

# Green Development

## Assessing Opportunities for the City of Atlanta

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### ABSTRACT

Given the current legislation and best practices of green development and using case studies from other municipalities, recommendations for encouraging and increasing the prevalence of green development in the City of Atlanta are made.



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## Introduction

Assuming continued economic and population growth, the demand for housing and development will continue to rise. At the same time, our cities and urban centers are facing a multitude of issues, such as concerns around air quality, water quality, stormwater management, emissions, threat of drought, and rising temperatures. With the current and future issues facing urban centers, it is important we reassess our development patterns and strategies so that we may accommodate growth and minimize the impacts on the natural environment.

Now and in the future, it will be increasingly more important to re-assess our current default building models and move towards more sustainable and green development models. Through best practices, case studies and other research, it will be evident green development makes economical sense, and provides a range of environmental and health benefits. This report will discuss the existing conditions of the green development industry, including the regulatory environment in Georgia and Atlanta, certification systems, and best practices for site development and the building itself. Case studies and example projects will be discussed and the benefits of and costs related to green development will be addressed. The report will conclude with suggestions for Atlanta, including policy, education, other methods and implementation.

## Current State of the Practice

Existing laws, regulations, and policy tools provide the framework from which development operates. Below is an overview of existing laws and regulations, as well as policy tools in Georgia and Atlanta.

### State of Georgia Laws and Regulations

#### Georgia Land Conservation Act

Passed in 2005, the Georgia Land Conservation Act “encourages joint partnerships between cities and counties on conservation and preservation initiatives, and provides land conservation funding options to financially incentivize individuals to either donate property to the State or voluntarily place conservation easements on their properties to ensure that Georgia’s natural resources are preserved for future generations” (Weissman 2013). The Act sets ten specific goals and objectives: water quality protection for rivers, streams and lakes; flood protection; wetlands protection; reduction of erosion through protection of steep slopes, areas with erodible soils, and stream banks; protection of riparian buffers and other areas that serve as natural habitat and corridors for native plant and animal species; protection of prime agricultural and forestry lands; protection of cultural sites, heritage corridors, and archeological and historic resources; scenic protection; provision of recreation in the form of boating, hiking, camping, fishing, hunting, running, jogging, biking, walking or similar outdoor activities; and connection of existing or planned areas contributing to the goals set out in this paragraph (Weissman 2013).

## **Georgia Erosion and Sedimentation Act of 1975**

Enacted in 1975, the Georgia Erosion and Sedimentation Act was designed to establish a statewide erosion and sediment control program. The law states “[i]t is found that soil erosion and sediment deposition onto lands and into waters within the watersheds of this state are occurring as a result of widespread failure to apply proper soil erosion and sedimentation control practices in land clearing, soil movement, and construction activities and that such erosion and sediment deposition result in pollution of state waters and damage to domestic, agricultural, recreational, fish and wildlife, and other resource uses. It is therefore declared to be the policy of this state and the intent of this chapter to strengthen and extend the present erosion and sediment control activities and programs of this state and to provide for the establishment and implementation of a state-wide comprehensive soil erosion and sediment control program to conserve and protect the land, water, air, and other resources of this state” (O.C.G.A. Title 12). Local governments must include requirements as strict as in the state statute, but may also impose stricter measures.

## **Energy Efficiency and Sustainable Construction Act of 2008**

Created in 2008 and effective in 2015, the Energy Efficiency and Sustainable Construction Act aimed to curb energy use and promote local products when applying for green certification (through programs such as LEED). Large facility developments must use at least 10% of materials harvested, manufactured or extracted in Georgia. Additionally, the law states "whenever green building standards are applied to the new construction, operation, repair, or renovation of any state building, the entity applying the standards shall use only those green building standards that give certification credits equally to Georgia forest products grown, manufactured, and certified under the Sustainable Forestry Initiative, the American Tree Farm System, the Forest Stewardship Council, or other similar certifying organization approved by such entity" (Energy Efficiency and Sustainable Construction Standards for Public Buildings 2016). This law also uses funding from the American Recovery and Reinvestment Act of 2009 to fund state facility retrofit projects, which is administered and implemented by Georgia Environmental Finance Authority (GEFA) (Energy Conservation Financing 2016).

## **“Takings” Law in Georgia**

The Georgia Supreme Court has its own test to determine if a zoning regulation has violated the Georgia Constitution and has resulted in a taking of one’s property or denying that person due process or equal protection under the law without just compensation (Weissman 2013). The Barrett test, as it is known, resulted from a 1975 case, Barrett v. Hamby. “If the zoning regulation results in relatively little gain or benefit to the public while inflicting serious injury or loss on the owner, the regulation is confiscated and void. Conversely, if the government’s interest in a regulation outweighed the private interests of the party, the regulation will be upheld” (Weissman 2013). To bring a case, the property owner must show he or she is suffering a significant detriment, and the Court has consistently upheld this cannot just be monetary loss from a potentially more profitable use.

Furthermore, the Barrett test also involves a two-tiered inquiry: a legitimacy review of the ordinance and an economic impact analysis on the owner of the property. Following Barrett v. Hamby, in Guhl v. Holcomb Bridge Road Corp., the Georgia Supreme Court established six factors to determine the constitutionality of a zoning action: (1) existing uses and zoning of nearby property; (2) the extent to which property values are diminished by the particular zoning restrictions; (3) the extent to which the destruction of property values of the plaintiffs promotes health, safety, morals or general welfare of the public; (4) the relative gain to the public, as compared to the hardship imposed upon the individual property owner; (5) the suitability of the subject property for the zone purposes, and (6) the length of time the property has been vacant as zoned, considered in the context of land development in the area in the vicinity of the property (Weissman 2013).

### **Low Income Housing Tax Credit**

A qualified allocation plan (QAP) is developed by each state's housing finance agency to evaluate Low Income Housing Tax Credit (LIHTC) affordable housing proposals. LIHTC is a federal program providing tax credits to help fund affordable housing developments. The QAP is a scoring system designed to evaluate and rank project proposals. Although it is a federal program, state housing finance agencies distribute the funds. In Georgia, the agency responsible for developing the QAP and evaluating proposals is the Georgia Department of Community Affairs.

Through QAPs, states determine the quality and design of affordable housing developments, which, according to Enterprise Community Partners, helps lay the foundation for building codes. The Enterprise report titled "Green Policies Build Green Homes" stated "[i]ncreasingly, today's building codes are yesterday's green building incentives." Through QAPs, states can influence not only the direction of affordable housing building and development, but also can illustrate that green building and sustainable practices are possible, attainable, and make economic sense.

### **Riparian Buffer Ordinances**

A riparian buffer is a "vegetated area near a body of water that helps protect the water body from potentially harmful surrounding land uses" (Weissman 2013). State law requires a minimum 25 foot riparian buffer and the City of Atlanta requires a 75 foot buffer and the Metropolitan North Georgia Water Planning District (Metro Water District) requires a 50 foot buffer along all water ways and a 25 foot impervious surface setback. Within the buffer, land-disturbing uses are not permitted, meaning development is not permitted. These areas must remain a natural and vegetated area. Riparian buffers are required under state law (Georgia Erosion and Sedimentation Act of 1975) and city law (City of Atlanta Riparian Buffer Ordinance).

### **Net metering**

The Georgia Cogeneration and Distributed Generation Act of 2001 allowed, but did not require, net metering from utilities. Net metering is the process whereby a customer can install an alternative energy system, such as a photovoltaic system, and can either sell all

kilowatts (kW) or remaining kW after usage back to the power company or can be credited on their next bill for excess power generated.

## **House Bill 57**

Passed in 2015 by the Georgia Legislature, House Bill 57 allows third-party organizations to finance, install, operate and/or lease solar systems to the benefit of consumers, schools and small businesses.

## **State of Georgia Tools**

### **Georgia Land Conservation Trust Fund and Revolving Loan Fund**

These funds were established by the Georgia Land Conservation Act of 2005 and serve to further the goals outlined in the Act. These funds are comprised of donations by public and private sources. Money from these funds may only be used to “defray the costs of acquiring conservation land for the conservation goals set forth by the Act” (Weissman 2013).

### **Conservation Easements**

Conservation easements are placed on land to protect and conserve the natural lands in perpetuity. Typically, when land is placed into a conservation easement, the owner of the land will receive tax incentives or tax credits. The easement is created when the landowner passes partial interest in the land to a government entity or nonprofit. The owner still owns and operates the land.

### **Deed Restrictions and Restrictive Covenants**

Deed restrictions are used to place limits on land use for current and future owners. According to the Land Stewardship Project, deed restrictions are easier to create than an easement, but harder to enforce.

Restrictive covenants can be used for conservation and apply to more than one landowner. They are used to preserve land for the future enjoyment and use by participating owners (Land Stewardship Project 2017). Restrictive covenants are popular amongst municipal governments, as they impose restrictions on the property without requiring a government to take partial interest or ownership in the land (Chris Faulkner, personal communication 2017).

### **Transfer Development Rights**

Transfer development right programs enable landowners to sell development rights to their properties without having to sell their land or develop it. Once sold, the land will most likely be placed in a conservation easement to prevent future development of the land. Transfer development rights may allow the buyers to add density to their projects, increase the floor area ratio, reduce setbacks or alter the minimum lot size (Weissman 2013).

