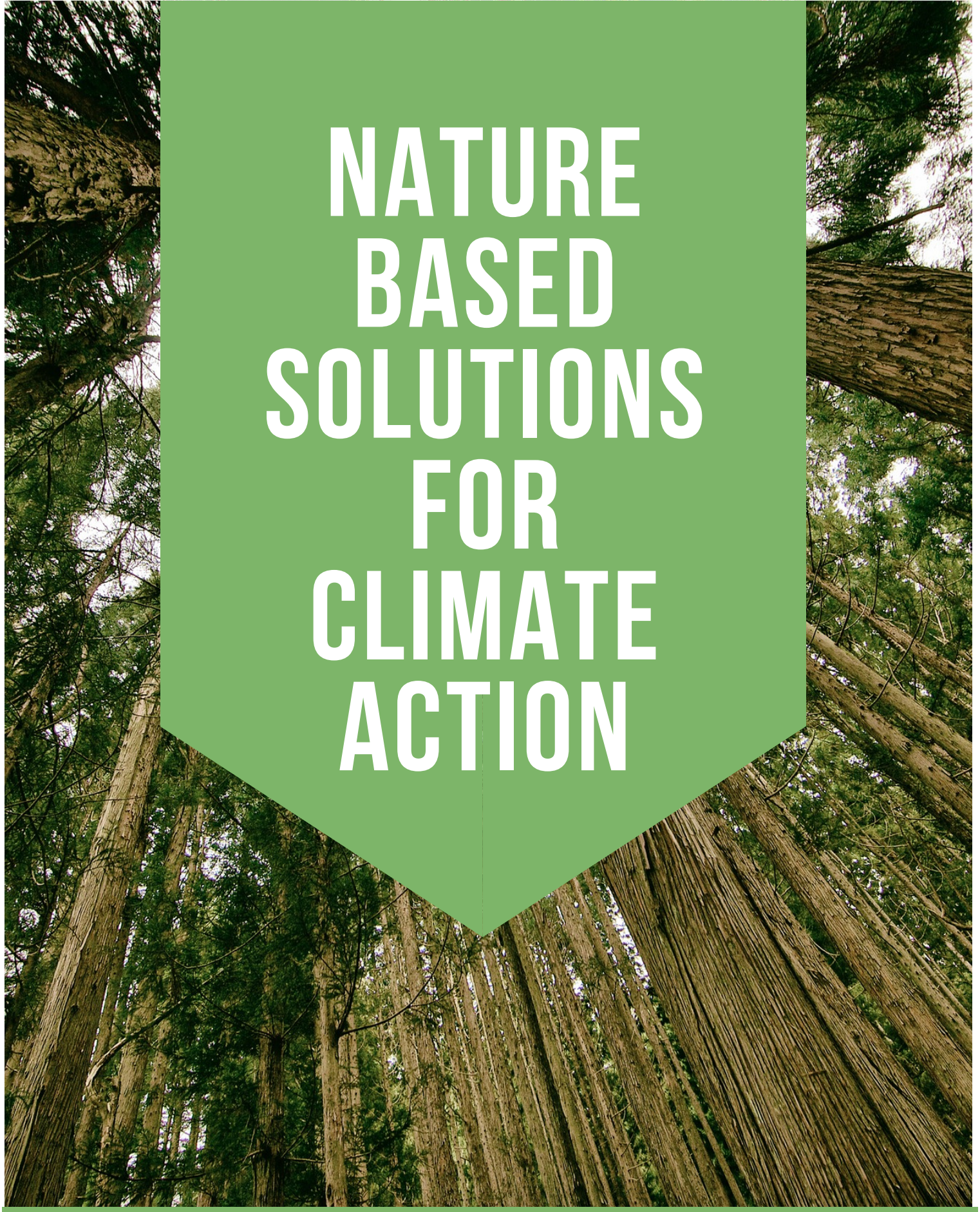


NATURE BASED SOLUTIONS FOR CLIMATE ACTION

A STUDY BY CHAPMAN UNIVERSITY
ENVIRONMENTAL SCIENCE AND POLICY PROGRAM
FOR THE CITY OF COSTA MESA

Executive Summary

The City of Costa Mesa is committed to environmental stewardship, community wellbeing and economic prosperity. As part of its ongoing efforts to advance sustainability and climate action in Costa Mesa, the City's Office of Sustainability collaborated with Chapman University to explore ways of enhancing local climate resilience and disaster reduction by using Nature-based solutions (NbS) such as green infrastructure, ecological restoration, urban greenspaces and carbon sequestration. This research project was funded by a National Science Foundation (NSF) grant and administered by STIR Labs.

NbS can improve the health of the local ecosystem and the quality of life for stakeholders within the city of Costa Mesa. Case studies explored throughout this document demonstrate the potential for using NbS to address and prepare for climate change impacts within the city. This document also demonstrates that providing education on the benefits of NbS can inspire future projects that can engage community members and lead to increased personal health and ecological benefits for the community at large. This study also explores how increased access to greenspaces such as parks, community gardens, and water features can improve the bond between community members and the environment, which can increase support for climate action and mitigation efforts.

This report also highlights the potential to create thriving and impactful partnerships between the city, other local agencies, the business sector and the existing community groups that can curate meaningful solutions to climate change. Through partnerships with local businesses and community organizations focused in areas such as urban agriculture and nature restoration the city has the ability to leverage existing community resources to conduct research and gather community input on possible NbS that can be implemented in Costa Mesa.

A living green wall located in Dubai, UAE.

