ECO-CITY ALEXANDRIA
environment | economy | community

EAP Policy Brief: Urban Greening

Allen Grace

VirginiaTech
Invent the Future®

CITY OF ALEXANDRIA VIRGINIA

TABLE OF CONTENTS

1 Introduction –Background and Overview

Urban Greening is a broad term in a recent sustainability field that has roots linking back to the creation of individual parks and the National Park system in the United States straddling the turn of the 20th century. There are a plethora of different definitions for urban greening and differing ideologies give it different attributes. For the intents and purposes of translating urban greening into the context of Alexandria in the 21st century, the most fundamental concept underlying urban greening is that it provides for the integration of the natural – green – environment with the traditional – gray – built environment. The amalgamating of these two environments gives impetus to more sustainable outcomes in the production and continual habitation of today's built environment.

This integration of the natural and built environment is usually connected to environmental and sustainability initiatives, and can loosely include the production, preservation and development of parks, public green spaces, gardens, natural habitats, greenways and other infrastructural components of both the built and natural world.[i] As Alexandria has industrial legacy districts, urban greening for Alexandria turns into a special meaning in the context of applying diverse treatments and interventions for reclaiming abandoned or transitioning properties.[ii]

As proposed for the translation of this brief, the Metropolitan Institute (MI) has classified urban greening research into six general categories:

- Parks, trails, and open space,
- Community gardening and greening (e.g. street landscaping, tree plantings, complete streets),
- Greening of under-used, abandoned or vacant land or lots as neighborhood stabilization strategies,
- Temporary pop-up interventions,
- Business / productive harvesting, such as urban agriculture and forests, at commercial scale and
- Green infrastructure with focuses on green building initiatives, and storm-water management.

The topics brought up in this brief are cross-cutting advanced systems and mentalities that are designed to realize goals and objectives stated in multiple chapters of Alexandria's Environmental Action Plan (EAP).

Several model complete and living street programs will be addressed in order to help grow Alexandria's open space inventory, provide places for community gardening and greening, and integrating green infrastructure with grey infrastructure that mitigates flooding events and helps provide additional storm-water management. The second set of programs looks to solicit trail networking ideas in order to provide Alexandrians an interconnected park, trail and open space network, community gardening and greening opportunities, while using natural infrastructure to green under-utilized land. A final section will look at living buildings, and how they have the potential to update and deepen Alexandria's existing urban fabric. A comparison chart showcasing regional approaches towards urban forestry will be utilized as part of the appendix to provide Alexandria with regional urban forest best management practices (BMPs). Test sites to be used as case studies for these ideas are finally discussed with formal recommendations.

Components of urban greening constitute the basis of Alexandria's Urban Forestry Master Plan (UFMP), the Open Space Master Plan (OSMP), and Chapter Two: Green Buildings and Chapter Seven: Land Use and Open Space in the EAP. Urban Greening can be seen as democratizing the built environment to include equal rights of way and more natural processes. Urban Greening redevelops and tries to re-foster the understanding of human's connectedness and interconnectedness with nature, as its goals are to transform cities from impervious, lifeless and inanimate piles of built concrete to pervious, fresh, resilient and naturally living micro-ecosystems.

Urban greening comprises many progressive and necessary goals and objectives within the EAP and the various master plans, and is directly relevant to City resident concerns. Urban greening is an integral part in mitigating storm-water runoff in normal and extreme weather events helping to prevent flooding, of which Alexandria is prone to by being surrounded by water on three sides. Urban greening also plays a part in seeking to remediate local and regional traffic congestion and all vehicular emissions associated with elevated levels of single occupancy vehicular (SOV) travel. It serves to preserve, protect and link urban open space resources in order to realize an interconnected system of trails and parks. Finally, urban greening is important to Alexandria residents because it starts to address city needs and requirements in achieving a net-zero community over the course of long-term planning actions.

The EAP and the Eco-City Charter lay the groundwork for urban greening that is outlined in the UFMP and the OSMP. The Eco-City Charter, the founding document in the City's quest for achieving greater levels of environmental stewardship, includes urban greening in multiple principles:

- Land Use and Open Space – Creates greater opportunities for sustainable compact development and redevelopment that requires the use of green building practices and prioritizes provision of usable open space and recreational areas.
- Land Use and Open Space – Ensures development protects and enhances natural resource capacity.
- Land Use and Open Space – Protects, enhances, and increases Alexandria's open space and green infrastructure including wildlife habitat, parks, trails, tree canopy, and watersheds.
- Water Resources – Use environmentally responsible flood management, storm water control, and wastewater treatment to protect the public's health and property.
- Transportation - Reduce the environmental footprint of travel by introducing, designing and encouraging sustainable methods of transport and infrastructure.
- Energy – Produce energy locally and sustainably, through installation and promotion of the use of renewable and efficient energy technologies.
- Building Green – Adopt and maintain initiatives that require best in practice measures to reduce overall environmental impact of renovation, redevelopment, and new development.
- Building Green – Integrate green building and sustainability standards into all private and public development, including historic preservation, renovation, and new construction.[iii]

The links EAP, the OSMP and the UFMP have with urban greening will be made clear in the introduction of comparable practices or BMPs.

The city has taken many measures in facilitating the integration and completion of urban greening strategies within the various master plans, and the EAP. A lot of the short-term action items have been

completed. A draft complete streets ordinance was proposed several years ago, and the city was able to acquire its goal of 100 open space acres within the city. Another stand-out goal that was accomplished was the closure of the GenOn Power Station just south of the Daingerfield Island Park. Other accomplishments include a completed canopy study of Alexandria with GIS software, an expected LEED Gold certificate of the new construction of Eisenhower Fire Station 210, and the achievement of more than 19% of the City government's electricity use was offset or generated by renewable energy in 2014.[iv] Although the city has completed many of its goals, the expansive list of goals laid out in the original EAP iteration and the various MPs have not been accomplished in their entirety.

The City of course would love to accomplish and complete all the goals, but the EAP drafted in 2008 was progressive and ambitious. Certain goals that have not been met, and are significantly behind in progress towards reaching completion are primarily attaining forty per-cent tree canopy crown coverage over the City, and all new buildings being carbon neutral by 2030.

This policy brief, concerning urban greening – through the three facets of open space, urban forestry, and trail networking – is set up to offer insight to Alexandria's Environmental Policy Commission (EPC) detailing cutting edge technology and ideologies that have since come into being after the draft of the previous EAP. If successful, this brief will discuss and give overviews of several BMPs that other jurisdictions have legislated or have provided guidelines for, which Alexandria could chose to borrow from. The goals here are thus to inform EPC members about BMPs in the field of urban greening in order to provide recommendations for changes to include within the second iteration of the EAP.

2 Comparable Practices

2.1 Introduction

Alexandria is a trendsetter on the regional stage. Enlisting progressive goals and pertinent recommendations, the EAP through the UFMP and OSMP is envisioning a greener and brighter future for all Alexandrians (see Table 1). The LEED program that began humbly in 1994 has grown to encapsulate more and more systems and requirements. Alexandria has the ability to innovate and integrate this process among other processes with new cutting edge trends and concepts. The following concepts are being brought forth to test the boundaries of Alexandria's commitment to truly green and sustainable living standards.

The first and most important set of ideologies that is already discussed in most major relevant City documents are complete streets. These are good inroads, yet more can be done. A review with what other municipalities are doing will be discussed, looking at Los Angeles' Living Streets initiative and programs in Buffalo, New York, and Philadelphia, Pennsylvania.

Secondly, in looking at the OSMP, this review will look at BMPs for trail linking in connection with the creation of an open space network that is interconnected. Alexandria's 'Green Crescent' provides a location and an impetus to realize a starting point in connecting trails and open space throughout the city. Pointedly, this review will look at urban design through the Philosopher's Walk in the city of Kyoto, Japan and the trail linkage strategies and goals within the Colorado Springs Master Plan

Table 1: Goals and Recommendations Suggested by EAP, UFMP and OSMP

Document	Goal	Action Range	Goal/Recommendation
EAP, Ch. 7	1		Continue to coordinate land use and site design decisions among City departments to ensure compatibility with existing City plans that promote walking, cycling, and taking public transportation
EAP, Ch. 7	1	Short-Term	Ensure that land use decisions incorporate smart growth principles that provide incentives and disincentives to reduce vehicle use and vehicle ownership.
EAP, Ch.7	1	Mid-Term	Promote more pedestrian and bike transportation features (e.g., underground parking, street front retail, and parking access behind buildings) in the land use planning for Alexandria's major thoroughfares, including Van Dorn, Duke, and Beauregard Streets, Eisenhower Avenue, and Route 1 Planning efforts.
EAP, Ch. 7	1	Mid-Term	Create benchmarks to measure achievement as to both qualitative and quantitative metrics, in the following areas: Creation of and enhancement of walkable streets, sidewalks, and non-SOV bicycle and pedestrian amenities and connections.
EAP, Ch. 7	3	Mid-Term	Work with community partners to add 500 street trees a year throughout the city to achieve full street tree stocking levels by 2020.
EAP Ch. 7	3	Mid-Term	Develop an appropriate standard, planting program, and areas for street trees, as with an underground trench; and replace existing street trees as needed to ensure their long-term viability throughout the city.
UFMP	24	Long-Term / Moderate Priority	Build on the Alexandria Open Space Plan's recommendation to seek innovative ways of creating more open space by developing and implementing pilot projects such as Green Streets (see Appendix F [of the UFMP]), which are aimed at redesigning streets to reduce impervious surface, thus freeing up land for tree planting and helping to meet other environmental goals, such as reducing the impact of storm water runoff.
UFMP	20	Mid-Term / High Priority	Explore opportunities to protect existing trees by using alternative paving materials and methods to correct conflicts between tree roots and sidewalks, such as rubber sidewalks, stone dust, permeable paving, and alternative pavement profiles
UFMP	51	Short-Term / High Priority	Encourage collaborative efforts with local schools of landscape architecture to study opportunities to improve streetscape, public open space, park, school, and facility designs.
OSMP	11		Enhance streetscapes and gateways.
OSMP	12		Expand citywide street tree program and protect existing trees and woodland areas.

Lastly, living, restorative, and regenerative buildings will be discussed. As technologies advance, it is becoming easier and easier to achieve the different standards of LEED certifications. The Living Building Challenge (LBC) issues three types of new designations that are much more stringent than the LEED designations and includes: the Living Building Certification, Petal Recognition, and the Net Zero Energy Building Certification.[v] Several organizations will be discussed and analyzed for the convenience of Alexandria, in order for the City to understand and integrate these building ideals into the EAP and Master Plans.

2.2 Complete and Living Streets

2.2.1 Introduction

Domestically, the complete streets movement began in the early 2000s with the launch of the National Complete Streets Coalition with the purpose to integrate "People and place in the planning, design, construction, operation, and maintenance of our transportation networks."[vi] This has been buttressed by the growing national trend in promoting, defending, and implementing complete streets as "By 2012, 130 communities adopted Complete Streets Policies, bringing the total close to 500 communities dedicated towards protecting pedestrians, bicyclists and motorists across 48 streets,"[vii] shows that the movement is anchored into city planning and is becoming more popular as more people break free from automobile dependent suburbia in favor of living in new chic compact urban environments.

Complete streets as previously mentioned are encapsulated within many of the City's planning documents and a memorandum dating from March, 2009 provides an update on the City's "Complete Street" Program, as Complete Streets were integrated within the Transportation MP in 2008. References to City plans, and a sample ordinance, drafted by Yon Lambert the Principle Transportation Planner can be viewed here. A revised draft ordinance, and 2010 iteration of the complete streets integration can likewise be found here.

This part of the brief will showcase three examples of complete and living streets found throughout the country. Of utmost importance is the dichotomy of the two variants of streets. With much research, there is no definable legal or public explanation into the differences between the subsets of living and complete streets. Research done for this project has individually concluded that there is a subtle difference. Complete streets are streets that are democratically used – all modes of transit have equal access to public infrastructure whether it is by automobile, bus, bicycle, pedestrian or any other form of transit. Complete streets also include design elements not limited to but include street art, public areas, and trees.

The distinct factor that distinguishes a complete street from a living street is the additional associated infrastructure. Living streets include all of the facets completes streets subscribe to in addition to utilizing additional infrastructure such as bioswales, rain gardens, runnels, apropos tree species, and other storm water mitigation techniques while also incorporating permeable pavers and different universal design standards that amalgamate the natural world with the built environment. Three case studies will be presented here. The first comes from Los Angeles with some of the only published material on Living Streets. The next two studies will showcase complete streets programs in Buffalo, New York and Philadelphia, Pennsylvania.