## **City of Atlanta Laws and Regulations**

### **Sustainable Development Ordinance**

The Sustainable Development Ordinance was adopted in 2003 with the goal to “enact the City of Atlanta Sustainable Development Design Standards; to promote consistent application of sustainable green building practices; incorporate sustainable building design and construction practices into city financed projects; and for other purposes” (SDO 2003). The ordinance applies to City buildings over 5,000 square feet or with a total project cost over \$2 million. It calls for strategies to incorporate green building practices into all City facilities (constructed, owned or managed); strategies to incorporate green building practices into “ongoing and future program areas”; and plans to “incorporate life cycle and total cost accounting in the design, construction, operation and maintenance of all city-owned and finance buildings” (SDO 2003).

### **Tree Ordinance**

The City of Atlanta enacted the City of Atlanta Tree Ordinance in 1995, after two decades of development resulted in a loss of just over 20% of the urban tree canopy for the City. According to an American Forests study, the loss of the tree canopy during this time resulted in a 33% increase in stormwater runoff and an increase of \$1.8 billion in costs of infrastructure (American Forests 2012).

The Atlanta Tree Ordinance aims for no net loss of trees within the Atlanta city limits. The ordinance requires tree replacement or compensation to the Tree Trust Fund, if replacement is not feasible. The ordinance applies to all trees within city limits, on both public and private lands. Urban trees provide multiple benefits, such as helps stop runoff and retain stormwater; reduces noise pollution; improves sightlines; cleans air and provides more oxygen; shades buildings, cars and pedestrians; reduces energy needs; and provides wildlife habitat.

### **Post Development Stormwater Management Ordinance**

The Stormwater Ordinance was originally adopted in 2003 and amended in 2012 with the goal of “promoting green infrastructure and runoff reduction practices; complying with the Metropolitan North Georgia Water Planning District’s model post-development stormwater management ordinance; streamlining the permitting process; promoting maintenance of stormwater management facilities; and for other purposes” (Post Development Stormwater Ordinance 2012). The ordinance’s key provisions include a requirement to treat the first inch of stormwater runoff on site, applying to new homes and large additions of single-family residences.

### **Impact Fee Ordinance**

In 1990, the state legislature passed the Georgia Development Impact Fee Act allowing for the local creation of impact fees. Impact fees are fees based on the expected impact of the new development on public infrastructure and services. Under the act, public infrastructure and services includes water supply production, treatment and distribution facilities;

wastewater collection, treatment and disposal facilities; roads, streets, bridges and local sections of state or federal highways, as well as traffic lights, rights of way and landscaping; stormwater collection, retention, detention, treatment and disposal facilities; flood control facilities; bank and shore protection and enhancement improvements; parks, open space and recreation areas; public safety facilities, including police, fire, medical and rescue facilities; and libraries (Weissman 2013).

## **City of Atlanta Tools**

### **Overlay Zones**

An overlay zone is a regulatory tool utilized by local governments to create a special zoning district on top of the existing zoning codes. This overlay zone has different regulations than the existing zoning code and is usually established to protect a specific resource or guide development (Center for Land Use Education). Examples include a natural resource protection overlay, development guidance overlay, historical overlay, and parking overlay.

### **Certification Systems**

#### **Enterprise Green Community Criteria**

Developed in 2004 by Enterprise Community Partners, Enterprise Green Community Criteria (the Criteria) is a building and community certification system for affordable housing developments. The theory behind the system is that affordable housing isn't truly affordable if the construction costs are low, but at the expense of the operating budget or tenant utility bills. Similar to a QAP scoring system, the Enterprise Green Communities is a scoring system with mandatory standards, as well as optional standards for additional points. The standards are divided into the following sections: integrative design; location+neighborhood fabric; site improvements; water conservation; energy efficiency; materials; healthy living environment; and operations, maintenance+resident engagement. Many states have since incorporated the criteria as threshold or optional criteria in their QAPs.

#### **EarthCraft Certification**

Developed by Southface Energy Institute and the Greater Atlanta Home Builders Association in 1999, EarthCraft is a green building certification system with the goal to provide a "blueprint for healthy, comfortable homes that reduce utility bills and protect the environment" (EarthCraft Program).

EarthCraft homes focus on energy efficiency, utilizing energy and resource efficient design, and systems to reduce utility costs by an average of 30% (compared to a typical new home). The homes are designed specifically for the Southeast climate zone. Southface reports that "[o]n average, EarthCraft builders report an increase of 0.5 – 3% in construction cost. However, since EarthCraft homes can be more cost effective to own, this upfront cost can be quickly recovered" (EarthCraft Program). EarthCraft homes are built by certified EarthCraft builders, inspected by EarthCraft staff and undergo a final diagnostic testing to ensure and measure the home's energy efficiency.

## LEED

LEED, or Leadership in Energy and Environmental Design, is a certification system developed by U.S. Green Building Council (USGBC) in 1994. According to USGBC, “LEED [is] the most widely used green building rating system in the world with 1.85 million square feet of construction space certifying every day” (LEED 2017). According to their website, “LEED certification provides independent verification of a building or neighborhood’s green features, allowing for the design, construction, operations and maintenance of resource-efficient, high-performing, healthy, cost-effective buildings. LEED is the triple bottom line in action, benefiting people, planet and profit” (LEED 2017). USGBC also states “LEED-certified buildings will directly contribute \$29.8 billion to U.S. GDP by 2018” (LEED 2017).

The LEED certification system addresses nine aspects of green building: integrative process; location and transportation; sustainable sites; water efficiency; energy and atmosphere; materials and resources; indoor environmental quality; innovation; and regional priority.

## Living Building Challenge

The Living Building Challenge was developed in 2006 by the International Living Future Institute and is a building certification system. According to their website, the Living Building Challenge aims to “create buildings that are: [r]egenerative spaces that connect occupants to light, air, food, nature, and community, [s]elf-sufficient and remain within the resource limits of their site. Living Buildings produce more energy than they use and collect and treat all water on site, [c]reating a positive impact on the human and natural systems that interact with them, [p]laces that last. Living Buildings need to be designed to operate for a hundred year’s time” (Living Building Basics). The certification system is guided by the idea that “the ideal built environment should be as simple and efficient as a flower” (Living Building Basics). The certification includes mandatory imperatives and requires an evaluation one year post-occupancy to ensure the building is meeting the goals and systems set forth in development and construction.

## Green Development Best Practices

Green development strategies apply to both the site, as well as the structure. This section will detail initial considerations and best practices for both.

### Site Development

#### *Considerations*

The design of a development site is critical to the environmental sustainability of the development. Utilizing green development strategies and elements of biophilic design will help ensure the development is environmentally sustainable. In *Developing Sustainable Planned Communities*, authors Richard Franko, et. al. suggest that “[r]ather than looking for a good piece of land to build a sustainable project, developers should look for a sustainable piece of land.” They go on to say that some pieces provide more opportunity to minimize ecological impacts and maximize sustainable attributes than others; for example,

brownfields provide an excellent opportunity to regenerate the land and also provide a site for a sustainable development.

The authors also list attributes of land that “lend themselves to [a sustainable development] goal at the lowest cost and greatest positive effect.” This list includes previously developed or impacted lands; lands contiguous to existing regional infrastructure; internal natural lands of high ecological value, or “conservation development”; adjacent natural lands of high ecological or connective value; existing county or city conservation initiatives, incentives and programs; local government-promoted healthy city concepts; market demand and demographics favorable to green building; existing or planned transit networks; opportunity to provide on-site or adjacent jobs/housing balance; and local utility companies that support alternative power generation.

In *Biophilic Cities: Integrating Nature into Urban Design and Planning*, author Timothy Beatley describes biophilic urban design elements for a building as green rooftops, sky gardens and green atria, rooftop garden, green walls and daylit interior spaces. He also states that courtyards and gardens provide lights and opportunities for outdoor activity, as well as give patrons access to nature.

## **Best Practices**

### Low Impact Development

Low Impact Development (LID) is a type of development that minimizes environmental impacts of development and utilizes natural methods of stormwater and rain management.

Affordable housing development company, Enterprise Community Partners, developed a set of green building standards called Enterprise Green Communities Criteria (the Criteria) that detail criteria developments must meet in order to achieve certification. According to these criteria, low impact development should include the following qualities: ability to retain, infiltrate or harvest the first inch of rain on site; roadways that adhere to the topographic contours and ridgelines to minimize erosion; minimal roads and parking; and retention of existing vegetation.

In *Stormwater Design for Sustainable Development*, author Ronald Rossmiller utilizes the Environmental Protection Agency’s (EPA) definition, stating LID is a “development approach (or retrofit or redevelopment) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness, and creating functional, appealing site drainage that treats stormwater as a resource rather than a waste product. Using LID, water is managed to reduce built-area impacts and promote natural water movement within an ecosystem or watershed.”

Rossmiller goes on to elaborate, stating: “LID incorporates five ideas: keep rainfall as close as possible to where it falls; infiltrate as much rain as possible; bite off rain in small chunks so BMPs on lots and developments are small and numerous; after development, keep the site as close as possible to its natural hydrologic condition, use BMPs to keep pollutants on a site as much as possible. The following five concepts can be used to implement LID’s ideas as we develop, retrofit, or redevelop land for various uses to achieve sustainability and

the TBL: maximize a development's attractiveness; minimize peak runoff rates and volumes leaving a site; maximize reduction of pollutants leaving a site; minimize construction operation and maintenance costs; use BMPs as an opportunity to educate local citizens of their environmental benefits."