Introduction

Nature-based Solutions (NbS) can be implemented to combat climate change using natural resources. These natural strategies and management techniques reduce and mitigate the effects of climate change. NbS such as green infrastructure, urban green spaces, and carbon sequestration can reduce the negative effects of climate change, by lowering the amount of carbon dioxide in the atmosphere while simultaneously decreasing the temperature of the city. The addition of urban green spaces provides more organic coverage to lower the urban heat island effect, and it can reduce the amount of flammable dry shrubs, which aids in wildfire prevention.

NbS can also be a way to address environmental justice concerns. Residents with low socioeconomic status often face environmental injustices due to their proximity to factories and lack of access to urban green spaces such as parks. It is critical to ensure that nature spaces are equally distributed throughout the cities and easily accessible for all residents. The mutual economic and environmental benefits make NbS appealing to cities such as Costa Mesa.

The city of Costa Mesa has already implemented some programs that support NbS. One such program is the work the city has done to a Tree City. Becoming a Tree City USA shows the city has taken serious efforts to expand its tree canopy and is looking to continue environmentally friendly practices. Costa Mesa also created other environmental programs, such as the former Green Team, the OC Organic Gardening Club, and the OC Urban Forest, which have aided in the understanding of NbS. Costa Mesa has partnered with the OC Parks and environmental consulting companies in its ecosystem restoration plans to restore Talbert and Fairview parks. The city has established two community gardens, the Hamilton and Del Mar that cover 102 parcels of land. Additionally, Costa Mesa communicates with residents through programs at the fire department to help mitigate fire risk and improve disaster response. Costa Mesa has the ability to cultivate more sustainability practices and initiatives, which can help conserve water and land. According to Executive Order N-82-20, by the year 2030 at least 30 percent of California's water and land must be conserved. With the right techniques applied and proper communication, then a unique and effective environmental mitigation plan that prioritizes NbS can be implemented in Costa Mesa.

A brief overview of the potential NbS that could be implemented in Costa Mesa are outlined below and explored more fully in the following chapter.

Carbon Sequestration

Carbon sequestration is the active removal of carbon dioxide from the surrounding areas as a way to lower emissions. Urban vegetation is the most common form of carbon sequestration using NbS. The efforts necessary to begin community carbon sequestration not only remove carbon from the atmosphere but the addition of urban forestry also helps with other environmental mitigation efforts such as increased shade coverage and microclimate regulation.

Ecological Restoration

Ecosystem restoration is a nature-based solution that works to repair damaged ecosystems while also engaging the local community to learn more about native plants. Solutions can include swapping out invasive vegetation to native–more drought friendly–plants, as well as creating community restoration projects, to encourage education and long-term engagement with local ecosystems.

Urban Green Space

Urban greenspace is an innovative nature based solution that expands the presence of natural spaces in cities. It enhances local climate resilience, mitigates the impacts of extreme weather events, and improves the health and quality of life for urban residents. Greenspaces can come in many forms, such as parks, nature reserves, and community gardens, and are therefore an important component of public open spaces that serve all members of the local community.

Urban Farming

Urban farming fights climate change by improving cooling, air circulation, and water regulation, while also providing food for the community. As noted by Kabisch et al., (2017) urban gardens can additionally combat the heat island effect, while simultaneously providing habitats for wildlife and educating the community about climate change. There are two types of urban gardens: allotments and community gardens. Allotment gardens are mostly larger areas divided into plots that are allocated under rental payments to a single person or a family for non-commercial cultivation of plants. Community gardens can have a permanent or temporary character, and are often characterized by informal claims of urban voids with the purpose of local community development.

Urban Forestry

Urban forestry is the practice of growing and managing trees (along with other types of forest plants) in cities. There are many options available to implement urban forestry, ranging from park development and maintenance to planting trees along streets and near buildings. Trees can help mitigate the urban heat island effect by providing shade and managing air and water flows through evapotranspiration. Trees can also bring biodiversity to cities by acting as habitats for birds and other animals.

Wildfire Risk Reduction

Wildfire risk reduction uses educational programs and other NbS such as increased vegetation to lower the risk of fires and fire starting. Wildfire risk reduction can include fire system plan reviews, building inspections, and permit renewals. This solution actively reaches out to the community and educates the people in preparation for a potential crisis. Wildfire risk plans help regulate and monitor the risks while implementation of green infrastructures.

Green Buildings

Green buildings are a nature-based solution that uses green infrastructure, where buildings can become more environmentally friendly such as implementing green walls, green roofs, or utilizing natural solar energy. By replacing conventional buildings with vegetated surfaces, they can prevent buildings from heating up meaning less energy is necessary to cool the inside of the building. Along with aiding the building's climate, these surfaces can also help regulate humidity and temperature around the building. The benefits from green solutions on buildings include utility cost savings, increased property values, and an extended lifespan of building materials.

Green Infrastructure

Green infrastructure is a nature-based solution that encompasses a sustainable approach to managing stormwater with green materials such as trees, lawns, and forests. When stormwater flows over grey infrastructure surfaces, such as concrete, it picks up pollutants, trash, and toxics from the roads and buildings, where it pollutes water, such as rivers and lakes. The implementation of green infrastructure allows for the reduction of polluted stormwater that reaches waterways and helps reduce temperatures in urban areas.

Carbon Sequestration

Background

Many nature-based solutions (NbS) are a response to a growing number of environmental changes and challenges. These solutions aim to prepare a city for the future of a changing climate while offering benefits to human health. Carbon sequestration, a NbS, is the process of trees and other forms of vegetation taking up carbon dioxide from the atmosphere and converting it into carbon stored in the soil. The idea of pulling carbon dioxide from the atmosphere has been in Western practice since as early as the 1920s and even earlier amongst Indigenous populations, but it was not until the end of the 1970s that carbon sequestration was used more consciously as a mitigation strategy for regional climate change action (IEAGHG). Carbon sequestration plays a role in other NbS, such as urban forestry and urban agriculture. Urban vegetation is the most common form of carbon sequestration using NbS, but there are other ways to sequester carbon from the atmosphere, such as working to improve soil quality by adding micronutrients and thermal energy capture by increasing tree canopy (USGS). The implementation of a carbon sequestration plan not only works to remove carbon from the atmosphere, they often also involve urban forestry, which increases shade coverage and micro-climate regulation.