2.2.2 Living Streets LA

The Model Design Manual for Living Streets, Los Angeles County was a culminating piece to a

> "2-day writing charrette, which brought together national experts in living streets concepts [while being] funded by the Department of Health and Human Services through the Los Angeles County Department of Public Health and the UCLA Luskin Center for Innovation. [The Living Streets] manual focuses on all users and all modes, seeking to achieve balanced street design that accommodates cars while ensuring that pedestrians, cyclists and transit users can travel safely and comfortably."[viii]

This manual is-able-to be adopted, amended, abridged, added to or changed in any way by any municipality that so chooses to incorporate it within local regulations free of charge. The only request made is that proper reference be made, and to catalogue jurisdictional usage by emailing the publishers. Neither the manual nor the associated websites list localities that have actually adopted this model guide in part or in whole. Los Angeles has been implementing parts of the guide, and a better overview of what they have done can be found in the Living Streets LA Case Study resource in the appendix of this brief.

The manual was created in 2011, and has a plethora of knowledge describing all aspects of what a living street should look like. From the onset the vision, goals, policies and new set of benchmarks and performance measures within the guide strictly adhere to the triple bottom line of economy, equity, and environment. This close to 400-page manual offers classifications and design standards for just about every aspect of street life. Separate chapters encapsulate design in different facets including street networks, intersection design, bikeway design, designing land use along living streets, and universal pedestrian access design guidelines.

In relation to the UFMP, and specifically recommendation number 24, this guide dedicates a full chapter to the Streetscape Ecosystem including street-water management, urban forestry, street furniture and utilities, as "…Street trees and landscaping are essential parts of the urban forest, as they contribute positively to the urban environment-to climate control, storm-water collection, and the comfort and safety of people who live or travel along the street… A healthy urban forest is also a powerful street-water management tool."[ix] The text outlines goals, principles and guidelines for successful street trees as being part of the greater Urban Forestry narrative.

Trees as part of the Living Streets ideology and Urban Forestry narrative offer advanced storm water management, heat island cooling effects, while increasing property values and lowering ambient air pollution levels. Albeit an integral part of Urban Forestry, these trees must be specifically chosen for purpose and place, and not only have adequate spacing and required maintenance, but also fit into the larger system of benefits as a whole that a street has to offer. Restated, trees need to be part of a greater ecosystem that includes bioswales, permeable pavers, rain gardens, runnels and other new innovations that compound the environmental affect Living Streets strive to achieve. New or refurbished streets in Alexandria should all strive to become a Living Street with these tried and true technologies, in addition to the possibility of testing new or disruptive technologies.

This manual does not list financial costs of implementing these projects, and does not have revenues or expenses, as it is just literature. Implementing Living Streets, the urban forestry associated with Living Streets or any of the other characteristics is scalable down to the individual street level. Alexandria would be advised to portion off extra finances for future street repairs in order to produce Living Streets in and around the city on a site-by-site approach, as "A large tree will yield $48 to $62 in average annual net benefits over 40 years with costs factored in."[x] These improvements will more than pay for themselves over the course of their lifetimes. A point of contact for the Los Angeles manual is Ryan Snyder Associates, and can be reached at ryan@rsa.cc. The manual can be downloaded and have its use reported at http://modelstreetdesignmanual.com/.

2.2.3 Complete Streets Buffalo

Buffalo, New York has recently propelled its Complete Streets initiative into a top caliber program. Producing the Bicycle Facilities Master Plan in 1996, Buffalo got off to a slow start having only seven miles of mostly unconnected bicycle lanes for the remainder of that decade. The plan since 1996 has outlined an interconnected network of 126 miles of bicycle lanes and infrastructure, with a recent dedication in 2013 by the Mayor to install at least ten miles of bicycle infrastructure per year. The city is also serious about maintaining its dedication towards bicycling, "By partnering with GObike Buffalo to develop a new bicycle master plan funded in part by the NYS Dept. of Transportation and NYS Energy Research and Development Authority [the bicycle master plan] will outline how this vision will be achieved over time."[xi] This aims at democratizing the streets by making them equally safe and accessible to all users – motorists, cyclists, pedestrians, bus riders, and wheelchair users.

Another noteworthy achievement by the City of Buffalo is that the city passed complete streets ordinances in 2008 at both the city and county levels (the hyper links are out of date for both of those ordinances). The city through its ten-mile per year goal is adding sharrows, cycle tracks and contraflow bike lanes on urban streets per the ordinance. This ordinance is also very important, as Alexandria can replicate it in that it "Require[s] retrofitting Buffalo's streets with bicycle and pedestrian infrastructure, where applicable, whenever maintaining or re-designing our roadways."[xii]

These initiatives are taken on by the Mayor's office through the help and consulting of GOBike Buffalo - an NGO http://gobikebuffalo.org, Alta Planning + Design http://www.altaplanning.com/, and sub-consultants Wendel and Mustard Seed Consultant Group http://wendelcompanies.com/. Funding for these initiatives as aforementioned came from state grants, matching city funds, and limited federal funding. The Buffalo Complete Streets website link has not been maintained, and can be found at: http://www.buffalocompletestreets.org/.

Buffalo is a little bigger both demographically and spatial vis-à-vis Alexandria with a population at around 260,000 and land area at just over 40 square miles. Alexandria is denser, having 3,000 more people per square mile. Alexandria should be able to implement some of the tactics Buffalo has been able to enact, even at a scaled down approach. Alexandria also has the Alexandria Bicycle and Pedestrian Advisory Committee (BPAC) https://sites.google.com/site/alexandriabpac/ that would theoretically be able to help draft written frameworks for citywide implementation whether it is an ordinance or an updated MP. The city also has several planning and consulting firms that would additionally be able to aid in any drafting.

GOBike Buffalo can be contacted at http://gobikebuffalo.org/contact/ and the City of Buffalo has two Bicycle Route Guides, which both are accessible at http://www.city-buffalo.com/Home/CityServices/BicyclePedestrianAdvisoryBoard/BicycleRouteGuide, and the city main page with hidden links to contacts can be found at http://www.city-buffalo.com/Home/. A final relevant site is the Coexist New York State site, as this organization "Was developed as a statewide public safety campaign that educates and encourages all roadway users… [and] is intended to provide tools for communities around the state to utilize on the local level."[xiii] Overall, Buffalo seems to be well on its way to creating an interconnected network of complete streets.

2.2.4 Philadelphia Complete Streets

Although Alexandria pales in comparison to the size and demographics of Philadelphia, the latter invokes progressive ideas that could help the former realize the potential complete and living streets have to offer. Philadelphia's Mayor Nutter wants to make his city the Greenest City in the nation.[xiv] Streets Philadelphia and Philadelphia Complete Streets are both located under the Office of the Mayor, and linked to the Mayor's Office of Sustainability. The City, the Mayor, and the Mayor's staff are all onboard to creating complete streets as,

> "Public streets are one of the most valuable assets a city has. The competition for the use of the public way is constant and varied. From serving emergency vehicles to automobiles, from accommodating pedestrians to delivery trucks, from bicyclists to buses, the management of these vital and constantly changing spaces is crucial and needs to be balanced in order to minimize congestion and maximize safety."[xvxvi]

This generalization should be a mindset that is touted in every municipality. These thoroughfares should be synonymous with democratic streets – a street that is conducive and safe for all modes of transit, with ample space for leisure activities.

Being progressive in its street policies, Philadelphia has adopted numerous programs and policies that promote the expansion of complete streets. The most important program or iteration that Philadelphia has to offer is the Philadelphia Complete Streets Design Handbook. This handbook is slightly dated, being drafted in June of 2009, and comprises primarily of policy and lateral implementation. This handbook compares to the previously mentioned Model Design Manual for Living Streets in Los Angeles, but addresses complete streets instead of living streets.

Policies within the handbook lay out three sections encapsulating street planning and design process, a typology of streets, and street components and design treatments. Out of the 150 plus page guide only two pages are dedicated to implementation. This implementation ties all of the policies outlined in the previous sections of the handbook and the Complete Streets Project Review Checklist, as shown below:

> "Philadelphia's Complete Streets Executive Order (NO. 5-09) [issued in 2009 and reading as] 'all City departments and agencies shall, in connection with input into and decisions regarding all transportation and development projects: A. Give full consideration to accommodation of the safety and convenience of all users of the transportation system, be they pedestrians, bicyclists, public transit users, or motor vehicle drivers; B. Balance the needs of all users in planning, design construction, maintenance, and operation; and

> C. Prioritize the safety of those traveling in the public right of way, and in particular the safety of children, the elderly, and persons with disabilities. Such efforts shall be known as the City's 'Complete Streets Policy'."[xvii]

Example completed checklists can be viewed at http://www.philadelphiastreets.com/complete-streets-handbook/project-reviews/. This link shows a list of projects by address and by clicking on the address will show the checklist being filled out by the developers to gauge what is being down to create a complete street at that individual project site.

The Philadelphia Complete Streets website also gives an overview of what a complete street means to the city, in addition to providing information on how complete streets affects members of the community and developers. Other noteworthy features include a Bike Rack Application Form – a form allowing local "Businesses and organizations to apply for the opportunity to convert one standard on-street parking space for cars into an on-street bike parking corral which will hold 12 bicycles,"[xviii] and a Parklet Application Form. The parklet form facilitates the creating of vibrant street life as, "Parklets are small platforms that take the place of two on-street parking spaces. They provide seats and tables, allowing residents and visitors alike to stop, sit and enjoy the neighborhood street life."[xix]

Quick to view examples of what Philadelphia considers good and bad streetscapes can be found at http://www.philadelphiastreets.com/complete-streets-handbook/gallery. Budget and staffing is not readily apparent within the site, or the city website for these programs, but each of these endeavors can be fittingly adjusted to fit the needs of Alexandria's streets. Contact information can be found at http://www.philadelphiastreets.com/customer-service/, with a dichotomy of customer service and pothole repair requests. On the Philadelphia City contact site there is also information for media and other city services.

2.2.5 Complete and Living Streets Conclusions

Although Alexandria adopted a Complete Streets Policy in 2011, the city needs to first look at this document and revise it in order to provide for the living elements endemic of living streets. Each of the programs mentioned is able-to-be synthesized, adapted and amalgamated to fit Alexandria's unique situation. The easiest way to promote living streets is to have the developer of any new development committed to retrofitting the site's streets with living streets.

Living streets are similar to complete streets, but enact more environmentally friendly measures that help aid and abet storm water runoff. These streets are safe to use, democratic in function and utilitarian in space and design aspects. As seen in the next section, living streets can also act in bridging open spaces together creating urban environmental serengetis. Another ideal in implementing living streets is that whenever a road is due for repairs and maintenance, have the repairs and maintenance align so that the street is thus replaced with a living street – not just a complete street.

2.3 Alexandria's Green Crescent: Open Space Networking & Trail Linking

2.3.1 Introduction

Open space is critical for cities and municipalities to possess and Alexandria is already meeting and exceeding certain open space goals within the EAP and OSMP. Albeit, in chapter 5 of the OSMP several

goals of the conceptual framework have not been addressed. The purpose for the following two practices discussed here is to show contextual ideas into how Alexandria can better link its open space and natural resources as, "The overall objective of the Open Space Plan is that of making connections… Linking open spaces to each other, expanding open spaces to provide better linkages and creating continuous parks along roadways and waterways will enable the City to finally have a park system built on Olmstedian principles of park planning."[xx] This is great oversight that leads into the second tenant of the framework that states,

> "The creation of a Green Crescent of open spaces that follows the alignment of the City's primary rivers and streams: Potomac River, Four Mile Run, Cameron Run and Holmes Run. The Green Crescent would be created by building upon the existing parks, natural areas and other open spaces, and by adding unprotected key sites to provide greenway and trail linkages and interconnected parkland."[xxi]

The Green Crescent refers to the conjoining of segmented open space along the entirety of Cameron Run and then arcing up along the entirety of the Potomac River – in order to form a singly cohesive, connected and integrated park. The 'Green Crescent' would then be integrally linked to all of the other open space resources within the city by a variety of means and ways.

This segment of the brief will look into two projects, one in Kyoto, Japan, and the other in Colorado Springs, Colorado. Each of these locals offers a unique approach to harnessing connections between each of Alexandria's open spaces. These methods or approaches could help in realizing the accomplishing of Alexandria's open space and natural resource conservation goals when used in tandem with other methodologies advanced by this brief.