Developed by the National Oceanic and Atmospheric Administration (NOAA), the Georgia Coastal Management Program of the Department of Natural Resources and the Coastal Georgia Regional Development Center, the *Green Growth Guidelines* (GGG) set forth guidelines and best practices for low impact development and stormwater management. According to the GGG, "[l]ow impact development strives to achieve a natural hydrological system that can maintain and even reduce pre-development runoff rates. Secondary goals include: water quality improvement, recharge of local groundwater aquifer, stream protection, wetland preservation, wildlife habitat creation, reduced urban "heat island" effects, improved air quality, and enhanced community aesthetical appearance."

### Integrative Design

Integrative design is the process of design and development of a building whereby all participants in the process are brought in from the beginning so as to ensure an efficient process with maximum beneficial results for the building and its systems. According to Francis Ching, author of *Green Building Illustrated*, "[i]ntegrated design has made an invaluable contribution to green building design, most significantly by promoting the early evaluation of energy tradeoffs", meaning that by utilizing integrative design, all actors are able to work together to ensure maximum energy efficiency. Similarly, author Sandra Melner of *HOK Guidebook to Sustainable Design* states that "[i]ntegrated design leads to the discovering of design synergies that multiply benefits." Enterprise Green Communities Criteria, Leadership in Energy and Environmental Design (LEED), and the Living Building Challenge (LBC) require integrative design to achieve certification.

Through integrative design, a development can successfully plan and incorporate the necessary requirements for green development strategies at the beginning of the process, so adjustments do not have to be made later on. Adjustments generally lead to an increase in cost and inefficiencies, saving the development team, and the city, time and money.

### Site Design

After understanding the importance of site design on a project, it is necessary to understand the best practices in terms of methods and techniques. According to the government of California's website on Green Building Basics, it is important to "[p]rotect and retain existing landscaping and natural features. Select plants that have low water and pesticide needs, and generate minimum plant trimmings. Use compost and mulches. This will save water and time." Retaining these natural features will allow for less work and money invest, as well as allow the site to maximize the existing features for stormwater management. According to Richard Franko, et. al., a site should be designed to leverage the natural power of the sun, wind and water. To do this "the development team should not lose sight of the big goals: conserving energy and water resources and reducing carbon dioxide emissions; reducing the use of products that negatively impact human health and ecosystems; creating renewable energy on or off site to support community needs, including individual buildings; improving regional ecosystem health, including watershed performance, habitat health and

connectivity, and water quality; creating environments that delight all the senses: sight, smell, touch, taste and sound; and developing an authentic connection to natural systems.”

Additionally, it is important to design the site, not only utilizing and maximizing the natural features, but also building off the local climate and the plants and varieties that thrive best and with the lowest maintenance. Designing a site with not only the environment and building in mind, but the people who will inhabit the site is important. According to Ca.Gov and Enterprise Green Communities Criteria, selecting a site near transit opportunities and providing an environment that promotes transit, walkability and bicycling is a key element of green site design.

#### Sustainable Construction Materials

Green building practices include utilizing sustainable products and green building materials. According to Richard Franko, et. al. and other industry professionals, a development team should consider the following when choosing the most appropriate products and materials to use in building: select materials with low emissions during and after installation; materials with low volatile organic compound (VOC) levels; reduce the amount of materials and finishes used; use recycled and recyclable materials; use local or regional materials; take into account the amount of energy used to produce the materials; evaluate the impact on habitat when extracting or harvesting the material; and consider the lifecycle impacts of the products and materials. The opportunity to select sustainable and healthy products should be incorporated into the beginning of the design process, as would be expected when using an integrative design process.

#### Recycling and Recyclable Materials

The authors of *LAND*, Balmori and Benoit, recommend using recycled materials wherever possible, and when not available, using local materials. Developers benefit through reduced costs, reduced transit and potential revenue from recycling materials. The authors also state that using local suppliers generates goodwill and good publicity in the community, which can also aid in the permitting process.

Franko, et. al. illuminates some examples of how recycled materials can be used: recycled rubber tires are used to create soft surfaces for playgrounds; recycled glass can be mixed in with concrete; and “[c]rushed concrete can be useful as an aggregate in the construction of roads and sidewalks, resulting in a reduction of embedded – that is, the total energy (and greenhouse gases) required to dig, crush and transport the material.”

In addition to using recycled products in redevelopment projects, every attempt should be made to recycle reusable materials and products. In Atlanta, the Lifecycle Building Center is an example of an organization that takes used materials and products and prepares them for reuse. Similarly, new construction projects should make every attempt to use recycled materials.

#### Soil and Erosion Control

Considering every phase of development is important to minimizing the environmental impacts of development. According to Diane Balmori and Gaboury Benoit in *Land and Natural Development (LAND) Code*, soil erosion is considered the major contributor to nonpoint source pollution, with urban land use causing more pollution than agricultural

uses. Working to minimize runoff and nonpoint source pollution helps maintain water quality and minimize impacts on wastewater treatment plants. Also according to the authors, more erosion occurs during the construction phase than the rest of the development process, so it is important to focus attention to this phase. As stated by the authors, erosion can be reduced by limiting the clearing of vegetation; staying away from steep, long slopes; and phasing construction to work around local weather patterns. To manage erosion, typical practices include straw bale barriers, silt fencing, and settling basins. However, according to the authors, there is little evidence that these practices are effective or are utilized properly. The authors also recommend developers only clear or grade areas that will be the building footprint and a small construction area surrounding that footprint.

Enterprise Green Communities Criteria also suggests common erosion control methods including: retain topsoil to better management erosion and save it for reuse; use silt fencing to manage runoff; protect sewer drains and water bodies with silt fencing, straw bales or other methods; and use swales to retain and infiltrate runoff.

## Building

### Considerations

#### Water Management

Water management is a key component and consideration of green development. Best practices for water management include: water conservation, stormwater management, green infrastructure, permeable pavement, green roofs and walls, rainwater harvesting and reuse, and rain gardens. Like other suggestions mentioned earlier, it is important to understand the site and flow of water in order to properly manage and maximize the natural features.

In *Land and Natural Development (LAND) Code*, authors Diane Balmori and Gaboury Benoit recommend understanding the flow of water into, through and off the site and to prepare a drainage plan. They state the goal is to make the system functions as closely as possible to predevelopment conditions. They also suggested crafting the drainage plan to accommodate flow from a 24-hour storm with a five-year recurrence interval. Through these recommendations, developers will see benefits such as aesthetically appealing surface water features and open space; cheaper water drainage systems; lower and less frequent maintenance costs; flood reduction; and a cooler environment in the summer, due to evapotranspiration.

Additionally, according to Franko, et. al., “[I]ike other components of a sustainable community, water is best dealt with in an integrated, holistic manner that involves both reducing the use of potable water and lessening the impact of stormwater on natural systems.”

#### Heat Adaptation

The urban heat island effect, as described by the authors in *LAND*, is “the name given to the higher air temperatures normally found in urban areas. The main cause is enhanced absorption of solar radiation by dark materials routinely used in buildings and pavement. Trees reflect more light back into the sky, directly shade the ground, and consume heat

energy in the process of converting liquid to water vapor (transpiration). Using light-colored paving and roofing materials is another strategy, besides retaining and planting trees, to minimize the heat island effect.” Other best practices include: passive house design, green roofs, better energy efficiency, net zero or net positive design and renewable or alternative energy sources.

According to the EPA, The term "heat island" describes built up areas that are hotter than nearby rural areas. “The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4 °F (1–3 °C) warmer than its surroundings. In the evening, the difference can be as high as 22 °F (12 °C). Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality.”

Brian Stone writes in his book, *The City and the Coming Climate*, that through the “greater prevalence of mineral-based building materials, such as stone, slate, concrete, and asphalt, cities absorb and retain substantially more heat than rural areas characterized by more vegetative cover.”

To minimize the heat island effect, the authors of LAND recommend keeping mature trees on site; maintaining and planting vegetation; planting trees on the south side of buildings to shade them in the summer; utilizing trees, bioswales and rain gardens in parking lots; and leaving an open pathway for the summer’s prevailing wind direction to provide natural cooling. In addition to combating heat, trees also muffle noise, sequester carbon, provide habitat, produce oxygen, stabilize soils, improve views and increase property values.

Additionally, Enterprise Green Communities Criteria assert that reducing the heat-island effect decreases energy consumption by decreasing loads on cooling systems. It also enhances resilience by reducing overheating of buildings in the event of power outages when air conditioning cannot operate.

## **Best Practices and Techniques**

### **From the Inside**

#### *Energy*

##### Net Zero and Net Positive

Net zero and net positive development is a type of development that either does not use more energy than it produces (net zero) or produces more energy than it uses (net positive).

This can be accomplished by incorporating renewable or alternative sources of energy and through passive house design. Franko, et. al uses an example of a development in San Francisco that is “planning to use PV panels and strict conservation measures to generate sufficient power during the day (contributing to the grid) to offset peak utilization periods at night (drawing from the grid), resulting in a zero-net off-site consumption on an annualized basis.” PV panels are photovoltaic solar panels utilizing solar power to produce energy. Additionally, according the Passive House Institute, a passive building is the best path to net

zero and net positive buildings because it minimizes the need for a large amount of energy and thus the load that renewables are required to provide.

