being paid to the role of environmental factors in health outcomes. **Emerging research indicates that—once again—built environment interventions are a necessary—or potentially transformative—approach to promoting human health at both the individual and community scale.** How to create a built environment that promotes health is of great interest to a wide spectrum of actors—planners, public health officials, medical practitioners, architects, landscape architects, and the real estate development community. Dialogue and discussion are particularly needed on the "how to's"—how do we build communities supportive of health in its many facets? Just what type of principles should we follow in our quest to create communities that not only provide for physical health, but also for mental health and emotional well-being?

To help spark an informed dialogue on design and health, Hart Howerton has collaborated with the Center for Design and Health at the University of Virginia to dive deep into the existing literature on health and design to identify specific aspects of the built environment that have been shown to positively impact human health. This evidence base can then help us formulate and substantiate key principles behind a normative "healthy neighborhood."

In this paper, we essentially sought to answer two questions:

- Can built environment strategies improve health in all its dimensions?
- What built environment strategies have proven linkages to health?
- Our definition of health is broad and inclusive—namely the perspective promoted by the World Health Organization, which is that "health is the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (http://www.who.int/about/definition/en/print.html).

METHODS

The primary method used to evaluate the evidence base associated with the built environment and health was a literature review. This method was chosen because there is a large, robust literature available and, with a few exceptions, this research was conducted by well-trained, objective researchers working in key disciplines (e.g., urban planning, public health, environmental psychology, and medicine).

The literature was identified using database services available at the University of Virginia library system. The indexes used were: JSTOR, PubMed, EBSCO Host, Medline, ERIC, and LexisNexis. In addition, specific journals were searched. These journals included: Journal of the American Planning Association, Journal of Planning Education and Research, Journal of Urban Health, Journal of Planning Literature, Journal of Environmental Planning and Management, Environmental Health Perspectives, Transportation Research Record, Social Science Research, Social Science & Medicine, American Journal of Public Health, Health & Place, BMC Public Health, International Journal of Behavioral Nutrition and Physical Activity, and the American Journal of Preventative Medicine.

There is a voluminous literature relevant to healthy neighborhood design; for our purposes we narrowed the literature to **look specifically for evidence on the following features of the built environment:**

Features researched included:

1. Mixed Land Uses
2. Sidewalks / Dedicated Pedestrian Infrastructure
3. Bicycling Infrastructure (e.g., bike lanes, bike boulevards)
4. Street Design (e.g., connectivity, street widths)
5. Mixed Income / Mixed Density / Multi–Generational Housing
6. Public Parks / Green Spaces
7. Public Plazas / Community Facilities
8. Public Transit
9. Building Technologies (e.g., green architecture)
10. Sustainable Infrastructure (e.g., LID, green infrastructure, integrating nature into cities)
11. Access to Sources of Healthy Food (e.g., full service supermarkets, community gardens, urban agriculture)
12. Access to Educational Facilities / Lifelong Education

We also looked at the relationship between feelings of community belonging and social capital to health outcomes/welfare. **Successful communities build a feeling of pride of place and belonging amongst their residents; a question is whether such factors also relate to better human health.**

In general, it is important to note a few methodological issues associated with the literature. A fair amount of the research that deals with urban form and health (particularly physical activity) is **cross-sectional**. That is, the studies present statistical comparisons of groups of individuals; the data for these comparisons were collected at one point in time (e.g., CDC's Behavioral Risk Factor Surveillance System which provides data on weight and physical activity). These studies are not longitudinal (i.e., they do not examine change over time), nor are they experimental (i.e., examining the group at two distinct times, before and then after some form of intervention—preferably with a control group). Longitudinal and experimental studies can be more challenging and expensive to do, but they are more suitable for investigating causation. One additional problem that researchers in this area worry about is **self-selection**. Many studies look at persons living in a particular place and examine the extent to which the urban form around them is associated with certain health measures (e.g., body mass index, reported levels of health, physical activity). It is possible that persons with a propensity to exercise, however, consciously decide to live in a certain location because of its features (e.g., access to transit, trails, mixed use). Attributing their higher levels of physical activity to urban form, thus, is potentially misleading. **To dig into causation researchers are now striving to look for "natural experiments" or to conduct longitudinal studies with cohorts of the same persons.**

ORGANIZATION OF THE REVIEW AND LINKS TO THEORY

The paper is organized to examine each proposed design principle and look at the design elements that relate to the principle. In each section we:

1) briefly discuss the design principle
2) highlight constituent design elements
3) provide a synopsis of the hypothesized linkages between the design element and health
4) present illustrative findings, and then
5) provide a "take away" for practice to inform public discussions and decisions relative to development.

There is, of course, some crossover between elements and principles: our organization cross-references sections as need be.

The recognition that the built environment is a critical factor for human health is part of a broader theoretical shift in public health and medicine that has moved our understanding/evaluation of health away from a single-minded focus on the individual (and his/her genetics and behaviors) to a larger embedded context. This is often referred to as a "social-ecological" understanding of health—which recognizes that there are social determinants of health (e.g., economic inequality, political repression) as well as environmental factors (e.g., exposure to toxics, lack of sanitary facilities, lack of access to beautiful, biologically diverse natural environments). For our purposes, we include one diagrammatic presentation here (there are many) that lays out the elements of and linkages between what have been called the "upstream factors" of health located at the fundamental, intermediate and proximate levels. The constructed/built environment is clearly central to health, but so too are policy, programmatic and social aspects of our communities that relate to and result from design, planning, and development such as quality of education, levels of community engagement, and exposure to pollutants and violent crime.

SUMMARY OF RESULTS

The overall findings from this literature review substantiate the proposition that built environment strategies can improve health in its many dimensions and broadly support the principles we have laid out. If we were to summarize the findings below in the most simple way communities should be built to accomplish two goals:

1) **facilitate physical activity across the life span**
2) **foster social interaction between community residents**

Physical activity has proven linkages to better health; drawing from the literature reviewed the design approaches with known connections to higher levels of physical activity are mixed land uses, accessible transit, and provision of open

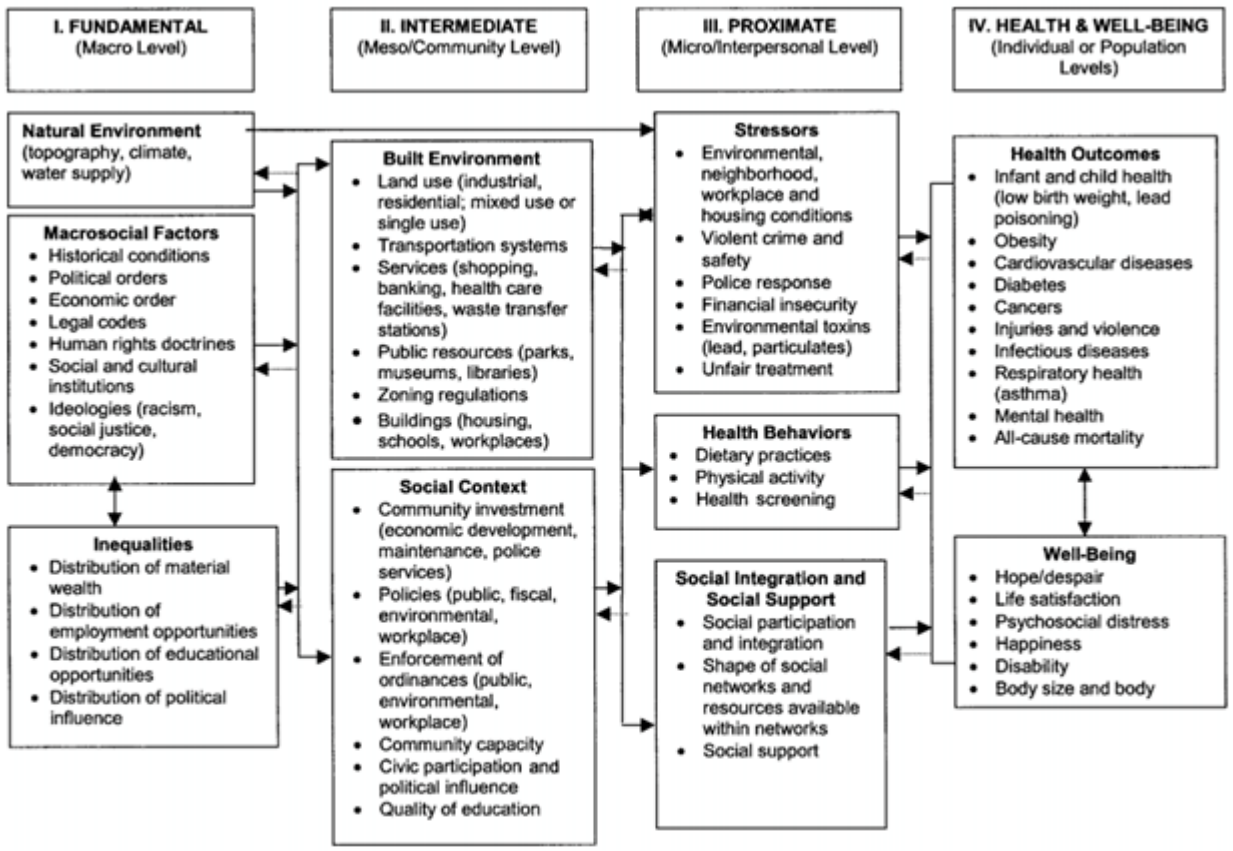


FIGURE 1. Social determinants of health and environmental health promotion. The model was developed for an article by AJ Schultz and ME Northridge.[5]

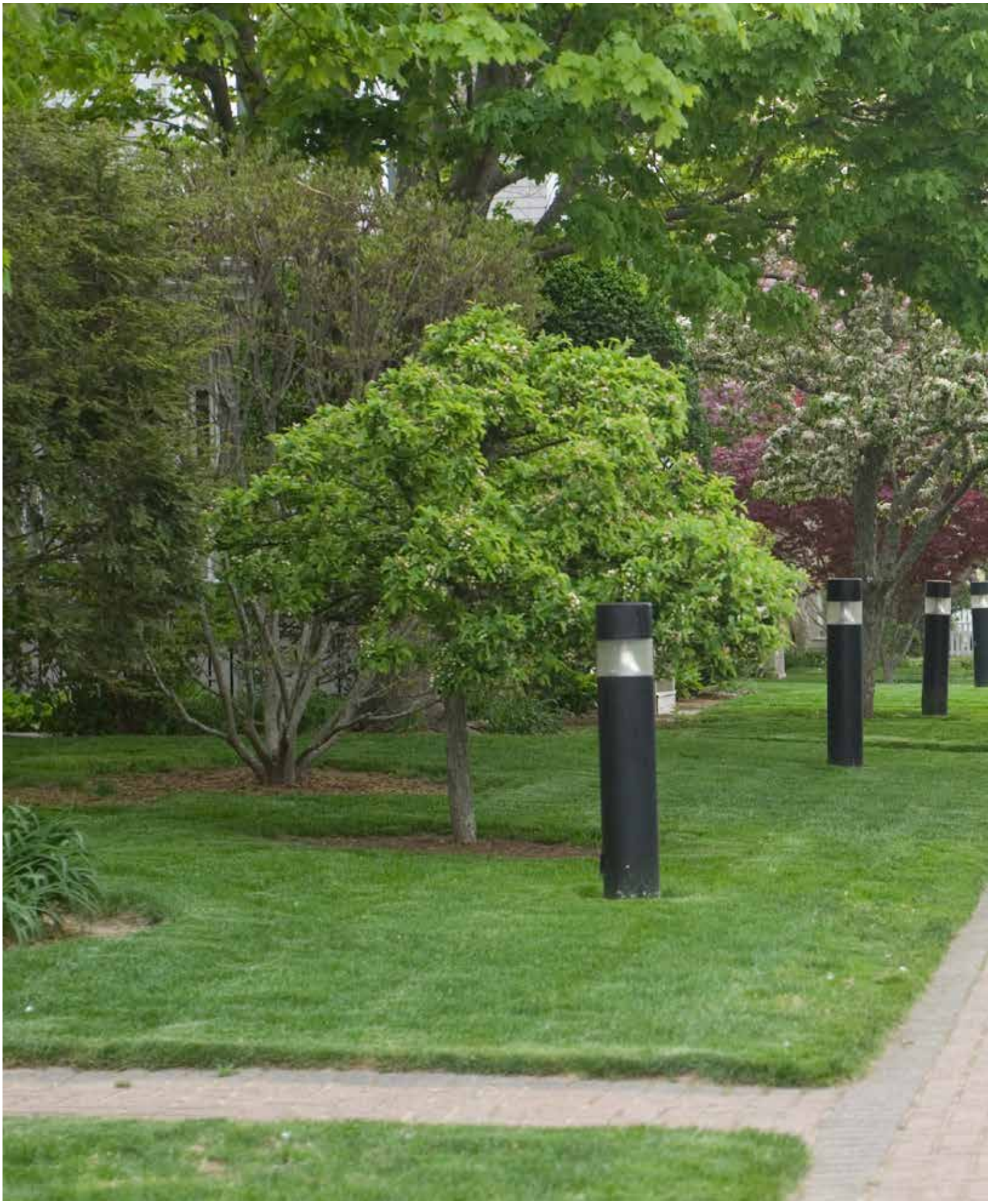
Model from: Northridge, Mary, Elliot D. Sclar, and Padmini Biswas. 2003. "Sorting out the Connections Between the Built Environment and Health: A Conceptual Framework for Navigating Pathways and Planning Healthy Cities" Journal of Urban Health 80(4): 556–568.

space, parks, and supportive (connecting) non–motorized infrastructure like sidewalks.

Social interaction is also consistently positive for health across the life span—such interactions not only facilitate better mental health but they appear to support physical activity as well as people are more physically active in social settings which they perceive as welcoming and secure.

The way one designs for greater social interaction fortuitously parallels the way we should design for physical activity—creating attractive mixed use environments with destinations and amenity–filled gathering places serviced by supportive infrastructure that encourage people to get out of their car and walk, bike, bus, mingle and linger instead.

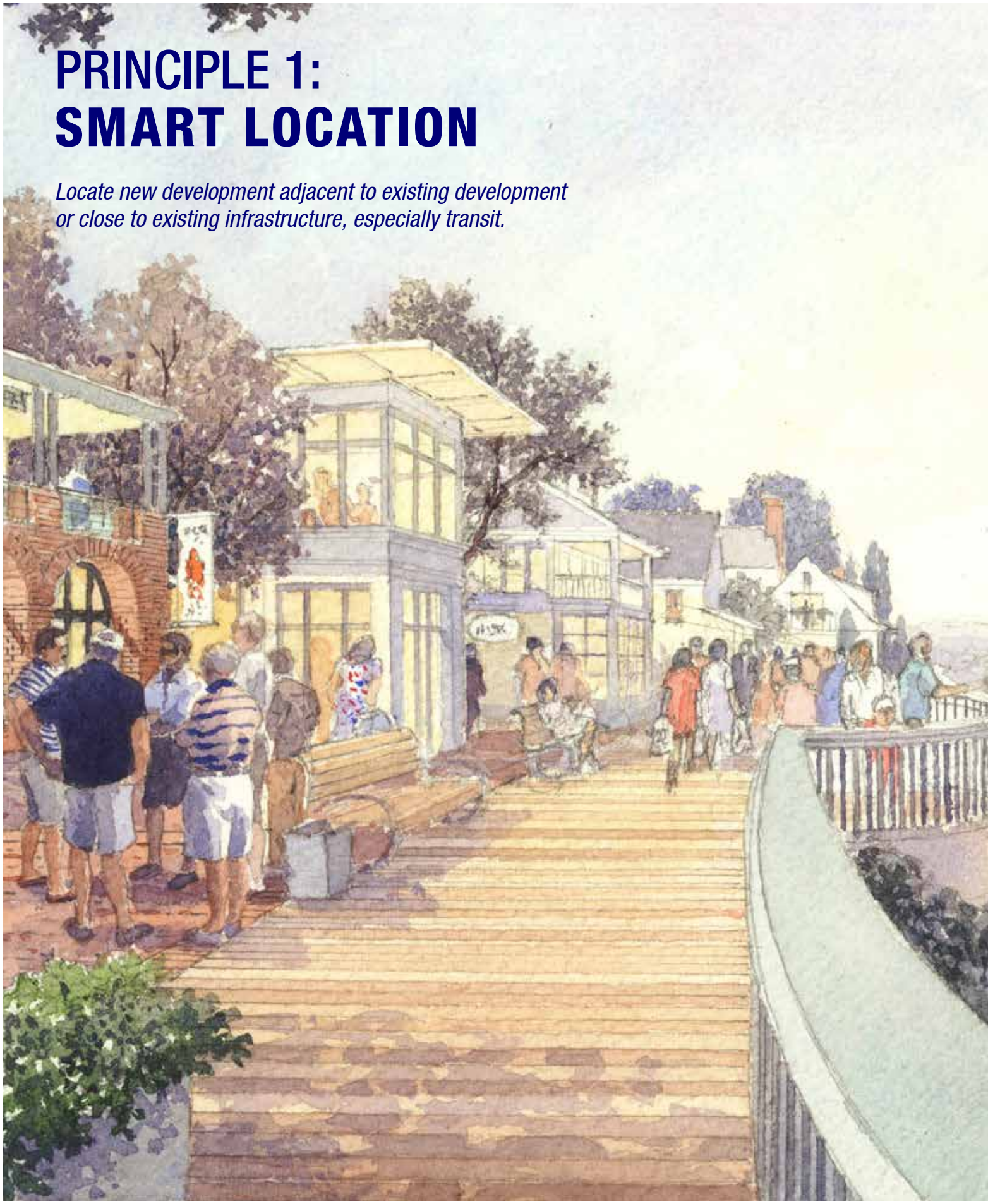
PART II: PROPOSED DESIGN PRINCIPLES & KEY FINDINGS FROM THE LITERATURE REVIEW

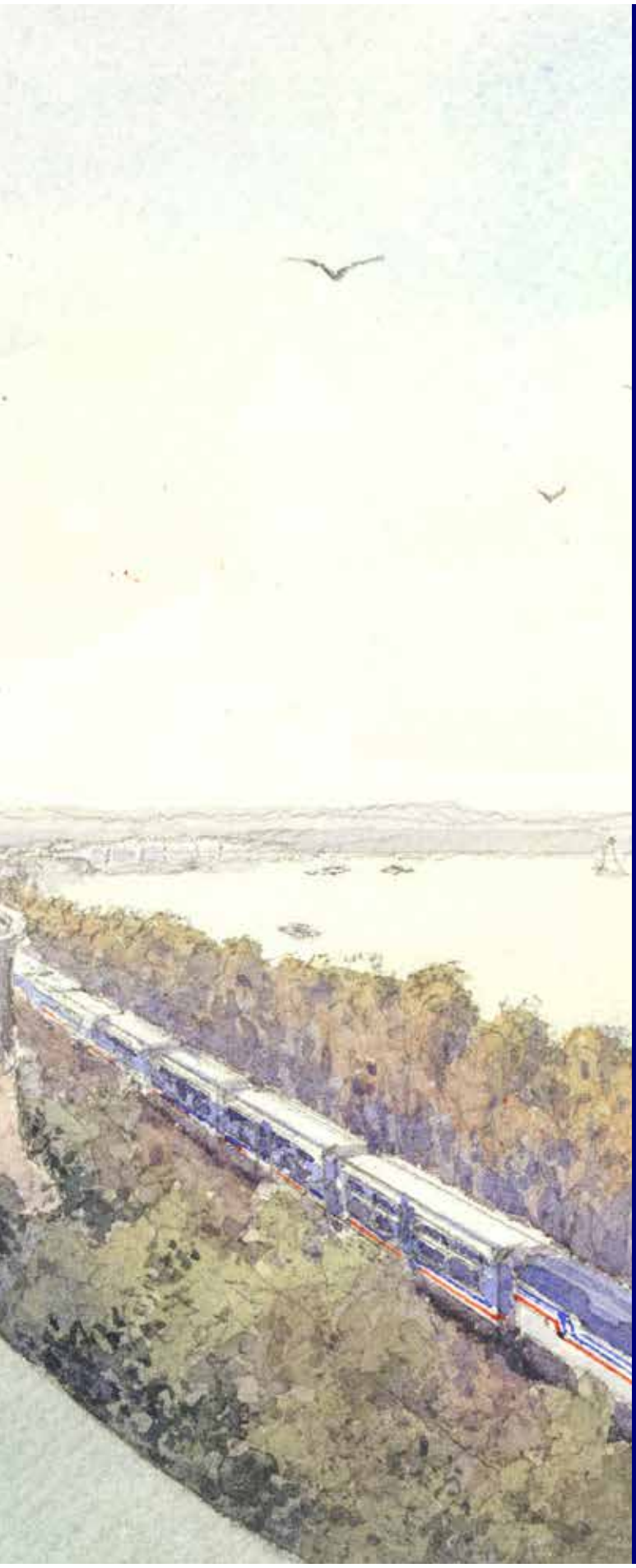


EXECUTIVE SUMMARY

PRINCIPLE 1:
SMART LOCATION

Locate new development adjacent to existing development or close to existing infrastructure, especially transit.

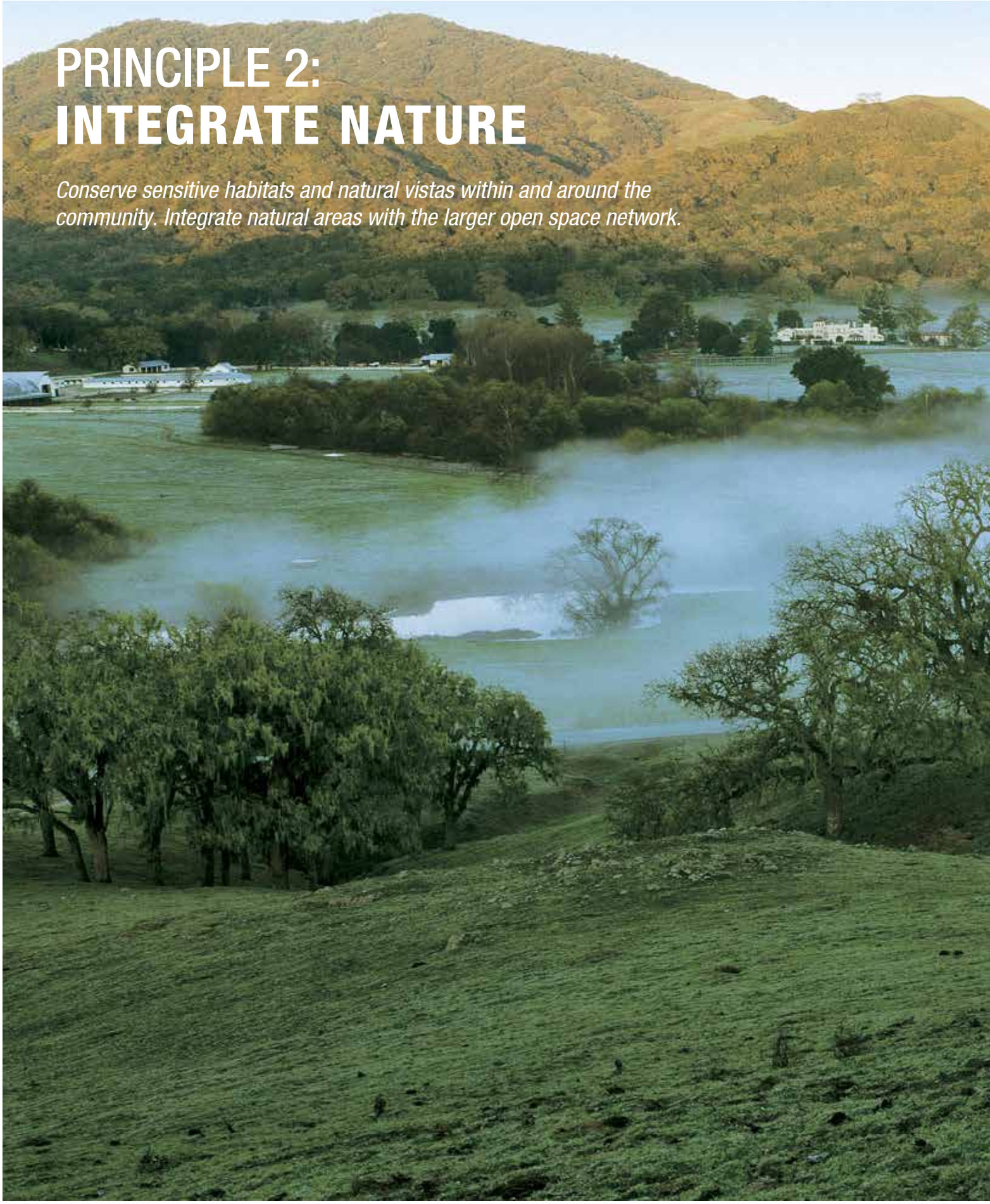




Take Away for Practice

"Smart Locations" help preserve habitats and biodiversity, translating in to positive health impacts. Further, they lower the use of the automobile by facilitating the link between physical activity and transit utilization. Simultaneously it reduces the need to use undeveloped land for roads and parking.