Carbon sequestration is possible; however, scientific research has made it unclear whether or not urban vegetation has significant effects on reducing a city or region's total carbon emissions (Kabisch et al., 2017). This uncertainty is because it is often difficult to quantify the amount of carbon being sequestered, and that often a city's carbon dioxide emissions are so numerous that it is difficult to make a significant impact using common sequestration methods. Other than tree planting (i.e., soil quality) the elements of this chapter required extensive research and consideration to ensure that our proposal will fit Costa Mesa's needs. From bioactivity in the city's soil to the species of vegetation planted, carbon sequestration is vital and yet difficult to measure.

Costa Mesa has already done substantial work regarding its urban vegetation efforts. By becoming a Tree City, Costa Mesa has shown that it has taken serious efforts to expand the canopy and is looking for more tools and resources to continue this work. Other environmental programs have also created a solid ground of understanding for the city, such as the former Green Team, the OC Organic Gardening Club, and the OC Urban Forest. With the right techniques applied and proper communication, a unique and effective environmental mitigation plan can be applied to Costa Mesa.

Because the efficacy of widespread carbon sequestration calculations are a little unclear, positive effects of increased urban vegetation could be significant for the city of Costa Mesa. Some analysis will have to be done to see how much vegetation would be required to begin to offset the City's emissions, and further research and surveillance

will have to be done to explore the logistics of the hypothetical vegetation. The goal of this chapter is to collect evidence from the community to further understand interest in exploring carbon sequestration strategies. Additionally, we provide suggestions for adaptation, education, and future change within the scope of AB-32. Costa Mesa is similar to many other cities across Southern California, therefore, what Costa Mesa learns or accomplishes from the CCS Protocol will be a model for the rest of California. This may also inspire other California cities to take on a DAC project. No matter what Costa Mesa can do, this is certainly a long-term project with broad goals in mind.

Case Study

There have been numerous studies around carbon sequestration through NbS across the world. These case studies will be explored below and what the City of Costa Mesa could learn from them will be discussed.

Boulder Case Study

In 2018, CSU Boulder and other academic institutions worked on a 120-acre plot of agricultural land set aside for several different carbon sequestration studies that would update current farming practices (Spina, 2019). While the work done in Boulder is hugely beneficial for future carbon sequestration efforts, there are still major differences between what was done in Boulder and what kind of work can be done in Costa Mesa. Furthermore, the bulk of the research was done on soil health restoration and agricultural benefits. Unlike Boulder, Costa Mesa is a largely developed urban city with minimal space for additional tree cover, let alone soil area. From this case study, it was understood that this project would take significant prior research before making any large investments. Most importantly, there has been mixed results regarding the efficacy of carbon farming, and it will likely be several more years before any strong conclusions can be drawn.

Gujarat Case Study

In the western state of Gujarat, India, the first tree enumeration studies were performed in 2011 to get an understanding of tree cover and density across several urban regions in the state. By developing Social Forestry Divisions across the area, the state government created tree-counting parties composed of government workers, NGO members, students, and other community members interested in increasing their region’s total tree coverage. This project has taken decades so far, with over 3.5 million trees planted in the 50 years since this program began. Much of the preliminary work involved tree counting, finding the major areas of deforestation, and deciding how many trees would need to be planted to make a difference. Much of this initial work may be alleviated through remote sensing data from Costa Mesa’s Forestry department. Other

calculations need to be taken into account as well; for instance, the rate of the carbon sequestration capacity in newly planted saplings is far less than it is for a fully grown tree canopy. In other words, this project is very likely to take decades before significant results begin.

A tree cover analysis was completed to find the urban areas with the least tree cover and density and worked for years to employ tree-planting programs across the state. As a combined effort from the state government and the surrounding community organizations, members are involved not only in the initial tree planting events but also in the pruning and general upkeep of all of the trees planted in these urban areas. In Costa Mesa much of the work involves continual costs; the city's involvement in Tree City USA indicated that Costa Mesa has the proper infrastructure to properly manage a potential uptick in urban forestry.

Results from the work the Gujarat government and people have managed to complete together are certainly promising, however, the Indian state is quite a bit different than the coastal city of Costa Mesa. For instance, Gujarat has an area of over 75,000mi², while Costa Mesa is slightly larger than 16mi². Another advantage to having more land means that more areas could be dedicated to tree cover as well as the dispersal of trees in the most urbanized areas. In Costa Mesa, it is vital to discover how much open land can be used for tree planting, as well as how many trees can be added around the city, such as among sidewalks and street medians. The case study in Gujarat also shows the importance of a connected community.

Though these case studies are valuable in allowing us to obtain a better understanding of what work has been done throughout the world to sequester carbon, it is important to note that case studies that take place in areas with climatic conditions similar to Costa Mesa are very difficult to come across. Our team has considered this when determining the best plan of action going forward. It helps especially to consider local policy involving carbon sequestration.