### Solar

The authors of *LAND* recommend integrating renewable energy sources because it can lower utility bills and produce long term cost savings. According to the authors, “photovoltaic panels convert sunlight into electricity, which “can be used immediately as direct current (DC), stored in batteries, or converted to alternating current (AC), with the option of selling power back on the grid.” Franko, et. al. states that the “most practical application is integrating a modest amount of solar cells into the roof construction and selling power back into the grid to reduce overall energy use and cost.” Enterprise Green Communities Criteria recommends a minimum of 30% of aggregated unobstructed roof area that is oriented within +/- 45 degrees of true south.

### Geothermal

Franko, et. al. describes geothermal technology and states it “takes advantage of the earth’s mass to offset dynamic temperature fluctuations above ground. This is done by installing a grid or series of vertical tubes into the earth to a depth greater than five feet and pumping a highly stable fluid such as water underground, where it is maintained at about 55 degrees Fahrenheit. The fluid is then pumped back up and used to either heat or cool rooms.”

### *Water Conservation*

#### Efficient products and fixtures

The use of efficient plumbing products and fixtures is key to water conservation in residential developments, or any development. According to California’s website on Green Building Basics, buildings utilize one-sixth of the world’s freshwater withdrawals.

Enterprise Green Communities Criteria sets forth recommendations for the use of WaterSense-labeled toilets, showerheads and faucets. WaterSense is a program through the EPA that encourages water conservation through water efficient products. Products that are deemed high efficiency or meet a certain threshold of water conservation are labeled with the WaterSense label.

Using water efficient products and fixtures not only reduces a development’s water bill, but can also reduce the energy bill.

### **From the Outside**

#### Passive House Design

Designing and siting a development to capitalize on natural types of heating and cooling is known as passive house design. Passive house design minimizes heating and cooling requirements by maximizing the energy of the sun and the shade from structures and vegetation. According to the government of California’s website on Green Building Basics “[p]assive design strategies can dramatically affect building energy performance. These measures include building shape and orientation, passive solar design, and the use of natural lighting.” Additionally, according to Richard Franko, et. al., “[p]assive solar techniques, which reduce heat gain in the summer and capture heat in the winter, can reduce energy costs with little investment.”

According to the Passive House Institute, the building envelope of a passive house is “extremely airtight, preventing infiltration of outside air and loss of conditioned air.” Additionally, a passive house “employs high-performance windows (typically triple-paned) and doors; [i]t uses some form of balanced heat- and moisture-recovery ventilation and uses a minimal space conditioning system; and [s]olar gain is managed to exploit the sun's energy for heating purposes and to minimize it in cooling seasons.”

According to Energy.gov, a passive solar home should have an unobstructed view of the sun, so that the home can collect solar energy throughout the day to store heat, known as thermal mass. Also according to Energy.gov, a successful passive solar home includes: windows oriented towards the sun; materials to retain thermal mass such as concrete, brick, stone and tile; distribution mechanisms such as conduction, convection and radiation (see below for explanation) to disperse the heat throughout the home; and control strategies such as roof overhangs, shades or shutters, and awnings to provide shade in the hotter months.

The website goes on to explain distribution mechanisms stating, “[c]onduction occurs when heat moves between two objects that are in direct contact with each other, such as when a sun-heated floor warms your bare feet. Convection is heat transfer through a fluid such as air or water, and passive solar homes often use convection to move air from warmer areas – a sunspace, for example – into the rest of the house. Radiation is what you feel when you stand next to a wood stove or a sunny window and feel its warmth on your skin. Darker colors absorb more heat than lighter colors, and are a better choice for thermal mass in passive solar homes.”

Enterprise Green Communities Criteria also sets forth standards for passive house design including elongating the building on an east-west axis and providing shading, such as overhangs or awnings, for south facing windows. The Criteria also recommend placing interior spaces that require the most lighting, heating and cooling along the southern part of the building; utilizing an open floor plan to capitalize on natural light and ventilation; incorporating materials with thermal mass; planting trees for shading on the south side of the building; and installing windows at the leeward and windward sides of the building for cross ventilation.

### Green Infrastructure

The term ‘green infrastructure’ is an all-encompassing term and can have different definitions. For the purposes of this report, green infrastructure is defined as a water management system utilizing natural systems and natural features to manage stormwater and runoff.

Green infrastructure is a system made of many components, much like today’s gray infrastructure (pipes and drains). According to authors Franko, et. al., “[a] healthy green infrastructure [system] consists of both ‘hubs’ and ‘links.’ Hubs anchor green infrastructure networks, providing origins and designations for wildlife and ecological processes. Links are the connections tying the system together.” The authors go on to explain the system stating, the “green infrastructure concept differs from a traditional city park and recreation system in

three ways: it emphasizes ecology not just recreation; it becomes part of a larger regional system; and it provides a framework to guide growth and urban form at the community and neighborhood levels.”

In *Stormwater Design for Sustainable Development*, Ronald Rossmiller explains the various typologies that make up a green infrastructure system: “buffer strips and zones, catch-basin inserts, cisterns, adding or eliminating curbs and gutters, detention basin, dry wells, filter strips, gardens, green roofs, infiltration basins and trenches, lawns, level spreaders, permeable pavers, porous asphalt and concrete pavements, rain barrels, rain gardens, retention basins, soil amendments, trees, tree boxes, underground basins, and vegetated bioswales.”

The *Green Growth Guidelines* expand on the role green infrastructure has in water quality. “Vegetation plays an important role in improving water quality. While soil microorganisms and soil-based chemical reactions remove a variety of nutrients, pathogens, and heavy metals, vegetation assists this process in a number of ways: slows runoff flow, filters large particulates, provides considerable amounts of surface area on which pollutant-removing microorganisms thrive, uses water for direct metabolic or storage purposes, decomposes into an organic soil layer active in neutralizing heavy metals, releases oxygen into the soil, improving water quality, and provides shade for the water surface, reducing water temperature.”

In addition to its environmental benefits, green infrastructure helps reduce runoff, resulting in costs savings for stormwater management; filters pollutants thereby reducing stress on wastewater treatment plants; reduces air temperatures and thus helps reduce energy costs; reduces noise pollution; improves sightlines; cleans air and provides more oxygen; shades buildings, cars and pedestrians; and provides wildlife habitat.

#### Permeable pavement

Pervious surfaces, such as roads and sidewalks, not only increase the heat island effect, but also increase runoff and reduce infiltration.

According to the EPA, “[r]oofs and pavements comprise over 60% of urban surfaces in some U.S. cities. On a sunny summer afternoon, these typically dark, dry surfaces get warm in the sun and in turn heat the air. The air in nearby rural areas tends to be cooler, because the rural surfaces are more reflective (absorbing less sunlight) and wetter (dissipating some solar heat gain by evaporating water).”

According to Balmori and Benoit, impervious surfaces pose a major threat to aquatic ecosystems. Runoff from roofs and roads have higher level of contaminants and flow with greater force, than if it were to pass through soils naturally. When water is able to pass through soils, the water goes through a natural filtration process. It also flows into streams gradually, regulating flow during dry periods and avoiding high water levels and flooding during wet periods. However, when runoff occurs, water does not go through the natural filtration process and is not available for plants, rather it flows rapidly into streams, picking up containments as it flows back to the rivers and streams. This rapid return causes swelling, the combination of which results in erosion and the destruction of aquatic habitat.

The authors continue by asserting that studies have shown that once the percentage of impervious surfaces nears 10%, environmental damage increases significantly. As a note, areas with quarter acre lots tend to have approximately 30% impervious surfaces and built up commercial areas tend to have 80% or more. To combat these impervious surfaces, the authors recommend disconnecting impervious surfaces from storm drains, substituting impervious paving materials for pervious ones, using green roofs and draining parking areas to rain gardens. Of course, reducing the size of parking lots and roads is also an effective method to reduce runoff.

Enterprise Green Communities Criteria recommends a development utilize roadways and sidewalks to reduce stormwater runoff and provide infiltration for stormwater. Developments can do this by designing roadways and sidewalks utilizing permeable or porous pavement. They recommend using “light-colored, high-albedo materials and/or an open-grid pavement, with a minimum solar reflectance of 0.3, over at least 50% of the site’s hardscaped area.” The Criteria goes on to say that utilizing methods that both reduce the heat island effect and provide infiltration for stormwater is preferable.

According to Richard Franko, et. al, “[p]ervious systems are typically concrete-paver blocks or other materials that allow stormwater to seep through small gaps or holes, percolate into subbase material, and infiltrate the underlying soils. In addition to porous pavement, other techniques can be used in the design of parking lots to provide some level of recharge. Planter islands or peripheral recharge drains can be employed without investing in a porous parking surface.” The authors go on to say “[p]ipes provide little, if any, treatment benefits for water quality. They also tend to increase flow rates and lead to concentrated discharge points into drainages or waterways that can cause downstream erosion and the introduction of concentrated pollutants.” By utilizing permeable pavement and other techniques, such as bioswales on the sides of roadways and sidewalks, developments can utilize natural processes to minimize runoff, the impact on the sewer system and flooding.