2.3.2 Kyoto Japan: Philosopher's Walk

The confines of this brief would traditionally limit BMPs to other similarly situated American cities and municipalities, and policies and programs undertaken. However, being recently enlightened to an international example during the Casey Trees Urban Forestry Workshop in Washington, D.C., it would be appropriate to include this exemplary model in the discussion. Philosopher's Walk is located in the Japanese city of Kyoto, along the small Biwako Canal. It became part of the city fabric in the early years of the 20th century as the famous Japanese philosopher and professor, Nishida Kitaro[xxii] is said to have worn the route into a distinguishable path due to his almost daily walks over the course of 18 years.

As it should be under open space or parks and recreational management, this path or trail does live up to parts described within the Outline of the Master Plan of Kyoto City (2001-2010) http://www.city.kyoto.jp/koho/eng/plan/img/english.pdf#page=13. This plan seems Eastern in thought, but is directly linked to contemporary Western planning, as careful dissection reveals that chapter 1, "Peaceful Life" corresponds to the triple bottom line notion of environmental stewardship, chapter 2, "Prosperous City" relates to economic well-being with chapter 3, "Aiming to build relationships of deep trust with citizens," discusses social equity. Each of these chapters is under the "Policies" subheading of the document.

One subheading of the first chapter is entitled, "Making Kyoto a nice place to take a walk," and its basic direction states, "…To make such a city, it is necessary to take steps to making walking about more

interesting by creating beautiful street landscapes, controlling the flow of traffic and promoting the use of bicycles."[xxiii] The section goes on to state five specific policies that meet those ends.

Here is where the context overlaps: Alexandria should mimic the environment of Kyoto's Philosopher's Walk while maintaining of the local context. The creation of a local "Philosopher's path" that utilizes the entire Green Crescent would not only link many of Alexandria's cultural and natural resources together along one cohesive trail, but would provide stimulus to increasing green and open space where it matters most.

The Green Crescent has a chance to be molded and shaped into a preeminent regional walking path much like the Philosopher's Walk in Kyoto. This path is part of multiple SAPs, yet does not have a SAP or overlay zone of its own. Within Kyoto, the Biwako Canal was built in 1890 as "Part of a modernization project and played a significant role in revitalizing Kyoto which had declined due the transfer of the capital… The Path of Philosophy (Tetsugaku-no-michi) and other pathways along the canal are some of the favorite [sic] walkways for the citizens."[xxiv] The canal and pathways to this day attract tourists and residents alike, in a fashion Alexandria could benefit learning from.

The Japanese websites have only limited English pages, but there is a city call center that provides information on procedure for living or on safety and can be reached internationally at 075-661-3755. The city's English webpage can be found at http://www2.city.kyoto.lg.jp/koho/eng/index.html.

2.3.3 Colorado Springs: Trail Linking

The second case study is located in Colorado Springs, Colorado and states that one of its top ten issues to address within the Colorado Springs Park System Master Plan (PSMP) within the next ten years are gaps in the trail system. The vision and goals of the PSMP are connected to chapter 4 of the city's Master Plan and include (but not limited to):

- Link trails to complete connections between recreation hubs.
- Fill in the gaps in the current open space ring. Enhance the value of existing open space land assets by expanding conservation to the high quality natural lands surrounding them.
- Create a network of "Complete Creeks" or greenway opportunities for urban open space and trails.

Key recommendations for obtaining a linkage of the trails includes notions of adding around 150 miles of urban and internal park trails to the existing network, that would be accomplished by a 54 mile 'ring of the springs' trail, the inclusion of open space that caters to current trends including Frisbee golf courses, and infrastructural support for challenge races and water-based sports areas.[xxv] Of course not all of these ideals would be applicable to the City of Alexandria. Colorado Springs, by comparison has a population of around 440,000 people with a land area just shy of 200 square miles. Scaling for size would be apropos and feasible for Alexandria, as investing to create 15 miles of connective trails would purpose the linking of already open areas to existing trails.

Stated within the purpose of the Colorado Springs PSMP is the management of an urban trail system, developed parks and an urban forest among others. The assessments within the plan all are backed by civic engagement and public outreach efforts engaging the denizens as to what they feel are the most pressing issues within the scope of parks and recreation as, "Sixty-three percent of public meeting and

online meeting participants felt that trails were the most important priority for the City to build or invest in the short term."[xxvi] A good starting point for Alexandria would be to engage the public as to what they would want to see changed, or addressed with open space within the City of Alexandria.

The Colorado Springs PSMP is not only conducive to looking towards linking trails, but also looking towards the background research to support the necessity, logistics and other pertinent information regarding urban populations, such as some research completed in inquiring how far someone is willing to walk to a park. This body of research points to a half-mile walk being comfortable with a quarter-mile being comfortable for families with children or for elderly people.[xxvii] In Colorado Springs only 53% of the population is within a half-mile walk of a park.

The Colorado Springs PSMP was also formally updated on September 23, 2014. Another top issue that needs to be addressed is the insufficient and uncertain funding. Alexandria could also look to Colorado Springs in its ever-increasing search for budgetary problems and woes. The vision is advocating for,

> "Fac[ing] our financial challenges and secure diverse funding sources over the next 10 years to ensure resilience. Key recommendations [include]: Increase TOPS [Trails, Open Space and Parks] sales tax. Negotiate water rate reductions for irrigation. Establish a non-profit park system foundation for proactive fundraising. Pass along some of the costs of new parks and trails creation to developers. Stabilize the amount of City General Funds distributed to the department. Consider additional recommended funding diversification ideas."

Additionally the PSMP dedicates an entire chapter entitled, "Funding, Operations, and Resources Evaluation" that looks predominately at existing financial infrastructure. The scope of the projects and plans would be too great for Alexandria to accomplish due to Colorado Spring's differential in population and geographic size. Although, Alexandria would be able to reduce the scope and scale of these projects in order to fit them into a more compact, urban municipality. The city general website can be found at: https://coloradosprings.gov/.

2.3.4 Open Space Networking & Trail Linking Conclusions

Through the example case studies in Kyoto, Japan, and Colorado Springs, Colorado, Alexandria can learn a lot as to how to promulgate a completely integrated trail and open space network that links City open spaces and natural resources. Linking each of the open spaces together by trails, open space and parkland would be ideal, but may not be achievable for the City's many natural resources. In such cases where open spaces were unable to be connected with trails or parks, the City could implement Living Streets concepts in order to provide the next best alternative. Having a green, living street would be able to surround the user or citizen with a natural setting that would not be far off from preserved open areas.

Creating a trail or network along the Green Crescent that represents equal parts of local culture and nature, as seen with the Philosopher's Walk in Kyoto, would help bring the City into a regional focus with an innovative idea that has the potential to bring much needed tax revenue into the city. This walk could be reknown locally and regionally with tree-lined vistas and strategically placed art, sculptures, murals, and other culturally and aesthetically pleasing sites. A common theme could link all the art

together along the trail, or even have all the art interweave with nature itself. The possibilities are limitless with what Alexandria could do to turn this currently disjointed allotment of open space areas into a singularly cohesive and interconnected urban nature and art trail that can produce and incubate a much needed local Bohemian Class of creative people as suggested by Richard Florida.

2.4 Living Infrastructure

2.4.1 Introduction

Unfortunately there are no local or municipal policies or programs that include Living Infrastructure within comprehensive or master plans. As of August of 2011, there were only three certified living buildings in the world.[xxviii] Almost two years later and as of March of 2013, that number doubled to six buildings worldwide. Although this number is slow on the uptake and the technological field is relatively new, there are over a dozen buildings that are presently occupied as buildings can only gain accreditation after twelve months of consecutive operation.[xxix] Therefore, in providing BMPs, this report will look toward the several organizations that foster and promote living infrastructure. A brief background will first be given from the Whole Building Design Guide (WBDG), which is a program of the National Institute of Building Sciences (NIBS). The organizations that will then be discussed include the New Buildings Institute (NBI), and the Living Building Challenge (LBC) associated with the International Living Future Institute (ILFI).

2.4.2 Whole Building Design Guide (WBDG)

The NIBS was founded with the enactment of the Housing and Community Development Act of 1974. Through the need for developing private-public partnerships (P3s), the government set up the institute to facilitate the transmission of information regarding advances in building science and technology that improves the built environment,

> "The Institute is a non-profit, non-governmental organization bringing together representatives of government, the professions, industry, labor and consumer interests to focus on the identification and resolution of problems and potential problems that hamper the construction of safe, affordable structures for housing, commerce and industry throughout the United States."[xxx]

The Institute is headquartered in Washington, D.C., and receives its budget from a balance of public and private funding. The past several annual reports can be found at: http://www.nibs.org/?page=about. The Institute administers a plethora of councils ranging from the Advanced Materials Council (AMC), and Building Seismic Safety Council (BSSC), to the High Performance Building Council (HPBC), and the Sustainable Buildings Industry Council (SBIC). The NIBS is also an umbrella organization to several projects and programs including the Integrated Resilient Design Program (IRDP), and the Whole Building Design Guide (WBDG).

Like NIBS, the WBDG fosters P3s, but specifically channels their resources into developing, promoting and disseminating guides, general information, and standards towards the 'whole building' perspective. The WBDG is strictly a web-based portal to access said information and partners with a myriad of agencies, including but not limited to the General Services Administration (GSA), the National Institutes

of Health (NIH), and the National Park Service (NPS).[xxxi] Furthermore, the WBDG describes the role of buildings and the case for whole building design guidelines stating,

> "At their best, [buildings] connect us with the past and represent the greatest legacy for the future. They provide shelter, encourage productivity, embody our culture, and certainly play an important part in life on the planet… They are incredibly expensive to build and maintain and must constantly be adjusted to function effectively over their life cycle."[xxxii]

Buildings are well known to consume more than half of domestically generated electricity and energy, and produce almost half of the countries green house gas (GHG) emissions. The WBDG approach also talks about the Energy Independence and Security Act (EISA) of 2007 paving the way for all federal buildings to becoming energy independent by 2030. In addition, the USGBC LEED program and the Building Security Council's (BSC) Building Rating System are mentioned. These programs are great initial steps, but as demonstrated later, can be vastly improved upon.

The site credits Christian Smuts and Buckminster Fuller with components of the Whole Building Design including *holism*, *interconnectedness* and *synergy* and state that the mentality of these three components come together to demonstrate that "The Whole is Greater than the Sum of its Parts."[xxxiii] Those three components then direct the integrated design approach used to design whole buildings that incorporates and requires buildings to be:

- Sustainable
- Safe / Secure
- Functional
- Aesthetic
- Historic
- Productive
- Accessible
- Cost Effective

In finalizing the integrated approach to designing, developing, and constructing buildings, a host of actors need to amalgamate in order to realize a single, direct goal for each site specific project. The actors required at the onset of the project are tailored for each individual project and could include architects, owners, clients, tenants, engineers, programmers, contractors, specialists, developers and a host of other parties that are either direct or indirect stakeholders.[xxxiv]

The most relevant information on the WBDG website in terms of this brief is the resource page that talks about living, regenerative, and adaptive buildings. Synthesizing and summarizing this information will allow readers to be better prepared to understand the following programs that will be discussed. There are subtle differences between the trichotomy of living, regenerative, and adaptive buildings. Focusing on living buildings, the big proponents are that the buildings are net zero in energy and water consumption – they produce all consumed energy on-site, harvest site rain water for on-site use, while treating wastewater and producing zero net waste. They mimic and integrate with natural processes,

and are only linked to the grid to feed excess production to other recipients on said grid. The building's materials are also sustainably sourced and the buildings can function autonomously.[xxxv]

The substantial difference between living and regenerative buildings is that regenerative buildings are living buildings on natural steroids. Whereas living buildings have zero net impacts, regenerative buildings have net positive impacts on the local environment – i.e. helping to restore the hydrology, or repairing damaged ecosystems. This design ideology helps to restore and improve the natural surrounding environment for all biotics. Likewise, adaptive buildings are able to adapt to the changing needs and conditions of the local environment. They can be likened to buildings that adhere to Form Based Codes (FBC), as they are open and are easily able to be repurposed or retrofitted with cutting edge technology.[xxxvi]

The site goes on to mention specific methods in achieving net zero energy and water use. These ideas include both supply and demand side economics. Demand side reduction options include waterless urinals, compostable toilets, and low-flow faucets and show heads for water consumption while efficient heating, venting and air conditioning (HVAC) systems, increased insulation, natural ventilation, and high performance glazing, can reduce energy consumption. Supply side options include cisterns, closed loop water systems, and harvesting systems for increased water collection and storage, to photovoltaics, wind turbines, geothermal, and non-combustion fuel cells for energy generation. This is not an exhaustible list of supply and demand side water and energy techniques, but provides basic examples of some existing technologies.[xxxvii]

There is no direct indication about how many people work for the WBDG, or any financial documents detailing project costs or revenues. Albeit, this is a guide and forum for information, that can be accessed and utilized by municipalities. Alexandria should be able to borrow full or partial concepts derived within the Guide to amend later iterations of the EAP in order to create truly net zero communities and further the recognition of the City as a global leader in sustainable and living metrics. Phone and email contact information can be found here: http://www.wbdg.org/contact.php, while additional resources including references, associated associations and organizations, and publications can be found at the bottom of this hyperlink: http://www.wbdg.org/resources/livingbuildings.php.