Assembly Bill 32 - The California Global Warming Solutions Act of 2006

In 2006, a historic bill was passed to pave the way for a low-carbon California. Assembly Bill 32, or AB-32, was one of the first bills in the nation that prioritized the reduction of greenhouse gas emissions and protected the environment while also framing it from an economic perspective. It is updated with a new Scoping Plan every four years that gives clear instruction for how to limit greenhouse gas emissions from a legislative and economic standpoint. The goal was to reach 1990 level greenhouse gas emissions (~15% reduction) by 2020, and the goal was met at the end of 2018. It was updated with stronger goals for 2030 and 2045. Part of this state-wide effort includes the Carbon Capture and Sequestration Protocol (CCS Protocol). As a section of Low Carbon Fuel Standards (LCFS), CCS projects completed by cities or regions in California receive LCFS credits for every metric ton of CO2 reduced.

There are many different programs (mostly around crude oil reductions) that have already been approved and implemented by Californian regions and organizations; unfortunately, no Direct Air Capture (DAC) projects have been submitted yet. The sheer scope of work, time, and free space required to accomplish a DAC project is difficult to achieve by groups and cities that are much larger than Costa Mesa. However, since nobody has even come close to completing a DAC project, it would be an incredible opportunity for Costa Mesa to become a forerunner in. The project requires lengthy and in-depth research on current carbon sequestration levels and how much is required to reach approved DAC levels. DAC projects might have minimal interactions because it may be too difficult for any Californian entity to attain. Costa Mesa's leadership in preliminary research, however, would still be greatly beneficial for considering future CCS Protocols.

Further Research

For continued research about carbon sequestration in Costa Mesa, it would be extremely valuable to utilize GIS layers that highlight land use and vegetation. Specifically, layers that display any potential open space as well as population density, to see which areas might be the most in need of carbon sequestration due to emissions from transportation. This includes general land use in Costa Mesa, both existing and planned. Existing City data on greenhouse gas emissions as well as carbon offset or sequestration potential would be helpful tools in this research. Partnerships with industries within the city already working on this issue and making progress can be considered. There may also be soil remediation potential within the city. In terms of goals within the scope of AB-32, an understanding of Costa Mesa's Tree City USA application would be helpful. This would allow an understanding of the full extent of forestry in the city, especially the different tree species and their abundance in the city. With this information, the amount of carbon that can be sequestered throughout different parts of the city could be calculated. These calculations could then be used for educational and implementation purposes.

Sample Calculation

A central part of our project considerations is the proposed sample calculation to determine how much carbon dioxide can be sequestered by a given tree. This sample calculation can be used to inform Costa Mesa city officials as well as the public in order to inform them about the benefits of carbon sequestration by means of urban forestry.

This sample calculation was performed using very simple mathematical equations. The method for this sequestration calculation was provided to our team from the California Air Resources Board “Urban Forest Projects” website (“Urban”). This website contains an Excel spreadsheet titled “Urban Forest Volume Equations Spreadsheet” which outlines a range of tree species and their corresponding measurements and calculations. This includes each tree species’ DBH, or diameter breast height, which is a standard method used for measuring trees. Additionally on the Urban Forest Projects website is a document called “The Center for Urban Forest Research Tree Carbon Calculator (CTCC).” This document contains information on how to perform the sequestration calculation. Below, an example calculation was performed on an adult *pinus radiata,* a popular species of pine tree endemic to Southern California (example detailed below):

DBH range given for pinus radiata species: 16.8-105.4 cm
Measured DBH of tree on campus: 47 cm

Volume calculation using equation given = 0.0283168466(0.019874 * (47/2.54)2.666079)
= 0.0278

Fresh Weight biomass (FW) = Volume * Species-specific density factor = 705(0.0278) = 19.56848667

Total FW including below ground portion of tree = FW * 1.28 = 19.56848667(1.28) = 25.04766293

Dry weight biomass (DW) = Total FW * 0.48 for conifers = 25.04766293(0.48) = 12.02287821

Kg C = (DW)(0.5) = (12.02287821)(0.5) = 6.011439104

Kg C(0.001) = metric tons C = (6.011439104)(0.001) =
0.006011439104 metric tons C sequestered =
6.012 Kg C
Equivalent to 20 hours of driving!

The document included a list of DBH ranges and volume equations for many popular tree species. The equations for FW, DW, and kg of Carbon were calculated using different constants, and the resulting number shows the approximate amount of carbon sequestered by that tree over the lifetime. These equations are easy to use and replicate, and the information that Costa Mesa could garner from a tree survey could be instrumental in researching future carbon sequestration efforts through additional tree planting.

Sample Survey Questions

Utilizing surveys can assist the city in obtaining insight from Costa Mesa's residents on preferred NbS and locations for the possible solutions. Specifically, the survey should reach people in the areas most disproportionately affected by carbon emissions in the city. In general, the following questions will help the City gain a better understanding of which areas in Costa Mesa might benefit from more greenery.

Additionally, the surveys can help to gauge the public's understanding of the benefits of sequestering carbon, so that in future communication the City can determine how much education this will be needed to increase community support for NbS. The survey may also help to find groups already operating in the City of Costa Mesa with goals that might be aligned with the City's NbS mission. Below are some examples of possible questions the City might ask:

1. Are you aware of the capability of plants and trees to absorb carbon dioxide - a greenhouse gas that contributes to anthropogenic climate change - from the atmosphere? (Y/N/Maybe)
2. Would you benefit from having more greenery in your city? (Y/N/Maybe)
3. Where do you see a need for more greenery in the city? (Open-ended)
4. Would you support the City spending more money on beneficial greenery for Costa Mesa? (Y/N/Maybe)
5. Are you aware of any environmental organizations in Costa Mesa which might be working towards providing carbon sequestration in the form of greenery? If so, which one(s) (Open-ended)

Communication

Prioritizing communication with community members is of utmost importance to the project. The survey was designed for those who live in the more densely populated areas of Costa Mesa so that their needs and wants can be taken into account. To partner with local businesses such as Ganahl Lumber and Pacific Coast Arborists, it is important to form relationships with their management staff. Forming relationships and beginning communication with Indigenous community partners and to those who manage the wetland areas in Costa Mesa are also important aspects of this proposal.