Permeable and porous pavement are similar, but distinctly different. Permeable pavement is what Franko, et. al. described above, whereas porous pavement “are paved surfaces of porous asphalt or Portland cement with a stone reservoir below them that stores runoff before infiltrating runoff into the subsoil” (Rossmiller). He also states “[p]ermeable pavement is different from porous pavement since rainwater passes around paver’s edges (such as cobbles, bricks or other manmade pavers) rather than passing through them.” This pavement looks very similar to normal pavement. Ronald Rossmiller describes porous pavement in his book, *Stormwater Design for Sustainable Development*, saying porous pavement consists of three layers: surface course, filter course and reservoir course. The surface course is porous asphalt concrete that is about 2 to 4 inches thick and has similar properties to normal asphalt. The filter course is about 1 to 2 inches thick and is made of crushed-stone aggregate. It provides some infiltration, along with adding stability for the surface course. The reservoir course is 2 to 3 inches of stone. This layer stores the runoff before infiltration.

### Green roofs and walls

Green roofs and walls are another method of green infrastructure that have become increasingly popular and increasingly viewed as an amenity, rather than just part of a

stormwater management system. In addition to providing an amenity to residents, green roofs reduce runoff, help lower temperatures in the summer and provide insulation in the winter, resulting in lower utility costs (Balmori and Benoit).

There are two types of green roofs, with some green roofs being a hybrid of the two. Intensive green roofs have thicker soil and can grow deeper rooted plants, while extensive green roofs have a thinner layer of soil and support more basic plant types, such as grass (Randolph). Intensive roofs tend to look more like a traditional garden, with plants being maintained individually, whereas an extensive roof requires little maintenance and tends to be just a green roof, rather than a rooftop garden like an intensive green roof might be (Dunnett) (Beatley). Green roofs are comprised of "several layers to provide structural support, moisture sealing, insulation, water drainage and storage, growing medium and the vegetation itself" (Randolph).

According to Randolph, while "green roofs have some energy insulating value, their primary benefit is their ability to absorb, detain and evapotranspire stormwater." The *Green Growth Guidelines* state "[v]egetation transforms heat and soil moisture into humidity through evapotranspiration, actually cooling the air immediately above the roof and resulting in a more pleasant microclimate in the roof area that translates into savings in reduced air conditioning use and lower energy costs." While it is helpful for cooling in summer months, the *Green Growth Guidelines* also state that a "green roof has some impact as insulation in winter, but this is dependent on moisture content of the soil. Dry soil or moderately wet soil adds about 25 percent effectiveness to insulation while wet soil can reduce heat loss by 50 percent."

Dunnett states that green roofs slow down runoff during storms, allow for more retention, higher water quality of runoff, improve air pollution conditions and reduce heat and noise. According to the *Green Growth Guidelines*, "[a]n average of 75 percent of water is retained on an extensive green roof, both in the plants and the soil layer." Additionally, the "25% of the precipitation that becomes runoff does so some hours after peak flow as excess water percolates through the soil and into the drainage system."

Dunnett also asserts that if "an appropriate method of construction is used, green roofs will last longer than conventional ones, with obvious cost benefits." The *Green Growth Guidelines* confirm this stating a "green roof can have double the lifespan of a conventional roof, due to protection of roofing materials from extreme temperature fluctuations, ultraviolet radiation, and other stresses and damage. Forty years is a reasonable lifespan." Dunnett further elaborates and confirms stating "[r]oofing materials are degraded over time by a variety of natural processes: by ultraviolet light and the constant expansion and contraction caused by extremes of temperature and freeze-thaw action. Disintegration of materials, cracking, delamination, and splitting are the end result." Therefore, the existence of green roofs lowers temperatures and manages fluctuations and thus lengthens the life of the roof.

As another added benefit, Beatley states "[e]xperience has shown that over time substantial biodiversity can take hold on green rooftops, and in some cities ecological roofs can even help in reestablishing populations of endangered and threatened species."

Living walls are not too different in terms of benefits, but the location is on the sides of buildings, rather than the roof. Green walls, also known as facade greening, utilize plants to be grown vertically; incorporate climbing plants or vines; or support vertical farming practices, such as hydroponic systems (Dunnett). According to Dunnett, green walls are long established in Europe, with vines being used for summer cooling to reduce indoor and surrounding temperatures. He goes on to elaborate with data points: “[d]aily temperature fluctuation being reduced by as much as 50%” and “[i]t has been calculated that a 5.5 (deg.C) (10 deg. F) reduction in the temperature immediately outside of a building can reduce the amount of energy needed for air conditioning by 50-70%.” However, he also asserts that effectiveness is related to total area, not thickness of the vegetation. “Buildings are most effectively insulated against high summer temperatures by shading rather than by building insulation into the structure, for the simple reason that shading stops the heat from entering in the first place - climbers are one of the most effective ways of achieving this” (Dunnett). The benefits to green walls are similar as those of green roofs. Green walls provide aesthetic appeal, reduction in pollution, management of stormwater, reduction in heat, reduction in energy costs and improved insulation (Dunnett).

#### Rainwater Harvesting and Reuse

Rainwater harvesting can be utilized to conserve water and reduce runoff. According to Franko, et. al., “[r]ainwater can be used for landscape irrigation, water features, cooling tower make-up water, and toilets. It provides a relatively clean source of water, and can be collected and reused with relatively little treatment or filtration.” *In Sustainable Infrastructure: The Guide to Green Engineering and Design*, author Bry Sarte lists the benefits of rainwater harvesting: supports municipal water supplies; reduces infrastructure costs; reduces energy and greenhouse gas emissions; increases water security; provides savings to residents; improves flood control; increases surface water quality; reduces sewer overflow; and community benefits.

Rainwater harvesting is also included in the Enterprise Green Communities Criteria, where it is recommended that rainwater be captured from impervious surfaces and carried by gutters and downspouts until it can be stored through rain barrels or cisterns and used for non-potable water uses, such as irrigation and toilet flushing.

According to the government of California’s website on Green Building Basics, it is important to design a development from the beginning to utilize rainwater, through a dual plumbing design. Through this design, the development can also incorporate ultra low-flush toilets, low-flow showerheads, and other water conserving fixtures. According to the authors of *LAND*, developers can save money on utility bills; enjoy aesthetically pleasing water features; and reduce consumption of potable water.

#### Rain Gardens and Bioswales

Rain gardens are a type of green infrastructure utilized for managing stormwater, with the added benefit of being an amenity for a residential development. According to Rossmiller, “[r]ain gardens are attractive and functional landscaped areas designed to capture and filter stormwater from roofs, driveways, sidewalks, patios, parking lots and roadways. They collect water in bowl-shaped, vegetated areas and allow it to slowly soak into the soil. This reduces erosion potential and reduces pollutant amounts from surrounding areas.” Rossmiller goes

to state that rain gardens are best situated near the source to slow runoff and allow for infiltration. In terms of typology, Rossmiller states “(1) they can be planted in a low point with shrubs, grasses and plants (2) they can take the form of a dry river bed with pebbles, rocks and plants (3) if they are located on a slope, a depression is created by excavation and the material is used to form a berm around the lower end.”

The benefits for rain gardens are similar to that of green infrastructure overall, with some additions. According to Rossmiller, they filter runoff to improve water quality; recharge local groundwater; remove standing water, which are breeding grounds for mosquitos; reduce flooding; and enhance aesthetics.

Similar to rain gardens, bioswales offer an opportunity to reduce and store runoff and stormwater. While rain gardens are more aesthetically pleasing, bioswales are more functional and are commonly situated or placed near sidewalks and along roadways. According to Rossmiller, “[b]ioswales are landscaped elements designed to remove sediment and pollutants from surface runoff. They have a swaled drainage course with gently sloped sides and are filled with vegetation, compost or/riprap.” Bioswales are part of a larger organization of green infrastructure and can be utilized in a variety of sites and areas that then lead into rain gardens and other basins. Rossmiller states “[t]hey duplicate a natural forest’s hydrology by collecting water in freeform vegetated areas and allows it to infiltrate. They reduce erosion potential and pollutants flowing into storm drains and creeks by taking advantage of runoff in their design and plant selection. They are designed to withstand moisture extremes and use nutrients, e.g. nitrogen and phosphorous, found in runoff.” He also states that “[r]ain gardens give the most bang for the buck.”

Richard Franko, et. al state “[b]ioswales offer a flexible approach to treating and managing stormwater runoff for a relatively low cost. They are shallow, fairly wide channels that remove pollutants through vegetative filtration, soil absorption, and plant assimilation. The ability to remove stormwater pollutants is dependent on the length of time that water remains in contact with herbaceous vegetation and the soil surface within the swale. Bioswales are best suited for sites with minor elevation changes; they do not perform well in steep topography or dense soil environments.”

## Case Studies and Examples

Given industry best practices and after discussions with industry professionals, ten case studies were chosen to illustrate examples of programs around the United States. These case studies serve to elucidate options available to the City of Atlanta to promote and increase the prevalence of green development strategies.

### Chicago Green Permit Benefit Tier Program

The Green Permit Program in Chicago allows for expedited review and possible reduction in permit fees for projects that meet the program requirements. According to the City of Chicago’s website, to qualify, commercial projects must earn certification within the LEED rating system; smaller residential projects must earn certification under the Chicago Green

Homes Program checklist based rating system or LEED for Homes; or projects must utilize certain green strategies or green technologies such as green roofs, rainwater harvesting, solar panels, solar thermal panels, wind turbine and/or geothermal systems.