2.4.3 New Buildings Institute (NBI)

The NBI was founded in 1997 as a non-profit organization and is currently headquartered in Vancouver, Washington. Also independent from governmental organizations the NBI

> "Work[s] collaboratively with commercial building market players-governments, utilities, energy efficiency advocates and building professionals-to remove barriers to energy efficiency, including promoting advanced design practices, improved technologies, public policies and programs that improve energy efficiency. [They] also develop and offer guidance to individuals and organizations on designing and constructing energy-efficient buildings through our Advanced Buildings® suite of tools and resources."

The Institute has several areas of focus that could be of beneficial use to Alexandria in its furthering the quest of being green and energy independent. Offering consulting services in Advanced Design

http://newbuildings.org/advanced-design, Energy Performance http://newbuildings.org/measured-performance, and code and policy development http://newbuildings.org/codes-policy the NBI would be able to develop compliant codes, that are currently up to date, while matching state thresholds, and provide building designs that would be compliant within those codes and energy guidelines.

The Advanced Design portfolio includes the Advanced Buildings suite of tools that is designed to help "Teams create energy-efficient, high performance commercial buildings."[xxxviii] The emphasis here is on retrofits on some of the 80 billion square feet of office space that has been deployed over the past decades. When it is not cost effective to retrofit, new development may be more attractive. A whole section is dedicated to Zero Net Energy (ZNE), its status, case studies and further recommended resources are available at http://newbuildings.org/zero-energy. The site also offers a 'Getting to Zero Buildings Database,' http://newbuildings.org/getting-to-zero-buildings-database; a database of existing ZNE buildings. As an example, within the free searchable database, Virginia is home to nine registered ZNE buildings. Three are in Arlington County, with one located in neighboring Fairfax County. Alexandria has no registered ZNE buildings while D.C. has three ZNE registered buildings.

Systems energy performance is critical and NBI provides case studies and research in order to back tried and true strategies. Relating to retrofitting older buildings, the NBI with support,

> "Investigated 11 examples of energy retrofits in existing commercial builds that, on average use 50% less energy than the national average—most with an energy use intensity (EUI) of less than 40 kBtus [kilo British thermal unit] per square foot. The case studies for each building include motivations, technologies and practices, energy performance, financial information, overall project results and quotes from owner and design teams."[xxxix]

Other case studies include the UC Merced campus that was originally designed with high performance standards in mind and various ZNE case studies. NBI also participates in research projects, most notable the Public Interest Energy Research (PIER) program http://newbuildings.org/PIER-Research, and post occupancy performance of LEED projects.

The Institute also helps collaboratively to develop local municipal energy and green codes while also currently assisting a federal level initiative to design a national model green code, the International Green Construction Code (IgCC). The IgCC is worth noting here, as it helped developed the Zero Energy Performance Index (zEPI). This scale differentiates from the Energy Star score, simply as it allows for time adjustment in building scores. The end result and best score in a zEPI score is zed, representing a building using zero energy from the grid. Energy Star scores also cannot differentiate how a current top preforming building would rank environmentally to a top preforming building, built 15 years ago http://newbuildings.org/zero-energy-performance-index-zepi. Right now the zEPI provides measurements to commercial buildings, but ultimately should include provisions to measure all buildings. Alexandria if implementing this new rating system would be able to realize how well buildings perform over the function of time in relation to energy use.

On the formal website, NBI staffs fourteen people. The annual report shows twenty-three individuals. For fiscal year 2012, the balances stated were revenues around US $3.3 million and expenses at around

US $3.9 million. Revenues about equaled project expenses, and the tipping point was in administrative expenses http://newbuildings.org/sites/default/files/AnnualReport2012.pdf. Contacting them can be accomplished through this website http://newbuildings.org/contact-us that provides the headquarters address, and email addresses. The NBI resource library can be reached at http://newbuildings.org/document-library, and other news, the Institute's blog, and past and future webinar information is available at http://newbuildings.org/news/whats-new.

2.4.4 International Living Future Institute (ILFI)

The ILFI released its 2013 annual report by excitedly moving across town to its new residence within the Bullitt Center – "The world's greenest commercial building and perhaps the most innovative new building of the past 50 years."[xl] This program, past and presently based in Seattle has international intentions, as it administers the Living Building Challenge (LBC) to any developer or contractor aspiring to achieve recognition. This Institute is independent of local, regional and national governmental bodies, yet "Seeks partnerships with leaders in the public, private, and not-for-profit sectors," and espouses to incubate and produce visionary programs.[xli]

The ILFI has helped redefine the green movement by raising the bar for sustainable development. Fundamentally, the Institute relies on revenue pulled from foundations, corporations, and programs to maintain financial viability. Smaller streams of revenue come from government, individual membership and investment income. To tell if this Institute is effective or efficient at this time warrants more time to accurately tell, but according to yearly reports there has been almost exponential increases in global projects desiring to gain recognition as being livable. A complete assessment of activities can be viewed for both the fiscal 2012 and 2013 years at: http://living-future.org/ilfi/about-international-living-future-institute.

The Institute can be called a leader in promoting the natural progression from LEED certified buildings to the next generation of sustainable, livable buildings. A good overview of the program can also be attained at http://www.sustainablebusiness.com/index.cfm/go/news.display/id/21215. This article states a founding in 2009 by the Cascadia Green Building Council (GBC), yet the IFLI website posits being a parent of the Cascadia GBC, so some discrepancies arise. The 2013 ILFI budget reports growing assets by around three-quarters of a million dollars during the fiscal year. Operating revenue for 2013 was at roughly US $4.5 million, and expenses at roughly US $3.6 million. The overwhelming majority of expenses went to program services. Staffing levels should be seen as minimal as management and general expenses were clocked in at approximately US $382 thousand.

The certification awarded for living buildings, which occurs after construction and a minimum twelve-month occupancy can be realized in full or partial recognitions. In order to achieve a certification of living building, the unit must achieve all seven unique petal requirements:

- Place – limits to growth, urban agriculture, habitat exchange, human powered living;
- Water – net positive water;
- Energy – net positive energy;
- Health and Happiness – civilized environment, healthy interior environment, biophilic environment;

- Materials – red list, embodied carbon footprint, responsible industry, living economy sourcing, net positive waste;
- Equity – human scale and human places, universal access to nature and place, equitable investment, just organizations; and
- Beauty – beauty and spirit, inspiration and education.[xlii]

Developers if unable to complete one or multiple petals, after application to the program can still receive petals that have been accomplished, so this process could be geared towards incremental steps in realizing complete living buildings in the near future. Example projects that have been completed and obtained living building certification are the Omega Center for Sustainable Living, in Rhinebeck, New York,[xliii] the Tyson Living Learning Center in Eureka Missouri,[xliv] the Hawaii Preparatory Academy Energy Lab, in Kamuela Hawai'i,[xlv] and the Bertschi School Living Science Classroom in Seattle, Washington.[xlvi] Many other buildings are in stages advancing towards living building recognition – whether they are currently occupied such as the acclaimed Bullitt Center in Seattle, Washington,[xlvii] under construction like the June Key Delta House in Portland, Oregon,[xlviii] or are still in the design phase such as a concept from the Alice Ferguson Foundation in Accokeek, Maryland.[xlix] A complete list of accredited projects, and projects that have applied can be found here: http://en.wikipedia.org/wiki/Living_Building_Challenge.

This program is very applicable to Alexandria. With climate change and global warming trending in social media and social and political circles the living building certification program would greatly advance Alexandria's reputation as a global community taking its part in fighting climatic change. Alexandria could develop capacity for such projects locally by initiating a local feasibility study into looking at implementing living buildings. If this was not ideal, the City could also look towards Washington, D.C., as the District just published its "Net Zero and Living Building Challenge Financial Study: A cost Comparison Report for Buildings in the District of Columbia," in the fall of 2013.[l] The primary contact for that study is Amy Cortese, whose contact information is on the third page of that study. Points of contact for the ILFI can be found here: http://living-future.org/contact. ILFI has its own publication, Ecotone Books that looks exclusively at sustainable design, and also publishes a quarterly online magazine, Trim Tab that discusses transforming the built environment.

2.4.5 Living Infrastructure Conclusions

The concept of living buildings was not even public when Alexandria adopted its EAP. There is readily available evidence that points to not a single municipality having living building concepts within its master or comprehensive plans. In this regard, Alexandria can truly set itself apart from just about every other national municipality in that it could be the first to adopt an ordinance and master plan components fostering and acting as a catalyst to propel the impetus of living buildings here in Alexandria, and on the national front. Recommendations would thus have to include in writing and incorporating livable buildings into the City's EAP and then Comprehensive Plan. Specific goals, objectives and model actions will be addressed in detail in the formal recommendations sections. Shorter-term action items could be to either commission a study on living building feasibility in Alexandria, or review or analyze the report coming out of D.C. a year and a half ago. Alexandria could set up an initiative to partially provide funding for a pilot living building project in the City, which could also be used as a test bed for disruptive technology.

Being able to have benchmarks towards implementation would also be ideal, as the realization of the additions of these buildings into the community would take years. A component of the UFMP or a SAP that will undergo future development could include short or mid-term goals to incorporate livable buildings into the plans, and as a long-term goal having a certain percentage, or a certain number of buildings throughout the city receiving and maintaining living certifications. Another step Alexandria could take is to promote the zEPI index in assessing all buildings in terms of energy consumption. Writing these ideologies into the EAP could be a mid-term action item while having a long term action item being the assessment of all buildings under the zEPI index and providing for replacing a percentage of the lowest performing or most consuming buildings to be replaced at regular intervals.

3 General Conclusions and Policy Recommendations

3.1 Possible Field Applications: Local Context for a National Framework

There are several areas within Alexandria that are readily available and conducive to implementing some aspects of the aforementioned themes. A primary case study would be the entirety of the North Potomac Yard SAP with a secondary case study looking at the Eisenhower West portion of the King Street Metro Station / Eisenhower Avenue SAP. Lastly, the GenOn Power Station site on the Northern portion of the general Waterfront SAP could provide a case study. These three sites are currently in various stages of planning, and will very soon transition into further iterations and phases of redevelopment. There is great potential within these sites to advance and provide framework for Alexandria's current goal of obtaining carbon neutral development by 2030 (EAP Ch.2, Goal 1, Long-Term Action Item 1). Many companies, such as the Alexandria Emerging Technologies Center (AETC) showcase and implement emerging and disruptive technologies in pilot projects in order to test and try cutting edge advances in construction and sustainability measures. Alexandria should take full active advantage of these sites in order to become a local and global leader in taking steps in reducing GHG emissions.

3.1.1 North Potomac Yard SAP

The North Potomac Yard SAP was published in April of 2010, and shows the most promise of achieving the high environmental standards Alexandria has set forth through the EAP. Revolving around the addition of a Potomac Yard Metro Station, the site will exemplify a transit-oriented development (TOD). Some plan principles include:

- Create North Potomac Yard as a model of environmental sustainability for its site planning, infrastructure, and buildings.
- Pursue a comprehensive multi-modal approach to transportation based on a highly walkable urban environment, minimal automobile impact, and maximum use of existing and new metro stations.
- Create landscaped streets and a network of usable open space and parks with a strong connection to Four Mile Run and the Potomac.[li]

Incorporating Scott Campbell's Planner's Triangle, the vision lists the three primary elements of sustainability: the economy, the environment, and society stating, "Environmental Sustainability –

Redevelopment is based on establishing long-term environmental goals, such as carbon neutrality… The phasing should anticipate a 20 to 30 year build-out of North Potomac Yard and the evolution of sustainability requirements and technology during that period."[lii] Some discrepancies arise as the plan calls for carbon neutrality by 2030. The plan should call for net zero energy consumption, and achieving several petals if not a complete Living Building Certification.