- Offer public transit alternatives.
- Support "aging in place" by providing transit and enabling longer-term independence and activity.
- Support accessibility to transit by placing transit stops strategically.
- Design inviting, well-lit, sheltered transit stops.



PRINCIPLE 2: INTEGRATE NATURE

Conserve sensitive habitats and natural vistas within and around the community. Integrate natural areas with the larger open space network.

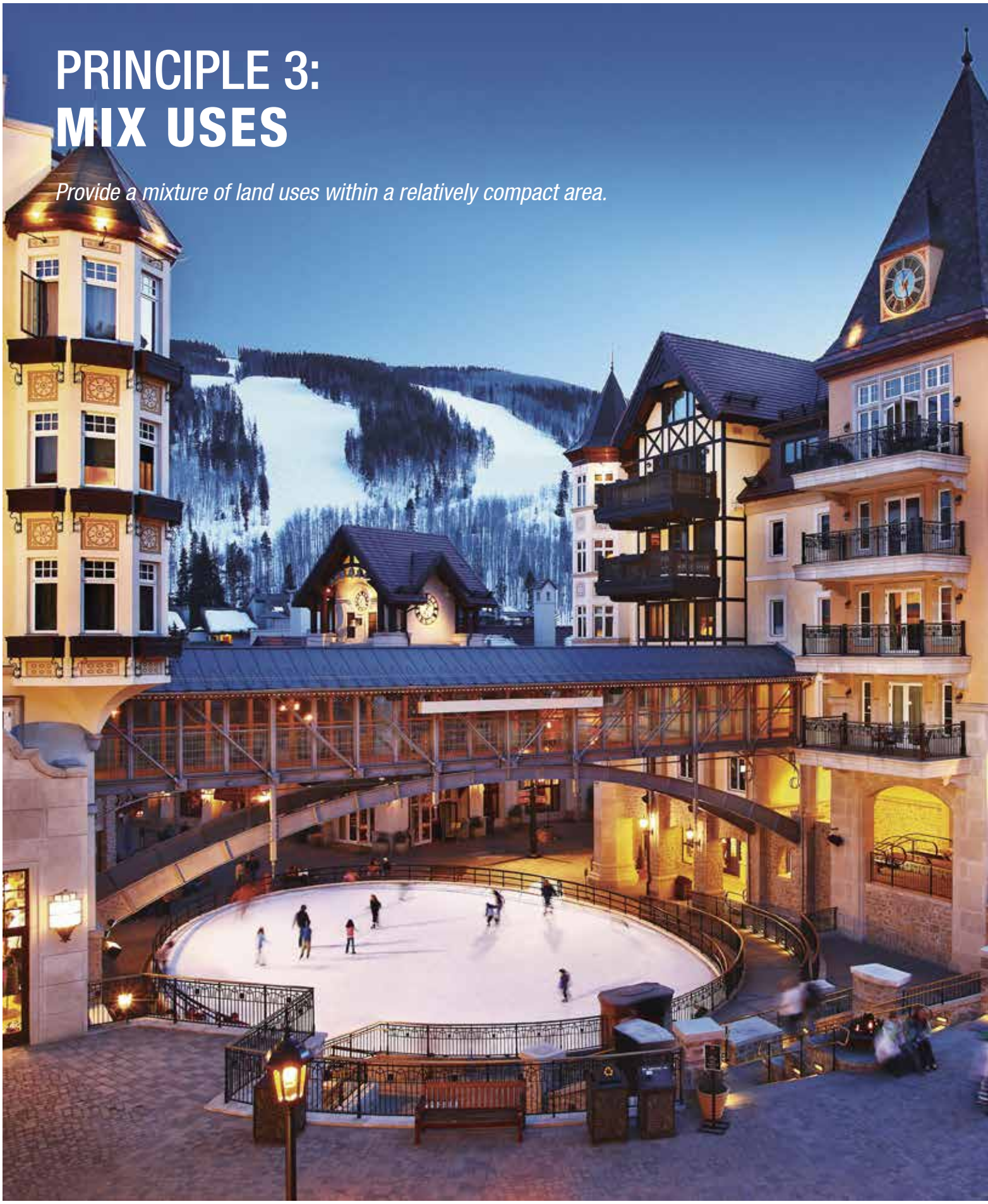
Take Away for Practice

At the broadest, most systemic levels, natural systems and diverse landscape experiences maintain and cleanse our environment while promoting physical health and psychological well-being at community scale.

- Local authorities need to be proactive in planning for coherent, integrated trail networks and quality open space (incl. passive and active recreation).
- Simultaneously, open space systems must protect contiguous habitat and or wildlife corridors.

PRINCIPLE 3:
MIX USES

Provide a mixture of land uses within a relatively compact area.



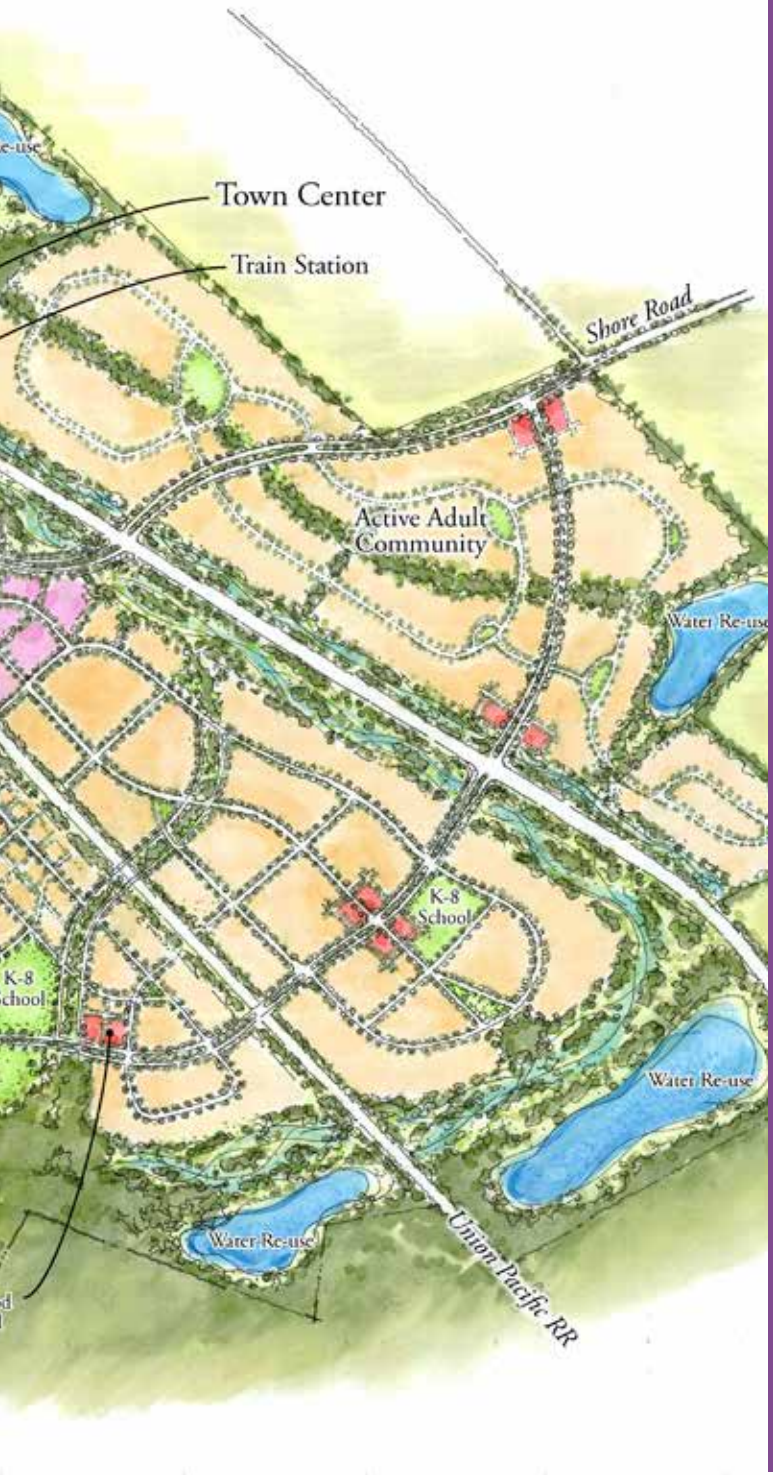
Take Away for Practice

Land use mixing provides for the daily needs of the community and enhances human health.

- ”Smart Growth” zoning and form-based codes need adoption as a means of regulating compact, mixed use communities that facilitate positive health impacts.

PRINCIPLE 4:
MIX IT UP

Create residential developments that include a variety of housing types and tenures; encourage attainable housing for all community members of all backgrounds and ages.



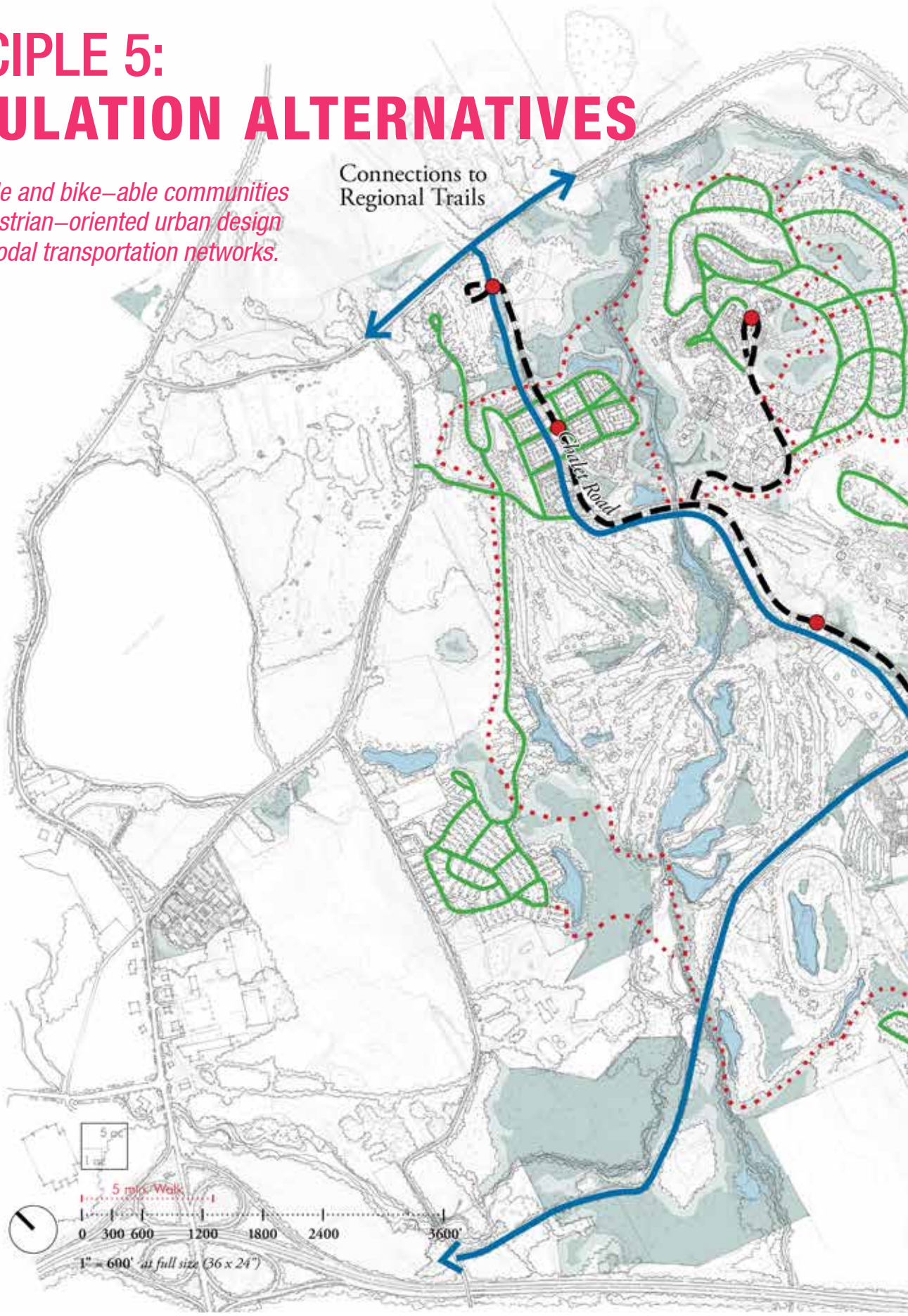
Take Away for Practice

Evidence supports the mixing of housing types, tenures and incomes in inclusive communities to enhance human health.

- Contemplate "inclusionary zoning" in order to encourage affordable housing as part of any development; offer "density bonuses" as an incentive.
- Include "secondary housing units" ("granny flats") within existing neighborhoods to encourage multi-generational living.
- Adopt universal accessibility design standards in home-building to lessen obstacles for proactive disabled buyers to move in to a given neighborhood.

PRINCIPLE 5:
CIRCULATION ALTERNATIVES

Build walkable and bike–able communities through pedestrian–oriented urban design and multi–modal transportation networks.



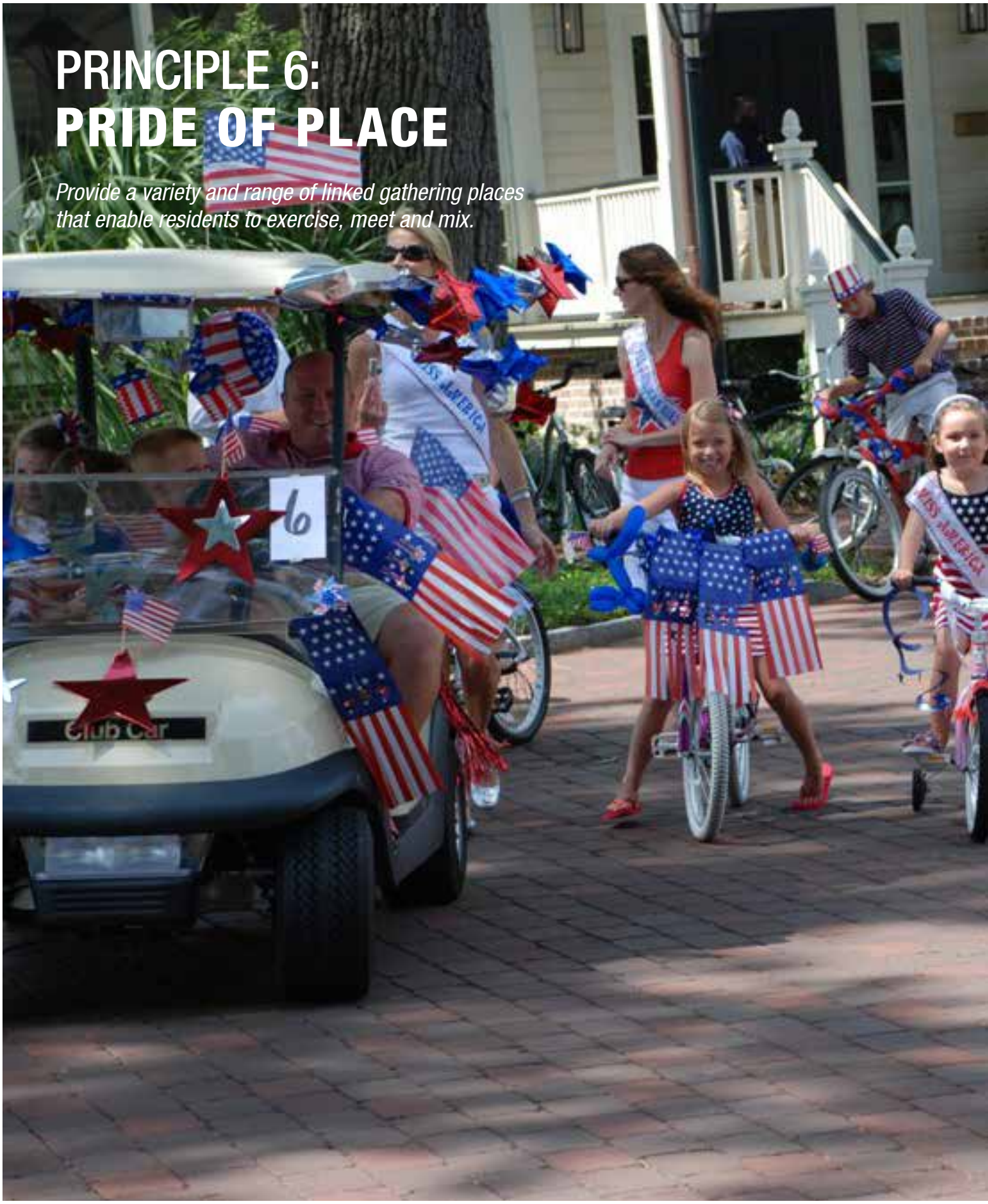
Take Away for Practice

"Active Transportation," that is walking and biking for utilitarian purposes, has been demonstrated to have a positive impact on population health including a reduced risk of obesity, cardiovascular disease, and all-cause mortality.

- Provide ADA-compliant sidewalks that are free of obstacles and designed as part of a greater utilitarian and recreational network wide enough for two-way traffic.
- Instill a feeling of safety by providing adequate lighting and separating pathways from vehicular roadways.
- Design roadways to accommodate all types of traffic, including cyclists and motorists (the "complete street movement").

PRINCIPLE 6:
PRIDE OF PLACE

Provide a variety and range of linked gathering places that enable residents to exercise, meet and mix.



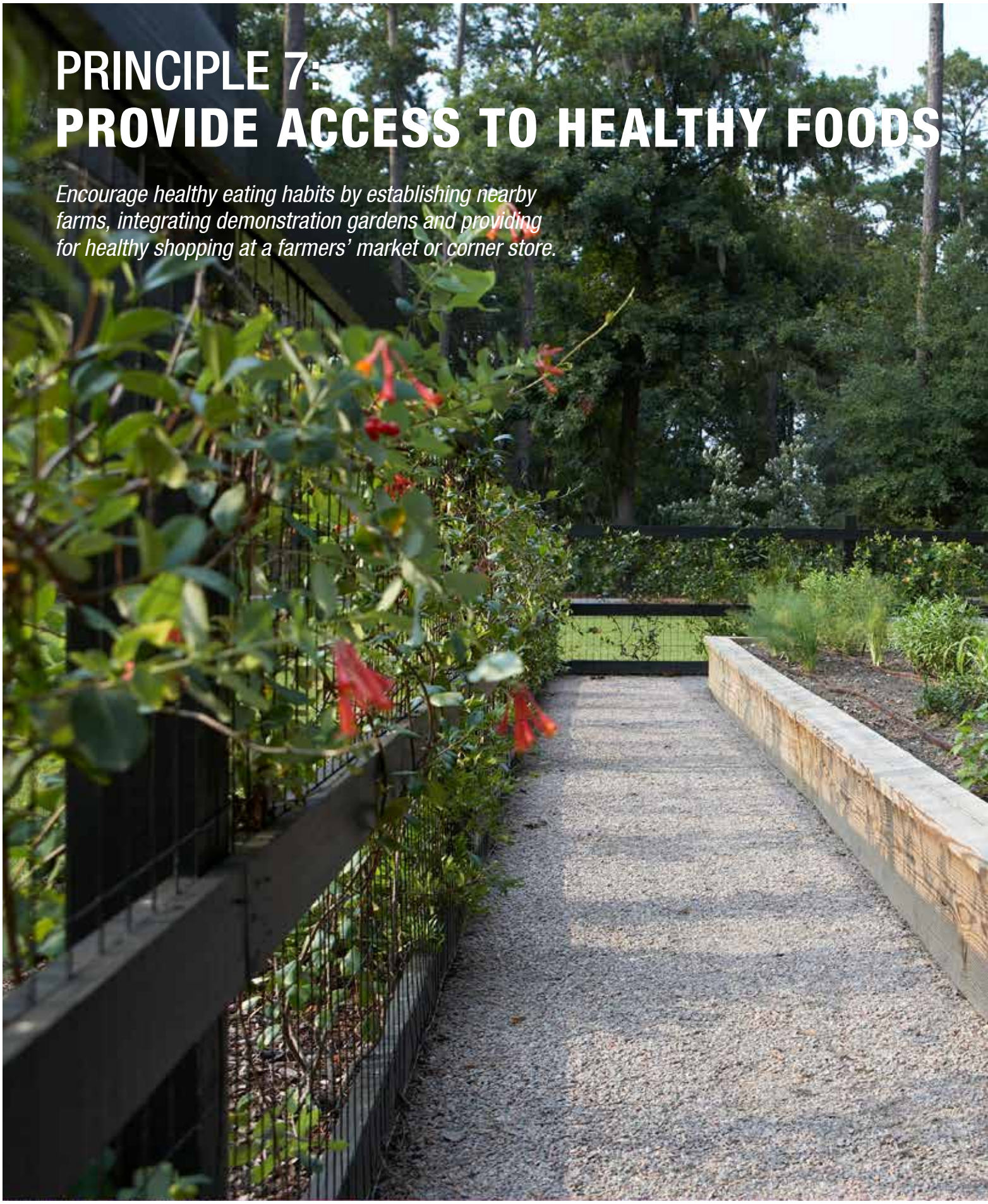
Take Away for Practice

Public spaces, at all scales, are a critical element in the land use mix needed to foster social capital and human health.

- Design communities to provide an "enabling environment" for social interaction in high quality public spaces, including streetscape.
- Consider "soft programming" (like festivals, fairs, and seasonal attractions) for the public spaces, activities that encourage community members to return throughout the year.

PRINCIPLE 7:
PROVIDE ACCESS TO HEALTHY FOODS

Encourage healthy eating habits by establishing nearby farms, integrating demonstration gardens and providing for healthy shopping at a farmers' market or corner store.