### **City of Cleveland Heights, OH : Sustainable Zoning**

In May 2012, Cleveland Heights, OH adopted the Sustainable Zoning Code Amendment in an effort to make development regulations more sustainable. This code is not a rewrite of existing zoning code, but is supplemental. The code aims to decrease water consumption, reduce impervious surface, increase tree and vegetation coverage, increase bio-diversity, encourage local food production, reduce landfill dumping, and encourage energy efficient and clean modes of transportation. The Sustainable Zoning Code amendment resulted after an analysis of the existing code and recommendations for specific zoning adjustments including improved lot coverage control, allowing for renewable energy, urban farming, community gardens, adaptive reuse, live/work dwellings, semi-pervious materials for driveways and parking, bike parking, natural vegetation for lawns, limited watering, pesticide restrictions, encouragement of LEED projects, water reuse systems, complete streets, solar orientation, green infrastructure and cluster development. It was also recommended to switch to performance-based standards, such as “a requirement that the post-development runoff rate cannot exceed 50% of the pre-development runoff rate if the site was previously developed, and no greater than the pre-development runoff rate if the site has never been developed (for lots greater than 10,000 square feet in area); require all new construction to capture the first inch of rainwater on-site; and allow community-based on-site water management” (City of Cleveland Heights, OH 2016).

### **Philadelphia: Green Roof Tax Credit**

The City of Philadelphia offers a tax credit for buildings with green roofs by providing the business or individual a rebate for 50% of the costs of the green roof, up to \$100,000 (Green Roof Tax Credit 2016). Instituted in 2007, the original tax credit was for 25% of the cost and was then doubled to 50% in 2015. The City of Philadelphia Water Department asserts “green roofs have been proven to absorb and permanently retain up to 50 percent of the rainfall they receive and ultimately extend the lifetime of the roof by 100-200 percent” (Tax Credit 2015).

### **NYC: Green Roof Tax Abatement**

New York City offers a one-year tax abatement of \$4.50 per square foot of green roof, up to \$100,000 or the buildings tax liability (whichever is less). This abatement applies to green roofs constructed after August 2008 and the green roof must utilize at least 50% of the existing roof space. Additionally, the green roof must have a vegetation layer (with at least 80% covered by live plants), a weatherproof & waterproof roofing membrane, a root barrier layer, an insulation layer, a drainage layer designed so the drains can be inspected and cleaned, and a growth medium including natural or simulated soil at least two inches in depth, as well as a maintenance plan that includes semi-annual inspection, plans for plant replacement, monthly inspections of drains, free from debris, and maintenance of green roof for a minimum of 4 years after the tax abatement is granted (Green Roof Tax Abatement).

## Portland Floor Area Ratio (FAR) Bonus

Enacted in 2009, the City of Portland offers a floor area ratio bonus for projects in the Central Business District that include an ecoroof, or green roof, in their project. Through this incentive, developers or builders can increase the footprint of the development or add a floor to the building, when zoning codes otherwise wouldn't allow it, if they include an ecoroof. This bonus applies to larger scale development projects such as industrial, commercial, and multi-family residential housing (e.g. condominiums, apartments). The amount of bonus received depends on the percentage of ecoroof coverage in relation to the building footprint. The breakdown is as follows: 10-30% ecoroof coverage earns one square foot of additional floor area per square foot of ecoroof; 30-60% ecoroof coverage earns two square feet additional floor area per square foot of ecoroof; and 60% or greater ecoroof coverage earns three square feet of additional floor area per square foot of ecoroof (Ecoroof Floor Area Ratio Bonus Option).

## Seattle's Green Factor

In 2007, the City of Seattle enacted a new program called Seattle Green Factor aiming to increase the amount and quality of landscaping around the city. According to the City of Seattle, the Seattle Green Factor is a menu of landscaping strategies that is required for all new development in neighborhood business districts with more than four dwelling units, more than 4,000 square feet of commercial uses, or more than 20 new parking spaces. This ordinance requires a percentage of a parcel to be vegetated, either 30% or 50% depending on zoning classification. If a project is required to meet the Seattle Green Factor, then the developer chooses from a menu of options and the project is then scored. The minimum score required depends upon zoning. The City of Seattle argues well-designed landscaping will improve the look and feel of a neighborhood, reduce stormwater runoff, cool cities during heat waves, provide habitat for birds and beneficial insects, support adjacent businesses and decrease crime (Seattle Green Factor).

## Seattle Living Building Ordinance (Demonstration Ordinance)

The Living Building Pilot Program (LBPP) was established to allow for the development of the Bullitt Center in Seattle, the first Living Building project in Seattle. According to the City of Seattle, the Living Building Pilot Program “allows you to request additional departures from the Seattle Land Use Code through Design Review, and provides height and floor area incentives for buildings attempting to meet the Living Building Challenge” (Living Building Pilot).

The pilot program also included a technical advisory panel, called the LBPP Technical Advisory Group (TAG). According to the City of Seattle, the group met for over a year and recommended changes to “maintain the rigor of the program while incentivizing Living Buildings. Incentives include a 15 percent increase in floor area ratio and a height increase up to 10 feet in zones with height limits of 85 feet or less, and 20 feet in zones with height limits greater than 85 feet. With the new legislation, these incentives are now granted outright for developers participating in the LBPP. This provides more certainty for project teams, in lieu of the previous program that allowed similar departure requests through the

design review process. Projects must still be reviewed under the Design Review Program and cannot be located in a shoreline district” (Living Building Pilot).

### **Emory WaterHub**

Completed in 2015, the Emory WaterHub is an on-site water recycling system utilizing hydroponic treatment and reciprocating wetland systems. Combined, the systems are capable of recycling up to 400,000 gallons per day, which equates to close to 40% of the campus water needs. The recycled water is used for Emory’s chill plants and for some toilet flushing. Emory estimates that the WaterHub system will reduce Emory’s water draw from DeKalb County by up to 146 million gallons of water every year (WaterHub at Emory University 2017).

Emory University partnered with Sustainable Water to construct and fund the project. The project was funded by Sustainable Water and the recycled water is sold back to Emory at a discounted price. A supportive partnership between DeKalb County Planning and Emory helped to facilitate this first-of-its-kind project.

### **City of Keene Zoning Ordinance**

The City of Keene, New Hampshire established a zoning overlay ordinance, called the Sustainable Energy Efficient Development (SEED) overlay, to promote green building, increase density, preserve architectural style, encourage economic development, expand the city’s tax base, increase property values, discourage sprawl, and encourage historical adaptive reuse. According to a local paper, the new overlay was supported by the local development community.

### **Form Based Codes in Beaufort, SC**

A form-based code is a zoning classification used to regulate the physical form of the built environment, rather than the actual land use, as in conventional zoning. The five elements of a form-based code are a regulating plan, which is a plan or map detailing building standards for each area; public standards, which details the design standards for the street; building standards, which seeks to define the allowable physical form of the buildings; administration, or the project review process; and definitions, a section to describe the technical terms used in the plans. Form-based codes typically divide a municipality into zoning districts; have a regulatory focus on building form, over density and use; encourage mixed uses and mixed housing types; focus on the design of the building, the design of the streetscape, as well as how the two interact; and also includes a public participation process. Form-based codes utilize a tool called a transect to illustrate the vision for the municipality and its various districts. The transect illustrates and details regulations by zone and area, from rural to urban core (Form Based Codes Defined).

Beaufort, SC recently enacted form-based codes in their Comprehensive and Civic Master Plan to encourage infill development and redevelopment, promote the historic district and make the project review process simpler and easier. According to Beaufort, SC, form-based codes provided many benefits, including, easy to find information on what is allowed or not allowed; concise and easy to read zoning regulations; ease of mixing uses without requiring

additional zoning procedures and processes; and a faster and cheaper process due to the clarity and succinct nature of form-based codes. To summarize, elements of a form-based code include, streetscape type; frontage; building placement and parking location; height; roof type; architectural detailing and style; use and parking (The Beaufort Code A Form-Based Code Guide).

## The Case for Green Development

Green development strategies provide a multitude of economic, environmental, and health benefits. While there is a small cost premium associated with green development strategies, the cost savings make it the economical choice.

### Costs of Green Development

According to a study done by Southface Energy Institute, premiums for LEED construction total approximately 1% of total development cost and, on average, 0.5 – 3% for EarthCraft homes. According to USGBC, LEED premiums average about 4%. Enterprise Community Partners states that for new construction, “[t]he overall median cost to meet the 2008 Enterprise Green Communities Criteria was \$3,546 per unit, which equates to a 2 percent increase in total development cost for a project. To integrate only the energy and water saving efficiency criteria, the median cost was \$1,139 per unit. Projected lifetime utility cost savings for implementing just the water and energy criterion is \$3,140 per unit, based on a 20-year life cycle” (Enterprise Incremental Savings Study).

The development premium can be easily recouped with utility savings, rent premiums and lower vacancy rates, which are associated with LEED construction buildings. According to USGBC, green retrofit projects enjoy a payback period of, on average, seven years. The WaterHub at Emory was built using third party financing and had a payback period of six years. According to parties familiar with the project, had the project been financed by Emory, the payback period would have been shorter. USGBC also states “[b]etween 2015 and 2018, LEED-certified buildings in the United States are estimated to have \$1.2 billion in energy savings, \$149.5 million in water savings, \$715.2 million in maintenance savings and \$54.2 million in waste savings.” When asked about the cost of green development, most professionals cited the cost of materials and the cost of labor, particularly training, as what drives costs. According to industry professionals, the cost of green development has greatly decreased over the past several years. In addition, professionals stated that utilizing an integrative design process greatly controls costs and unexpected expenditures that typically drive up costs on developments.