The transit section of the plan is ambitious, as it aims to reduce automobile usage within the site. Revolving around a planned metro station, the site also will be multi-modal friendly with ample other public transit options, complete with pedestrian and bicycle right of way options. Although, there is no direct mention of complete or living streets, the closest recommendation would be, "Consider all users in the future design of streets and streetscapes."[liii] Portions in the 'Infrastructure' chapter do hint towards other tenants of living streets, such as removing impervious surfaces and using harvested rainwater to meet irrigation demand, and saving land for community gardens[liv] but there is no direct link to net zero water consumption.

Overall the North Potomac Yard SAP incorporates a lot of EAP action items. It is progressive for regional and national development, yet it could take an extra step to achieve not only net zero development, but also net zero levels during occupancy. Living Streets need to be directly referenced in order to ensure that all people are included in the redeveloped street layout. Additionally, connectivity is only briefly mentioned within the document and could stand to be expanded upon.

3.1.2 Eisenhower West SAP

The original King Street Metro Station/Eisenhower Avenue SAP was last modified in 1992, yet the newly formed Eisenhower West SAP is currently acting through the Eisenhower West Steering Committee to give direction and impetus to the area's redevelopment. The Steering Committee is tasked with "Generating plan principles and goals; and developing a general draft framework for the area including land use, connectivity and streets, and density options… in order to have an up-to-date plan for how the area can take advantage of its location near transit and regional road networks, and improve connectivity."[lv]

The Steering Committee was formed in early 2014 and is writing the SAP with a 2040 end goal that "Will include a land use plan, a framework of roads, bicycle/pedestrian connections and parks, community facilities, and implementation strategies."[lvi] With the end goals being 2040, some if not all of the proposed construction would start and or finish after the EAP's 2030 goal of all new construction obtaining net zero energy consumption. The Eisenhower West Steering Committee's initial report, http://www.alexandriava.gov/uploadedFiles/planning/info/EisenhowerWest/EWSAPPlanBoundary.pdf, includes a lot of background information, a vision statement, and concept diagrams. Of course this is at an initial stage within the grand project, but the vision statement needs to be amended to directly include aspects of the City's EAP.

There is no mention within the document of net zero construction or habitation of buildings. Indirect references at best may point to complete streets, as no direct mention of living streets is brought up in the plan. This SAP needs to incorporate such pivotal concepts like living buildings, living streets and trail connectivity (which is brought up on several occasions) from the get-go. Projects like Eisenhower West

that are in very primitive planning stages are the easiest projects to be significantly steered towards incorporating more sustainable, and living infrastructure into the plans' entirety and align directly with more of the EAP's goals and targets. Additional resources for this project including a calendar of events for meetings can be found at http://apps.alexandriava.gov/Calendar/Detail.aspx?si=8658, and a detailed map of the SAP is available at http://www.alexandriava.gov/uploadedFiles/planning/info/EisenhowerWest/EWSAPPlanBoundary.pdf.

3.1.3 Decommissioned GenOn Power Station Site

The GenOn Power Station ceased operations and shut down on October 1, 2012[lvii] several months after the February 2012 update of Alexandria's Waterfront SAP.[lviii] This is important because within the Waterfront SAP, the GenOn site is not slated for redevelopment. Firstly, this SAP needs to be updated with the intentions on what will provide the infill on the GenOn site. There is a comprehensive approach, Potomac River Green (PRG) that solicits redevelopment on the site. The main internet webpage for PRG can be found at www.potomacrivergreen.org/our-plan, with a detailed plan discoverable at www.potomacrivergreen.org/sites/default/files/PRG_RedevBook_08.04.11_v2_3.pdf. This plan composed in 2011, is inclusive of the latest iteration of EAP, Eco-City Charter, and CAP goals, and provides among other ideologies, alternative fueling capacities, basement geothermal systems, on-site waste-water treatment, solar power production with energy storage solutions, and urban trail connectivity that would theoretically build demand for the Daingerfield Island Park.

All of these design elements were great for the EAP that was drafted in 2009, but unfortunately 2015 is the current climate. The sustainability field is progressing faster and faster and the cutting edge technologies that were savvy in 2009 are not good enough in today's metrics or for Alexandria's standards. The current PRG plan is satisfactory, and should be used as a base that needs to be amended and improved upon. Additional facets, if applicable would be that each of the three neighborhoods within the plan are built and occupied in zero net usage of water and energy. The steps that need to be added to the plan should be minimal as the plan already provides for some water reclamation and energy production. Having the site aspire to at the least, one or two of the petal objectives would be ideal.

A similar project that could provide reference could be the Glenwood Power Station site in outside New York City in Yonkers, New York. The Goren Group is developing the site that has been vacant since 1963 into a local and regional arts and culture center with a rustic industrial aesthetical vibe.[lix] This example does not espouse modern high-sustainability topics such as the conversion of the campus into a living building, or being a walkable destination, but it does offer similar ideas to Alexandria's Torpedo Factory of how to convert or utilize derelict space. The Glenwood Power Station plan could be tweaked to achieve the equity and or beauty petals of the LBC. The American Clean Skies Foundation, who authored the PRG site proposal, has another noteworthy resource, The Repurposing Legacy Power Plants: Lessons for the Future Report.[lx] This report, also authored in 2011 gives note that many coal fired power stations have been retired and lay dormant, or are approaching their retirement age quickly and profiles,

> "Eight power plant repurposing projects that have been completed or begun. These projects highlight the compelling case for remediating and redeveloping these sites. They also offer points of reference for business leaders, policy makers, and community

stakeholders who wish to prepare for the coming wave of power plant retirements in their localities."[lxi]

Even though this report does not include strategies to reimagine these parcels as living communities, it does provide redevelopment plans, costs and lessons learned from each of the eight case studies in order for readers to better understand each of the projects in their entireties. Retrofitting the PRG site design plans with topics such as living buildings, living streets, and open space linkages would be ideal.

3.2 Policy Recommendations

The structure for the EAP appears to be helpful and many of the goals have already been met. As of now, the EAP is broken into chapters, with broad targets, and then specific goals each with short, mid, and long-term action items. The short-term action items should have been completed by 2011 with the mid term action items being completed by 2020. Primarily, all of the action items that have been met and are completed need to be struck from the EAP while being added to a newly created document that provides for the maintenance of completed goals and action items. All of the mid-term action items then need to then be recalibrated for the short term, while repurposing the long-term action items for the mid-term. A new set of long-range goals should be envisioned and completed by 2040 or 2050. Any of the previous short-term action items that were not met should be reaffirmed on the updated list of short-term action items as priority measures. Table 2 provides some recommendations for chapters 2 Green Building, and 7 Land Use and Open Space within the EAP:

Table 2: Recommendations for chapters 2 and 7 within the EAP

EAP Ch.	Goal	Recommendation Text
Ch. 2	2020 Target	(Proposed) Adopt legislation that supports the Living Buildings movement, and its corresponding social awareness, and mandates all new construction after 2030 to conform to net zero standards.
Ch. 2	2030 Target	(Current) All new buildings will be carbon neutral. (Proposed) All new buildings during construction and occupancy will be net zero regarding water and energy consumption, and waste production.
Ch. 2	2050 Target	(Proposed) All inhabited buildings within the city are to be net zero or within a standard deviation of ten percentile points of being net zero.
Ch. 2	Goal 1	*Building on the City's Green Building Policy, all development, either new or renovation, should be constructed with the lowest ecological impact as is reasonably practical by advancing energy-efficient green construction, sustainable building location, site design, and emerging technologies.*
Ch. 2	Goal 1 Short-Term Actions (2015-2020)	(Current) Develop a green building policy for retrofitting all existing buildings, including residences and buildings in historic districts. Use nationally recognized criteria, such as those of the Leadership in Energy and Environmental Design (LEED), the Passive House Institute US, and the Environmental Protection Agency's ENERGY STAR criteria, in establishing such standards. (Proposed) Develop a green building policy for retrofitting all existing buildings, including residences and buildings in historic districts. Adopt the zEPI Rating

		System as the City's official way to measure energy usage and environmental impact on all new projects. (Proposed) Utilize the adopted zEPI Rating System to measure existing building's energy usage, and develop standards on a 5 year rotating scale to retrofit the worst performing buildings. (Current) Require all new buildings to incorporate alternative energy systems (e.g., wind, solar) on the roof, consistent with the building design, or otherwise ensure that each rooftop maximizes its productive space (e.g., green infrastructure, green roofs, and urban agriculture) by 2020. (Proposed) Require all new buildings to incorporate alternative energy systems (e.g., wind, solar) on the roof, consistent with the building design, or otherwise ensure that each new building acquires 2 petals from the LBC after 2020.
Ch. 2	Goal 1 Mid-Term Actions (2021-2030)	(Current) Require all new construction by 2030 to be carbon neutral. (Proposed) Require all new construction by 2030 to be carbon neutral. (Proposed) Develop a typology for determining where Regenerative Buildings (as an ecosystem service) are needed, and implement a plan to incorporate these buildings into SAPs, and development sites. (Proposed) Actively assess all buildings with the zEPI scale and set up indicators to measure the success of retrofitting the city's worst performing buildings.
Ch. 2	Goal 1 Long-Term Actions (2031-2050)	(Proposed) Require all new construction projects commenced after 2050 to be Living Building certified or compliant. (Proposed) Ensure all buildings and structures by 2050 are either net zero or within the tenth percentile above being net zero.
Ch.2	Goal 2	*Expedite the Commonwealth's adoption of further green building standards/building codes and expansion of local government authority to adopt green building ordinances, programs and policies.*
Ch. 2	Goal 2 Short-Term Actions (2015-2020)	(Current) Seek local authority to adopt additional green building regulations and require energy efficient technologies such as smart metering technology and energy audits at time of sale or legal transfer. (Proposed) Seek local authority to adopt additional green building regulations, including living building guidelines and require energy efficient technologies such as smart metering technology and energy audits at time of sale or legal transfer.
Ch. 2	Goal 4	*The City will lead by example in green building practices.*
Ch. 2	Goal 4 Short-Term Actions (2015-2020)	(Proposed) Ensure redevelopment in NPY, Eisenhower West, and the GenOn site have assessed certified Living Community development feasibility and to incorporate and require as many living building principles in redevelopment as possible.
Ch. 7	2020 Target	(Proposed) Formally adopt a 'Living Streets' Ordinance.