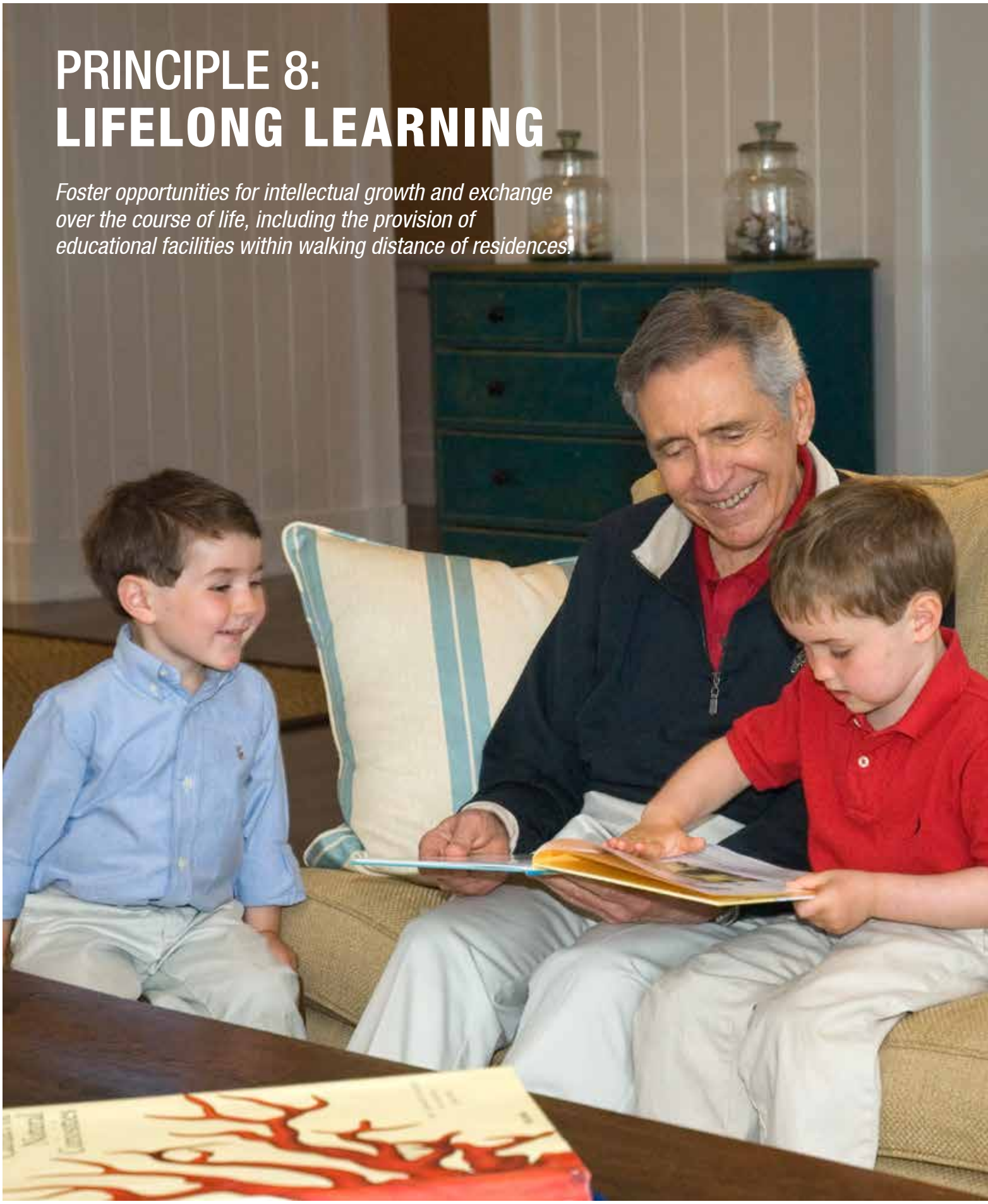
Take Away for Practice

Communities with poor food access, commonly referred to as "food deserts," require the integration of sources of fresh fruits and vegetables in to the built environment.

- Facilitate access to healthy foods through food policy councils, land use policies and city investment strategies.
- Provide for urban agriculture, backyard gardens, or community gardens depending on local conditions.

PRINCIPLE 8:
LIFELONG LEARNING

Foster opportunities for intellectual growth and exchange over the course of life, including the provision of educational facilities within walking distance of residences.



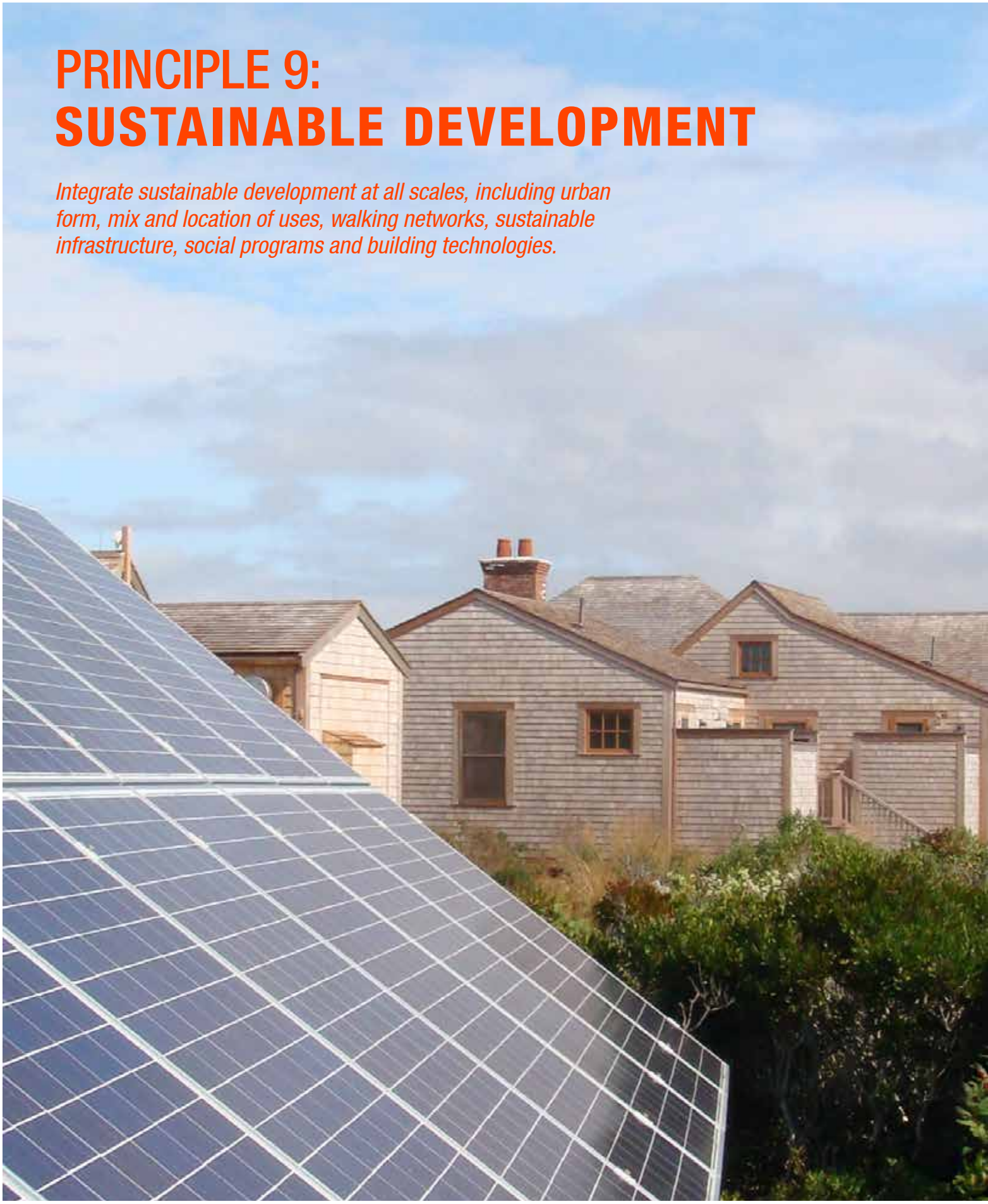
Take Away for Practice

Lifelong education at all ages is important for positive health outcomes.

- Integrate facilities that can accommodate educational programming in to residential development.
- Locate schools as part of a greater “active transportation” network so walking and biking to school become viable options in a safe and well-lit circulation system.

PRINCIPLE 9:
SUSTAINABLE DEVELOPMENT

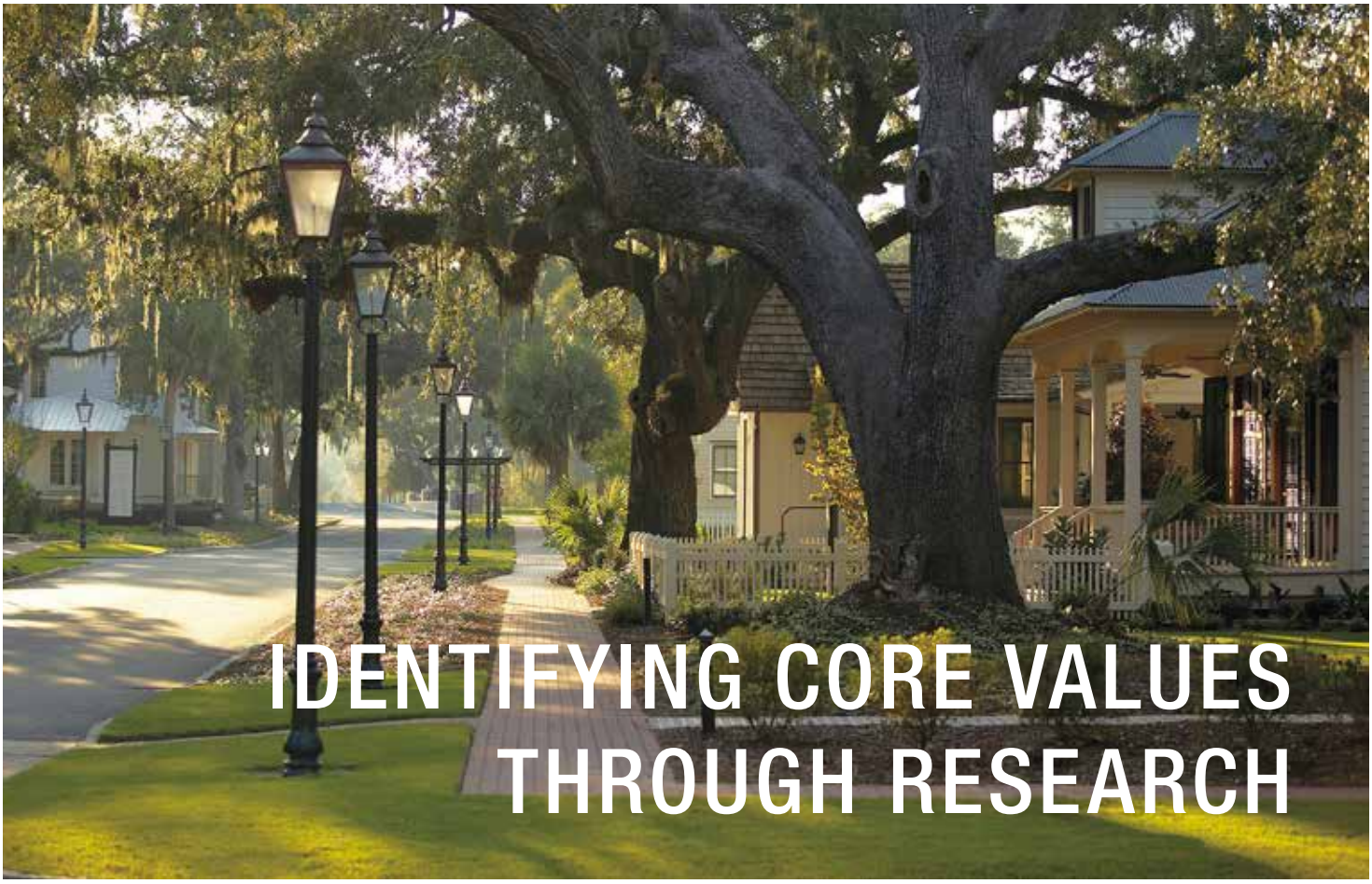
Integrate sustainable development at all scales, including urban form, mix and location of uses, walking networks, sustainable infrastructure, social programs and building technologies.



Take Away for Practice

Low-impact development (LID) and green building technologies can yield positive benefits for the ecosystem as well as human health.

- USGBC programs such as LEED and WELL help measure successful adoption or particular tools in a broad, integrated approach to sustainability.



IDENTIFYING CORE VALUES THROUGH RESEARCH

PRINCIPLE 1: SMART LOCATION

Locate new development adjacent to existing development or close to existing infrastructure, especially transit.

There are many broad arguments for placing development in a smart location—that is, avoiding so-called "leapfrog development" that serves to fragment natural habitats and undermine agricultural production and rural economies. While many of the arguments one hears for contiguous development are fiscal/economic (e.g., infrastructure savings) or environmental (e.g., habitat protection)—there are also **health benefits from smart locations**. In a review of research on smart growth practices undertaken for SmartGrowthBC, Frank, Kavage, and Litman (2006) identify seven public health outcomes affected by the broader type of development dubbed "Smart Growth;" these are physical activity and obesity, air quality, traffic safety, noise, water quality, mental health, and social capital.[2] **Relative to the narrower dimension of "smart location", several health benefits derive from the fact that smart locations enable lower use of the automobile** and result in less conversion of undeveloped land to facilities to accommodate the automobile (e.g., roads and parking lots).

Communities characterized by sprawling land use patterns and higher levels of per capita automobile usage have been shown to have higher levels of traffic and pedestrian fatalities (Lucy, 2003; Ewing, et al, 2003). Sprawling development is also characterized by extensive impervious surfaces, such as massive parking lots or wide roadways; these, in turn, have negative impacts upon water quality in both surface and ground water sources. Likewise, lower levels of automobile usage resulting from a smart location have been shown to have a positive impact on air quality, which relates to respiratory diseases such as asthma. **Because smart locations also help preserve habitats and biodiversity, the ecological services provided by these (e.g., intact mature tree canopies are good for local microclimates, air quality and cooling; functioning natural wetlands filtrate stormwater) also translate into potential positive health impacts.**

The impact of public transit is worth looking at in-depth. Public transit in the United States generally takes four classic forms: buses, on-street trolleys or streetcars, light rail, and subways. Additionally, smaller towns and/or peri-urban areas often provide transit through paratransit ("dial a ride") type services although these may be reserved for certain populations. Bus Rapid Transit, a type of bus service that runs on dedicated lanes alongside or within established streets, has been widely discussed by US transportation planners, but has only been implemented in a limited fashion thus far (i.e., often just short stretches or in conjunction with reversible high occupancy vehicle (HOV) lanes on highways). Public transit is hypothesized to make positive contributions to human health through several pathways. Fundamentally, greater provision of public transit allows commuters and other travellers to make a "mode shift"—in the United States rising levels of public transit utilization (best seen during the recession and episodes of higher gasoline costs) generally result from travelers moving from single occupancy vehicles (SOVs), our dominant mode of commuting. Lower levels of SOV travel is beneficial—it results in lowered levels of traffic congestion and less petroleum being burnt with a subsequent lowering of air pollutants such as volatile organic compounds (VOCs), nitrogen dioxide, small particulates, and carbon dioxide.[3] Reduction of these pollutants is positive since they are associated with a range of respiratory illnesses, including asthma. In 1996, for instance, the City of Atlanta reduced traffic downtown in order to manage congestion for the Olympic Games—and it had a dramatically positive health effect. Peak morning traffic decreased 23%, peak ozone reduced 48% and emergency room visits for asthma events in children went down 43% (Friedman, et al, 2001). Transit is also expected to induce greater levels of physical activity as commuters often bookend their transit trip with walking to and from the transit stop from their home or place of work; this may have impacts for obesity prevention and reducing medical costs (Edwards, 2008). Transit that accommodates other modes, such as equipping buses with bike carriers, is seen as furthering this even more as cyclists can use the combination transit/bicycle to accomplish a longer distance trip that might normally necessitate an automobile.

Transit is hypothesized to be particularly beneficial in terms of enabling physical activity, self-sufficiency,

and social interaction for those who cannot or choose not to drive, including older adults, the disabled, the visually impaired, and children. Finally transit is seen as having the potential for building community connections and contributing to social capital—as taking the bus or the subway can be a highly social experience through which individuals who might (literally) not cross paths have opportunities to interact.

While public transit is hypothesized as having positive health benefits, utilization of public transit is lower on a per capita basis in American cities than in European cities (2% of urban trips versus 10%) (TRB, 2001). At least three obstacles to achieving greater ridership levels on public transit relate to the way we design our cities and neighborhoods; they are: 1) levels of population density; 2) the accessibility of transit services and 3) the design of transit stops and waiting areas, particularly from a safety/security perspective. These are addressed in the take away section.

FINDINGS

Research does indicate that transit use promotes physical activity; this occurs because most transit trips also involve walking or cycling links. In their analysis of U.S. travel survey data, Weinstein and Schimek (2005) found that 16 per cent of all recorded walking trips were part of transit trips and that these tended to be longer than average walking trips. When Besser and Dannenberg (2005) looked at transit users among the 105,942 adult respondents to the 2001 national household travel survey, they found that Americans using transit spent a median of 19 minutes a day walking to transit and that 29% of U.S. transit users walked more than 30 minutes daily on their transit trip alone.

Similarly, in a study of Atlanta commuters published in 2005, Lachapelle and Frank found that transit users accumulated the greatest total walking distance across all income groups. In this study income proved important with higher income transit users reporting the most walking. A study of light rail transit (LRT) in Charlotte, NC, also showed a positive impact on health from the city's new transit investment (MacDonald, et al., 2010). Specifically, in this case the use of LRT was associated with a lower body mass index (BMI) and reduced odds of becoming obese over time. Finally, in a recent study of randomly selected residents of different medium and low-income neighborhoods of Seattle and Baltimore, Lachapelle, et al (2011) found that transit commuters accumulated more minutes of physical activity (approximately 5 to 10 minutes) and walked to more destinations near their homes and workplaces than non-transit commuters. Finally and most recently, Freeland et al., (2013) found that transit walkers in large \urban areas with a rail system were 72% more likely to transit walk 30 minutes or more per day than were those without a rail system.

The provision of transit has been identified as particularly important for successful aging (see, the World Health Organizations Age-Friendly Communities studies; the North American city studied was Portland, Oregon written up in Neal and DeLaTorre, 2007). A critical health threat for older persons is social isolation (loneliness) and the loss

of independence, both of which have been shown to affect individuals negatively resulting in poor health outcomes (Hawkley and Cacioppo, 2003; Hawkley et al., 2008; Russell and Taylor, 2009). While social isolation is hardly guaranteed in old age, it is a common experience resulting from physical decline, more limited mobility, and the loss of friends and family over time. These changes can be exacerbated by what is often a quite traumatic event in the life of an older adult: the cessation of driving. Research has shown that older adults who continue to drive experience better health than those who do not and driving cessation has been associated with declines in various measures of health, including depression (e.g., Ragland, et al., 2005; Edwards, et al., 2009). Although driving is good for the independence and self-esteem of older adults, it does raise public safety concerns and is seen to be a incipient problem as the majority of older adults are now living in car-dependent suburban communities (Peck, 2010). **Transit, thus, can play a significant role in enabling older adults remain active and independent.** A question is: to what extent does the literature validate this conclusion?

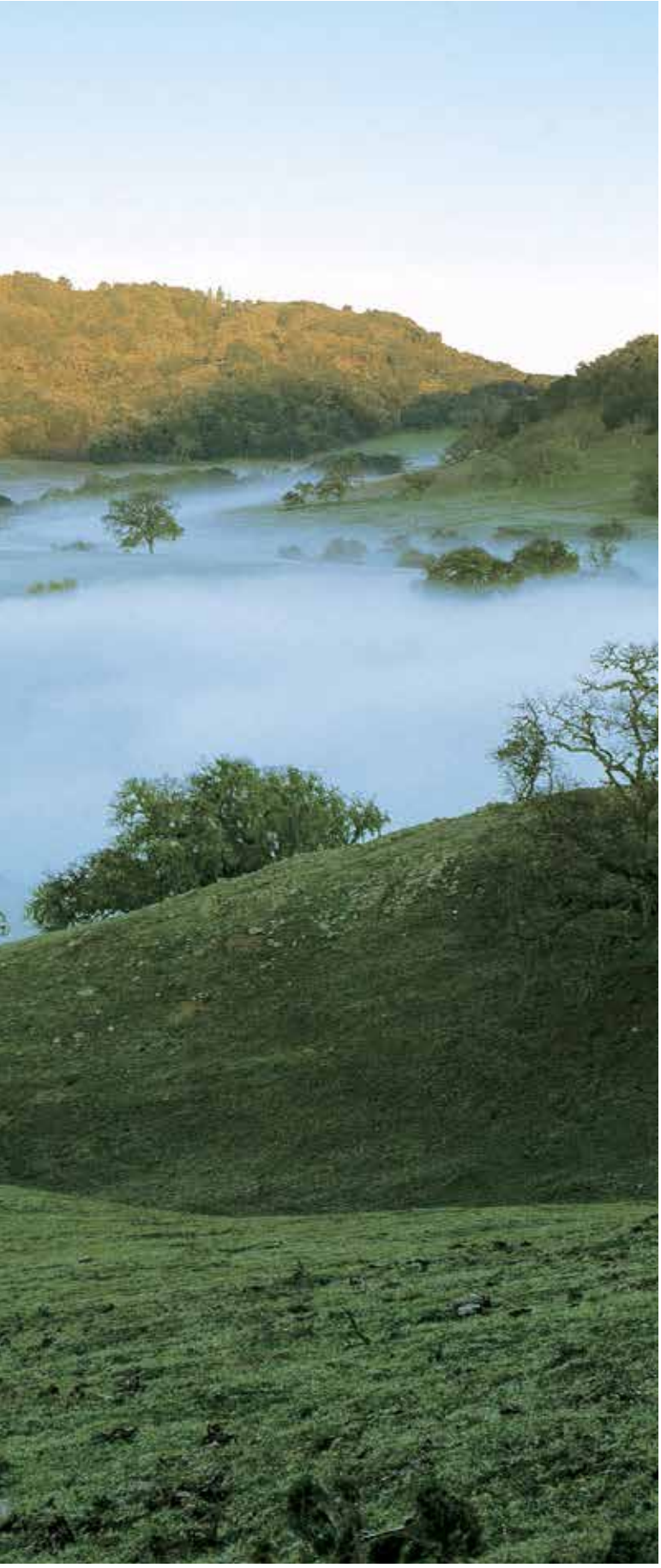
Our literature search did not uncover research that isolated the health impacts of transit utilization on older adults. There is literature, however, that provides some insights into the need for effective transit and for thinking about how to structure communities and transit systems so as to encourage transit utilization by older adults. In a study from 2002, Foley et al. determined that the demand for alternative (non-auto) transportation differs across gender with non-driving older men facing an average of 6 years of reliance on alternative transportation forms and older women facing about 10 years (largely due to their longer longevity). Despite the need to use alternative forms, older adults have low levels of transit ridership (only an estimated 1.3 % of their trips (TRIP/ASHTO, 2012). They perceive three main barriers to using such transportation, namely safety, expense, and (lack of) availability. A number of studies have shown that older adults are reluctant to use public transit and prefer to use informal networks such as travel with friends, neighbors or family members (Dickerson et al., 2007; Choi, et al., 2012). A number of US communities have begun to offer "urban travel training" to familiarize older adults with transit systems and how to access transit information independently (see: Babka, Cooper and Ragland, 2009 for an evaluation of Alameda County's program).

TAKE AWAY FOR PRACTICE

The takeaway from these studies is that a smart location appears to be beneficial from a health perspective. The link between physical activity and transit utilization, in particular, is consistent across studies. As noted above, however, the key to expanding this impact is expanding transit ridership amongst Americans and addressing the attitudes/perceptions and system characteristics that impede great utilization (Taylor and Fink, 2003). One way of expanding ridership, of course, is to simply **offer the service**. (You can't walk to transit if there is no transit.) Unfortunately in large swaths of

the United States we have developed our land at such low population densities that conventional wisdom is that the provision of transit is financially unfeasible. Both the ITE (Institute of Transportation Engineers) and the TCRP (Transit Cooperative Research Program of the Transportation Research Board) offer analyses on levels of density needed to support transit. At its lowest level—that is, just to support an hourly bus localities are advised to plan for 4 to 5 dwelling units per acre or a gross population of 3,000 to 4,000 people per square mile. Light rail systems require much higher densities. An analysis by Cervero and Guerra (2011), for instance, suggests that light trail systems need around 30 people per gross acre around stations. But some recent experiments with transit—particularly light rail—seem to be challenging such findings as metropolitan areas like Phoenix and Salt Lake City have been investing in such systems and experiencing unexpected levels of ridership (see, http://www.valleymetro.org/pressreleases/detail/ridership_increases_5.1_over_2011_12 and http://www.sltrib.com/sltrib/news/55986137-78/ridership-percent-trax-transit.html.csp). Supporting compact urban development with a mixture of land uses—two additional principles examined here—will facilitate transit system viability and utilization. A second key factor that affects level of transit use is accessibility—this is often translated as the question: "how far are people willing to walk to get the bus?" (And again in this overall levels of residential densities and the configuration of road networks and connectivity are highly important.) The general rule of thumb for Americans is 400 meters or ¼ of a mile. But as is noted by Jerrett Walker, this rule of thumb is fraught with issues, including the fact that people appear willing to walk farther to faster services (e.g., rail) and that you cannot necessarily judge willingness to walk from existing walking behavior. **Decisions on the placement of transit stops thus must take several factors into account, but aim to support accessibility.** (See Walker's book Human Transit (2011) for a very intelligent and accessible discussion of the multiple facets of transit.)