In addition to building construction, green infrastructure can provide profound cost savings for municipalities. According to a 2001 study by American Forest on the Urban Tree Canopy of Atlanta, due to the decline of the urban tree canopy between 1974 and 1996 (prior to passage of the Atlanta Tree Ordinance), there was a 33% increase in stormwater runoff (33% = 591 million cubic feet of water) and an increase in the cost of infrastructure to support the increase totaling \$1.8 billion (\$1.8 billion = \$2/cubic foot of water) (American Forests 2012).

## Benefits of Green Development

Green development has many benefits and co-benefits to residents, the community, the natural environment, developers, business owners and municipalities. It has been established that with minimal additional upfront costs, green development strategies and projects can provide benefits such as water conservation, energy conservation, stormwater management, in addition to other benefits to our health and the natural environment. All these benefits come with reduced utility bills and short payback periods that make economic sense.

With much of our lives being spent indoors, it is important we understand the impact of buildings and the built environment. On average, Americans spend about 90% or more of their time indoors. Indoor levels of pollutants may be two to five times higher, and occasionally more than 100 times higher, than outdoor levels. (According to the EPA, the average is approximately 10x greater).

Additionally, in *Removing Market Barriers to Green Development: Principles and Action Projects to Promote Widespread Adoption of Green Development Practices*, author Christopher Choi offers some interesting statistics in terms of buildings and energy usage, as well as buildings and human usage. While the data is dated, the information is still relevant. Paralleling USGBC, Choi states: buildings accounted for 39.4% of total U.S. energy consumption in 2002; residential buildings accounted for 54.6% of that total, while commercial buildings accounted for the other 45.4%. Buildings accounted for 67.9% of total U.S. electricity consumption in 2002; 51.2% of that total was attributed to residential building use, while 48.8% was attributed to commercial building usage. Buildings in the U.S. contribute 38.1% of the nation's total CO<sub>2</sub> emissions, including 20.6% from the residential sector and 17.5% from the commercial sector. Building-related construction and demolition debris totals approximately 136 million tons per year, accounting for nearly 60% of total nonindustrial waste generation in the U.S. Additionally, building occupants use 12.2% of the total water consumed in the U.S. per day, of which 25.6% is used by commercial building occupants and 74.4% by homeowners (Choi). This information tells us that there is much to be gained by moving towards green development strategies, especially in the residential sector.

USGBC has been able to collect and analyze much of the data on green buildings due to the LEED certification system. According to USGBC, buildings in the United States account for 41% of national CO<sub>2</sub> emissions and 14% of potable water, however LEED-certified buildings produce 34% less CO<sub>2</sub>, consume 25% less energy and 11% less water. They also state that 80 million tons of waste has been diverted from landfills due to LEED strategies (USGBC, Benefits).

Between conventional development and green development, there are many clear benefits to green development. Below benefits are summarized into environmental, economic, and health benefits.

## Environmental

The environmental benefits of green development compared to conventional development are extensive, including better water quality, increased energy conservation, a focus on land conservation, better air quality, reduced emissions, and less waste produced.

Many of the tools discussed in Best Practices have great environmental benefits that would not be present in a conventional style development. A reduction in impervious surfaces replaced by green infrastructure, such as green roofs, rain gardens and bioswales, offers such environmental benefits as reduced runoff, reduced soil erosion, greater infiltration, greater groundwater recharge, better stream health characterized by a reduction in runoff pollutants, reduced urban heat island effect through vegetation, reduced energy consumption, less waste, and increased carbon sequestration through vegetation. In addition to green infrastructure, utilizing alternative energy sources, such as solar panels, can reduce energy consumption. Additionally, the use of efficiency products, such as WaterSense, can reduce water and energy consumption. If these practices were utilized, the impacts of these benefits would be broad, far-reaching and highly impactful.

## Economic

While there is a cost premium associated with green development on the front-end, costs can be easily recouped. Utilizing green development strategies can provide significant water savings, lower energy costs, reduce cost of construction materials and lower construction waste costs. In addition to utility savings, green development practices can increase land values, command higher rents, provide amenities, and have also shown to be associated with lower vacancy rates.

Water savings, in terms of lower utility bills, are the result of more efficient products, such as WaterSense; less water needed for landscaping by using native plants; and rainwater harvesting, allowing for harvest rainwater to irrigate the landscape and potentially flush toilets. A decentralized wastewater treatment plant, such as the WaterHub at Emory University, can allow for huge water savings as discussed earlier.

The use of green infrastructure, such as green roofs or white roofs, trees, green walls and permeable pavement can reduce energy costs. Green infrastructure not only reduces water consumption, but also reduces temperatures. Green roofs help reduce building temperatures inside and green infrastructure surrounding the building helps reduce ambient temperatures. By reducing temperatures on, in and around a building, the building will enjoy lower cooling costs. In addition, these same tools that reduce temperatures in the summer, also help insulate the building in the winter, reducing heating costs. Moreover, these same strategies also serve as amenities to residents, allowing a building to command higher rents. Lastly, the use of these strategies not only saves money through utility bills, but can also be cheaper to install than conventional systems. If installed properly, green roofs have been shown to last longer than conventional roofs.

Other green development strategies such as passive house design and the use of alternative energy sources also help save on energy costs. Passive house design allows for

strategic house placement, interior design and a tighter building envelope to use solar energy as its natural heating source and for day lighting, while utilizing other strategies, such as awnings, for cooling measures. This reduces the need for heating and cooling systems, as well as lights, and thus reduces energy costs. Using alternative energy sources, such as solar panels, can allow for production of energy that can be sold back to the grid, greater reducing energy costs.

Green development strategies also call for the use of recycled materials and to recycle materials after their use, particularly when engaging in a redevelopment project. Utilizing recycled materials can save on construction costs. At the same time recycling or reusing products and materials can save money or generate money in resale of the materials or products. Additionally, using local or regional materials and products reduces the cost associated with transit.

With an average seven year payback period and lower maintenance and utility costs, coupled with the higher rents and lower vacancy rates green developments command, green developments make clear economic sense (Green Building Benefits 2007) (Benefits of Green Building 2017).

## Health Impacts

In addition to the many benefits discussed above, there are also health impacts associated with green development strategies over conventional development. The use of sustainable materials and green infrastructure have many health impacts. Green development strategies call for using healthier, less hazardous materials, such as products with low VOCs. This contributes to better air quality and a healthier indoor environment. Green infrastructure helps mitigate the urban heat island effect and thus negative health impacts associated with heat and sun exposure. In addition, green infrastructure allows for recreational space, wildlife habitat, and more exposure to natural elements, espousing the values of biophilia.

## Proposals and Suggestions

### Introduction

As detailed above, green development makes economical sense and provides many benefits to the natural environment and human health. Utilizing case studies from other municipalities, suggestions will be proposed for the City of Atlanta to further green development strategies. The suggestions are categorized by policy suggestions, education strategies, other methods, suggested implementation, and next steps. The following suggestions have been cultivated based on research, including print and online sources, as well as personal communications and consultations with industry professionals.

It is important to recognize and underscore the economic benefits of green development, as well as the environmental and health benefits. As discussed above, while there is a slight increase in upfront costs, the payback period can be relatively short, and management and

tenants will save on utility costs. Due to these savings to the tenants, higher base rents can be charged. In addition to monetary savings, the current market shows increasing interest in sustainable living and green development, thus allowing for the ability to attract more tenants and command higher rents. On the other hand, the utility and cost savings associated with green development support not only higher rents, but also are critical elements to effective affordable housing. An organization called Global Green has been analyzing the continued inclusion of green practices in QAPs and they have “long recognized that the LIHTC program and QAPs are critical drivers in the national adoption of green building criteria in affordable housing design and construction.”

## **Policy**

The following section begins with suggested strategies, focusing on policy changes that would be categorized as mandatory, and continues to discuss more permissive strategies.

### **Mandatory Laws**

#### *Zoning*

Two options for the City of Atlanta to pursue pertain to the zoning code – an amendment or zoning rewrite. The City of Atlanta is currently reviewing the existing zoning code for updating. One option would be to adopt a Sustainable Zoning Code Amendment, like Cleveland Heights, OH. This would allow for an existing zoning code or a conventional zoning code to remain, with a green development amendment. However, instituting a green development code as the base zoning code is clearly preferable. A green development amendment or code would allow for better integration and broader use of green development strategies than other suggestions discussed below, as it would apply to all construction.

#### *Ordinances*

Other options include a zoning overlay, special purpose district or ordinance, demonstration ordinance and PACE style financing. A zoning overlay district can be used in an area, such as the BeltLine district (0.5 miles on either side of the BeltLine) to ensure that all new development and/or renovations utilize green development strategies. This would have the effect of incorporating green development, but also illustrating that green development is feasible, and even profitable, prior to an entire zoning code re-write. A zoning overlay can also be applied to a specific area in need of additional protection or attention. For instance, if there is an area of the City that is prone to flooding more than other areas, a zoning overlay can be utilized to require additional green infrastructure or site protection to reduce runoff, flooding or the effects of both.