Ch. 7	2030 Target	(Proposed) Adopt or develop a set of metrics that ranks streets in terms of 'livability' and 'completeness.' (Proposed) Ensure that 25% of all City streets are deemed 'Living' and or Complete Streets. (Proposed) Form an Overlay Zone and acquire enough land to ensure the 'Green Crescent' is a singularly connected resource. (Current) Reuse the site of the coal-fired power plant. (Proposed) Ensure the coal-fired power station site redevelops as living friendly
Ch. 7	2050 Target	(Proposed) Ensure 75% of all City streets are deemed 'Living' and or Complete Streets. (Proposed) Ensure that all open space resources are interconnected through open space pathways or through 'living' or complete streets.
Ch. 7	Goal 1	*Continue to coordinate land use and site design decisions among City departments to ensure compatibility with existing City plans that promote walking, cycling, and taking public transportation.*
Ch. 7	Goal 1 Short-Term Actions (2015-2020)	(Current) Complete City's current City Bikeway and Trail network through development review, grants and CIP. (Proposed) Update the Bicycle Facilities Master Plan, and City bike and trail maps. Conduct feasibility studies for new links, trails and networks that would connect the City's entire open space infrastructure.
Ch. 7	Goal 1 Mid-Term Actions (2021-2030)	(Current) By 2030, reuse the site of the coal-fired power plant, imagining such possibilities as a renewable, clean energy generation facility, regional transit center for river-based transportation, open space, arts center, or other community-based function. (Proposed) By 2030, reuse the site of the coal-fired power plant, imagining such possibilities as a renewable, clean energy generation facility, regional transit center for river-based transportation, open space, arts center, or other community-based function. Ensure compliance with several LBC petals.
Ch. 7	Goal 2	*Ensure that all City development or redevelopment projects and all plans, policies, and ordinances regarding land use reflect the sustainability vision and principles of the Eco-City Charter*.
Ch. 7	Goal 2 Short-Term Actions (2015-2020)	(Current) Revise City's Strategic Plan and any future revision of City's Master Plan to incorporate sustainability principles of Eco-City Charter and Environmental Action Plan as requirements for all land use decisions. (Proposed) Revise City's Strategic Plan and any future revision of City's Master Plan to incorporate sustainability principles, to include living streets, and living buildings of the Eco-City Charter and Environmental Action Plan as requirements for all land use decisions. Update the Charter and EAP to include new ideologies from this iteration. (Current) Ensure that newly adopted and revised Small Area Plans, and new development and redevelopment projects are consistent with the vision and

		principles of the Eco-City Charter and Environmental Action Plan. (Proposed) Ensure that the NPY, Eisenhower West, and GenOn Power Station site SAPs can include net zero opportunities, and other Small Area Plans and new development and redevelopment projects be consistent with the vision and principles of the Eco-City Charter and Environmental Action Plan.
Ch. 7	Goal 3	*Protect and enhance Alexandria's open space and green infrastructure include wildlife habitat, parks, trails, tree canopy, and watersheds. Incorporate the natural environment into the built environment.*
Ch. 7	Goal 3 Short-Term Actions (2015-2020)	(Current) Develop an appropriate standard, planting program, and areas for street trees, as with an underground trench; and replace existing street trees as needed to ensure their long-term viability throughout the city. (Proposed) Adopt City design standards and guidelines that require all new and repaired streets to become 'Living Streets' after construction. (Current) Expand urban forestry training to residents and designate more "Tree Stewards" to maintain street trees. (Proposed) Expand urban forestry and 'Living Streets' training to residents and designate more "Street Stewards" that are responsible for future maintenance of street trees, street furniture, street art, and reporting environmental degradation of natural and built systems. (Current) Update the City's trails map, identifying existing trails and proposing additional trail connections and extensions. (Proposed) Update the Bicycle Facilities Master Plan, and City bike and trail maps. Conduct feasibility studies for new links, trails and networks that would connect all-of-the City's open space infrastructure. (Taken from Chapter 7, Goal 1, Short-Term Actions). (Current) Develop a goal for acquiring and/or protecting additional green space (after achieving the first 100 acres), consistent with the Open Space Master Plan and with guidance from the Open Space Advisory Group. (Proposed) Develop a goal for acquiring and/or protecting additional green space (after achieving the first 100 acres), consistent with the Open Space Master Plan and with guidance from the Open Space Advisory Group that links presently disconnected open space resources into a singularly contiguous open space network inclusive of the 'Green Crescent.' (Proposed) Create an overlay zone encompassing all of the Green Crescent and work towards making it a regional, national and or globally desired trail that functions as a cohesive trail that is interconnected to all other city open space and recreation resources.

Appendix A
Overview of Common Terminology

- AETC - Alexandria Emerging Technologies Center
- BMP - Best management practice
- CAP - Climate action plan
- CBD - Central business district
- EAP - Environmental Action Plan
- EPC - Environmental Policy Commission
- EPI - Energy Performance Index
- EUI - Energy use intensity
- FBC - Form based codes
- GBC / USGBC - Green Building Council / United States Green Building Council
- GHG - Green house gases
- GI - Green infrastructure
- GIS - Geographic information system
- IgCC - International Green Construction Code
- ILFI - International Living Future Institute
- LBC - Living Building Challenge
- LEED - Leadership in Energy and Environmental Design
- NBI - New Building Institute
- NIBS - National Institute for Building Sciences
- NGO - Non-governmental organization
- NPS - National Park Service
- NPY - North Potomac Yard
- OEQ - Office of Environmental Quality
- OS / OSMP - Open Space / Master Plan
- P3s - Public-private partnerships
- ROW - Right of way
- PRG - Potomac River Green (GenOn power station redevelopment vision)
- SAP - Small area plan
- SOV - Single occupancy vehicle
- TOD - Transit-oriented development
- UD - Universal design
- UF / UFMP - Urban Forestry / Master Plan
- UFA - Urban Forestry Administration (D.C. specific)
- WBDG - Whole Building Design Guide
- ZNE - Zero net energy
- Bioswales - Swaled drainage course filled with vegetation along roads
- Contraflow Bike Lanes - Bicycle lane on a one-way road, directed opposite of car traffic

- Cycle Tracks - Dedicated bicycle lane in between automobile and sidewalk grades
- Parklet - Small on street area used to liven street life
- Runnel - Narrow, shallow channel in the ground used to direct water flow
- Sharrows - Car / bicycle shared use lane marked by a bicycle logo and chevrons

Appendix B
Matrices of Regional Urban Forestry Programs

City of Alexandria Initiatives

Practices	City of Alexandria Initiatives[62]
Street Trees	High demand; currently lacks species and age diversity; implement pilot programs to develop and adopt alternative street profiles, alternative paving profiles (36-37)
Park Trees	Little is known about the tree population, no comprehensive plan for tree maintenance, develop Green Streets and rededicate Fort Ward as the City's Arboretum (38-39)
Private Trees (i.e. SFDH/ businesses)	Trees are threatened by new development goals; private properties should preserve, plant and maintain trees. Develop guidelines for private property tree planting (41-42)
New Developments	No stand alone section, trees are threatened due to limited regulatory powers
Staffing Levels	Minimal: Robert Taylor, 8 total positions inclusive of 1 vacancy (28)
Funding	FY 2009 budget $2.2mil. Estimated Annual Cost is $3.25 mil (6) Funding is currently inadequate (43)
Canopy Goals	+500/ year street trees EAP, Ch. 7 G. 3 + 400/ year public space trees UFMP, R.4; 40% canopy coverage by 2020 Ch.7 Target
Inventoried?	Completed canopy study through GIS (interview with Robert Taylor)
Compliance with Laws	Current City regulations are outdated and are hard to enforce, goal is to strengthen Alexandria's ability to protect and increase its tree canopy (42-43)
Replacement Requirements?	Insufficient replacement stock for mature and over-mature trees (42)

Arlington County Initiatives

Practices	Arlington County Initiatives[63]
Street Trees	Street tree inventory rated at 60% according to CTLA, trees are fair to good condition (12) Create more opportunities for tree planting in public ROW – tree nubs, street narrowing, larger planting strips, curb, gutter and sidewalk design and material innovations, ensure tree species diversity (21)
Park Trees	Monitor tree health, begin to inventory park trees, manage forested areas on public lands, control and manage invasive plant species, maintain BMPs (23)
Private Trees (i.e. SFDH/ businesses)	Establish tree fund dedicated to planting trees on private property and educating citizens, establish program working with Civic Associations with volunteers to plant private property trees (16)
New Developments	Ensure early review of development plans during the design process to promote tree preservation as opposed to tree replacement, when feasible (19)
Staffing Levels	Implementation through DPRCR, DES, DCPHD, UFC (33)
Funding	Half of programs have been funded, many are not applicable for funding (33-36)
Canopy Goals	40% tree canopy coverage overall, 50% for suburbs, 25% urban residential, 15% CBDs (10-11) (One study estimated a 41% county canopy coverage in 1999 – due to majority of county being residential) (12)
Inventoried?	GIS street tree inventory, canopy satellite analysis, and GIS based planting plans (3)
Compliance with Laws	Tree Preservation Ordinance Nov. 2002, inclusive of regulation of trees and shrubs on public property and heritage, memorial, specimen and street trees on public or private property (31) Admin. Regulations 4.1 and 4.3, Chesapeake Bay Preservation Ord. (32)
Replacement Requirements?	Explore options to offer incentives to preserve canopy and encourage planting on private property (16)

Fairfax County Initiatives

Practices	Fairfax County Initiatives[64]
Street Trees	Tree Action Plan recommendations will be incorporated into the Environmental Improvement Program (EIP) Annual report (14) Plant and protect trees by streams, streets and trails – plant trees along streets and along sidewalks and trails – partner with VDOT to encourage and implement tree planting along streets. Develop and implement a tree-planting program for streets and trails that encourages businesses, homeowners associations and residents to participate (30)
Park Trees	Manage the forest ecosystems holistically by taking into account the wide range of organisms that make up and inhabit forests, manage the county's urban forest as a functional ecosystem and factor climate change into urban forest management plans (26)
Private Trees (i.e. SFDH/ businesses)	Encourage businesses and private citizens to plant native species, make sustainable design practices such as green roofs and rain gardens a countywide goal, develop desirable and effective incentives to encourage tree planting (8)
New Developments	Encourage Sustainable Design Practices in site development and redevelopment (29), optimize tree conservation in land development (33)
Staffing Levels	Unknown – no mentioned structure
Funding	Develop, estimate the cost and budget for tree maintenance programs along streets, trails and sidewalks (31)
Canopy Goals	Current 41% 104,000 acres of canopy over county landmass of 252,828 acres urbanized Virginia average of 35.3% canopy coverage, urbanized Maryland average of 40.1% canopy coverage (10)
Inventoried?	Studies conducted and satellite imagery (throughout the plan)
Compliance with Laws	First tree preservation and planting ordinance in 1973 (4)
Replacement Requirements?	Not mentioned in the county Tree Action Plan

Washington, D.C. Initiatives

Practices	Washington, D.C. Initiatives[65]
Street Trees	Viewable on city database; Urban Forestry Administration (UFA) plants 4,150 trees in the public ROW every year, UFA also maintains street trees (15)
Park Trees	NPS plants and maintains trees on National park land (18)
Private Trees (i.e. SFDH/ businesses)	Casey Trees offers homeowners $100 for each tree they purchase and plant – most trees planted are understory trees (17)
New Developments	Casey Trees Community Tree Planting Program gives grants to businesses and communities that apply to plant ten or more trees, 850 trees planted / year through this grant (17)
Staffing Levels	Unknown at city level; Canopy Keepers through UFA – trains and provides resources for residents who sign an agreement to maintain trees (16)
Funding	Cooperative Forestry Assistance Act (CFAA) Funding (14) and Casey Trees Initiatives (17)
Canopy Goals	40% by 2032 – chosen because it is specific, measurable, achievable, realistic and time oriented, goal of planting 10,800 trees/ year, DC UFA plants 4,000 trees / year removes 1,500 trees / year. Will need public, private and non-prof to add 2,041 acres of canopy cover over next 20 years (18-19)
Inventoried?	Completed in 2002 by volunteers, included measures on tree species, health indicators, economic value and environmental worth (12)
Compliance with Laws	Urban Forest Preservation Act: Enacted in 2001 to protect and expand the District's tree canopy; has schedule of fines for violations (16&22)
Replacement Requirements?	Prioritizing planting areas and implementing planting efforts based on priority areas (21)

Urban Forestry Management Plan BMPs

Practices	Urban Forestry Management Plan Recommendations[66]
Street Trees	No direct recommendations
Park Trees	No direct recommendations
Private Trees (i.e. SFDH/ businesses)	Develop a tree care door hanger or brochure to go to each residence where new trees are planted to encourage them to help maintain the tree and not damage it during mowing (14) general public relations and education material (14)
New Developments	No direct recommendations
Staffing Levels	Adopt a Tree Board or Advisory Council Development (13)
Funding	An UF Management Plan provides data and analysis needed to determine specific levels of funding for tree maintenance and tree planting projected over a multi-year period (2)
Canopy Goals	Not stated within the manual, but 40% is the American Forests recommendation
Inventoried?	GIS, GPS supported collection, Windshield Surveys, types of data to collect (4), statistical sample inventories and partial versus complete inventories (5), utilize tree inventory and mapping data management software (9)
Compliance with Laws	Next UF Management Plan review – complete an ordinance, policies, and procedures review and recommend revisions (18)
Replacement Requirements?	Provide a tree cost-benefit analysis (18)
Extra information	Does provide links to other resources and UF tools