Finally, **the design of transit stops also matters,** particularly for more vulnerable users like the elderly or persons with young children. The location of the stop is fundamental—stops must be located at highly visible locations (for both rider and driver); they should be at locations that ensure safe road crossings and they should have no physical obstacles (e.g., fire hydrants, electrical poles, etc.) that impede access. To the extent possible, stops should be sheltered and transparent. They should be illuminated—potentially from streetlights, nearby structures, or by lighting built into the shelter itself. Likewise, benches or places to rest are critical for less physically able users. Numerous professional guidelines on bus stops exist; crowdsourcing approaches have been tried to build a better bus stop. See: http://thecityfix.com/blog/crowdsourcing-bus-stop-designs/.



PRINCIPLE 2: INTEGRATE NATURE

Conserve sensitive habitats and natural vistas within and around the community. Integrate natural areas with the larger open space network.

The conservation of natural features and ecological systems as part of new residential development is widely considered a best practice today. While many of the initial impulses for the conservation of habitat and natural vistas originally related to providing and maintaining high environmental quality and protecting essential elements of a locality's character and beauty, **the integration of nature into urban development is increasingly being seen as a method for promoting human health and well-being at the community scale** (Beatley, 2013). At the broadest, most systemic levels, of course, natural systems maintain and cleanse our environment, which has health effects. Forests, wetlands, grasslands, and even agricultural land uses provide essential eco-system services (such as removing harmful toxics from air and water).

There are several pathways through which natural environments are hypothesized to positively affect human health at the individual level. **Both physical and psychological benefits have been attributed to green spaces.** Physically the provision of open spaces and the linkage of open spaces to each other through walking paths and recreational trails are expected to enhance physical activity. Physical activity, of course, has numerous health benefits including positive effects on cardiovascular disease, diabetes, osteoporosis, depression and different types of cancer. Simple visual exposure to natural beauty (through vistas, gardens, living walls) is felt to be calming (Ulrich, 1984); integration of green spaces and biotic communities
into urban environments and buildings themselves is hypothesized to create positive psychological effects, such as lowering reported levels of stress. Stress has known negative impacts upon human health; these are most tangibly evidenced in physical symptoms such as headaches, upset stomach, elevated blood pressure, chest pain, and problems sleeping. Additionally, working with nature—particularly contact with plants and landscapes as part of gardening—is seen as having myriad positive impacts that relate to health including stimulating moderate-level physical activity, enhancing mental health (through feelings of self-efficacy, amongst others), and strengthening social capital through interactions with other gardeners and neighbors while working outside the home (Frumkin, 2001).

FINDINGS

There is a voluminous literature on the relationship between natural features—particularly greenspace and open space networks but also healing gardens and landscapes designed for therapy—and human health (the latter are not reviewed in depth here; see, Williams, 2009 and Marcus and Barnes, 1999). **Overarchingly, most studies find that green space has a beneficial health effect** (Jorgensen and Gobster, 2010 provides a good recent review). However, as is noted in a broad review by Lee and Maheswaran (2010), from an epidemiological perspective the effects should be considered weak as such studies are hard to craft methodologically due to the complexity of the relationships.

That said there are some very compelling studies that illustrate important positive associations between the provision of accessible greenspace and human health; one set of researchers has dubbed this “Vitamin G” (Groenewegen, et al, 2006). We highlight those that have evident design implications here. In relation to physical activity, a number of studies have looked at “green exercise”—defined as activity in the presence of nature. Typical green exercises are cycling, gardening, walking, horse-riding, fishing, boating, and farming activities. In one of her earliest studies, Pretty et al., (2005) tested the impact of “nature through a window” by projecting different landscape themes in front of treadmill exercisers and examining their impacts upon blood pressure, self-esteem and mood.

Four scenes were differentiated and described as urban pleasant/unpleasant and rural pleasant unpleasant. Among their findings were that green exercise has greater impacts than exercise alone. Rural pleasant scenes had the greatest effect in reducing blood pressure as well as positive effects on self-esteem. But urban scenes also had impacts—with pleasant scenes improving all mood measures and unpleasant scenes, unexpectedly, producing improvement for 3 mood measures including anger/hostility. Another study by these UK scientists gathered data on 263 green exercisers before and after exercise using a composite questionnaire that gathered general physical and psychological health information. They found significant improvements in measures of self-esteem and total mood disturbance (i.e., an index of overall mood measuring items like anger, fatigue, tension, etc.) for all participants (Pretty et al, 2007). Most recently, in a meta-analysis of data drawn from 10 studies undertaken by the University of Essex that analyzed change in mood and self esteem after exposure to green exercise, Barton and Pretty (2010) found that short term exposure to green exercise (approximately 5 minutes) improved both self esteem and mood and that light intensity activities had the biggest impact. Interestingly while all types of green environments improved both self-esteem and mood, the presence of water generated greater improvements.

The role of quantity and accessibility of green space have also been investigated (e.g., Nielsen and Hansen, 2006). In a series of studies from the Netherlands, researchers look at health measures and access to open space. Maas, et al. (2006) calculated green space access for over 250,000 individuals submitting perceived health and socioeconomic data through their general practitioners. They found that people living in greener environments reported better perceived health and that the effects inside a 1 kilometer or 3 kilometer radius were equally strong. However, in another study with a much smaller sample, Maas, et al., (2008) found no relationship between amount of green space and meeting recommended levels of physical activity. In a third such study using national data, Dutch researchers again examined the relationship between two health measures (perceived mental health, number of health complaints in last two weeks) and access to open space with a 3-kilometer radius of their place of residence (van den Berg, et al, 2010). Respondents with a high amount of green space within 3 kilometers were less affected by a stressful life event than those with lower amounts of green space, but interestingly proximate green space (within 1 kilometer) did not have a relationship with any of the three health measures. The authors suggest that this may reflect the scale of the green space—urban green space areas are usually small so a larger concentration within 3 kilometers may reflect the presence of more large scale natural areas such as forests, dune areas, or agricultural fields.

The quality and range of uses (e.g., passive or active recreation) within the greenspace also matters. A study of greenspace users in Sheffield, England, examined the relationship between levels of real and perceived levels of biodiversity (dubbed plant, butterfly and bird "richness") in 15 different

greenspaces and four component measures of psychological well-being (Fuller et al, 2007). Well-being measures were most strongly associated with plant and bird richness; butterfly richness was not associated with any well-being measure. A study from Sweden that looked at the relationship between eight perceived sensory dimensions of urban green spaces and stress alleviation provides additional insights into design (Grahn and Stigsdotter, 2010). They found that open spaces perceived as "serene" (defined as an undisturbed, silent, and calm environment) were most preferred in general, but individuals reporting high levels of stress preferred green spaces characterized as "refuge" (places enclosed by bushes and higher vegetation in which people can feel safe, play or simply watch others) and "nature" (places with wild or untouched quality).

An additional insight from the literature relates to who is experiencing nature and whether there are differential health benefits according to characteristics such as gender, age, socio-economic status, and place of residence. The previously discussed set of studies from the Netherlands (de Vries, et al., 2003; Maas et al., 2006) have suggested that residential green space has a more beneficial effect on young people, the elderly, housewives, and persons with lower socio-economic status. One reason for this effect was duration of stay with these groups spending more times in their residential area and thus having higher exposure to that particular green space. In a study from the UK which sought to relate green space to measures of physical activity, self-reported ill health and lung cancer mortality, Richardson and Mitchell (2010) also observed clear gender differences. In their study, however, men showed the benefit as residence in greener urban wards decreased cardiovascular disease and respiratory mortality for them, but not for women. They suggest that quality of green space and perceptions of safety may be an important factor as other literature has show that women are often under-represented in public parks and have concerns regarding safety that make them less willing to use green spaces for vigorous activity (Cohen et al, 2007; Foster, Hillsdon, and Thorogood (2004). Finally, to try to tease apart whether green space could play a role in addressing health inequities (i.e., lower income persons tend to suffer from greater levels of ill health than higher income persons), Mitchell and Popham (2008) examined the relationship between socio-economic status, measures of mortality, and green space exposure. They found lower mortality incidence rate ratios (IRR) for populations with levels of green space exposure. Most interestingly while income deprivation was still related to mortality, the income-related gradient in all-cause and circulatory disease mortality was less steep for populations with exposure to green space. They note that the implications of the study are clear—namely that environments that promote good health may be key in reducing health inequities. It is important then to think about the distribution of green space in our communities as some research has shown that there are disparities in access to green space and recreational programming in many communities with lower income and minority populations have less access than higher income,

non-minority groups (e.g., Coen and Ross, 2005 for Montreal; Dahmann, et al., 2010 for Southern California; Crawford et al., 2007 for Melbourne). One final study worth noting tried to understand just why green space might have these positive impacts; the authors (Maas, et al., 2008) posited that social contact might be the underlying mechanism. Again looking at green spaces in the range of 1 and 3 kilometers from one's residence, the researchers tapped data from an administered health interview survey in the Netherlands. This interview gathered socio-economic data, environmental data, social contacts/support, as well as the 3 self-reported physical and mental health indicators used in the study. While they again found that people with more green space in their living environment had higher scores on all three health indicators, they also found that people living with more green space feel less lonely and experienced less shortage of social support; they did not, however, have more contact with neighbors or receive more social support. Neighborhood level green space was most beneficial for social support and this was strongest for children and the elderly, potentially because of more limited mobility.

TAKE AWAY FOR PRACTICE

The integration of nature into new and existing communities and the provision of a network of green spaces is a design approach that is supportive of human health. Green spaces should be provided, they should offer diverse landscape experiences, and they should be accessible to all income levels and demographic groups.

A challenge to effective conservation of natural areas, protection of vistas, and the development of coherent, integrated trail networks is our piecemeal method of planning for and approving development at the local level. Local governments are reactive—they often know little about potential land conversion until a development application is made by a private entity. **Localities and their conservancy partners need to be proactive in planning for such systems and obtaining the resources, including funding, that might be needed to purchase critical land holdings or obtain conservation easements or other forms of protection.** The best park systems in the United States—think of Boston's and Cleveland's respective park systems (both called an "Emerald Necklace"—one formally, one informally)—did not occur by happenstance, they were planned. Increasingly, green infrastructure approaches (see:http://

www.conservationfund.org/our-conservation-strategy/focus-areas/green-infrastructure/) are one way in which localities are analyzing their land base and planning for land acquisition, conservation easements, and other protections. Green infrastructure not only protects open space resources but also ensures environmental benefits that can result in significant fiscal savings for local governments (Foster, Lowe and Winkelman, 2011).

An additional approach that has been widely utilized to protect open space and natural systems is conservation sub-division design (also known as cluster zoning) (Arendt, et al., 1994, Arendt, 1996). Such subdivisions often use **conservation easements** as the legal method for protecting their open space areas. While conservation sub-divisions can be effective in protecting land resources within the residential sub-division itself, it is challenging to use this technique to create contiguous tracts of protected land and/or wildlife corridors (Gocmen, 2012, Lenth, et al. 2006; Milder, et al., 2008). To ensure optimal environmental protection through conservation easements, states, localities and regional entities have set up purchase of development rights (PDR) and transfer of development rights (TDR) programs that coordinate and prioritize land protection so as to have optimal outcomes at a regional, sometimes even watershed, scale. (A comprehensive review of TDR programs and their performance across the USA was conducted by Resources for the Future; the Walls, 2012 overview is a good starting place and can be found at: http://www.rff.org/Publications/Pages/PublicationDetails.aspx?PublicationID=22112.)

PRINCIPLE 3: MIX USES

Provide a mixture of land uses including residential, commercial, educational, and institutional within a relatively compact area. Land use mixing provides for the daily needs of the community, as well as access to employment, services, schools, and other civic institutions. It helps cut reliance on the automobile and opens up the option of different forms of transportation, including walking and biking.

The idea of creating compact communities that provide for both a mixture of land uses and a mixture of incomes has been embraced by the environmental community, Smart Growth adherents, members of the Congress for the New Urbanism, and by advocates concerned housing affordability and problems of housing and employment opportunities for lower income persons. Mixed land-use refers to a situation in which we allow a variety of land uses to comingle in a physical location. Generally, these uses are non-industrial in nature, that is, residential, commercial, and office uses.

This type of land use arrangement is in contradiction to the strict separation of land uses embodied in conventional zoning codes, often referred to as "Euclidian zoning." Code strictures, however, are loosening; current best practice in zoning increasingly supports the simplification of codes (particularly use designations) and the expansion of the "mixed use middle" (Elliot, 2008: 146).

Mixed land uses are hypothesized as being positively associated with human health because it is thought that having different activities and destinations located in close proximity to one another will facilitate physical activity as well as encourage social interaction. Mixed land use reduces travel distances and enables one to use non-motorized options such as walking or biking for mobility. Lowered automobile dependency has myriad positive impacts on health including lowered levels of air pollution, fewer pedestrian injuries and fatalities, and better water quality (Frumkin, 2002). The mix of activities and destinations is also seen as encouraging social interaction by people who might not meet otherwise as residents fulfill more of their needs (e.g., shopping, dining, visiting the doctor) in their local area. It is also thought that mixed land uses can lead to enhanced mental health as people are less isolated. Jane Jacobs, in The Death and Life of Great American Cities, for instance, claimed that streets are safer when there are more people on them (Jacobs, 1961). The gathering of people increases the amount of "eyes of the street", which improves mental health by encouraging a feeling of safety and reducing stress.

FINDINGS

The research base generally supports the view that mixed land uses are positive for human health and that many of the linkages hypothesized above are borne out (e.g., for good overviews of the research base see: Frumkin, 2002; Heath, et al., 2006; Sallis and Glanz, 2009). Because of the increasing evidence around the linkage between design and health, the influential Guide to Community Preventive Services (created by the independent Task Force on Community Preventive Services) included specific recommendations on community scale urban design (including mixed land use) and street scale urban design for the first time in 2004 (Heath, et al, 2006).

The research base on mixed land use is particularly robust in relation to **physical activity and active transportation** (e.g., walking and biking)—this is not surprising as we have particularly rich data on travel behavior and a strong cohort of transportation planning researchers interested in land use-transportation linkages. We draw upon a few of the most notable studies here. An early much publicized study by Ewing, et al., (2003) examined the relationship between urban sprawl (places with poor accessibility due to little to no mixed use) to levels of physical activity, obesity, body mass index (BMI), hypertension, diabetes, and coronary heart disease. It found that more sprawling places had small but significant (negative) associations with minutes walked, obesity, BMI and hypertension. Residents

of sprawling counties were less likely to walk, more likely to weigh more, and more likely to suffer from hypertension than persons living in less sprawling, more walkable spaces. An article from 2004 by Frank et al. reported results from a study evaluating the relationship between the built environment around each participant's place of residence and self-reported travel patterns (walking and time in a car) to body mass index and obesity. They found that land use mix was significantly associated with obesity (with lower levels of land use mix predicting higher levels of obesity as was hours spent in cars). In another study that used actual data (as opposed to reported data) on physical activity collected by accelerometers, Frank et al. (2005) found that land use mix, residential density and intersection density (a measure of connectivity) were positively related to higher levels of moderate activity. The converse has also been shown to hold. A study by Oliver et al., (2011) that utilized land use and health data from suburban metropolitan Vancouver found that low levels of land-use mix, few commercial destinations, and lower recreational land increased the odds of low levels of walking for errands.

As shown in Oliver (2011) above, a subset of studies looking at the effect of land use mix upon walking behavior have differentiated effects according to whether the walking was so-called utilitarian/functional walking (e.g., errands, commuting) or recreational or leisure walking. In general, studies have found stronger associations between the neighborhood built environment for walking for transportation as compared with walking for exercise or recreation (McCormack and Shiell, 2011). In a study of walking for exercise, Lovasi, et al., (2008) used common measures of the built environment that get at land use mix (e.g., number of destinations) to examine the extent to which they were predictive of walking for exercise. They found that these measure did not help explain recreational walking and suggest that importance of immediate physical surroundings may not be as important here because of the many social and psychological factors that play a role in physical activity behavior. Dog walking is associated with more recreational walking across all seasons (even in Calgary where the study took place)(Lail, et al, 2011). Another study by Christian, et al, (2012) found that measures of land use mixture (LUM) were strongest for transport walking, when the LUM included more "public open space", "sporting infrastructure" and "rural" land uses more recreation walking was reported. Most recently, Giles-Corti et al. (2013) found that if there is increased access to destinations, transport-related walking increased by 5.8 minutes per week for each type of transport-related destination. The study also found that recreational walking increased 17.6 minutes per week for each type of additional recreational destination. They conclude that the study illustrate the potential of local infrastructure to support behavior that is health-enhancing.

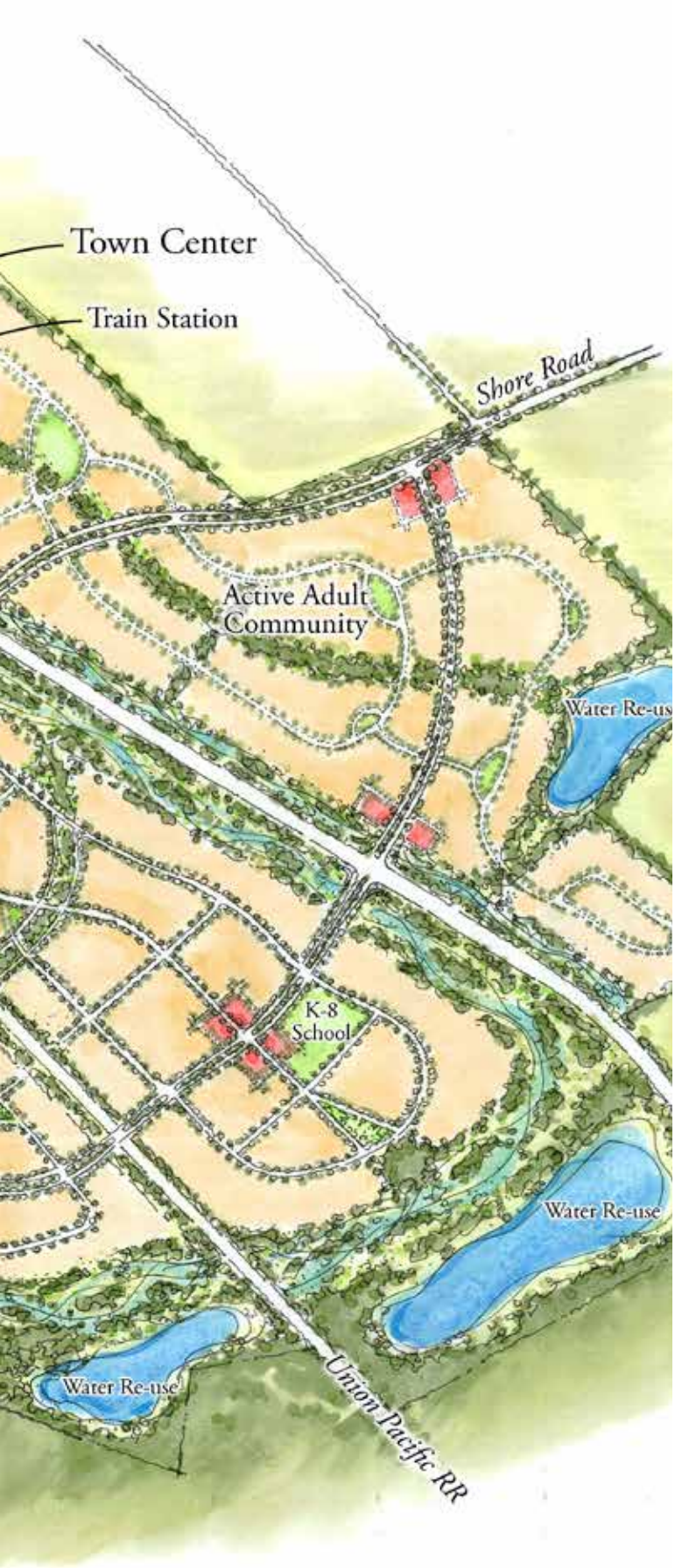
The benefits of mixed use, walkable neighborhoods have been shown to differ across populations. An Australian study found higher levels of walking for transport in disadvantaged neighborhoods; walking levels were associated with living in a built

environment more conducive to walking (i.e. greater street connectivity and land use mix) as well as having more limited access to automobiles (Turrell, 2013). Mixed land use is an important feature for facilitating health across the age spectrum (Kerr et al, 2012). In a comprehensive review of the literature on active ageing and urbanization, Beard and Petitot (2010: 436) found that "despite methodological challenges" (often relating to causality), the "evidence for neighborhood influences on the health of older people is growing and that there were positive impacts on both physical activity and mental health." In a study of older adults living in community setting but in neighborhoods differing in income and walkability, for instance, King et al. (2011) showed that older adults living in more walkable neighborhoods had more transport activity and moderate-to- vigorous physical activity and lower body mass index relative to those living in less walkable neighborhoods. In contrast, there was a lack of association between neighborhood walkability and more recreational forms of outdoor aerobic activity (e.g., leisure walking, leisure cycling, jogging), a finding the researchers attribute to their use of a walkability index that measures utilitarian or "destination based forms" of travel. Similarly, a study of older adults in western Australia, researchers found that the types of commercial destinations that inspired older adults to walk were different from other adult samples. Destinations that facilitated social interaction (e.g., church, restaurant) or created opportunities to incidental interactions (e.g., hardware store) were most associated with walking amongst seniors (Nathan, et al., 2012). The research results appear a bit more mixed for children and adolescents (Giles Corti et al, 2009). The age of the child and levels of independence are important factors in determining impacts. Higher levels of out-of-school-hours physical activity and walking have been shown to be significantly associated with higher levels of urban density and neighborhoods with mixed land uses, particularly for older children and adolescents. Parents' concerns for safety are most likely part of this. In a study of perceived safety and use of local playgrounds, for instance, Miles (2008) showed that disorder (e.g., litter, graffiti, lack of greenery) had a negative impact upon perceived safety and this in turn negatively affected adults' readiness to encourage their children to use local playgrounds. Her findings substantiated the work of Molnar, et al., 2004.

TAKE AWAY FOR PRACTICE

There is evidence to support mixed land use development forms as a strategy for enhancing human health. There are myriad approaches for facilitating the development of such types of communities. Importantly, the regulatory environment of many localities stands in the way of creating the more compact, mixed use communities that facilitate positive health impacts. **Localities interested in understanding the impact their code may be having should investigate alternatives to classic Euclidian zoning that strictly separates uses.** Smart Growth America has a smart growth audit tool that can be used for such an analysis. Many communities are looking into an entirely new type of code, namely the Form-based codes. This type of code emphasizes the relationship of the built structure to the street and deemphasizes the traditional scrutiny of use and is an important and increasingly widespread method for supporting mixed-use development. (See, amongst other potential resources, the Form-Based Codes Institute: http://formbasedcodes.org/.) Donald Elliot in his book A Better Way to Zone gives straightforward and widely applicable advice on reformulating codes to achieve a "mixed use middle" as well as strategies for dealing with issues of non-conformance and standards.


To Regional Trails
SR 25
Water Treatment
Water Re-use
Algae Ponds
River Walk
Pajaro River
Wetlands
Town Lake
Lakeview Park
Vineyard
High School
K-8 School
San Benito Parkway
Silt Basin
Central Park
Foothill Blvd
High School
K-8 School
Bike and Walking Trails
Aroyo Parks (typ.)
Neighborhood Commercial



PRINCIPLE 4: **MIXED HOUSING TYPES / MIXED INCOMES / MULTI-GENERATIONAL**

Create residential developments that include a variety of housing types and tenures (both attached and detached, rental and owner–occupied, single and multi–family) as this provides opportunities for attainable housing for all community members. Build for America's demographic shift by developing well–designed accessible units that enable aging in place as well as accommodating multi–generational households.

Creating residential communities that mix housing types has been a central tenet of good planning for quite some time. We have realized that housing needs are not the same for every family or individual and that housing preferences and needs change over one's life course. Building communities with diverse housing stock provides choice for consumers. In recent decades the norm of providing housing accessible to individuals and households across an income spectrum has also been considered a best practice in housing policy.

There is a fairly strong consensus in the housing community that concentrated poverty has negative social and economic effects on individuals and families. Availing affordable housing in higher or mixed income neighborhoods serves to deconcentrate poverty and facilitate access to jobs, educational facilities, social services, and other amenities such as higher quality, safer built environments (note: all preceding are often referred to as "opportunities") that are not found in lower income neighborhoods due to disinvestment, local government fiscal distress, poor urban policies (e.g., subsidized suburbanization) and perceived as well as real levels of crime (Imbroscio, 2012).