It is also important to ensure that the project goals are effectively communicated to Costa Mesa city officials. The sample calculation case study can help inform city decision makers about the widespread benefits of carbon sequestration and the potential for future successful projects under the urban forestry protocol. The information should be clear and easy to understand so that it is accessible and the communication is as widespread as possible.

Considerations

There are a series of opportunities that the city of Costa Mesa could consider. The most significant proposal involves education and community outreach within the scope of carbon sequestration under the urban forestry protocol under AB-32. Since there are so few projects working under this protocol due to challenges such as “the protocol’s requirement of a 100-year, lifetime guarantee of project, the high costs of urban trees and monitoring/reporting costs, and the limited eligibility for applicants (e.g. non-governmental organizations and developers are not allowed to apply),” the City can utilize the opportunity instead to quantify carbon sequestration in other proposed projects, classifying carbon sequestration as a co-benefit (Marritz, 2012). Utilizing Costa Mesa’s Tree City USA application along with calculations using Excel will allow the City to figure out how much carbon can be sequestered in a given plot of forestry in the city of Costa Mesa. This sample calculation, detailed above, can be used by city officials to consider the benefits of carbon sequestration and possibly consider the merits of pursuing a project in the future under the urban forestry protocol. The City would then be able to communicate these benefits as well as continue calculations in the future using the methods from this project.

Additionally, future implementations by city staff for this project could benefit from partnering with local groups such as Ganahl Lumber and Pacific Coast Arborists. Ganahl Lumber Company is a very well-known name in Costa Mesa and is the oldest lumberyard and hardware supply store in California (Ganahl). Ganahl Lumber could be a great partner in this process because they would provide a great community relationship and because they are very environmentally conscious in their actions. Pacific Coast Arborists would make an excellent partner as well because their services are multitudinous. They handle tree site planning, soil remediation, planting, and more (Professional Arborist Services). Additionally, future collaboration with Indigenous groups in Costa Mesa would ensure that environmental justice is accounted for, and that future opportunities for sequestration under the urban forestry protocol can be carried out in a fair and equitable way.

Ecosystem Restoration

Background

Ecosystem restoration is a nature-based solution that implements native plants to repair damaged ecosystems. This nature-based solution benefits the ecosystem for both local and migratory species, can improve biodiversity, and requires less upkeep than non-native vegetation. These solutions typically revolve around protecting or preserving an ecosystem with the intention of leading to better conditions for local residence. For example, protecting a forest to help with carbon sequestration or planting more trees on the coast to prevent coastal erosion. Generally there is a larger up-front cost, however the benefits are long term, both financially (limiting future need to invest, and cheaper than most developmental projects) and to the health of constituents. Costa Mesa worked with OC Parks to create a restoration plan in 2018. OC Parks partnered with environmental consulting company, Moffatt and Nicol in 2015, and the project was associated with Chambers Group Inc.

Along with 2018's restoration plans, Endemic Environmental Services has also implemented a restoration plan in Fairview Park in Costa Mesa, partnered with the City of Costa Mesa, County of Orange, and Army Corps of Engineers.
Previous legislation, specifically EXECUTIVE ORDER N-82-20, states that at least 30 percent of California's water and land must be 'conserved' by 2030. This was signed by Governor Newsom in 2020.

The aim of ecosystem restoration is to support the local ecosystems, residents and community that use the nature spaces in Costa Mesa. These recommendations include changes such as swapping out invasive vegetation to native plants, in public and private spaces, and following up with the current restoration projects being executed in Talbert and Fairview parks.

Case Studies

The four different projects we reviewed were Ashland, Oregon, Los Angeles, California, San Diego California, and Newport Beach, California. All these projects dealt with ecosystem restoration ideas; education, community engagement, and mutually beneficial solutions.

Restoration Ecology Education–Ashland, OR (Lomakatsi Restoration Project)

The Restoration Education program occurring in Ashland, Oregon engages the local elementary schools by creating a space for students to learn about restoration, from the beginning to the end. They have the opportunity to learn about restoration project planning, management, and maintenance. Their mission is to promote long-term, community based stewardship. They engage volunteers, students, and young in every step of the restoration process. The Restoration Ecology Education program was created by the Lomakatsi Restoration Project, an organization that provides expertise, planning, management, and design, and implementation for ecosystem restoration

projects. Along with Restoration Ecology Education, they facilitate restoration practice with science, education, and workforce training.

Program Components:

- In-class presentations
- Site adoption
- Restoration planning and
- monitoring
- Hands-on restoration
- Native shade house
- nurseries

Activities:

- Tree and vegetation
- planting
- Weed removal
- Mapping
- Project planning
- Native plant propagation or nursery case

U.S. Forest Service Stewardship Contracts:

- WildRivers Master Stewardship Agreement (2008): Nov 2008 Lomakatsi Restoration Project, Siskiyou Project and U.S. Forest Service entered into a 10 year agreement to achieve ecosystem restoration and climate change resiliency
- Ashland Forest Resiliency Master Stewardship Agreement (2010): U.S. Forest Service, City of Ashland, Lomakatsi Restoration Project, and The Nature Conservancy partnered to protect water quality, late-succession habitat, human life, and property, and ecosystem sustainability. This is a 10 year agreement.