Appendix C
Additional Resources and BMPs

Living and Complete Streets

Organization / Locality	Synopsis	Hyper-link
Wikipedia.org	Living streets history, design, and typology around the world	http://en.wikipedia.org/wiki/Living_street
Living Streets LA Resources	Resource page for Living Streets LA, inclusive of the publication Tactical Urbanism 2 that details the future of urban planning including topics on "Guerilla Gardening," "Chair Bombing," and "Site Pre-vitalization"	http://www.livingstreetsla.org/resources-2/
Nooga.com	A plan to make Chattanooga Streets complete news release	http://issuu.com/livingstreetsla/docs/living_streets_la_case_study
Chattanooga Complete Streets Model Ordinance	Used to create and publish a set of design standards, with a subsection on implementation and reporting strategies	www.chattanooga.gov/city-council-files/Agenda-Minutes/Agenda/2014/04-01-2014_Agenda_Packet/Ordinances/V(a)_City_Code_Ch_32_complete_streets.pdf
Chicago Complete Streets	Compendium of design guidelines, plans, reports, program projects and safety education program resources	http://chicagocompletestreets.org/your-streets/design-guidelines/

Trail Networking and Open Space Connectivity

Organization/ Locality	Synopsis	Hyper-link
Halifax Open Space Functional Plan	A document providing overview of scope and process in Nova Scotia	www.halifax.ca/boardscom/documents/120119atac731.pdf
Indiana County Open Space, Greenways and Trails Plan	A comprehensive Pennsylvania plan showcasing purposes, goals, methodologies, opportunities, corridor typologies, actions for implementations and more	www.countyofindiana.org/plan/Greenways%20&%20Open%20Space/2025_Greenways%20Plan%20FINAL.pdf
Kennett Township Open Space Network Plan	Chapter 11 of the Comp Plan, provides open space typology, benefits of open space, local network connectivity, regional connectivity potential, recommendations and more	http://kennett.pa.us/wp-content/uploads/2013/10/Ch-11-Open-Space-Nov-2014.pdf
Dallas, Texas Parks and Recreation	Trail typologies, documents, and contacts	www.dallasparks.org/149/Trails
Preservation Dallas, Mobile Apps	Mobile Apps designed around urban trails in Dallas, Texas	www.preservationdallas.org/get-involved/featured-groups/urban-armadillos/
Seattle, Washington, The Trails Program	Part of the Green Seattle Partnership with the vision, "Of a city with diverse, invasive-free sustainable forested parklands… Seattle's urban forest will be supported by an aware and engaged community…"	www.seattle.gov/parks/environment/trails/trailsprogram.htm
Portland Maine: Our Trails	Model trails and open space map with a searchable feature, and preferred running routes	http://trails.org/our-trails/
SLC: the 9 Line	A recent linear trail addition linking several Salt Lake City neighborhoods together along an abandoned rail corridor	http://redthread.utah.edu/now-open-9-line-trail-linking-slc-west-to-east/6510
Urbis Think Tank	Article titled Innovation in Open Space for Urban Infill Sites	http://www.urbis.com.au/think-tank/newsletters/innovation-in-open-space-for-urban-infill-sites
Land Trust Alliance	The Urban Green Space Conservation Assessment Report of December 2014 "Reports on the state of land trust within cities and outlines some opportunities for the Alliance to help advance urban green space conservation for testing and further consideration"	www.landtrustalliance.org/conservation/community-conservation/urban-green-space-conservation-assessment-report

Living Buildings

Organization / Locality	Synopsis	Hyper-link
Scientific American	Article entitled "Green Architecture: What makes a Structure a 'Living Building'?" A well written article describing the fundamentals and providing an overview of what is, and what is expected to come of living buildings	http://www.scientificamerican.com/article/earth-talks-living-building/
Living Building Annual Report, July 2009	An initial report on the then new next generation of buildings and the conceptual framework behind the LBC	https://ilbi.org/education/Resources-Documents/Reports-Docs/ProcessDocs/09-0729%20code%20paper%20Eisenberg.pdf
Living Building Pilot Cities	Cities that have neighborhoods aspiring to attain living community certification. For example D.C. is questioning the ability to provide all energy required by the city from rooftop solar by 2050	https://living-future.org/lcc/pilot-cities
Living Building Certificates	Article on sustainablebusiness.com showcasing three living building certificates awarded and the requirements needed to attain those awards. From 2010	www.sustainablebusiness.com/index.cfm/go/news.display/id/21215
The Father of the Green Roof	Friedensreich Hundertwasser architecture looking at eccentric green projects in Europe and the Pacific dating from the 1980s to the 2000s	http://www.inspirationgreen.com/hundertwasser-architecture.html
Passive House Institute US	Passive building cuts energy consumption by 60-80% and provides more comfortable indoor environments	http://www.phius.org/home-page

Urban Forestry

Organization / Locality	Synopsis	Hyper-link
ISSUU	Site provides Pittsburg's UFMP, ***More importantly is the wealth of resources and related publications underneath the UFMP – master plans, strategies, report cards, case studies from all over the world***	http://issuu.com/treepittsburgh/docs/final_pittsburgh_urban_forest_management_plan_augu
The Urban Forest Project, Washington, DC	In conjunction with DDOT, fosters awareness of UF through art	http://ufp-dc.com/
The Urban Forest Project, Global Site	(This site has been broken for several weeks)	http://www.ufp-global.com/
Virginia Department of Forestry	Programs, services, regional foresters, forest health, education and conservation	http://dof.virginia.gov/locations/alexandria.htm
Tree Pittsburgh	Pittsburg's progressive UFMP	http://treepittsburgh.org/urban-forest-master-plan
Washington State Department of Natural Resources	Pacific Northwest UF Online Technology Transfer, UF Restoration Project, Tree City USA, Community Forestry Assistance Grant Resources, and Don't Top Trees	http://www.dnr.wa.gov/ResearchScience/Topics/UrbanForestry/Pages/Home.aspx

Other Urban Greening Resources

Organization / Locality	Synopsis	Hyper-link
The Natural Step Organization	Compendium of toolkits from around the world	www.thenaturalstep.org/en/toolkits-around-world
The Natural Step Organization	United States Sustainability Primer is a resource giving basic background on sustainability – looking at the big picture, root causes, system conditions and backcasting among other topics	www.naturalstep.org/sites/all/files/sustainability_primer_usa.pdf
Chicago Green Roofs	Chicago under Mayor Daly has become a leader in green roof policy and action with almost 5.5 million square feet of coverage	www.cityofchicago.org/city/en/depts/dcd/supp_info/chicago_green_roofs.html
Living Architecture Monitor	A publication dedicated to green roofs, and architecture. One such issue covers biodiversity conservation, green policy, and understanding the business case for green roofs	http://www.nxtbook.com/dawson/greenroofs/lam_2014winter/#/22
Universal Design for New York City	Universal design (UD) standards are required components for living streets and buildings. This 236 page manual covers more than just essentials when it comes to UD standards	www.nyc.gov/html/ddc/downloads/pdf/udny/udny2.pdf
California New Home Universal Design Checklist	Building a new home? Here is a checklist to make sure it adheres to UD standards	www.hcd.ca.gov/codes/shl/6-Text-Universal_Design_Checklist.pdf
Town of Southampton Universal Design Building Code	A model building code for UD building compliance	http://suffolkcommunitycouncil org.cv.siteprotect.net/documents/SouthamptonBuildingCodeforUniversalDesign.pdf
Plastic Bottle-less San Francisco	Article entitled, “San Francisco Becomes the First City to Ban Sale of Plastic Bottles	http://http://ht.ly/JyUyY
Rainwater collection	Ideologies by the Department of Ecology of rainwater collection in the context of Washington State	http://www.ecy.wa.gov/programs/wr/hq/rwh.html

Links to Relevant National Government Programs

Organization / Locality	Synopsis	Hyper-link
Energy Policy Act of 2005	The outdated Federal Energy Policy Act	http://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf
USGBC History	The history of the USGBC	http://www.usgbc.org/about/history
National Capital Region (NCR) GBC	This site is the overview from the main GBC site, and does not include the City of Alexandria or other cities in the list of member municipalities	www.usgbc.org/chapters/national-capital-region-chapter, and a direct link: www.usgbcncr.org
Building Security Certification Program (BSCP)	Offers certification programs, renewal certification services, and a database to find certified professionals	http://bscp.asce.org/

Internal Links to Local Government Resources

Organization / Document	Hyper-link
City of Alexandria's EAP	http://ecocity.ncr.vt.edu/docs/FINAL_EAP_06_18_09.pdf
City of Alexandria's UFMP	www.alexandriava.gov/uploadedFiles/recreation/info/UFMP%20Final.pdf
City of Alexandria's OSMP	http://www.alexandriava.gov/uploadedfiles/recreation/info/OpenSpacePlan.pdf
City of Alexandria's Bicycle MP 2008 Final Draft	http://alexandriava.gov/uploadedfiles/tes/info/tes_tmp_bicycle.pdf
City of Alexandria's Draft Complete Streets Ordinance	http://alexandriava.gov/uploadedFiles/tes/info/DRAFT-%20Complete%20Streets%20Ordinance%202010-06-01%20revised%20CLEAN.pdf
City of Alexandria's Local Motion and Transportation MP	http://alexandriava.gov/localmotion/info/default.aspx?id=14184
City of Alexandria's Local Motion and Complete Streets	http://alexandriava.gov/localmotion/info/default.aspx?id=49868
City of Alexandria's North Potomac Yard SAP	http://www.alexandriava.gov/uploadedFiles/planning/info/potomacyard/Potomac%20Yard%20%20Approved%20SAP.pdf
City of Alexandria's NPY SAP Communications	http://www.alexandriava.gov/news_display.aspx?id=84393
City of Alexandria's King Street Metro Station/Eisenhower Avenue SAP	http://www.alexandriava.gov/uploadedFiles/planning/info/masterplan/King%20Street%20Eisenhower%20Avenue%20Metro%20Station%20web%20version.pdf
City of Alexandria's Eisenhower West SAP	http://www.alexandriava.gov/uploadedFiles/planning/info/EisenhowerWest/09082014%20EW%20SC%20Mtg.pdf
City of Alexandria's Eisenhower West Planning Process	http://www.alexandriava.gov/EisenhowerWest

GenOn Power Station Site Specific Resources

Organization / Locality	Synopsis	Hyper-link
Potomac River Green (PRG) Plan	Link to full developer's website	http://potomacrivergreen.org/our-plan
PRG	The full plan can be read here	http://potomacrivergreen.org/sites/default/files/PRG_RedevBook_08.04.11_v2_3.pdf
SWA Group	A leading international landscape architecture, planning and urban design firm	http://swagroup.com/
SWA Group	A published article about the repurposing of coal-fired power plants	www.ideas.swagroup.com/repurposing-coal-fired-power-plants/

Cascadia GBC Case Study

The Cascadian GBC is the northwest regional chapter of the USGBC that encompasses 15 collaboratives in Alaska, British Columbia (BC), Washington State and Oregon, and is also a program and partner of the ILFI. The USGBC and Cascadian GBC are both non-governmental organizations promoting green building projects and education throughout the United States. The online representation for this program is very similar to the ILFI. This case study has been moved to the appendix due to much overlap with the ILFI.

Implementing some of the same ideologies, the Cascadian GBC is an organization directed by its members. Currently the Council is advocating a call to action regarding its Sustainable Water Campaign through public invitations and proposals directed towards three different water scarcity issues. The Council is also producing its own research on emerging BMPs regarding water usage and production. This is all geared towards aligning sustainability measures with smart business decisions and actions, in this case regarding water scarcity and usage.

Other research outlets and projects include "Net Zero and Living Building Challenge Financial Study," – a fiscal study on the feasibility of the LBC in Washington, D.C. This study will be further discussed at the end of this section. Other research projects include "Affordable Housing" – how the LBC can be possible for multi-family affordable housing projects, and "Code and Regulatory Barriers to the Living Building Challenge for Sustainable, Affordable, Residential Development (SARD)" – this project incorporated several green residential project case studies in assessing code and regulatory barriers in achieving living building standards in future developments.[67]

The Cascadia GBC also has its own version of the Trim Tab periodical, and several education programs. The Council helps green leaders gain accreditation in different programs and puts on a Living Future unConference that attracts the worlds most innovative and influential leaders in urban greening. Additional resources on the site can be found here: http://living-future.org/cascadia/resources, and the

involved collaboratives here: http://living-future.org/cascadia/collaboratives. Some of the resources included are the LEED Education Providers, http://www.usgbc.org/?CategoryID=127, King County GreenTools, http://your.kingcounty.gov/solidwaste/greenbuilding/index.asp, and the Green Building Hotline, http://www.portlandoregon.gov/bps/45837.