Facilitating access to higher opportunity neighborhoods has occurred in two main ways: deconcentrating poverty by dispersing lower income households or persons into existing neighborhoods and housing units through housing vouchers such as Section 8 and creating mixed income neighborhoods from scratch through policies such as inclusionary zoning or Hope VI public housing redevelopment. The mixing of incomes within new build communities is largely premised on mixing both housing types (so single family, multiple family, duplexes, studios, live-work units) as well as tenure (providing both opportunities for rental and ownership or even more innovatively equity-capped ownership models such as community land trusts).

One reason to expect that mixed income housing might have a positive health effect is that we know that income inequality has a proven relationship with poorer health—at least in the United States, UK, Chile and Brazil, countries which are characterized by high levels of income inequality (Lynch et al, 2000; Subramanian and Kawachi, 2004; Kawachi, et al, 1997). A key research question then is what is the impact of policies aimed at mixing incomes and providing greater access to opportunity such as Section 8 or Hope VI on human health?

FINDINGS

The published research on this question is in its nascent stage—although several papers exist that explore the connections between income mixing and health and lay out interesting agendas (e.g., Saegert and Evans, 2003). In a study of the "Moving to Opportunity Program" in New York City, Leventhal and Brooks-Gunn (2003) found that moving to higher opportunity neighborhoods had positive effects on mental health. Specifically they found that parents who moved to low-poverty neighborhoods reported significantly less distress than parents who remained in high-poverty neighborhoods. The findings were particularly positive for boys with those moving to less poor neighborhoods reported significantly fewer anxious/depressive and dependency problems than did boys who stayed in public housing. Another paper based on that same intervention focusing on relocated adults in Yonkers found many positive impacts from the move (e.g., employment) but specific to health found that **adults who moved to low-poverty neighborhoods were less likely to be exposed to violence and disorder, experience health problems or abuse alcohol**, when compared with adults who remained in high-poverty neighborhoods (Fauth, et al., 2004).

A literature review on deconcentration/mobility housing policies by Acevedo-Garcia, et al., (2004: 1), while it criticized many of the 13 studies reviewed for methodological issues, did conclude that these policies "may contribute to improving the health of both adults and children."

A final current topic that relates to residential mixing and the provision of a range of housing types is that of multi-generational housing. Since the Second World War, the stereotypical American household has been depicted as a nuclear family living the single family detached home (i.e., the Cleavers). In recent decades, however, as the country's demographic profile has changed, three important drivers have begun to affect housing design and raise demand for multi-generational housing. First, because of increased life expectancy, we have a large cohort of older persons needing/wanting appropriate housing that can accommodate aging and caregiving. Second, because of immigration and differing fertility rates, the country is ethnically, culturally, and linguistically more diverse; immigrant communities have different housing needs and preferences. Finally, due to changing preferences and social mores, we have new types of household formation occurring, including a dramatic growth in single person and single parent households (Masnick, 2002). (There are commentators who also point out the negative effect the recession on employment and the role of economic need in creating multi-generational housing, whether this is a long-term trend remains to be seen.) Taken together, these forces have resulted in a reconsideration of traditional building patterns with increasing numbers of actors/advocates calling for more community-based housing forms, such as Co-Housing (see: http://www.cohousing.org; Thomas and Blanchard, 2009), or **more flexible housing designs and zoning standards that will enable older adults, for instance, to live together with their children and grandchildren or have them in close proximity** (see, http://www.aging2.com/2013/04/multigenerational/). (Keene and Batson, 2010 provides a good overview of the research on why different generations of one family decide to live together.)

There are numerous reasons to expect that accommodating multi-generational housing would be heath enhancing. From the perspective of an older adult, **living within a larger family unit could enable continuous social contact/reduced isolation**—which has mental health benefits. It can help **facilitate mobility, ensure nutrition, and help prevent/address problems like accidents and falling**. From the perspective of younger generations, multi-generational housing can be beneficial since it can ease the strain of caring for an older, physically distant, parent; likewise, elders in the home can help with childcare and bring financial and other skills and resources to the family unit. A question arise then: Is there any literature examining multi-generational housing that tests these hypothesized impacts on health?

The study of multi-generational households from a social welfare/health perspective is much more developed relative to other countries. There are a number of studies examining countries that have

traditionally embraced such households (Japan, India, Taiwan)(Hwang, 1997; Levkoff, 2000; Takagi, et al., 2007); one focused on Japan, for instance, found lower levels of depression in parents coresiding with daughters (Tiedt, 2013). We found no studies that looked at multi-generational housing in the United States and compared its health outcomes relative to other forms of housing including institutional forms like assisted living—presumably because it has not been a particularly common form. Several studies have examined the role of grandparents raising their grandchildren due to factors such as AIDs, drug additional and incarceration. In general that type of multi-generational living has been associated with worse physical and health status and greater stress (e.g., Hughes, et al., 2007; Minkler and Fuller-Thomson, 1999, Burton, 1992). A conclusion here, thus, is that **there is a potential research agenda around Americans' renewed interest in multi-generational living and its impact on health broadly conceived**. Any newly built residential community that provides options for flexible housing forms to accommodate multi-generational housing (in addition to other housing types) would be worth tracking over time.

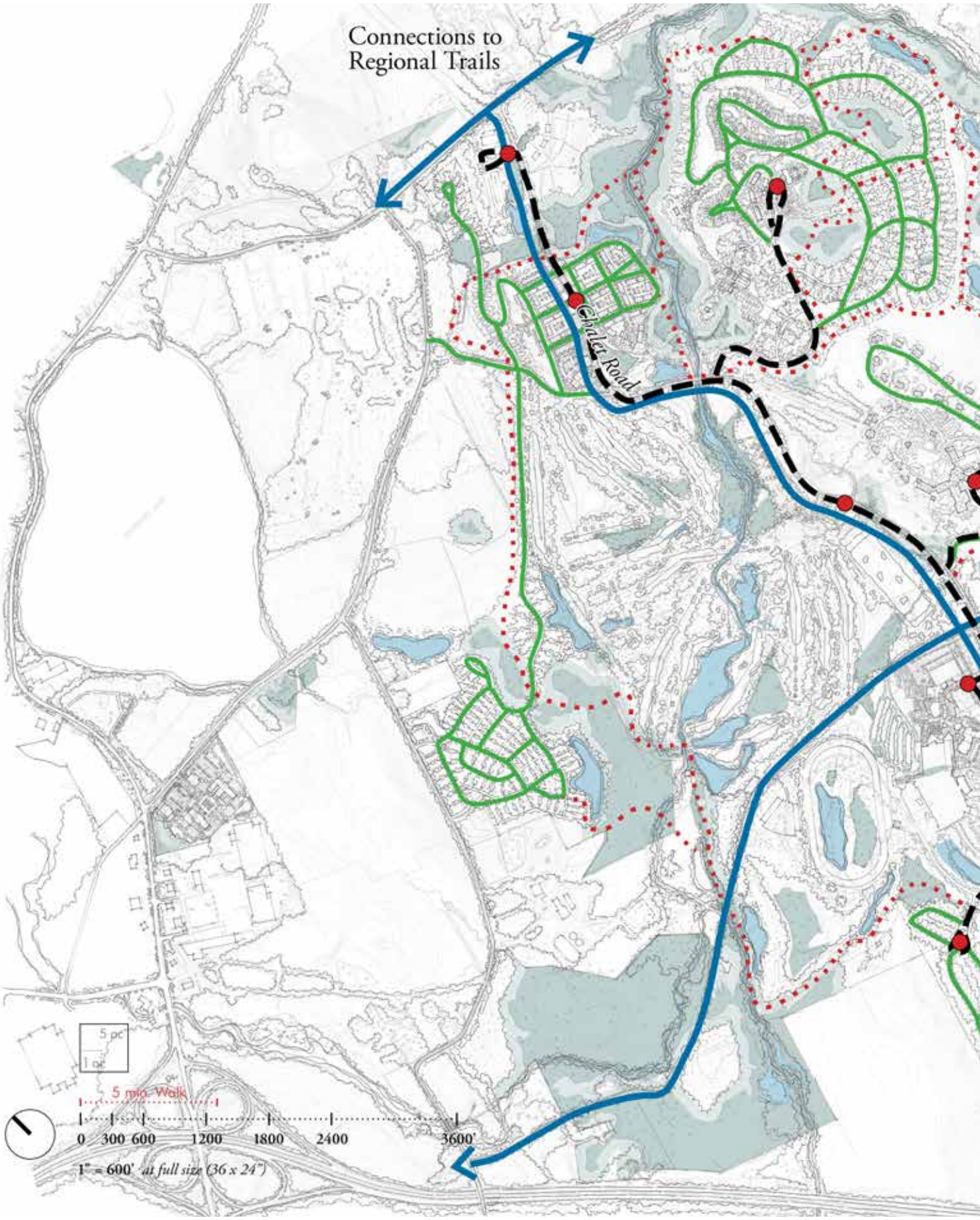
TAKE AWAY FOR PRACTICE

There is evidence to support the mixing of housing types, tenures and incomes in your communities to enhance human health. **Living in more inclusive communities has been shown to have positive health impacts for populations** that often suffer the worst health inequities, namely lower income and/or communities of color. There are myriad approaches for facilitating the development of such types of communities. Likewise there are different approaches for facilitating income mixing within neighborhoods, although the major mobility programs like Moving to Opportunity have tended to be federally funded programs implemented locally. Many California communities have adopted **"inclusionary zoning"** programs that require or encourage developers to develop a certain percentage of housing that is affordable as part of any residential development project. Affordability is achieved in different ways—including through the design process (e.g., units of different sizes)

and through governmental subsidies or incentives (e.g., density bonuses). PolicyLink has an excellent resources on inclusionary zoning (see: http://www.policylink.org/site/c.lkIXLbMNJrE/b.5137027/) and does the national Center for Housing Policy (see: http://www.nhc.org/publications/Inclusionary-Zoning.html).

Another approach utilized to address both housing affordability and multi-generational living preferences in diverse localities is to encourage the **development of secondary housing units within existing neighborhoods** (Antoninetti, 2008, Nichols and Adams, 2013; Chapman and Howe, 2001). Often called ADUs (accessory or ancillary dwelling units) or granny flats, these smaller housing units can be specially built (guesthouses in backyards or above new garages) or conversions of existing spaces (e.g., existing garages, attics or basements). While the academic evidence on how these units fare in providing affordability housing is still lacking, these approaches have been lauded as ways of providing housing that helps individuals to age in place (Rosenthal, 2009). A final consideration relating to aging in place relates to housing design and the need to utilize lifelong perspective. We know that older adults strongly prefer to stay in their homes or communities as long as they can (see The Maturing of America, 2011)—thus it only makes sense to **build communities and housing stock in such a way that aging, household formation, and multigenerational reformation can be facilitated**.

Among the many recommendations for facilitating this is the adoption of **universal design standards in most home-building** (these can, for instance, accommodate increasing disability and thus reduce or eliminate costs of any retrofit) and lessening regulatory obstacles to constructing accessory units into which children or caregivers can move (Brinig, 2010; Pollack, 1994). (Also see work produced by the American Planning Association under its Family Friendly Communities project at http://www.planning.org/research/family/.)


Connections to
Regional Trails
Chalet Road
5 pc
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1" = 600' at full size (36 x 24")

PRINCIPLE 5: CIRCULATION ALTERNATIVES

Build walkable and bike–able communities through pedestrian–oriented urban design and multi–modal transportation networks.

Americans are famous for their love of and reliance upon the automobile. Attaining one's drivers license and purchasing one's first car have historically been key rites of passage from childhood to adulthood in our society. But car culture appears to be waning. Recent research has shown that "Today's American teenagers and twenty-somethings aren't loving—or driving—cars nearly as much as their predecessors did. They're getting their freedom from smartphones, which can travel distances and reach speeds that make cars seem quaint. They're increasingly interested in commuting by bike or public transit. And growing numbers of them say they see cars more as nuisances and less as toys." (Ball, 2014). Not surprisingly, the type of community in which this age groups wants to live is not premised on the automobile. They want to live in communities in which they can live free of the automobile and instead travel by foot, bike or transit. Think Portland, Chicago, and Washington, DC—not Beaverton, Schaumburg, or Fairfax County.

WALKING

Unfortunately, development patterns adopted since the 1950s in the United States have not created the type of communities that support such preferences or lifestyles. Whether or not one walks is influenced by factors of location, land use mix, recreational facility and open space access, and aesthetics. One critical element affecting walkability is the nature of the public realm. One key piece of infrastructure that facilitates walking is, of course, the sidewalk. In this section we will look at sidewalks and to a lesser extent the nature of the street itself. After the sidewalk, we turn to infrastructure for bicycling.

Sidewalks are a well-known design feature of many places and simply refer to paved paths generally along roadsides intended to provide a dedicated space for pedestrian movement. While the provision of sidewalks was a common design feature of American neighborhoods through much of the 20th century, suburban design standards and their emphasis on automobile mobility and low density saw the disappearance of the sidewalk in many subdivisions and developments starting in the 1970s.

Reintroducing sidewalks is a common recommendation of designers such as those working with the Congress for the New Urbanism or persons committed to the **"complete street movement."** Sidewalks, however, are surprisingly complex from a design perspective since their usability and function depends upon other design dimensions such as street buffers, pavement width, street crossings, street lighting, adjacent land uses, vehicular speeds, network connectivity, and perceived safety.

Sidewalks are hypothesized to have a positive health impact because they facilitate physical activity in the form of walking behavior. Walking is a particularly important activity for health as it is generally doable for people of all ages including children and the elderly. Likewise, walking due to sidewalks is seen as potentially positive for mental health as sidewalks are democratic spaces that enable all members of a community to interact.

FINDINGS

Several studies have honed in on sidewalks and indicated that **they are an important design feature with some positive associations with improved community health** (e.g., Alfonzo, et al, 2008). In this research there is some differences in findings depending upon whether the sidewalk availability is self-reported (by the respondent) or objectively measured by the research team. (Self-reported data has generally more positive results.) Three studies (Rodriguez, et al., 2008; Rutt and Coleman, 2005; Lee and Moudon, 2006) found no association between objective sidewalk measures (availability/density) and different measures of physical activity; in the latter study, however, the researchers did find a positive relationship between walking for recreation and sidewalk length. Lovasi et al. (2008) looked at sidewalk-lined streets within one kilometer of

home and found a small but positive association in participation in exercise walking. In one of the most recent studies, McCormack, et al. (2012) looked at sidewalk availability and whether it had an impact upon neighborhood walking for transportation and recreation. This study is particularly interesting as it is quasi-experimental—respondents who participated changed neighborhoods; baseline walking behavior from neighborhood 1 were compared with behavior in neighborhood 2 as were the physical differences between the neighborhoods. They found that sidewalk length was associated with walking for transportation, but not with walking for recreation. While their model only showed the probability of a small change in total time walking at the individual level relative to a large increase in sidewalk length (5 minutes per week for each 10 KM of sidewalk), they note that **from a population health perspective this could potentially improve health and reduce disease burden and health care costs**. Carlson et al. (2012) focused on the built environment and destination walking in two New Hampshire cities using self-reported and objective data; they found that the strongest associations with destination walking were found for sidewalks and road connectivity. Survey respondents who mentioned that there were few places to walk reported walking to significantly fewer locations and less often.

Research has shown that perceptions of the built environment and infrastructure can be barriers to walking (see Loukaitou-Sideris, 2005 for a review)—the question is how much of a barrier and for whom? In a study from 2005, Hoehner, et al., (2005) looked at different environments in St. Louis (a "low walkable" city) and Savannah, GA (a "high walkable" city). They conducted telephone surveys to gather perceived environment and physical activity data. They also physically evaluated neighborhoods gathering characteristics of land use, transportation, aesthetics, etc. As expected they found that more destinations correlated strongly with transportation activity. They did not find an association between perceived sidewalk availability and physical activity, which they attributed to a lack of variation in their sample (all areas had high sidewalk availability.) They were also surprised to find an inverse relationship between sidewalk levelness and physical disorder (e.g., more disorder = more walking) and attribute the finding to income effects in lower income areas where more residents walk and bike for transport. Suminski, et al. (2008: 184) also found that walking behavior seemed unaffected by quality and reports that they saw a "greater number of walkers using more defective sidewalks in less aesthetically pleasing neighborhoods with high volumes of vehicular traffic." Carlson, et al., (2012—referred to above) concludes that the ultimate goal of improving walkability also relies on residents' perceptions of walkability as well as built form. (This may be most relevant for persons with choice about whether to walk or not, unlike many lower income neighborhoods.) Affecting perception might be helped by activities such as "get to know your local store" type campaigns that raise awareness of destinations or programs to organize local neighborhood walking groups.

The nature of the street along which the sidewalk runs is also important for walkability. Research has

shown that walking is affected by street speeds and widths with higher volume, faster, and wider streets being characterized by less walking (e.g., Carver et al., 2005; van Lenthe, Brug and Mackenbach 2005). The nature of flow on the street also matters. One way streets, for instance, have a mixed record in the literature—while they have lower levels of pedestrian injuries and fatalities they are also characterized by higher speeds which can lead to more severe crashes as well as reportedly worse air quality (HIP, 2012). Walkability experts, like Dan Burden, thus, tend to recommend **narrower streets with two-way traffic** (Burden, 2001). "Slow streets" have been strongly embraced by local governments in the United Kingdom where numerous cities have adopted 20 mile per hour speed limits in recent months (see: http://www.news-leader.com/usatoday/article/1928745).

Finally, aesthetics and amenities have been shown to matter (for instance see introduction to a special issue on pedestrians and urban design in the Journal of Urban Design by Forsyth and Southworth, 2008). Just to give one example, a study of walking routes in Salt Lake City that used both objective measures of physical attributes using the Irvine-Minnesota Physical Audit Instrument (which gathers data on aesthetics, natural features, land use mix, pedestrian street furniture, building form) and reported perceptions of University of Utah students regarding whether a street was good for walking found that a convergence between the objective and subjective measures for what was considered a desirable walking route (Brown, et al., 2007). In short, **walkable routes had more pleasant social and/or environmental atmosphere and better traffic safety**. The researchers were also interested in what "repelled" people from walking—their findings indicate that the social milieu was important. **People enjoyed walking in areas where they could see others enjoying themselves;** they expressed discomfort when confronted with issues of urban poverty and homelessness. **Pedestrian amenities like benches, shade and bathrooms were highly praised component of the highly walkable street segments.**

BICYCLING

A wide variety of infrastructure has been developed to accommodate bicycles in American cities and suburbs in recent decades. Three types of infrastructure are most common: on-street bike lanes, designated bike boulevards, and off-street bike (often multi-use) paths. The three types of infrastructure generally serve different types of users. Bike lanes are intended for and most utilized by bicycle commuters; as such, they tend to be located along major arterials providing direct routes from home to destinations such as work places. Off-road bicycle paths are intended for recreational cyclists. While they can be used for commuting such paths are often found along meandering amenities such as rivers and they usually are multi-modal in nature—accommodating recreational walkers, birdwatchers, skateboarders, and rollerbladers amongst others. Bike boulevards lie somewhat in-between—they are designated paths along low volume roadways often marked with "sharrows" (bike symbols and arrows painted on the pavement). Their users

include commuters, but also recreational or occasional cyclists, including families with children.

The provision of bicycle infrastructure is hypothesized as having a positive health benefit because **such facilities provide a safe and convenient location for individuals to be physically active,** in this case through bicycling. It is thought that many individuals would opt to use non-motorized transportation modes (like bicycles) particularly for short trips but are prevented from doing so because of safety concerns. Just building bicycle infrastructure, however, is not guaranteed to foster utilization and impact health. Since different types of infrastructure serve different groups, **the choice of infrastructure and elements like buffers, street lighting, and surface materials matter**. We know, for instance, that bicycle commuters are overwhelmingly male—so increased investment in on-street bike lanes (the facility used most by commuters) may not facilitate physical activity by sub-groups like women, children, and recreational users (Garrad, Handy, and Dill, 2012).

FINDINGS

The positive impact of cycling upon human health has been demonstrated in many different studies of examining "active transportation," that is walking and biking for utilitarian purposes. Unfortunately many of these studies do not disaggregate bicycling from walking behaviors in their findings so we mainly report highlights from the active transportation studies here. Amongst the documented benefits of active transportation is a reduced risk of overweight and obesity (Lindstrom, 2008), cardiovascular disease (Hamer and Chida, 2008), and all-cause mortality (Andersen et al., 2000). It is thought that active transportation can facilitate positive environmental outcomes (such as less pollution) and economic effects (such as lowered expenditure on automobiles) that have health benefits. A large sample study of Chinese women in Shanghai showed that those who walked and biked for transport had lower rates of mortality (for all causes) than those who did not (Matthews, et al., 2007). A cross-sectional study of young adults from four American cities enrolled in the Coronary Artery Risk Development in Young Adults (CARDIA) study found that active commuting was associated with higher levels of fitness in men and women and inversely associated with BMI, obesity, triglyceride levels, blood pressure, and insulin level in men (Gordon-Larsen, et al, 2009).

Relative to biking alone, a study of Danish men and women similarly demonstrated a 40% decrease in mortality rates for those who biked to work (Andersen, 2000). Interestingly, however, a study out of Belgium found that biking to work was associated with higher levels of stress amongst blue collar male employees, a finding that they indicated might reflect economic factors (Asztalos, et al, 2009). A recent systematic review of the literature looked at 16 cycling specific studies and found that across study types (cross-sectional, longitudinal, intervention, and observational studies) **consistently positive associations were found between cycling and various measures of health** (Oja, et al, 2011). Taking into account the

strength of the research designs in the reviewed studies, they conclude that the strength of the evidence is strong for fitness benefits, moderate for benefits in cardiovascular risk factors, and inconclusive for all-cause mortality, coronary heart disease morbidity and mortality, cancer risk, and overweight and obesity.

Given the indications that cycling has health benefits, a number of studies have looked at different types of infrastructure provision and their relationship to levels of cycling behavior. Dill and Carr (2009) used Census 2000 Supplemental Survey data, other federal data sources, and gathered first hand data on class I and class II bike facilities from bicycle coordinators and other staff for 35 US cities.[4] As is more than hinted at by the title of their article "If you build them, commuters will use them", they found that higher levels of bicycle infrastructure are positively and significantly correlated with higher rates of bicycle commuting. In another study of infrastructure in Portland, Oregon, Dill (2009) examined the bicycling behavior of 166 regular cyclists using global positioning system (GPS) data. Her study participants used their bicycles primarily for utilitarian, not recreational purposes. She found that the distribution of bicycle travel differed significantly from that of the network—with cyclists preferring to use secondary roads with bicycle lanes, bicycle/multi use paths and bicycle boulevards (39% of their travel was on such paths, although they only make up 4% of the region's network). Two main factors informed their route decisions, namely minimizing total distance followed by avoiding streets with lots of vehicle traffic.

There are a number of studies that show a positive impact from the installation of bike lanes on ridership across groups. A longitudinal study by Krizek, et al., (2009) drew from census data and found an increase in the number of cyclists after the striping of roads for bike lanes. Another study from Los Angeles, found that lane treatments there also resulted in an increased level of observed biking along newly created bus ways, although the increase was only for male riders (Cohen, et al., 2008). A study from New Orleans showed the impact of a new bike lane on ridership on an arterial in a predominantly African American neighborhood using before and after observations (Parker, et al, 2011). They found that the designation of a bike only lane was associated with a 55% increase in the average number of riders per day. Notably the increase in female cyclists (133% increase) was greater than that for male cyclists (44%). The number of riders using the sidewalk, however, did not go down—a finding that they attribute to the relatively high speed limit (35 MPH) and the fact that the street is a major thoroughfare for petroleum tankers.