Lomakatsi Restoration Project: Completed Stewardship Contracts

- South Stew Stewardship Contract
- Ashland Westside Stewardship Contract
- Penny Stew Stewardship Contract
- Boulder Stewardship Demonstration Project
- Logistics:
    - Environmental Educator cost: $13.29 per hour in California
    - Greenhouse cost: Between $7,380 and $28,370 depending on the size, materials, and type

Cash for Grass–Los Angeles, CA

The Cash for Grass program in Los Angeles, California offers economic incentives, a rebate, to residents, for removing water inefficient grass with drought tolerant landscaping. This program creates a mutually beneficial relationship between

the city of Los Angeles and the residents. This program was successful at removing 2 million square feet of lawn and replaced in the water efficient landscape. This also took up to 4 months for each resident to get approved for this rebate.

Loans are available to residents who want to implement native plants, through the LA county Property Assessed Clean Energy (PACE) program. The PACE program was discontinued in 2020 due to COVID-19.

- Applicants were accepted on a first- come, first-served basis
- Customers have 6 months to complete conversion in order to get rebate
    - Artificial turf conversion is not eligible for rebate
- Potential Grass Replacement:
    - Native or drought-tolerant plants
    - Mulch, decomposed granite, or rock
    - Un-grouted stepping-stones
    - Permeable hardscape

San Diego Ecological Restoration:

Nature Collective (formerly San Elijo Lagoon Conservancy) has been responsible for the improvement of San Elijo Lagoon and other natural spaces in San Diego. The organization has helped improve the health of local ecosystems, park infrastructure and create opportunities for environmental education all while encouraging community engagement. They currently are working on five conservation projects ranging from habitat restoration to running their own native nursery. They also provide a lot of information about the nature preserves for potential visitors. The park center has clear trail maps and information online about the species of plants and animals within the park.

San Elijo Lagoo Restoration (thenaturecollective.org)

Funding

Initial funding for the project came from the Wildlife Conservation Board to create the nature center and Nature Collective (originally San Elijo Lagoon Conservancy). 25 year cooperative agreement between the County of San Diego Parks, California Department of Fish & Wildlife and Nature Collective. Most of the funding comes from TransNet, a local tax of .5 cents on all transportation administered by the San Diego Association of Governments (SANDAG).

Benefits to Costa Mesa:

A project similar to the Nature Collective would bring many benefits to the city of Costa Mesa. Their native plant nursery encourages educating the public about native species, while growing plants to build up the ecosystem of the area. Having a central organization to plan potential future restoration projects.

Project Grow:

Project Grow is an example of a strong community-participation driven ecological restoration project based out of Newport Bay. Led by Matt Yurko, with the help of several Chapman students, the program is structured around educating the community and using those skills to improve the health of local ecosystems. There are two events per week: Steward days are focused mainly on education and learning restoration skills, and Roots is the day of the week when the group does hands-on work improving the health of local open spaces. This program is a great example of a program with limited funding but is still able to make a large impact on the health of Orange County parks.

Funding**:**

Sponsored by Tides Center, a nonprofit organization focused on sustainability and raising environmental awareness

Benefits to Costa Mesa

A low cost community engagement program. Raise the public's awareness and interest in the environment and its restoration while actually working to improve the local community’s ecosystem.

Communications

Working closely with those in OC Parks, City of Costa Mesa government, and the consulting companies is a given for this project, but engaging with the community is an equally important aspect of ecosystem restoration. Surveying the community is highly encouraged to understand the community preferences around ecosystem restoration. Engaging local residents, senior center program managers, elementary schools, and people living in the community and accessing the park will help to ensure continued equitable access to nature spaces. Once the City has a better understanding of areas of

concern for the community, it will be easier to create more incentives for the public and private companies to want to support ecosystem restoration.

Considerations

Based upon the research presented in this section, it would be most beneficial to implement restoration efforts reinforcing the current restoration efforts in Talbert Park. This includes protecting the native species, nurturing the land, and engaging the community. Through the case studies, success was seen in engaging the local community by leading programs that teach groups the benefits of restoration, and show them the processes of restoration work. Empowering young children and people who use the parks creates a relationship between the community and nature. The case study on Los Angeles' "Cash for Grass" program showed that when giving incentives to replace lawns, it can be successful. The downsides of this option is that many people chose to implement artificial turf, which leads to urban heat islands, and the process of getting approved took a long time for most residents–because it was such a popular program. If the city could offer economic incentives or city legislation to implement native or drought resistant species, it could be a way to reintroduce wildlife into human impacted nature spaces.

Community Engagement Restoration Efforts

- Create a more appealing space for the community
    - Implementing community based restoration
    - Elementary school classes
    - Senior center programs

Implementing and catering to native species in private spaces

- Economic Incentives: Cash for Grass Incentives
    - Drought resistant species implementation and fostering
    - Potential for private spaces; residents and business owners
- Benefits:
    - Saving money because there is no need for pesticides and labor to maintain native plants. They also consume less water
    - Perennial plants! They don't have to be replanted every year