#### *Permitting Process*

In addition to reworking the zoning code, reviewing the existing permitting process is another way to facilitate green development. This can take the form of reduced permit fees or expedited review like the Chicago’s Green Permit Benefit Tier Program, or a mandatory strategy for plan review that reflects the idea of integrative design utilized in certification

systems such as Enterprise Green Community Partners and the Living Building Challenge. Integrative design requires all aspects of a development team, from architect to contractor, to work together from the beginning, ensuring the best results and fewer issues down the road. This encourages collaboration, mutual learning benefits, and a better end product. Cherokee County in Georgia utilizes a similar model, where a project is required to meet with all departments that might need to review the proposed project along its permit review process to identify future problems and mitigate issues from the beginning.

### *Qualified Allocation Plan*

Georgia's Qualified Allocation Plan (QAP) is a progressive plan in relation to other states in terms of green development strategies. According to Laurel Hart of the Department of Community Affairs (DCA), Georgia's QAP began to incorporate more green development strategies in 2006-2008 due to two factors: economic stimulus funds incentivizing green development and the economic downturn, which put the impetus on the developers to create developments that were more affordable, not only in rent, but also in utility bills. Hart stated the rising cost of water as one of the main reasons they discovered tenants were not able to pay their rents. Sustainable Fellwood in Savannah was the first type development in GA to receive LIHTC credits. One of the developers, Gregg Bayard of Parallel Housing, worked closely with DCA and the project served as a demonstration project. Since 2008, green development strategies have been an integral part of Georgia's QAP and continue to be. As stated earlier, the organization Global Green states the inclusion of green practices in QAPs have "long recognized that the LIHTC program and QAPs are critical drivers in the national adoption of green building criteria in affordable housing design and construction."

### *Impact Fees*

Two other options are imposing higher impact fees and/or special assessment fees associated with the increased impact the developments will have on not only conventional infrastructure, such as roads, but also on waterways, sewer systems, stormwater runoff, air quality and temperature increase. Impact fees are fees assessed to a developer for a proposed development and the relative impact that development will have on the accompanying infrastructure. Increasing the scope and amount of impact fees could have a large impact on guiding behavior, while also providing additional revenue for the City.

### *Green Factor Program*

In 2007, the City of Seattle enacted a new program called Seattle Green Factor, as discussed earlier. This program requires a certain percentage of qualifying parcels to be vegetated depending on the zoning classification. The City of Seattle argues well-designed landscaping will improve the look and feel of a neighborhood, reduce stormwater runoff, cool cities during heat waves, provide habitat for birds and beneficial insects, support adjacent businesses and decrease crime. This requirement is integrated into the permitting process and is required for all projects seeking a development permit. This is arguably the most comprehensive green infrastructure program and could help alleviate some of the stormwater issues the City of Atlanta currently faces. This could be used in conjunction with the Post Development Stormwater Ordinance, which has already been instituted in the City of Atlanta. A stormwater utility fee would also help provide additional resources, such as

additional stormwater projects like Historic Fourth Ward Park. However, a stormwater utility fee was originally instituted in Atlanta in 1998 and was then overturned. It would be of great benefit to the City and its inhabitants. The Commissioner of the Department of Watershed Management is on record requesting and advocating for one, but the political will need to be there for it to be realized.

## **Incentives or Permissive Strategies**

Permissive strategies, rather than mandatory, provide for a way to incentivize green development and illustrate its strengths, and weaknesses, prior to instituting a mandatory program. Such strategies include a green permit program, reduction in permit fees, expedited review, tax abatements, retrofit programs, demonstration ordinances, and different funding opportunities. Incentives could include density bonuses and floor area ratio (FAR) bonuses.

A green permit program, like Chicago's Green Permit Benefit Tier Program, offers the potential for a reduction in permit fees and/or expedited review if the project meets the requirements for the program. Additionally, New York City offers a tax abatement program and Philadelphia offers a tax credit for installing a green roof. Developers are primed to welcome these opportunities, as the market increasingly seeks more eco-friendly options. Providing developers with an opportunity to make green roofs and other similar strategies economically attractive can increase the amount of developments incorporating this strategy.

Lastly, offering incentives to both offset mandatory policies and promote new or prioritized strategies has traditionally been used. Incentives are also used to promote green development, such as Portland's FAR bonus, which allows for a FAR bonus if the project utilizes a green roof. Another example is Seattle's Demonstration ordinance, where Living Building projects qualify for height and FAR bonuses.

Demonstration ordinances can also be an effective strategy to illustrate the potential of green development strategies. In Seattle, as discussed earlier, a demonstration ordinance was utilized to facilitate the development of the first Living Building Challenge in Seattle, the Bullitt Center. This ordinance allowed for the unconventional style of development that the Living Building Challenge requires, such as rainwater capture, composting toilets and water reuse. This demonstration ordinance was created in partnership with the City of Seattle and the Living Building project team. Once the building was constructed and the strategies accepted by the City, the demonstration ordinance continued and was expanded for more projects. Therefore, demonstration ordinances are a great way to allow progressive green development strategies, while also instituting the framework that will be required in the future for other developments.

PACE, or Property Assessed Clean Energy Financing, is a policy which allows for building owners (typically, commercial and residential) to utilize third party financing to pay for the upfront costs associated with solar installations. The upfront costs are then paid back through the property's tax bill. This allows more owners to utilize solar energy, without having to pay for the capital costs. Invest Atlanta has been working on implementing PACE financing

in Atlanta for solar installations, but it has not yet been successful. In talking with Susan Rutherford of the Department of Watershed Management, one option to increase green infrastructure would be to apply a similar model to the financing of green infrastructure strategies, but perhaps to provide low interest loans and allow for pay back through the sewer bill. This can also be applied to green construction or retrofit strategies, with the payback either through the property bill, water bill or power bill (Personal Communication, Susan Rutherford).

Another option may be to pursue alternative financing options, sometimes referred to as alt-financing, either through a foundation or individual benefactor. Utilizing alternative financing structures outside the traditional can allow for more ingenuity and unique strategies.

## Education

Policies can incentivize or mandate certain strategies, but the key to success is education of the public, consumers, developers, contractors, property managers, politicians and business leaders on what green development is and its benefits. For developers to want to find ways to achieve greener development, consumers must demand it. To build and maintain it, developers need qualified contractors and subcontractors, as well as property managers and tenants. The right products and manufacturing processes are also necessary to ensure its ease and success. To ensure this, it must become more commonplace and there must be higher demand to make manufacturers prioritize their production over conventional. Educating the public, government officials, developers, contractors, subcontractors and property managers is an important strategy to making green development more prevalent. This can be accomplished through a multitude of ways through a variety of entities. Many groups, such as Southface Energy Institute, provide trainings for contractors, architects, planning professionals and developers the like. Other entities such as the Atlanta Regional Commission (ARC) and North Georgia Water Planning District (Metro Water District) provide trainings through the Community Planning Academy targeted towards planning professionals and those that work in stormwater and watershed management.

The certification systems also provide and require educational components, as well as advocacy. Advocacy can come in many forms, such as forums, signage detailing the project and its components, and working with government personnel to facilitate better understanding of green development strategies, such as composting toilets. Education can also come in the form of continuing education classes, signage, tours, accessibility to green development projects, partnerships with trade organizations and awards or recognition. What is paramount is to increase education to all target groups from different organizations and groups, so the discussion and information will become more prevalent across all groups and organizations.

It is also very important to frame the argument in terms of what will be most successful in the current market. For Atlanta and for Georgia, this means framing it in terms of economic benefits to the state, city, and businesses; and as an amenity to residents.

## Other Methods

A combination of policies and education strategies, coupled with demonstration projects can help facilitate the prevalence of green building strategies. Demonstration projects such as the Bullitt Center (Living Building) in Seattle, the Eco-Commons (Living Building) at Georgia Tech, and the WaterHub decentralized wastewater treatment facility at Emory serve as excellent demonstration projects. These projects set the stage for new and effective policy, and facilitate education and advocacy for green development strategies. In fact, it is interesting to note that the two projects developed in Georgia were both on college campuses. Both serve as excellent laboratories for innovation in student learning and development strategies. Projects on college campuses tend to have more autonomy than traditional development projects, can provide excellent demonstration projects, and help pave the way for future developments outside of campus.

Beyond demonstration projects, a municipal or state task force or commission could serve to conduct the initial exploratory options, as one currently exists for the implementation of green infrastructure within the City of Atlanta. Similarly, the City and County of San Francisco has a Municipal Green Building Task Force, which according to the website “provides communication among city departments on green building issues and policy development, supports the integration of green building practices into city departments, and plays a key role in implementing Chapter 7 of the Environmental Code. The task force consists of a representative from each of the city departments list below and one member of the public” (Municipal Green Building Task Force 2012).

## Conclusion

After conducting research for the purpose of this paper it appears the best method to promote the prevalence of green development strategies is to establish green development as a city priority, facilitate demonstration projects, institute a program similar to Seattle’s Green Factor, rework the City of Atlanta’s permitting process (to require an integrative process), rewrite the City of Atlanta zoning code to promote such strategies, and investigate and pursue partnerships to conduct education and advocacy work. It is also important to reframe green development through the lens of the economic benefits.

Green development is the next logical step, as it makes economical sense and provides environmental and health benefits. With the current and future issues facing urban centers, it is important we reassess our development patterns and strategies so that we may accommodate growth and minimize the impacts on the natural environment. Utilizing green development strategies will help change the course of development towards the future and future needs of this region.



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