One major obstacle to greater levels of cycling is concerns over safety; these are most pronounced in more vulnerable populations (e.g., older cyclists, women cycling with young children, children). To increase ridership amongst these groups **enhancing cyclist safety is imperative**—two recent experiments with infrastructure in Portland, Oregon thus warrant review. A study by Dill et al, (2012) looked at the use of **"bike boxes"** (essentially large painted boxes at stop lines at intersections expressly set off for cyclists) and their impact on bicycle safety as they

were established to prevent "right hook" collisions that had resulted in much publicized bicyclists' deaths in the city. They found that in intersections with bike boxes, 75% of motorists did not encroach into the bike box. Observations of the boxes also indicated that there was an improvement in motorists yielding to cyclists at those locations. Based on the data, the study utilized negative binomial modeling techniques that predicted fewer conflicts with the boxes, even when right turning motor vehicle volumes increased. A second experiment in the city was the installation of a **cycle track** and a pair of buffered bike lanes on major arterials in the city's downtown. Cycle tracks can be characterized as one- or two-way bike lanes with greater physical separation from motor vehicles (e.g. parked cars, curbs, raised pavement, or other physical barriers). Buffered bike lanes similarly seek to create greater separation from vehicles; this is normally done through painted buffered zones. Using survey findings from bicyclists, pedestrians, motorists, and business owners lining the routes, Monsere et al. (2012) found that cyclists felt that the new facilities had enhanced their safety with the buffered bike lane receiving greater approval (89% agreeing with the statement that the new facility had made that portion of their route "safer for me as a cyclist) than the cycle track (71%). Women were more positive about the cycle track than men (94% versus 64%); their perception of the safety of the buffered land was similar to that of male cyclists (94% versus 84%). In contrast, motorists felt safety was improved on the road with the cycle track but not on the streets with the buffered bike lanes. This finding is explained by the authors as arising from motorist confusion over the rules as to when motor vehicles can be in the bike lane, particularly relative to turning. The authors conclude that the new facilities may serve the city's objective of attracting new riders, particularly women, as they were more positive about the facilities and are known to have higher concerns about cycling and safety than men.

TAKE AWAY FOR PRACTICE

Sidewalks are clearly a critical design element for any community seeking to enhance health. Providing sidewalks—and retrofitting neighborhoods developed in the era in which sidewalks were unfashionable—is a tangible step that localities can and are taking to enhance walkability. A few rules of thumb should be kept in mind. **Sidewalks should be designed to create a network**—that is they should effectively link multiple destinations and optimally enable a variety of routes to these destinations in order to realize what planners dub "high connectivity". Connectivity is important not only for utilitarian travel (like walking to school), but also for recreational actions like strolling or dog walking since it enhances options for seeing new and varied sights and maintaining interest in being active. **Sidewalks should also be designed for a variety of users** from an older adult depending upon a walker to a young family strolling with toddlers, a baby stroller and a dog. **Obstacles, like fire hydrants, telephone poles and**

garbage cans, should be eliminated; curb ramps should be ADA (Americans with Disabilities Act) compliant. Sidewalk width is an important factor; design guidelines recommend that at minimum **sidewalks should be wide enough to accommodate two-way traffic**. In places where lingering or gathering is anticipated (e.g., near parks, major intersections) or should be encouraged broad sidewalks are recommended. One important design element to think in relation to walkability is user perception of safety. Loukaitou-Sideris (2005), for instance, notes there are human elements (e.g., reckless drivers) as well as non-human or environmental elements (e.g., poor infrastructure, loose dogs) that present perceived risks for pedestrians (and cyclists). While not all of these are dealt with through design interventions, there are a range of design and policy interventions that can and should be used to manage traffic and instill feelings of safety in neighborhoods. The installation of buffers between the road and the sidewalk, most commonly **tree planting strips**, make the walking environment more pleasant, while having the added benefit of slowing down traffic. **Street lighting** is also important for an enhanced feeling of safety. It is recommended that streetlights be placed at pedestrian scale (under 17 feet and configured so as to illuminate the sidewalk area, potential tripping hazards, and make the pedestrian visible to any driver). Lights should not be affixed to power or telephone lines. (See: http://activetransportationpolicy.org for more detailed guidelines on lighting and complete streets in general.) **Bulb-outs or curb extensions** that reduce lane widths are also recommended as ways to make street intersections and crossings safer.

Providing infrastructure for bicycling is also an important way to facilitate physical activity and enhance human health. The findings from the literature reviewed above indicate that design does matter for cyclists and thought should be given to the types of infrastructure provided with the goal of having a variety of infrastructure in the community designed in a way that a complete network is available. A fundamental aspect would be to **design for the safety of all road users—cyclists, pedestrians and motorists**. By and large separation of users appears to enhance the perception of safety if not the actual safety itself. Getting bikes off of sidewalks by providing appropriate bike paths, bike lanes and bike boulevards appears a sensible design priority because it protects both pedestrians and cyclists. Common traffic calming techniques—such as narrower roads and buffered roadsides with

full tree canopies should also be an investment priority as such street designs will slow motorists and thus contribute to safety for all travelers. **Complete streets—in short—should remain a goal for all development.** Likewise designers would be well advised to plan for the most vulnerable populations or less confident cyclists—that is older cyclists, parents with children, women, and children. Buffering bike lanes, providing multi-use trails, and designating slower, safer bike boulevards with visible signage will facilitate cycling by these groups. Design processes would benefit by **involving such diverse groups in the planning process** to give specific feedback and ideas to the engineers, planners and designers working in new community development.

There are a variety of good professional and academic studies of street and sidewalk designs. Two of the most well known are, of course, Donald Appleyard's Livable Streets (1981) and Allan Jacobs' book Great Streets (1993). Additionally, there are numerous design guidelines—mainly associated with the idea of creating "complete streets" (that is streets that work for all users) and bicycle/pedestrian plans—from a wide variety of states and localities. While some of these are "the usual suspects" (the City of Portland has a good pedestrian design guidebook), a number are from places we don't associate with such planning. The State of Florida has a well-written chapter on sidewalks with strong consideration of wheelchair users and Americans with Disabilities Act compliance (http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalks/chap4a.cfm); the State of Tennessee has complete streets design guidelines that examines other potential interventions that are supportive of walkability including road diets (eliminating travel lanes), access management (minimizing curb cuts), crosswalks and signaling. The National Complete Streets Coalition (see: http://www.smartgrowthamerica.org/complete-streets), however, is perhaps the best single source for public sector actors, developers and local residents who want to learn more about why and how they can enhance walkability in their community. A good design resource to consult in relation to issues of crime perception and crime prevention are associated with CPTED (Crime Prevention through Environmental Design); while there are numerous resources for learning more about CPTED a particularly good one is at the Bureau of Justice Assistance at the US Department of Justice, see: https://www.bja.gov/evaluation/program-crime-prevention/cpted-index.htm.


Club Car
6
MISS AMERICA
MISS AMERICA

PRINCIPLE 6: SOCIAL CONNECTIONS TO INSTILL PRIDE OF PLACE

Provide a variety and range of open spaces from natural areas, regional parks, community parks, neighborhood parks, recreation centers, pocket parks, and public plazas/squares that enable residents to exercise, meet and mix. Provide trail systems that connect these open spaces to one another and, if possible, to regional trail systems.

Well-planned communities have long sought to integrate open and public spaces into their physical design. Early park planners like Frederick Law Olmstead, for instance, were heavily motivated by concerns for human health. When speaking of the purpose of parks, like Central Park in New York City, he is often credited with saying that parks would function as the "lungs of the city"—providing green open spaces in which city residents could escape the dirt and pollution of the city and breath fresh air.

The impact of connected green spaces and recreational trails for "green exercise" has been largely reviewed under Principle 2 Integrate Nature; likewise, civic spaces (like farmers markets, libraries) have been captured in both the principle of mixed uses and the principle on food access. In this section we limit our review to **community gathering spaces in the forms of public plazas and civic squares** as well as what one author calls "ordinary" or everyday public spaces like small neighborhood parks and shopping streets (Cattell, et al., 2008). The terms "public space", "public plazas," "health" and "urban parks" were used in various iterations to try to focus this review.

As with other aspects of the built environment, public spaces are seen as beneficial to health because they facilitate physical activity, contribute to local environmental quality, and encourage social interaction. Ideas of how to best design public spaces like public plazas or urban pocket parks abound—with many of the most fundamental principles harkening back to a foundational study of public spaces, known as the Street Life Project, by William H. Whyte (Whyte, 1980). The Project for Public Spaces (PPS), an advocacy group promoting the re-embrace of city squares, plazas, and parks, has updated and utilized his work in their place-making principles and specific projects in cities across the USA. (See: http://www.pps.org).

FINDINGS

There are no apparent studies that have isolated the impact of public plazas or squares on human health using empirical measures of health as dependent (or outcome) variables. In relation to public plazas and urban open spaces, however, we must note that the literature on public space is probably one of the largest in urban design. In addition to Whyte's work, for instance, Claire Cooper Marcus and her students at UC-Berkeley conducted research on how people use urban public spaces such as public plazas and how to design them to accommodate an evolving range of social and economic activities (see, Marcus and Francis, 1998). Likewise, research and design work by Gehl (1987), Wooley (2003) and Shaftoe (2008) all show that good public spaces are ones that are well used and accessible to a wide variety of people. Public spaces with those characteristics are optimal settings for the creation of social connections/social capital, which we review as well in this section.[5]

To turn to the topic of smaller public parks and ad-hoc or informal community gather spaces, we looked at a handful of recently published studies that focus on them and by and large their findings echo the literature review under Principle 2 Integrate Nature—which is that public spaces (green or not) contribute to human health; in this case a critical pathway is the role they play in fostering community connections.[6]

A recent study from Denmark provides some sense of this literature (Peschardt, et al., 2012). Noting that

the use and health benefits of urban green space have received increased attention in recent years, the authors decided to examine whether smaller (and more commonly found) public urban green spaces (SPUGS in their terminology) have similar effects. Their research examined the use of nine SPUGS in the city of Copenhagen and drew on intercept survey responses from 686 park users. They found that Copenhagen's SPUGS were used primarily for "socializing" (by younger users—under 49 years of age—on their way home from work) as well as for "rest and restitution" (by older users). They authors suggest that **designers should recognize the importance of small parks and take their findings as "inspiration"** for the future planning of dense city areas. In a similar vein, Kazmierzak (2013) examined small local parks in Manchester, England to see to what extent they contributed to the development of social ties in three inner-city neighborhoods. Using both quantitative (a survey of residents) and qualitative methods (focus group discussions), he gathered data on levels of material deprivation and ethnic diversity for each neighborhood as well as on park utilization and social networks. Associations were found between the quality of the parks, the character of visits (e.g., frequency of visits, duration of stay, engagement in social activities) and the extent of social ties in the neighborhood. He concludes that **inner city parks can play a greater role in supporting social interactions and developing ties** but that their quality and maintenance matters. A study by Francis, et al., (2012) looked at the association between quality of public space and sense of community in new residential communities built in the Perth metropolitan area of Western Australia. The four public spaces were public open space (e.g., parks), community centers, schools and shops. **Sense of community was of interest as it has been associated with improved wellbeing, increased feelings of safety and security, and greater participation in community affairs.** They found a positive and significant association with the perceived quality of neighborhood public open space and shops with measures of sense of community. Interestingly, frequency of use of those assets did not affect the relationship—but having them in proximity was important.

Finally a study of "mundane public spaces" from the United Kingdom warrants a small call out, particularly given changing demographics in the United States. Cattell, et al., (2008) sought to explore the links between public spaces and different conceptualizations of well-being. The research was set in the culturally and racially diverse borough of Newham in East London—a setting that was 60% minority and had no large or conspicuous 'formal' public spaces. Interestingly, the "public spaces" identified by discussion groups were quite varied—two shopping streets, two public markets, two parks, and a football (soccer) stadium. Not surprisingly the sites played different roles and had different meanings across groups. In terms of social interaction, places of commerce like the market provided a comfortable multi-ethnic setting through which different groups (e.g., black Africans and Indians) easily interacted, whereas parks were seen as less intense social environments since they did not necessarily involve interaction. The researchers conclude by saying that:

A wide range of everyday public open spaces were perceived as having a positive influence on both individual well-being and community life. Some people derived restorative benefits from the opportunities provided by spaces to be alone, but for many others, it was their social value, their shared and collective use which was instrumental both in alleviating stress and for maintaining health and well-being (Cattell, et al., 2008: 556).

Shared public spaces have also been identified as assets for building social capital within a community; social capital as we will see has been identified as a significant variable in health outcomes.[7] Social capital as a concept can be defined as the features of social organization, such as civic participation, norms of reciprocity, and trust in others that facilitate cooperation for mutual benefit. There are two main types of social capital—**bonding social capital** which can be thought of as ties between similar individuals or groups (e.g., homeowners, Catholics) and **bridging social capital** which is defined as ties across diverse or different groups (e.g., inter-racial or inter-faith relationships) (Putnam, 1995; Pridmore et al, 2007). An important aspect of many studies of social capital is discerning levels of reciprocity—that is the extent to which a person can rely upon or call upon an unrelated person to help out in a time of need and is willing to help others out as well. Another critical element is trust in others and in social institutions (like the police). It is thought that trust will influence the development of reciprocal relationships at the individual level; trust is also considered important—potentially a precursor—for participation in civic life at both the neighborhood and citywide scale. High levels of social capital are also expected to contribute to the development of community spirit and a sense of pride of place. Residents who are proud of and committed to their community express that pride in higher levels of volunteerism, greater participation in local civic groups (like residents or neighborhood associations), and shared concern with property investment and upkeep.

Researchers working on social capital and health differentiate social capital into two types: individual social capital and collective social capital (Bourdieu, 1986; Portes, 1998). Individual social capital refers to the ability of persons to secure benefits for themselves due to their membership in social networks. Berkman and Glass (2000) have identified 4 aspects of social networks that they hypothesize might influence health. These are: 1) social support (e.g., the ability to rely on others, seen as a buffering factor for stress; 2) social influence (e.g., exposure to norms, can be health enhancing if norms are health positive norms like not smoking); 3) social participation (which confers opportunities to learn new skills and builds a sense of community belonging); 4) material access (e.g., group membership can give access to resources that can have an impact on health, including information on job opportunities or services). Marmot (2005) has also argued that status is an important aspect of social capital; high status due to group membership is thought to influence health by decreasing stress.[8]

Collective social capital refers to norms and networks that facilitate collective action to benefit an entire community. It might be thought of as higher-level social cohesion. (The research of Putnam in Bowling Alone is in this vein.) Collective social capital is judged by measures such as strength/density of civic organizations, voter turnout, and levels of volunteerism. The linkage between collective social capital and health is debated and less easily hypothesized than individual social capital. Wilkinson (1996) has hypothesized that collective social capital may be able to mediate between income inequality and health building on the observation that more equal societies have higher levels of social cohesion. It is also thought that perhaps more social capital could work to address inequities since more cohesive neighborhoods are more effective at lobbying for policies and services (Kawachi, et al, 1999).

FINDINGS

There has been a dramatic rise in number of published studies examining the relationship between social capital and health since the topic got into public consciousness in the mid-1990s. Looking at PubMed, in 2000 there were 15 articles published with that term in the title alone; in 2012 there were 106; cumulatively the search engine yields 760 articles in total. (Search conducted July 2013.)Given the physical impossibility of reviewing such a trove, this review highlights a few of the more interesting studies by type of social capital.[9] In general, according to a more recent review, the linkages between social capital and health remain unresolved with further research needed (Eriksson, 2011).

Individual Social Capital: The research on the importance of social capital to positive health outcomes at the individual level appears to be the strongest. Writing in The Lancet some 12 years ago, Whitehead and Diderichsen (2001: 165) noted that:

> *It has long been known that at an individual level, networks, social participation, and supportive social relationships are good for a person's health. People with strong social networks, for instance, have mortality half or a third that of people with weak social links. Low control at work and low social support predict coronary heart disease, and in the Whitehall II Study low control in the workplace accounted for about half of the social gradient in cardiovascular disease.*

More recent research has sought to add nuance to this consensus by examining whether the positive effect of social capital holds across individuals differentiated by key characteristics, such as gender, race, age and income. Relative to gender, for instance, there are a few studies out of Australia that have shown that social capital is particularly important for women's health. A study done by Young and her colleagues honed in on social capital as measured by the feeling of community belonging amongst Australian women aged 73 to 78. They found that women who had a "better sense of neighbourhood" was associated with better physical and mental health, lower stress, better social

support and being physically active (Young, Russell, and Powers, 2004: 2627). Not surprisingly duration of stay mattered here with women who had lived longer at their present address indicating a stronger sense of belonging. Security of income also influenced feelings of belonging (Young, Russell and Powers, 2004). A study by Berry and Welsh (2010) used Australian national data from the WAVE 6 Household, Income and Labour Dynamics Survey to explore social capital and its relation with three forms of health—general health, mental health, and physical functioning. Found that higher participation was (not unexpectedly) related to higher levels of social cohesion, it was also related to all three forms of (better) health, particularly strongly to mental health. They highlighted the fact that there were notable gender differences here, with women reporting greater community participation and social cohesion than men, but also reporting worse mental health. Their findings of difference by sex and the link of social capital with mental health as being reflective of other findings in the literature, namely Baum et al., (2000) and Berry, (2008). Another 2010 publication by Ball, et al., looked at the health status of women in neighborhoods differentiated by their level of socio-economic disadvantage in Melbourne. They found that leisure time physical activity was associated with SES as well as social capital measures. Specifically, the most physically active women were university-educated; they knew more neighbors, had higher levels of social participation, and reported high levels of interpersonal trust as well as stronger norms of reciprocity and social cohesion.

Researchers have also examined the effect of social capital on mental health. In a review of extant studies published in 2005, de Silva et al. systematically examined 21 papers—14 measured social capital at the individual level and the remainder measured it at the population level. Of the 14 studies, 11 reported higher levels of social capital to be associated with lower risk of mental illness; in contrast findings from the studies of "structural social capital" (measured by items like trust, attachment to neighborhood) were inconclusive (only two show showing a positive benefit from social capital). They conclude that the "current evidence is inadequate to inform the development of specific social capital interventions to combat mental illness." More recently, Ivory et al. (2011) researched relationships between mental health and social fragmentation (i.e., weak social ties) at the neighborhood level in New Zealand. Their research found that fragmented neighborhoods did affect mental health but that gender mattered here again with women, particularly unemployed women, being the most negatively affected.

Collective Social Capital: As noted above, the evidence base relating to collective social capital and health is thought to be weaker. We highlight three studies here mainly to give a sense of what this research looks like and the types of conclusions being drawn. A large sample study looking at data from 40 US communities by Kim, Subramanian and Kawachi (2006), for instance, sought to distinguish between the effects of different forms of social capital on human health. It gathered data at both the individual and the community level and sought to examine differences in effect from

bonding versus bridging social capital. They found that higher community bonding was associated with 14% lower odds of reporting fair-to-poor health, while higher community bridging social capital was associated with 5% lower odds of self reported fair-to-poor health. They found some interesting effects by race/ethnicity with the positive effects of higher community bonding social capital on health begin significantly weaker among black persons and among those assigned to the ''other'' racial/ethnic category. They conclude there may be modest protective effect on health from these two types of social capital. Another study by Carpiano, also published in 2006, analyzed data from the US Census and the Los Angeles Family and Neighborhood Survey to test a more sophisticated conceptual model of neighborhood conditions and social capital developed by Bourdieu. He looked at the relationship between neighborhood social capital forms (social support, social leverage, informal social control, and neighborhood organization participation) and select adult health behaviors (namely, smoking, binge drinking) and perceived health. He found relationships between social capital and health behaviors—informal social control and higher levels of neighborhood social leverage were associated with lower levels of binge drinking and smoking, but conversely higher levels of social support were associated with higher level of both behaviors. He notes that this is consistent with social capital theory that points out the negative potentialities of social capital. A final study from 2011 by Kim, et al., (2011) drew data from the European and World Values Surveys to estimate the effects of country-level social trust on individual self-rated health for a very large sample of persons living in 64 countries. They also looked at whether the relationship varied by gender or individual levels of trust. Their regression analysis found higher average country-level trust to be associated with better self-rated health in both women and men. Interestingly they also found the effects of country social trust to be stronger for women than men. They argue for the importance of collective social capital noting that "the estimated health effects of raising the percentage of a country's population that trusts others by 10 percentage points were at least as large as the estimated health effects of an individual developing trust in others" (Kim et al., 2011: 8).

If social capital is potentially good for health, then a clear counter question is whether the loss of social capital is bad for health. In a cross sectional study that looked at the relationship between income inequality and social capital using data from 39 states, Kawachi et al., (1997) found just that. Specifically they found that higher income inequality was negatively correlated with two measures of social capital, namely levels of per capita group membership and social trust. These two negative characteristics, in turn, were positively correlated with total mortality as well as negative health outcomes like higher rates of coronary heart disease and infant mortality. They conclude that their study supports "the notion that income inequality leads to increased mortality via disinvestment in social capital" (Kawachi, et al., 1997: 1491).

TAKE AWAY FOR PRACTICE

Public spaces—at all scales—are a critical element in the land use mix needed to foster human health. One brief take-away from the previous discussion is our need to think broadly about just what constitutes a "public space" and formulate creative strategies to better utilize existing land resources, including vacant or underutilized properties, to make them work as community gathering places. While advocacy organizations such as PPS do provide compelling arguments for public investment in public space, it is often difficult to justify such expenditures in times of fiscal distress. Parks or police officers? Lower cost alternatives are needed.

In terms of crafting of such alternatives, open space advocates and community members are increasingly looking to the most common public space in our cities and towns—**the street**. (Persons familiar with William Whyte's 1979 video The Social Life of Urban Spaces might recall that the documentary begins and ends in the same location and he confesses that he could have discovered everything uncovered by the research focused on formal places like Seagram Plaza and Bryant Park by simply by observing a lively street in Harlem.) In 2005, Rebar, a San Francisco art and design studio converted one metered parking space in downtown San Francisco into a temporary park as one way to draw attention to and protest the shortage of green space in that part of the city (see, http://rebargroup.org/parking/). Since that time, "Park(ing) Day" has taken off globally with 975 parks being "built" in 162 cities in 35 countries in 2011 alone (see: http://parkingday.org). Inspired by public squares and piazzas, CityRepair in Portland, Oregon focuses on creating public gathering places in neighborhoods across the city. During their 10 day "village building convergence", neighbors come together in place-making exercises like painting intersections, building benches, planting gardens, creating mosaics and so on. The material cost is low, but the community building effect is reportedly high. (See: http://vbc.cityrepair.org)

Additionally, as we have concluded from this admittedly truncated review that **social capital has health implications and the potential for positive impacts** (even though research will clearly be on-going) a question for the planning, development and design communities is what role can design play in cultivating social capital—that is in **facilitating the formation of community connections, creating a sense of community, and building pride of place?**

One evident response is that communities should be designed to provide an enabling environment for social interaction—that is, we should **create a high quality public realm that encourages community members to get out of their private homes** and rub shoulders. Many of the design ideas already discussed—investment in sidewalks, the creation of regional trails and linked park systems, and planning for high quality public spaces and streetscapes—will create just such an enabling environment.[10] While we might hope that simply providing appropriately and attractively designed infrastructure and amenities will do the trick, such investment should also be supported by programming (like street festivals, art fairs, seasonal attractions like ice skating rinks) that keep community members coming back throughout the year. The Project for Public Spaces has lots of ideas and examples drawn from around the country on innovative programming and events. See: http://www.pps.org/reference/reference-categories/programming/).

PRINCIPLE 7: PROVIDE ACCESS TO HEALTHY FOODS

Encourage healthy eating habits by establishing farms nearby, integrating demonstration gardens within parks and open spaces, integrating community gardens, encouraging rooftop gardens and window boxes and other forms of urban agriculture. Provide a location for a Farmer's Market and/or healthy corner store.

As concern has grown over America's obesity epidemic, increased attention is being paid to food environments. Public health practitioners speak of "obesogenic environments"—that is physical and social settings that encourage the overconsumption of calorie-dense, low-nutrition foods. While any place at any spatial scale can be an obesogenic environment (e.g., your work place—all those baked goods!), the biggest policy debate over obesogenic environments is evidenced in discussions of K-12 schools, soft drinks/soda pop, the school lunch line, and vending machines. Neighborhoods themselves can be obesogenic if they offer limited access to healthy fresh foods, particularly fruits and vegetables. The most extreme cases of poor food access are seen in neighborhoods referred to as "food deserts"—these settings do not have a literal lack of access to food but the food that is easily accessible is often junk or fast food and/or of low nutritional quality (Walker et al., 2010).