Urban Forestry

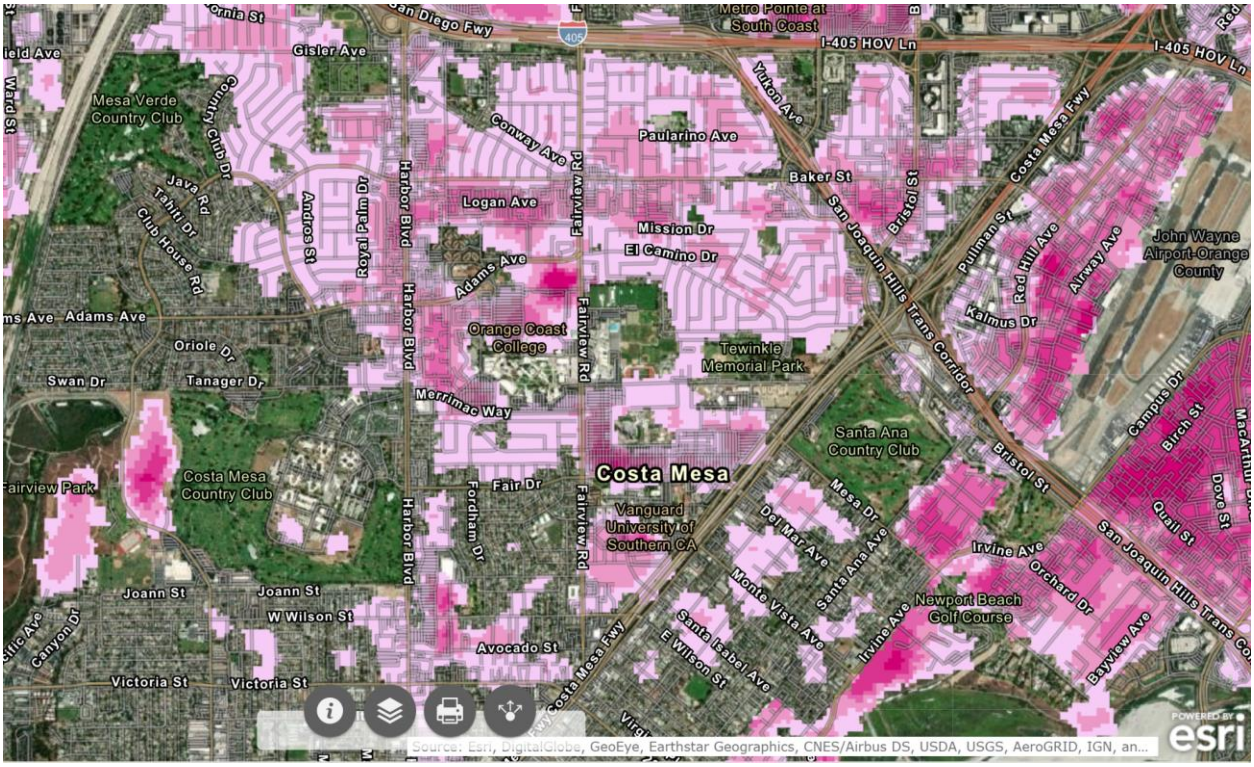
Background

Urban forestry is an example of a nature-based solution (NbS) that brings the ecosystem benefits of forests to urban contexts. Urban forestry refers to growing and managing trees (along with other types of forest plants) in cities. There are many ways to implement urban forestry, ranging from park development and maintenance to planting trees along streets and near buildings. Similar to other nature-based solutions, urban forestry brings a variety of ecosystem benefits to urban areas. Specifically, trees can help mitigate the urban heat island effect by providing shade and managing air and water flow through evapotranspiration. Trees can also bring biodiversity to cities by acting as habitats for birds and other organisms. Since urban areas experience higher temperatures due to climate change compounded with the urban heat island effect, urban forestry can be a cost-effective and popular option for adapting to a warming world.

Benefits of Urban Forestry

Urban forests provide the benefit of mitigating the harmful impact of urban heat islands. According to the United States Environmental Protection Agency (EPA), urban heat islands occur when infrastructure traps heat, leading to detrimental consequences such as air pollution and related illnesses. Planting trees and vegetation in as many areas as possible can minimize the urban heat island effect. Based on Geographic Information System (GIS) data from the Trust for Public Land, we were able to identify several areas within Costa Mesa with significant urban heat island severity (Trust for Public Land). The parking lots near the OC Fairgrounds and Orange Coast College, as well as the area surrounding John Wayne Airport, all experience severe effects from urban heat islands. These could potentially be good areas to target with urban forestry programs.

Example of Urban Forestry at Virginia Tech University



Other benefits of urban forests are that they reduce energy use by providing shade, allowing cooler temperatures, and thereby decreasing the need for fans and air conditioning. Shade also slows the process of pavement deterioration, which cuts maintenance expenses. Urban forests also positively impact the air quality and decrease greenhouse gas emissions since they reduce energy demand. Urban forestry encourages carbon sequestration and the removal of air pollutants through trees' natural ability to sequester carbon and filter air. Trees also act as a water filter and thus improve the quality of water. Finally, trees can reduce noise and provide aesthetic benefits ("Using Trees and Vegetation to Reduce Heat Islands").

Case Studies

India

Hyderabad in India offers a pristine example of leadership in the urban forestry sector. Hyderabad has been named the "Tree City of the World," the only one in all of India. It has led the green city revolution. One of the reasons urban forestry has been so successful in the city is that there is a local law in place that manages forests and trees. These policies outline tree care and worker safety and some even contain penalties for violations. A tree inventory is also part of the city's success story. The inventory helps to facilitate long-term plans for urban forestry. Furthermore, Hyderabad encourages active participation from the local residents by celebrating the achievements of the residents

and staff who are involved in the program ("Hyderabad Recognized as a 'TREE City of the World'.").

Australia

When examining case studies, Australia offers an excellent example. It's warm and dry climate is similar to that of Southern California, providing an example comparable to Costa Mesa. Over the years, Australia's urban forestry initiatives have seen differing approaches, yet all of them have been integrated into the country's policies and regulations. Urban forestry expanded in the state of Victoria as a policy response to unemployment issues and the deterioration of the urban lifestyle in its cities. The state plants trees and flowers in a manner that mimics that of forests, appearing like the native Australian bush. The plants are grown intensively to minimize grass growth and give a more natural appearance. Before the emergence of these urban forestry initiatives in Australia, the country distinguished the urban world and the natural world as two completely separate entities. In the 1970s, however, pioneers recommended urban forestry, stating that they would mitigate the damage to natural forests and assist with potential future urban planning issues. Arborists developed technology and software to budget and for cost-benefit analysis ("An Historical Geography of Urban Forest Projects in Australia"). Today, urban forestry is an essential part of Australian public policy, and its benefits are the pride and joy of its citizens.