The USGBC was started in 1993, and the Cascadian GBC started several years later in 1999. Unfortunately there are no references to budget or staffing. This chapter of the USGBC, and the actions, research, and other initiatives could be replicated in the National Capital Region chapter of the GBC. Although it is not quite clear if the City of Alexandria is part of that chapter as the Chapter website, www.usgbc.org/chapters/national-capital-region-chapter, does include the City within the jurisdictions covered. A greater integration between the City of Alexandria and the GBC could be considered here. All contact information including email and phone contacts can be retrieved at the ILFI main contact page: http://living-future.org/contact.

Endnotes

[i] De Sousa, C., *The greening of urban post-industrial landscapes: past practices and emerging trends,* Local Environment, 2014, 19(10): pages 1049-1067.

[ii] Schilling, J. and J. Logan, *Greening the Rust Belt: A Green Infrastructure Model for Right Sizing America's Shrinking Cities,* Journal of the American Planning Association, 2008, 74(4): pages 451-466.

[iii] City of Alexandria, *Eco-City Charter 2008*, Environmental Policy Commission, City of Alexandria and The Urban Affairs and Planning Program Virginia Polytechnic & State University, Alexandria Center, June 14th, 2008, https://alexandriava.gov/uploadedFiles/tes/oeq/EcoCityCharter2008.pdf (accessed May 3, 2015).

[iv] Eco-City Alexandria, *2014 Alexandria's Top Ten Environmental Accomplishments*, http://www.alexandriava.gov/uploadedFiles/tes/oeq/info/Alexandria's 2014 Environmental Accomplishments-Final.pdf pages 2-3 (accessed May 3, 2015).

[v] Living Building Challenge, *The Certification Process*, http://living-future.org/lbc/certification (accessed March 31, 2015).

[vi] Smart Growth America, *National Complete Streets Coalition,* http://www.smartgrowthamerica.org/complete-streets (accessed April 20, 2015).

[vii] Philadelphia Complete Streets: Safe. Comfortable. Convenient., *The Handbook,* http://www.philadelphiastreets.com/complete-streets-handbook/the-handbook/ (accessed April 20, 2015).

[viii] Model Design Manual for Living Streets, Los Angeles County, *About the Manual,* 2011, http://modelstreetdesignmanual.com/index.html (accessed April 1, 2015).

[ix] Model Design Manual for Living Streets, Los Angeles County 2011, *Chapter 11. Streetscape Ecosystem,* http://www.wsdot.wa.gov/NR/rdonlyres/7342382D-C102-47CA-A806-32247EA07CCC/0/model_street_design_manual.pdf page 11-31 (accessed March 29, 2015).

[x] Ibid., page 11-33.

[xi] GObike Buffalo, *Complete Streets,* http://gobikebuffalo.org/programs/complete-streets/ (accessed April 1, 2015).

[xii] Ibid.

[xiii] Coexist New York State, *Welcome* http://coexistnys.org/ (accessed April 1, 2015).

[xiv] Mayor's Office of Sustainability, City of Philadelphia, *Sustainability Programs,* http://www.phila.gov/green/index.html (accessed April 20, 2015).

[xv] Philadelphia Complete Streets: Safe. Comfortable. Convenient., *Overview,* http://www.philadelphiastreets.com/complete-streets-handbook/the-handbook/ (accessed April 20, 2015).

[xvi] Mayor's Office of Transportation and Utilities, *Philadelphia Complete Streets Design Handbook,* http://www.philadelphiastreets.com/images/uploads/documents/Binder2.pdf page 1 (accessed April 20, 2015).

[xvii] Ibid., page 9.

[xviii] Mayor's Office of Transportation and Utilities, *City of Philadelphia Bicycle Parking Corral Application,* http://www.philadelphiastreets.com/images/uploads/resource_library/City_of_Philadelphia_Bike_Corral_Application.pdf page 1 (accessed April 20, 2015).

[xix] Mayor's Office of Transportation and Utilities, *City of Philadelphia Parklet Guidelines & Application,* http://www.philadelphiastreets.com/images/uploads/resource_library/City-of-Philadelphia-Parklet-Application.pdf page 2 (accessed April 20, 2015).

[xx] Rhodeside & Harwell, Incorporated Economic Research Associates, Inc. Under Contract to City of Alexandria, *Alexandria Open Space Plan,* 2002 www.Virginiaalexandriava.gov/uploadedfiles/recreation/info/OpenSpacePlan.pdf page 48 (accessed April 20, 2015).

[xxi] Ibid.

[xxii] *Philosopher's Walk* http://en.wikipedia.org/wiki/Philosopher%27s_Walk (accessed April 1, 2015).

[xxiii] Office of the Mayor, Kyoto City, *Outline of the Master Plan of Kyoto City: Life of peace, City of prosperity, Built on mutual trust Kyoto, in the 21st century 2001-2010*, January 2001, http://www.city.kyoto.jp/koho/eng/plan/img/english.pdf#page=13 page 16 (accessed April 1, 2015).

[xxiv] Kyoto City Official Website, *The Historical Scenic Beauty of Kyoto: The historical scenic beauty of Kyoto to be maintained and improved*, 2013, http://www.city.kyoto.lg.jp/tokei/page/0000120167.html page 174-176, (accessed March 29, 2015).
[xxv] City of Colorado Springs Parks, Recreation & Cultural Services, *City of Colorado Springs Park System Master Plan*, September 23, 2014, http://parks.coloradosprings.gov/sites/default/files/parks_recreation_and_cultural_services/cos_masterplandocument_140923-view.pdf pages 13-14, (accessed April 1, 2015).
[xxvi] Ibid., page 26.
[xxvii] Ibid., page 70.
[xxviii] Sarah Nugent, Anna Packard, Erica Brabon and Stephanie Vierra, *Living, Regenerative, and Adaptive Buildings*, Whole Building Design Guide: a program of the National Institute of Building Sciences, August 10, 2011, http://www.wbdg.org/resources/livingbuildings.php (accessed March 29, 2015).
[xxix] Wikipedia: the Free Encyclopedia, *Living Building Challenge*, February 19, 2015, http://en.wikipedia.org/wiki/Living_Building_Challenge (accessed March 29, 2015).
[xxx] National Institute of Building Sciences, *About the Institute*, 2015, http://www.nibs.org/?page=about (accessed April 11, 2015).
[xxxi] Ibid.
[xxxii] Don Prowler, *Whole Building Design*, Whole Building Design Guide: a program of the National Institute of Building Sciences, March 22, 2012, http://www.wbdg.org/wbdg_approach.php (accessed April 11, 2015).
[xxxiii] Ibid.
[xxxiv] Ibid.
[xxxv] Sarah Nugent, Anna Packard, Erica Brabon and Stephanie Vierra, *Living, Regenerative, and Adaptive Buildings*, Whole Building Design Guide: a program of the National Institute of Building Sciences, August 10, 2011, http://www.wbdg.org/resources/livingbuildings.php (accessed March 29, 2015).
[xxxvi] Ibid.
[xxxvii] Ibid.
[xxxviii] Advanced Buildings: Energy Performance Solutions from NBI, *High Performance Buildings Made Easier*, 2014, http://www.advancedbuildings.net/ (accessed April 1, 2015).
[xxxix] New Buildings Institute, *A Search for Deep Savings*, 2014, http://newbuildings.org/case-studies-research (accessed March 29, 2015).
[xl] International Living Future Institute, *Annual Report 2013*, 2013 https://living-future.org/sites/default/files/reports/ILFI%202013%20Annual%20Report_sm_pages.pdf page 3, (accessed March 29, 2015).
[xli] International Living Future Institute, *About the International Living Future Institute*, 2015, http://living-future.org/ilfi/about-international-living-future-institute (accessed March 29, 2015).
[xlii] International Living Future Institute, *Living Building Challenge 3.0: A Visionary Path to a Regenerative Future*, 2014 http://living-future.org/sites/default/files/reports/FINAL%20LBC%203_0_WebOptimized_low.pdf page 21, (accessed May 4, 2015)
[xliii] Omega Institute, *Omega Center for Sustainable Living*, 2015 http://www.eomega.org/omega-in-action/key-initiatives/omega-center-for-sustainable-living (accessed May 4, 2015).
[xliv] Washington University in St. Louis, *Living Learning Center at Tyson Research Center*, 2008 http://tyson.wustl.edu/llc/index.php (accessed May 4, 2015).
[xlv] Hawai'i Preparatory Academy, *The HPA Energy Lab*, http://www.hpa.edu/academics/energy-lab (accessed May 4, 2015).
[xlvi] Bertschi School, *Where Science Lives*, 2013, http://www.bertschi.org/who-we-are/our-campus/science-wing/ (accessed May 4, 2015).
[xlvii] Bullit Foundation, *The Greenest Commercial Building in the World*, 2013 http://www.bullittcenter.org/ (accessed May 4, 2015).
[xlviii] Delta Sigma Theta Sorority, Incorporated, *Green Sustainable Buildings*, 2015, http://www.portlanddeltas.org/#!green-sustainable-build/c1agq/ (accessed May 4, 2015).

[xlix] Alice Ferguson Foundation, *Potomac Watershed Study Center*, 2012, http://fergusonfoundation.org/living-building-on-the-potomac/ (accessed May 4, 2015).
[l] Amy Cortese, *Net Zero and Living Building Challenge Financial Study: A Cost Comparison Report for Buildings in the District of Columbia*, ILFI, NBI, and Skanska, 2013, http://newbuildings.org/sites/default/files/ZNECostComparisonBuildingsDC.pdf (accessed May 4, 2015).
[li] City of Alexandria Department of Planning and Zoning, *North Potomac Yard Small Area Plan*, April 7 2010, http://www.alexandriava.gov/uploadedFiles/planning/info/potomacyard/Potomac%20Yard%20%20Approved%20SAP.pdf 4.27 page 4, (accessed April 27, 2015).
[lii] Ibid., pages 5 and 10.
[liii] Ibid., page 63.
[liv] Ibid., page 69.
[lv] City of Alexandria Department of Planning and Zoning, *Eisenhower West Small Area Plan Planning Process*, May 7, 2015, http://www.alexandriava.gov/EisenhowerWest (accessed April 27, 2015).
[lvi] Ibid.
[lvii] Sourcewatch.org, *Potomac River Generating Station*, May 23, 2013, http://www.sourcewatch.org/index.php/Potomac_River_Generating_Station (accessed April 26, 2015).
[lviii] City of Alexandria Department of Planning and Zoning, *Alexandria Waterfront Small Area Plan*, February 25, 2012, http://www.alexandriava.gov/uploadedFiles/planning/info/Waterfront/Entire%20Waterfront%20Plan_No%20Appendices_High%20Quality%20for%20Print_FINAL_070612.pdf page 1, (accessed April 26, 2015).
[lix] C.J. Hughes, *Converting a Run-Down Power Plant*, New York Times, June 3, 2014, http://www.nytimes.com/2014/06/04/business/converting-a-run-down-yonkers-power-plant-into-an-arts-complex.html?_r=0 (accessed March 27, 2015).
[lx] American Clean Skies Foundation, *Repurposing Legacy Power Plants: Lessons for the Future,* August, 2011, www.potomacrivergreen.org/sites/default/files/ACSF_layout_coverANDtext.pdf (accessed March 27, 2015).
[lxi] Ibid., page 5.
[62] City of Alexandria's UFMP (accessed May 11, 2015).
[63] Arlington County Department of Parks, Recreation and Cultural Resources*, Urban Forest Master Plan,* July 28, 2004, http://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2014/04/Urban-Forest-Master-Plan.pdf (accessed May 11, 2015).
[64] Fairfax County, *Tree Action Plan: A 20-Year Strategic Plan to Conserve and Manage Fairfax County's Urban Forest*, December 2006, http://www.fairfaxcounty.gov/dpwes/environmental/treeactionplan.pdf (accessed May 11, 2015).
[65] Government of the District of Columbia, *District of Columbia Urban Tree Canopy Plan*, January 2013, http://ddoe.dc.gov/sites/default/files/dc/sites/ddoe/page_content/attachments/Draft_Urban_Tree_Canopy_Plan_Final.pdf (accessed May 11, 2015).
[66] APWA Press, *Urban Forest Management Plan: Urban Forestry Best Management Practices for Public Works Managers*, http://www2.apwa.net/documents/About/CoopAgreements/UrbanForestry/UrbanForestry-4.pdf (accessed May 11, 2015).
[67] Cascadia Green Building Council, *The Research Agenda for the Bioregion and Beyond,* 2015, http://living-future.org/cascadia/ideas-action/research-agenda-bioregion-and-beyond (accessed April 1, 2015).