Cities and neighborhoods across the USA have begun to actively address the problem of food deserts and obesogenic environments through a variety of interventions. Commonly **cities are encouraging food production within city limits** (i.e., urban agriculture.) Urban agriculture programs and policies vary greatly depending upon local factors such as land availability, current land use development patterns (e.g., the existence of backyards for gardens), land contamination, and consumer or resident demand. These programs also differ relative to rules over livestock production (e.g., allowing chickens or small ruminants like goats or sheep). Some cities are accommodating fairly large-scale farms within city limits—the city of Lake Oswego, Oregon, for instance, has Luscher Farm, which covers 56 acres (not all of which are in production), while the city of Detroit is debating selling 140 acres of its extensive vacant landholdings to establish the Hanzt Farm. Other urban farms are modest in size, but have major impacts in terms of community food access, job training and entrepreneurial education, and decreasing urban blight. Growing Power in Milwaukee, one of the more well-known examples of urban agriculture, has only 2 acres developed in its community food center; its myriad activities show what can be done with proper planning, community support and adequate funding. (See: http://www.growingpower.org.)

More commonly, cities are facilitating food access through **the establishment of community gardens** (Twiss, et al., 2003), which are officially defined by the American Community Gardening Association as "a single piece of land collectively gardened by a group of people". Community gardens are accommodated on all types of land—some are located in less utilized portions of public parks, others on excess or underutilized public right of way, and even others have been purposefully planned with acres set aside as part of a development or redevelopment plan. Some community garden programs include demonstration plots and kitchens that help teach interested residents the fundamentals of gardening, cooking, and food preservation.

Finally, many localities are supporting access to fruits and vegetables and other healthy foods through the development of **municipal or neighborhood farmers' markets,** particularly in lower income areas with worse food access (Fisher, 1999). In areas less served by full service grocery stores, advocates in the "health corner store" movement are working with convenience stores to stock their shelves with more nutritious food options, including locally sourced produce. (See: the Healthy Corner Store Network for more information; http://www.healthycornerstores.org.) This is being done as these retail outlets are common in poorer, less-served urban neighborhoods, but they have been demonstrated to carry less healthy food options (see: Laska, et al., 2009 for a four city comparison; Gebauer and Laska, 2011 for Minneapolis/St. Paul).

FINDINGS

While the role that is played by proper nutrition in human health is clear and there is lots of activity to facilitate access to healthy foods through food

policy councils, land use policies and city investment strategies, a question remains as to how effective these policies or interventions are in terms of facilitating better health outcomes. To compose a parallel to an old adage: you can lead a kid to vegetables, but can you make her eat them? A recent review of 21 studies looking at food and nutrition environments by Sallis and Glanz (2009) provides some answers, particularly relative to retail food outlets. They report that the presence of food stores does affect the eating patterns of residents (drawing on Ford and Dzewaltowski 2008; Glanz and Yaroch 2004), and that neighborhood supermarket availability was associated with a better-quality diet (Moore et al. 2008) and a lower prevalence of obesity and overweight in adults (Morland, Diez Roux, and Wing 2006) and adolescents (Powell et al. 2007). The evidence is less strong for bringing in new food retail outlets (like a full scale supermarket) with two studies showing little impact on food purchasing and eating behaviors. Sallis and Glantz (2009: 139) summarize the overall findings as indicating that: **"Evidence is rapidly growing that proximity to supermarkets is associated with an intake of more fruits and vegetables and that proximity to fast-food restaurants is associated with an intake of higher-energy foods and a lower-quality diet".**

There is a smaller body of research on the effect of farmers markets and healthy corner stores on food availability and nutrition (Gittelsohn et al., 2012). Relative to farmers markets there are very few studies that look at their specific health and nutritional impacts, although there are myriad papers examining their growth and trumpeting their potential for positive health impacts (e.g. Holben, 2010). A review article by McCormack, et al., (2010) looked at 12 papers that examined the impacts of farmers markets on diverse populations including WIC/SNAP (the variously named supplemental nutrition program of the federal government) and seniors. While they (McCormack, et al., 2010) were highly critical of the methodological flaws of these studies (and they did set standards for how future studies should be conducted), the articles reviewed did show positive impacts as participation in farmers markets was associated with greater intake of fruits and vegetables.

In contrast, there is more robust research around healthy corner stores (Gittlesohn et al, 2012). In a quasi-experimental study linked to the Baltimore Healthy Stores program, for instance, researchers from Johns Hopkins chose 10 foods to promote within a select group of Korean owned convenience stores for a 10-month period (Song et al, 2009). Their study evaluated program acceptability for storeowners, changes in stocking behavior by storeowners, and the impact of the promotional activities on actual sales. Relative to the last measure, the researchers found that weekly sales of low-sugar cereals, cooking spray, baked/low-fat chips, low-salt crackers, whole wheat bread and 100% fruit juices increased from their baseline measures in intervention stores while they decreased in the control (comparison) stores. Of the 10 promoted foods, the increase in weekly sales of cooking spray was statistically significant for intervention stores. Another study of corner stores in predominantly African American and Latino

neighborhoods of Hartford, CT found that for each additional type of fruits or vegetables available in the store, the odds of a customer purchasing fruits increased by an estimated 12%, while the odds for purchasing vegetables increased by 15%. Interestingly, customers participating in the Supplemental Nutrition Assistance Program (SNAP) were 1.7 times as likely to purchase fruit as those not receiving SNAP (Martin, et al., 2012). These findings are representative of the broader research on the topic. In a literature review of 16 extant studies of interventions in corner stores both within the US and elsewhere (including the Baltimore program discussed above), Gittelsohn, et al., (2012: 5) reports that: "Significant increases in sales of promoted foods were reported among all trials that collected sales data (Apache Healthy Stores, Baltimore Healthy Stores, the Good Neighbors Program, Scottish Grocers Federation Healthy Living Neighborhood Shop, and Have a Heart Paisley). Trials that measured produce sales observed 25% to 50% increases."

The potential for community gardens to have positive health impacts has also received attention in the literature. Two strains of research dominate: 1) understanding the impact of the gardens upon fruit and vegetable consumption and 2) evaluating their more psychological / social impacts, including impacts on mental health and life satisfaction.
A study by Litt, et al. (2011) of residents of Denver, Colorado showed that neighborhood aesthetics (e.g., using perception measures of trees, litter, etc.), social involvement (e.g., using measures like participation in neighborhood meetings) and community garden participation were significantly associated with fruit and vegetable intake. **The consumption of fruits and vegetables by community gardeners was higher than that of home gardeners** (5.7 versus 4.6 times per day) and non-gardeners (3.9). This study notably was demographically limited—with the average respondent being white, female and college educated. An earlier study from Flint, Michigan with a larger representation of African Americans, however, showed a very similar result with respondents with a household member who participated in a community garden consuming more fruits and vegetables than respondents without a gardening household member (4.4 times per day as compared to 3.3 times)(Alaimo, et al, 2008).

A number of researchers have also looked at community gardens for their impacts on mental health, general physical health and the development of social capital; while these studies are primarily qualitative (and not longitudinal or experimental in design) the impacts reported are consistently positive. In a qualitative study of community gardeners in Toronto, Hale et al., (2011) interviewed 67 gardeners from 27 community gardens to understand the interrelationship between people, ecology, and health. They found that gardeners related strongly to their garden and experienced it as a physical, social, and aesthetic experience (e.g., enjoying the way their vegetables taste, the feeling of the dirt in their hands, and the view of the garden). The physical and social qualities of garden participation stimulated a range of responses that influenced interpersonal processes (learning, affirming, expressive experiences) and social relationships that were supportive of positive health-related behaviors and overall health. In another earlier study of community gardens also in Toronto, Wakefield

et al., (2007) used a community-based participatory research approach to gather data on perceived health impacts of community gardening. Their results, drawn primarily from participant observation, interview and focus groups, indicate **gardeners perceive community gardens as providing numerous benefits including improved access to food, improved nutrition, increased physical activity and improved mental health**. They also reported that the gardens served to promote social health and community cohesion. A study of "allotments" (communal gardens) in the UK indicates that the benefits from gardening serve to maintain the health and wellbeing of older persons as well. In their study, Milligan, et al., (2004) showed that older people gained a sense of achievement, satisfaction and aesthetic pleasure from their gardening activity. The authors caution, however, that older people do face physical shortcomings in continuing with gardening and that programmatic support may be need to facilitate gardening over the life course. One of the earliest studies found (Armstrong, 2000) looked at community gardens in upstate New York facilitated by Cooperative Extension found that participation in community gardening had a large impact upon leadership in lower income communities. She writes: "Community gardens that were located in low-income neighborhoods were four times as likely as gardens not in low-income areas, to lead to other issues in the neighborhood being addressed. Furthermore, gardens located in low-income neighborhoods were four times as likely to be cultivated by mainly African American and other minority gardeners compared with gardens not located in low-income areas" (Armstrong, 2000: 324).

TAKE AWAY FOR PRACTICE

The literature clearly supports the integration of sources of fresh fruits and vegetables into the built environment as a strategy for improving human health. The choice of strategy selected—larger scale urban agriculture, backyard gardens or community gardens; healthy corner stores, full service supermarkets, or farmers markets—depends on local conditions and opportunities. One critical element to keep in mind regarding food production / urban agriculture is the need for farmers and urban gardeners to have secure land tenure in the way of a land title or longer-term lease. Without long-term tenure security, farmers are reluctant to undertake the types of investment they need (e.g., water sources, soil amendments, processing kitchens) for success. This is particularly important if the purpose of the urban agriculture also relates to skills transfer, job training or small enterprise development. PolicyLink has an excellent analysis of this and other obstacles to effective urban agriculture in its report "Growing Urban Agriculture". The report also lays out the policy and investment choices that local governments can and should take to support it (see: http://www.policylink.org/atf/cf/%7B97C6D565-BB43-406D-A6D5-ECA3BBF35AF0%7D/URBAN%20AG_FULLREPORT_WEB1.PDF).

PRINCIPLE 8: **LIFELONG LEARNING AND TEACHING**

Foster opportunities for intellectual growth and exchange over the life course by providing a range of education opportunities, including elementary, middle and high schools, charter schools, vocational schools, community colleges and other forms of higher education.

The provision of educational facilities within walking distance of residences was a central component of residential developments in the United States through much of the 20th century. Clarence Perry's "Neighborhood Unit" from the 1929 Regional Plan of New York and its Environs is exemplary—neighborhoods were designed so as to center on public facilities with the school designated as the preferable walkable center of the community. The development of autocentric residential subdivisions in the post-war period as well as the escalation of standards for school facilities (particularly relative to athletic fields and parking) has resulted in educational facilities no longer being central components of many planned residential communities.

Given the shifting demographics of the United States (e.g., ageing Baby Boomers) and the prospect of late career shifts and/or the need for retraining due to the changing nature of our economy, educational facilities are reemerging as the center of residential life. Such facilities, however, are doing more than just providing space for K-12 education—instead they are conceptualized as centers of lifelong education and intellectual enhancement intended to serve residents throughout their lifecycle. Communities centered around lifelong teaching and learning, moreover, aren't simply focused on formal or structured education processes. Informal education that taps the community's assets—namely its residents—is equally important. Community members of all ages and backgrounds have opportunities to share their skills, training and experience with others through pathways such as mentoring, community-wide (shared book) reads, informal lectures and ad hoc classes and workshops.

Access to education, in general, and lifelong education, in particular, is expected to have beneficial impact upon human health. Higher educational attainment alone—that is, apart from its relationship to income or occupational choice—has been consistently linked with lower rates of obesity, lower likelihood of smoking or abusing alcohol, lower levels of morbidity, and longer life spans (e.g., Lleras-Muney, 2005; Cutler and Lleras-Muney, 2006; Feinstein, et al, 2006; Walsemann, Geronimus and Gee, 2008). The timing of education also counts—Walsemann, et al. (2008) have shown that greater educational advantage in youth is associated with better health over the life course and fewer health-induced work limitations. In an aging society, it has further been suggested that continuing the educational process through opportunities for lifelong education might contribute to health over the lifecycle. Specifically, education is seen as playing a role in achieving "active aging", "successful aging" or "productive aging" because of the mental stimulus, social supports, and continued employment possibilities provided by the educational / skills-development process (Deeming, 2009).[11] (A very comprehensive theoretical discussion of the causal pathways between education and health is provided in Feinstein, et al., 2006).

FINDINGS

There is a growing literature looking at K-12 schools and their role in health outcomes. The focus on schools is due to two primary concerns—1) rising levels of childhood obesity and 2) the dramatic rise in Type II (formerly Adult Onset) diabetes in children (Jackson, 2011).[12] Studies have honed in on the school cafeteria line and the extent to which changes in nutritional approaches (e.g., changing food offerings; linking to local farms in "Farm to School Programs") or nutrition education (e.g., through school gardens and cooking classes) have positive impact on weight, nutritional status and behavior (e.g., Joshi et al., 2008; Story et al., 2009).

The research that relates most directly to the built environment, however, is that which focuses on

children and physical activity. There are two elements of physical activity related to schools that have concerned researchers—the role of diminished physical education offerings in schools (which will not be examined here) and the decline in walking and biking to school. According to the National Safe Routes to School Program the percentage of elementary school age children who walk or bike to school has declined greatly in the US, going from 48% of children five to 14 years old in 1969 to 13% of the same cohort in 2009. Among the factors at play here are (1) school siting decisions that have placed schools at the urban periphery; (2) parental fears over safety and crime; and (3) school policies that have actively discouraged biking and walking (e.g., removal of bike racks). (See: http://guide.saferoutesinfo.org/introduction/the_decline_of_walking_and_bicycling.cfm.)

A key research question that relates to the larger physical environment, thus, is what role can active transport to school play in positively affecting children's health? There are a number of targeted studies that provide some indication—but the findings appear strong only for enhanced physical activity (PA). An early study by Rosenberg et al, (2006) measured the activity levels of 4th and 5th graders over a two-year period in order to examine the potential effect of active commuting to school on weight status and physical activity for youth. They found that for boys the results were positive as those who actively commuted to school had lower BMI and skinfolds than non-active commuters to school in the fourth grade. However there was no association with BMI change or overweight status. A literature review by Faulkner, et al, from 2009 examined the findings of published research looking at the relationship of active school transport with health-related outcomes. Of the thirteen studies reviewed, nine showed that children who actively commute to school accumulate significantly more PA and two studies reported that they expended significantly more kilocalories per day. Lower body weight, however, was only found in one study of active commuters and the authors conclude that the evidence for active commuting as a method of promoting healthy body weight was not compelling. A UK study from 2009 drawing upon data from the Avon Longitudinal Study of Parents and Children (Bristol, UK), collected in 2002–2004 showed physical activity effects as well with children who regularly walked to school being more active during the week than those travelling by car, especially if the distance was greater than one half a mile (van Sluijs, et al., 2009). Finally, a recent study of school children in Alberta focused just on levels of physical activity found that urban children who used active transport (AT) to and from school accumulated more daily steps and were more likely to achieve the recommended 13,500 steps per day than students not using active transport, although the latter findings was not statistically significant (Pabayo, et al., 2012). Like van Sluijs et al. (2009), they conclude that **there may be a benefit to active transport as a method of supplementing physical activity**, although they only generalize their observation to urban children.

Given that **there are consistent physical activity benefits from active transport**, a few studies have looked at the efficacy of programs and investments intended to encourage/enable students to walk or bike

to school. A cross-sectional study of the California Safe Routes to School (SR2S) program looked at the relationship between urban form changes (e.g., sidewalks funded by California state funds) and walking and bicycle travel to school. Using survey data of parents of third- through fifth-grade children at ten schools, the research found that children who passed by completed SR2S projects were more likely to show increases in walking or bicycle travel than were children who would not pass by projects (15% vs 4%) (Boarnet, et al., 2005). They conclude that their results support the effectiveness of SR2S construction projects in increasing walking or bicycling to school. A large cohort study of school children in Auckland, New Zealand, shows a similar effect (Hinckson, et al., 2011). Participation in NZ's School Travel Plan (STP) program, which included educational initiatives, enforcement activities and urban form changes around school environments, positively raised active commuting rates from 40.5% in the baseline year to 42.2% in year three. (Note difference with American rates of active transport to school.) The effects of this, however, did differ by groups with higher income students showing greater change than medium or lower income students. They found that student enrolment did not seem to make a difference with the STP proving equally effective in schools with small to medium-sized student bodies compared to large schools. A recent quasi-experimental study of students in Eugene, Oregon looked at the impact of Oregon's Safe Routes to School program on walking and biking (McDonald et al., 2013). As with the California and New Zealand studies, this research also showed an association between increased walking and biking and SR2S participation. Specifically, education and encouragement programs were associated with a five percent point increase in biking. Infrastructure investment (e.g., crosswalks) in addition to education was associated with increases of walking and biking of 5-20 percentage points. These authors also conclude that their study illustrates the potential of Safe Routes to School type programs for increasing levels of physical activity by children and youth.

The impact of lifelong or adult education and as a subset of that the impact of placing accessible educational facilities within residential communities is much less studied than the other design elements discussed in preceding sections. Researchers in the United Kingdom, such as Hammond (2002a, 2002b, 2003) have enumerated **positive benefits from adult or continuing education including feelings of greater self-sufficiency and health**. In a paper from 2004, Feinstein and Hammond found statistically significant effects from adult learning on health behaviors for a cohort of UK learners aged 33 to 42. Those participating in adult education showed increased chances of giving up smoking, doing more exercise and joining more organizations. In another paper from 2004 utilizing qualitative interviews with 145 individuals and 12 focus groups with teachers of adult learners in the UK, Hammond found consistent evidence that **learning can "lead to improved well-being, increased efficacy, protection and recovery from mental health difficulties and more effective coping, including coping with**

physical ill health" (Hammond, 2004: 553). A study of older adults participating in programming at senior centers in Manitoba, Canada arrived at similar positive conclusions stressing that participation in adult education and lifelong learning appeared an important component of successful aging. Specifically, the older adults surveyed reported high levels of self-perceived health and wellbeing (Sloane-Seale and Kops, 2010). In another Canadian study from 2008, Narushima examined the experiences of older adults participating in a traditional non-vocational, post-work educational program in offered by the Toronto District School Board. The seniors interviewed indicated the positive effects of being able to pursue their "enduring interest in learning" on their physical and mental health. As all participants expressed their fear of losing physical and cognitive functions, a particularly strong finding was the impact of lifelong education on feelings of self-control and autonomy as well as their ability to form new friendships and social supports. A study by Deeming (2009) looked at two aspects of active aging, namely participating in weekday classes and group activities like neighborhood associations. As with the study by Narushima (2008), these older adults indicated that classes provided important mental stimulation and opportunities for safe physical exercise for them. Notably, these study participants stressed the importance of community halls and their facilities as a resource for local residents and as a focal point for the lives of older adults; they expressed fear and worry at governmental moves to defund such centers and cut back programming.

TAKE AWAY FOR PRACTICE

Education is clearly important for positive health outcomes over the life course. While it is clear that early formal educational opportunities (e.g., K-12) are strongly associated with better lifelong health, the literature provides hints that lifelong educational opportunities and programming are also important. Integrating facilities that can accommodate such programming into residential developments appears a sensible design option supportive of healthy communities.

Addressing issues associated with K-12 is admittedly more challenging. As was noted at the outset of this section, classic models of neighborhood development recognized the centrality of the school to community life. In recent decades, however, attending the nearby neighborhood school has become less common. Schools and particularly school campuses have scaled up in size—due to demand for larger building facilities, recreational and sports grounds, and parking (EPA, 2003). As a result, schools have increasingly been sited in remote locations accessible only by car or bus. Known as "school sprawl" this phenomenon prevents students from walking or biking to school and places the burden on parents and school administrators to ensure that they get there safely and on time.

(See a recent article on school sprawl and the cancellation of bus services in Loudon county for a compelling current example of the problems presented by school sprawl in a time of fiscal distress at: http://www.theatlanticcities.com/politics/2013/07/how-sprawl-makes-fighting-childhood-obesity-so-much-harder/6321/.)

Two design actions could help ameliorate the problem of school sprawl. First, it is clear that existing communities need to think about how they can **retrofit their street networks so that walking and biking to school can become a viable option**. The National Center for Safe Routes to School (see: http://www.saferoutesinfo.org) is an invaluable resource with toolkits, training, and fact sheets that can help communities assess their existing conditions and make a plan for moving forward. A number of local governments have hired bicycle/pedestrian coordinators to spearhead these activities and act as a liaison between community members, school districts, and transportation and health departments at both state and local level. Second, when we are designing new health-centric communities **we should actively seek to work with school systems, transportation planners, and parents to identify appropriate locations and formulate innovative school designs that can be supportive of active transportation** and the return of the school to the center of community life. One method for facilitating dialogue on school siting and development would be to conduct a Health Impact Assessment (HIA) to ensure that health impacts are weighed as part of the investment decision. While relatively new, communities in the USA are increasingly conducting HIAs; an example of a school siting HIA was recently completed by the metropolitan transportation organization of greater Nashville, TN (Sequeira and Meehan, 2013). See the Health Impact Project of Robert Wood Johnson Foundation, http://www.healthimpactproject.org, for more information on the process of health impact assessment.

PRINCIPLE 9: SUSTAINABLE DEVELOPMENT

Integrate sustainable development at all scales, including urban form, mix and location of uses, walking networks, sustainable infrastructure, social programs and building technologies.

The integration of principles of environmental sustainability into residential and commercial development projects has been embraced by communities across the country. Many of the features of sustainability identified in the principle above have been reviewed in different sections of this document (i.e., Mixed Use, Walkability, Integrate Nature; the element of social equity/sustainability which is facilitated through community-based social programs like job retraining and skills development is captured under Principle 8 Lifelong Learning). Techniques associated with sustainable infrastructure, such as implementing low impact development techniques for stormwater management, and utilizing green building technologies have not yet been reviewed.

Such sustainable development techniques are anticipated to have a positive impact upon health because **they contribute to the maintenance or even improvement of environmental quality, particularly air and water quality**. Drawing from the Environmental Protection Agency's official definition (see: http://water.epa.gov/polwaste/green/) low impact development (LID) is considered a sustainable stormwater management technique because it works with nature to control and treat stormwater on site. LID approaches build upon two main principles, namely preserving/recreating natural landscapes (like reconstructing wetlands) and minimizing impervious surfaces. There are many techniques used in LID including construction of rain gardens, development of bioswales (or green streets), construction of green or vegetated roofs and walls, disconnection of stormwater drains from sewage systems and adoption of on-site storage techniques, and investment in permeable pavement. If done at a broad scale, it is argued that LID can maintain or even improve the hydrologic and ecological functions of local watersheds.

Green buildings are also hypothesized as creating health benefits. US EPA defines green building as: "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction." A dominant standard for green building is known as LEED (Leadership in Energy and Environmental Design) certification overseen by the US Green Building Council. At the scale of the building, indoor environmental quality is of particular interest since—if poor—IEQ can negatively affect building occupants' physical health. There are five main pathways through which indoor environmental quality is seen as affecting human health; these are: 1) poor air quality, 2) extreme temperatures, 3) excess humidity, 4) insufficient ventilation and 5) inadequate lighting, acoustics, and ergonomic design. The first four are factors in respiratory illnesses such as asthma or allergies, while the last factor is seen as also playing a role in psychological health (e.g., depression, stress)(see for example: Baughman and Erens, 1996; Hoskins, 2003; Spengler and Sexton, 1983).

FINDINGS

There is a more limited body of research looking into the health effects of these two sustainable development approaches. At the scale of the building, there is a significant amount of research into the so-called "Sick Building Syndrome" mainly focused on buildings constructed using conventional building techniques (e.g., Menzies and Bourbeau, 1997; Burge, 2004), as well as the role of interior and day lighting relative to Seasonal Affective Disorder (SAD) (Heerwagen, 2000).Such research set out a basic set of findings illustrating that buildings can in fact contribute to human illness largely through the pathways laid out above. A critical question, thus, is whether new forms of construction such as those using the suite of green building techniques are better for human health broadly defined. A number of the studies reviewed here have focused on measures of

productivity—with productivity seen as a proxy for health since drags on productivity are often health related (e.g. Fisk, 2000). As noted by Miller et al, (2009), however, productivity is hard to measure and most commonly indirect measures (e.g., absenteeism, tardiness, employee turnover) are utilized. So the findings of this literature should be seen as indicative, as direct health measures (e.g., incidence of asthma amongst building occupants) are not utilized.

That said, **studies of "building performance" do provide some evidence of positive impacts of sustainable or green architecture upon building occupants**. A study from 2010 by Singh, et al. focused on improved indoor environmental quality and examined whether a shift from a conventional building to a LEED certified structure had any impacts on perceive health and productivity of employees. Drawing from two surveys of employees (pre-move and then 3 months later post move), the authors found that the improved environmental quality contributed to substantial reductions in self-reported absenteeism and affected work hours as a result of perceived improvements in health and well-being. They conclude that these preliminary findings indicate that green buildings may positively affect public health. A more recent analysis of indoor environments by Newsham et al. (2013) did a similar paired analysis of 24 conventional/green commercial buildings in Canada using on-site physical measures and surveys of building occupants. They found that the 12 green buildings evaluated had superior performance as measured by outcomes including environmental satisfaction, satisfaction with thermal conditions, satisfaction with the view to the outside, aesthetic appearance, mood, physical symptoms (e.g., visual and physical discomfort), and reduced number of airborne particulates. They found no impact upon days away from work for illness. This research built upon a previous review by Birt & Newsham (2009) that concluded that in general, occupants of green buildings had higher satisfaction with air quality and thermal comfort, but there was little or no difference in terms of satisfaction with lighting.

Perhaps ironically, some green building approaches—particularly those formulated to maximize energy efficiency—are now being investigated for their health effects (e.g., Hasselaar and Morawska, 2003; Sundell, 2004). Of particular worry are buildings that are "too tight"—that is, in the pursuit of energy efficiency newer homes are poorly ventilated and are trapping in pollutants such as carbon monoxide, VOCs and formaldehyde found in building materials, carpets, paint, and furniture((Franklin, 2007; Bone et al., 2010). Trapping in naturally occurring radon is also a concern (Jones, 1999). (Alas cooking also appears to be an additional worry since the pollutants it creates can also be trapped within a house if no exhauster hood is installed, see a recent New York Times article: http://well.blogs.nytimes.com/2013/07/22/the-kitchen-as-a-pollution-hazard/.) In a paper on the Northern European passive house standard, Hasselaar (2008) details that poor ventilation is the chief health concern and a variety of complaints (e.g., headache, irritated eyes, chest tightness) are common. Technical papers acknowledge these issues and focus on utilizing mechanized systems like heat recovery ventilators for

ensuring fresh air circulation within homes (e.g., Yu and Kim, 2012; see also EPA's new protocols at http://www.epa.gov/iaq/).

One element of green building—the green roof—in contrast is enthusiastically embraced as health supporting (Rosenzweig, Gaffin and Parshall, 2006). Given climate change there is increased concern about the negative health impacts of rising temperatures and the challenge of cities managing the urban heat island effect (UHI). UHI, in brief, is shorthand for the phenomenon that cities tend to become hotter than suburbs or rural areas during prolonged heat events due to the fact that cities lack dense vegetation and are dominated by engineered urban surfaces (like paved roads) that have high thermal absorbance. In a review of "environmental design strategies for cool cities", Luber and McGheehin (2008) note that green roof standards and high albedo (reflective) surfaces for roofs serve to cool buildings and they recommend the promotion of such techniques. Several studies have looked a green roof performance relative to the mitigation of air pollution (see Rowe, 2011 for a detailed review of the literature here); in one modeling study from Toronto the authors found that extensive green roofs comprised of grasses could augment the positive effect of street and yard plantings in air pollution mitigation; however, placing shrubs on roof tops (intensive green roofs) would have a more significant impact (Currie and Bass, 2008).

Very few studies were found that related LID techniques to human health outcomes. A number of studies did evaluate these approaches in light of their efficacy at managing stormwater and pollution—which can be extrapolated to have health effects. A review of extant research on a wide range of LID techniques by Dietz (2007: 361) found generally positive impacts. His summary of findings states the following:

> Bioretention cells {i.e., rain gardens} have been effective in retaining large volumes of runoff and pollutants on site, and consistently reduced concentrations of certain pollutants such as metals. However, retention of certain pollutants such as nitrate–nitrogen and phosphorus has been problematic. Porous pavements have been extremely effective in infiltrating stormwater runoff. Concerns have been raised about groundwater contamination, but research has shown that this is not a problem in most settings. Green roofs have been found to retain a large percentage of rainfall (63% on average) in a variety of climates. A common thread across bioretention, green roofs and grassed swales was found: the export of phosphorus.… Contrary to popular belief, research has shown that bioretention and pervious pavements continue to infiltrate even with frost in the ground. Although issues have been identified with retention of certain pollutants, the LID approach has been found to result in increased retention of stormwater and pollutants on site, mimicking predevelopment hydrologic function.

More recent work appears to underline these findings. A study by Davis (2008) that monitored the performance of bio-retention facilities on the University of Maryland campus for two years concluded that bioretention was effective at minimizing hydrologic impacts of development on nearby water resources. A technical study looking at biofilters at a larger field scale showed that biofilters could effectively attenuate peak runoff flow rates—in this research by at least 80%. The authors, however, offer up technical design advice relating to biofilter design to manage seasonal drying which affects the survival of vegetation (Hatt et al. 2008). Finally, a 2013 study looking at residential rainwater harvesting in 23 US cities found that rainwater harvesting can reduce stormwater runoff volume up to 20% in semiarid regions, but less in regions receiving greater rainfall amounts (Steffen, et al., 2013). Overall the authors suggest that U.S. cities and households can benefit from implementing rainwater harvesting as a stormwater control measure and as an alternative source of water.

To close, one study that did directly look at human health evaluated the impact of the City of Portland, Oregon's "green street" program on physical activity, social activity and neighborhood social capital. The hypothesis tested by Dill et al. (2010) was that green street features (e.g., enhanced tree canopy, bioswales, rain gardens) might make the neighborhood more attractive and encourage more walking behaviors and social interaction. Taken together these were expected to positively impact physical and mental health. Using surveys, environmental on-site assessment, and hedonic price analysis, the researchers found that green streets were positively related to increased walking with residents living near the green street road segments reporting more walking than control neighborhoods without the landscape improvements. Green streets were also associated with more social interaction, such as waving or saying hello, than control areas but there were not significant differences in other types of interactions (e.g., asking a neighbor for help). Interestingly satisfaction with the aesthetics of green streets differed over age groups with persons over 65 years of age much less likely to agree that the green street installations "make my neighborhood more pleasant" than persons under 65 (50% versus 78% respectively).

TAKE-AWAY FOR PRACTICE

The two sustainable development strategies discussed here, low impact development and green building technologies, can yield positive benefits for ecosystem and human health. Investment in natural systems (like street trees) or nature-mimicking or enhancing systems (like permeable pavements or green roofs) can help mitigate air and water pollution. Two obstacles, however, have impeded widespread adoption of these technologies: perceived cost and questions about effectiveness. There are growing numbers of studies of the costs and benefits of green building technologies; some show that in a full cost accounting model additional construction and design costs are

generally recovered over time through benefits like lower maintenance and lower water utility bills (e.g., Kats, 2003; Fowler, et al, 2011). There is debate, however, about the energy/heating savings in LEED certified commercial structures and challenges associated with measuring such benefits (see: Newsham, et al., 2009; Scofield, 2009; Diamond, et al., 2011.) And, as reviewed above, there are increasing numbers of studies showing the efficacy of LID approaches for managing stormwater. Cities can facilitate the adoption of such technologies by (again) changing the regulatory environment to require or incentivize the adoption of these technologies. Leading by doing is also effective—the installation of the green roof on Chicago's city hall being one of the premier examples of an influential embrace of green technology. Perhaps even more importantly the city supports the Chicago Center for Green Technology, which serves as a resource center for green design education for the city and the entire Midwest region. See: http://www.chicagogreentech.org.


DAVID JONES
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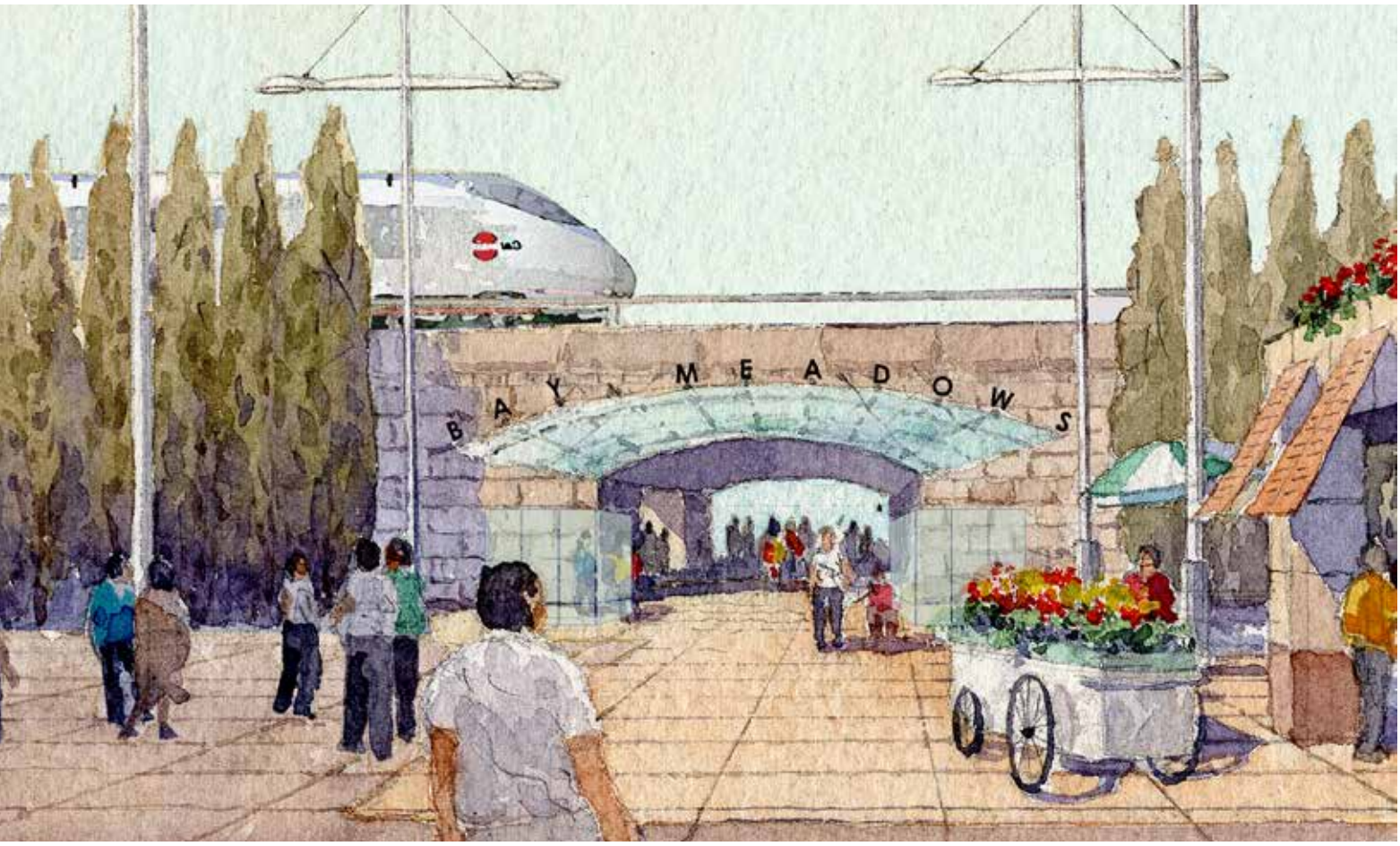
bar



SUMMARY & NEXT STEPS

The purpose of this paper is to help spark an informed dialogue on the relationship between design and health. We started this process by examining and synthesizing the large—and growing—literature on the topic; we have used our findings to derive nine succinct and actionable principles to guide the architectural design and real estate development community.

The principles underscore that the physical design of our communities matters and that the interface of land use with transportation networks and non-motorized modes of travel is particularly significant. **Communities should be built in locations and using urban forms and densities that support the provision of transit.** Transit provides mobility and independence for residents of all ages; it correlates with higher levels of physical activity; it facilitates community interaction. In addition to transit, **our communities need to accommodate circulation alternatives**. Walking and biking necessitate planning and investment; we need to utilize designs that enable these behaviors and do so in a way that is safest for our most vulnerable societal members, namely children and older adults. The **provision of natural space** also yields health benefits, particularly related to mood and stress. But not all natural space is created equal—quality does count. Proximity and distribution of space also need to be considered as there are disparities of access according to socio-economic status with poorer communities having fewer natural areas. **Mixed land use is an undisputed core principle.** Our community designs must discard the old model of segregated, exclusive uses—we need to have a mixture of residential, commercial and institutional uses within a relatively compact area. Such mixing allows community members to meet their daily needs for food and sustenance, while providing access to employment, services, entertainment, schools, and other civic institutions. In such environments walking and biking are enhanced; reliance on the automobile is lessened. **Housing choice is also central.** Residential developments should include a variety of housing types with owner-occupancy and rental tenures availed. We need to build for America's demographic future (the country is aging and becoming ethnically more diverse) by creating well-designed accessible units that enable aging in place as well as accommodating multigenerational households.

Design has impacts that extend beyond physical activity, which has been a primary concern of the principles reviewed above. **Fostering community cohesion**—or the social connections known as social capital—has positive health benefits. Community bonds can be fostered by creating environments that enable residents to mix and get to know each other. One suggested design technique is to provide sufficient open spaces at different scales with different intended purposes and users. Don't just provide a neighborhood park—make space for trails, markets, plazas, and street-adjacent resting places. Nutrition is clearly a critical ingredient for health. The evidence base supports proactively **ensuring access to healthy foods in our communities;** such food should be nearby—preferably within walking distance. There are myriad ways to do this including integrating community gardens into residential subdivision

layouts, encouraging rooftop gardening and other types of urban agricultural, and setting aside spaces for farmers markets and healthy corner stores. Our communities also need to provide opportunities for the intellectual stimulation and growth that contributes to health and welfare over the life course. To that end, communities should provide a range of facilities to foster **lifelong educational opportunities** of both an informal and formal nature. In addition to school facilities, community centers that can host peer tutoring, community-wide reading events, and public talks and exchanges are necessary. Finally, our communities need to be built to support the underlying ecosystems and habitats upon which all human health relies. Health conscious designers need to integrate sustainable development into their work at all scales from the region to the subdivision plan to the structure. Building to meet a LEED designation is not enough—sustainability requires **investment in and protection of existing natural systems**, as well as adopting best practices such as low impact development to lessen the environmental impacts of development and land use change.

Taken together these principles provide guidance related to our central finding, which is that communities—those already built and those on the drawing table—should seek to accomplish two main goals, namely to:

- facilitate physical activity for persons of all ages, and
- foster social interactions and connections between community residents. Physical activity has proven linkages to better health. Social interaction is also consistently positive for health across the life span and luckily the way one designs for physical activity also creates a community environment that is conducive to greater social interaction and the creation of social capital.

NEXT STEPS

While this literature review may appear exhaustive and the principles well thought out and substantiated—they are both really just a few first steps intended to spark a research-based conversation between design professionals, the real estate community, health advocates, health care providers, and community leaders. One challenge in this research and in any future conversation on health-oriented development is the lack of a shared definition of what we mean by a healthy community. **A precise definition with clear quantifiable attributes is necessary in order to develop metrics to measure outcomes.** A key challenge in the United States is that the spatial scale at which we collect health data (county, region) doesn't accord with the level at which we design and plan our communities (neighborhoods, sub-regions, parcels). We need a different type of data with more detail on community members, their health and health behaviors, and where they live in order to better understand the relationship between the built environment and health. Long-standing calls for research focused on evaluating "natural experiments" such as the development of new communities embracing these principles or the redevelopment of existing communities toward denser, more walkable designs continue to be relevant.[13]

A second research need relates to the understanding of the market for such communities and how it fits with processes and objectives of the real estate development community. American communities are built by private hands working in a competitive marketplace. To achieve widespread construction of health-centered communities requires a paradigm shift in the industry. But paradigm shifts are difficult when the commercial viability and benefits of this development model are untested and risk appears high. One unparalleled opportunity is the significant interest and enthusiasm within the real estate industry for a new approach to community design and building. To support this, we again need to develop metrics for judging success—but this time the measures must include economic and monetary metrics that speak to the concerns of investors, prospective residents, and public officials with fiscal responsibilities. **What is the value added by designing for health?** We know it requires an analysis far beyond return on investment—does it include enhanced productivity, longer lives, lower health care expenditures, more robust tax bases, and blacker balance sheets? If so, how do we measure them?

Addressing these two issues requires convening a broader discussion between the public sector, particularly public health officials, land use and transportation planners, and city engineers, and the private sector, including architect/designers, health care practitioners, private developers, and bankers. Their leadership is imperative for moving all this research about health and the built environment from an interesting (if somewhat long) academic discussion into a lived reality.

FOOTNOTES

FOOTNOTES:

[1]Acute diseases are those that begin abruptly and last only a short time. They might be thought of those that kill you fast or those from which you recover over the course of time with the expectation of a return to normal health. Chronic diseases usually develop slowly, last a long time and can be progressive or incurable.

[2]Smart Growth is considered a type of growth pattern that meets 10 central principles. These include smart location but the concept is broader and includes elements such as compact (higher density) growth and mixed use. See: http://www.epa.gov/smartgrowth/about_sg.htm

[3]Benefits here, however, depend upon the mode shift made. Buses are still predominantly diesel in the United States and there is evidence that the pollutant mix would be different with more particulate matter and sulfur dioxide and fewer VOCs (Harford, 2006).

[4]Class I facilities are defined as a bikeway physically separated from motorized vehicular traffic (bikes paths or shared use paths). Class II facilities are defined as a portion of a roadway that has been designated by striping, signing and pavement markings for the preferential or exclusive use of bicyclists (i.e., bike lanes).

[5]While no designers appear to question the importance of good public spaces, there is a lot of discussion in the literature about the privatization of public space (particularly the rise of the mall) and the extent to which this places limitations on use or interferes with social mixing and the democratic functioning of public space. See just about any issue of the Journal of Urban Design.

[6]There is an enormous literature in the fields of community and environmental psychology examining open space, landscape design, and sense of place/place attachment/place identity. A comprehensive review of that was not possible here, however, Manzo (2003) and Manzo and Perkins (2006) provide good overviews.

[7]Social capital has been identified as an important factor in a wide range of social outcomes beyond health. Researchers have looked at the role of social capital as a driving agent in poverty alleviation, community development, entrepreneurship, technological innovation, and the management of natural resources (to name a few) (e.g., Warren, Thompson and Saegert, 2001; Pretty, 2003; Dakhli and de Clercq, 2004).

[8]Marmot's most current research on status, stress, and health outcomes was recently covered by the New York Times, see: http://opinionator.blogs.nytimes.com/2013/07/27/status-and-stress/ .

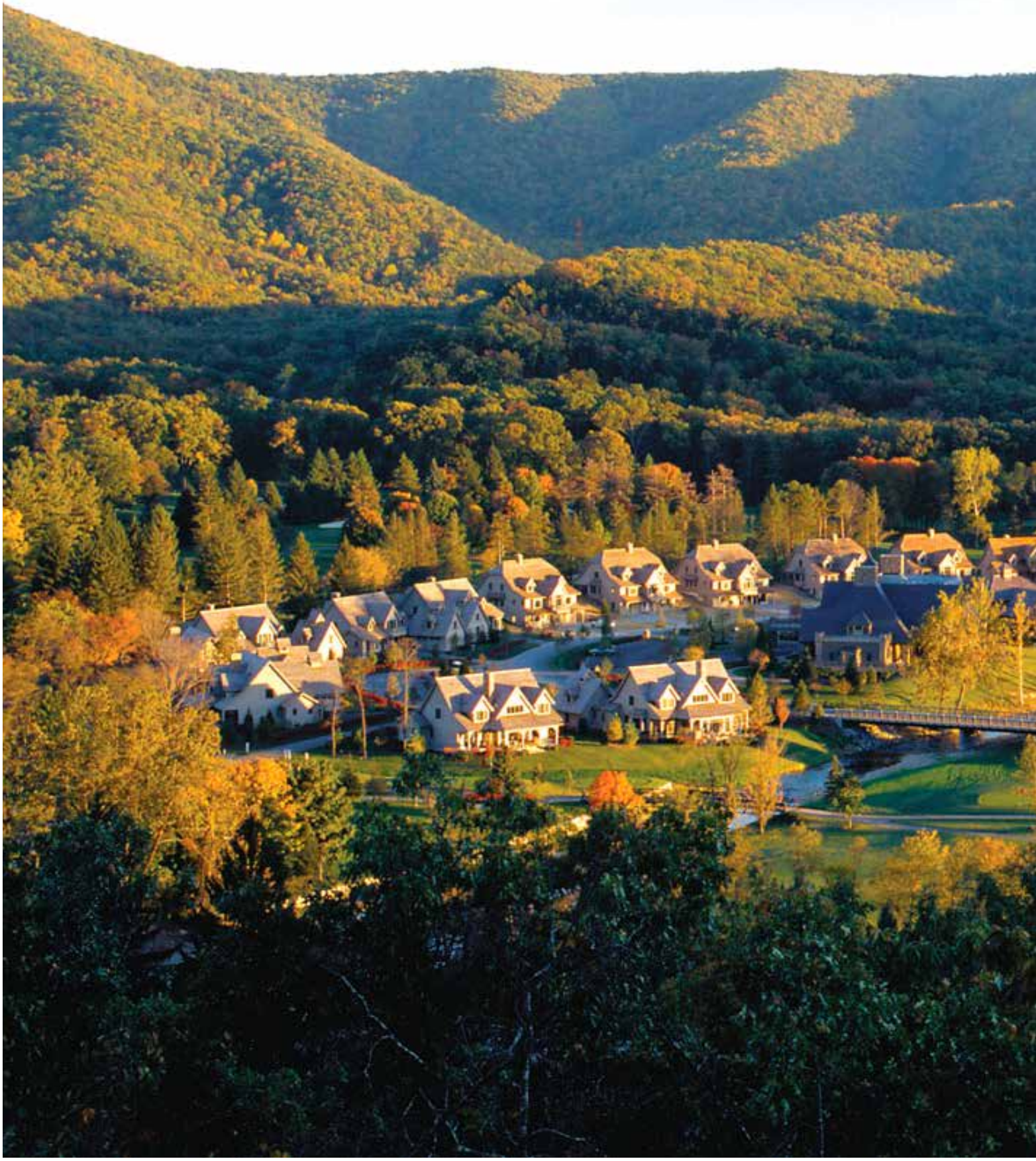
[9]A relatively recent book by Kawachi, Subramanian and Kim (2008: 1) warrants review by the very interested reader and their count is much higher than mine: “Search on Pubmed for “social capital and health”, and one sees over 27,500 articles listed (as of December 2006).

[10]An interesting study by Wood, Frank, and Giles-Corti (2010) is worth noting here. They looked at sense of community and how it related to community design using data from Atlanta. They found that sense of community was associated with leisurely walking which in turn was associated with lower levels of land use mix but also higher levels of commercial FAR. They note that their results suggest that the presence of commercial destinations may inhibit social interaction among local residents and they advise that urban design should be used to create convivial pedestrian-friendly commercial areas, and not flat surface parking

[11]Active aging is a contested idea as are the subset of policies that have been created around it. Active aging is “the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age” (WHO, 2002). While this sounds unchallengeable, policies adopted around this concept include a “balance of rights and obligations” in which individuals are required to make “personal efforts to adopt positive personal health practices at all stages of life.” Critics worry that active aging policies are merely cover for the on-going erosion of public and social services by neo-liberal governments since ill health in old age might presumably be blamed upon bad personal choices (Stenner, McFarquhar, and Bowling, 2010; Deeming, 2009).

[12]Although there is some recent good news that childhood obesity rates appear to be leveling off. See: CDC’s Vital Signs, August, 2013 at http://www.cdc.gov/VitalSigns/pdf/2013-08-vitalsigns.pdf .

[13]The Robert Wood Johnson Foundation in its Active Living Research program consistently included calls for such research in its funding cycles.



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PRINCIPLE 1: SMART LOCATION

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