Sacramento

Sacramento is another example of a city that could serve as an example for Costa Mesa. In 2007, the city began a coordinated pruning campaign and cycle to protect and maintain the trees that had already been planted (American Forests). The city also focuses on planting trees every year rather than focusing on growing too many trees at once. This helps ensure that the trees in the city have a diversity of ages, and as trees get older and have less canopy or even die, there will not be a widespread pattern across the city. When the city plants trees, it carefully irrigates them for the first 3-5 years of life to ensure the tree is able to survive into adulthood and begin to provide ecosystem services to the community. The Sacramento Municipal Utility District is also an essential partner in urban forestry. Since 1990, they've planted about 500,000 trees to save on utility costs around the county. One final aspect of urban forestry that has been successful for Sacramento is its focus on public-private partnerships. The Greenprint Initiative pairs the utility district with citizen groups and nonprofits to get broad community feedback about implementing urban forestry. However, there are challenges facing the community. As the population of the city grows, they have focused more on creating housing than on leaving space for forestry. Moving forward, the city will have to be intentional during development to leave room for trees and all the services they provide.

A final case study that could have exciting implications for Costa Mesa is Lynwood, Washington. The city offered vouchers for residents to plant trees from local nurseries. Individuals had to apply for a voucher and use it within a year and were able to reapply every year. In this way, the city supported local businesses and encouraged individuals to increase the canopy without necessarily needing to do the maintenance work itself. A version of this type of incentive could be an option for Costa Mesa to increase canopy cover in the city.

Urban Forestry Policy

Successful urban forestry programs can be aided by clear policies which define how such programs will be managed. The City of Riverside has an urban forestry manual that details the guidelines for the upkeep, planting, and care of trees. According to the manual, the policies were established based on national standards for taking care of trees created by the International Society of Arboriculture (ISA), the National Arborists Association, and the American National Standards Institute. The policy manual also utilized input from a variety of community groups and the City's citizens. Some of the involved community groups were the City Council, Public Works Development staff, and the Parks, Recreation and Community Services Commission ("Urban Forestry Policy Manual"). The manual begins by explaining the importance of urban forestry upkeep and the duties of each commission and group. The policy manual is structured to provide the reason for a particular practice. For example, the importance of pruning is explained, followed by the proper methods. Because of the way the policy manual is structured, it ensures that the audience understands the importance of urban forestry maintenance before the methods are explained. It also identifies the key groups involved at the very beginning to provide a sense of validity and assurance that important community groups are supportive.

The state of California also has a number of different resources available to local communities who hope to implement robust urban forestry programs. California Assembly Bill 1530 required the Department of Forestry and Fire Protection to update the California Urban Forestry Act in order to better manage and encourage the state's urban forests. The bill specifically requires the Department of Forestry to provide training to "disadvantaged communities," and to establish local and regional targets for urban tree canopy. In order to implement these programs, the bill further authorizes the Department of Forestry to provide funding to communities working to improve their urban forests. In pursuit of these goals, Cal Fire, the Strategic Growth Council, and the USDA all have grant programs which communities can use to create and implement urban forestry plans.

Education

The United States Forest Service encourages the implementation of urban forestry education. The service explains that it is vital to increase public awareness of urban forestry and make education on the environment accessible to promote stewardship. The US Forest Service lays out three key ways to do so. The first is by creating environmental education programs that focus on problems in both urban and community forestry. The second is by establishing a nationwide campaign that focuses on raising public awareness and education. The third is by encouraging socioeconomically disadvantaged communities to engage in both the establishment and stewardship of urban forestry. By doing so, communities can heighten their understanding of the importance of urban forestry and thus make doing so an integral part of the community (“Urban and Community Forestry Program”). When the community can rally together in support of one idea because they have received a firm education and thus have a strong understanding of it, they will be able to encourage mobility at the government level.

Arbor Day

Arbor Day was established in Nebraska. The State was once a tree desert, and so Arbor Day was established in the 1800s in an effort to increase tree cover across the state. The State’s pioneers began planting a multitude of greenery across the state. In 1872, a tree planting day was proposed, dubbed “Arbor Day.” Throughout the 1870s, various states also adopted the tree-planting holiday. California has adopted the holiday, designated on March 7, a nod to horticulturist Luther Burbank ("Arbor Day”).

Arbor Day is celebrated by planting trees, but each community can celebrate it differently ("Celebrate Arbor Day 2021”). For example, the cities of Sidney and Kimball in Nebraska are teaming up this year to host an event involving a tree giveaway, information session, and mass-planting event spearheaded by local elementary school students ("Sidney, Kimball Plan Arbor Day Celebrations"). The City of Costa Mesa has been celebrating Arbor Day for many years and it continues to provide a great opportunity to engage Costa Mesa residents in tree-planting events.

Community Partners

One consistent aspect across successful case studies of urban forestry is strong community input and participation. When examining ways to expand urban forestry in the city, Costa Mesa should reach out to community groups and nonprofits for their

input. The following is a list of organizations and businesses in Costa Mesa which could potentially be good partners in urban forestry efforts.

- Orange County Coastkeeper
- South Coast Plaza
- Newport Mesa Unified School District
- College Hospital
- Orange Coast College
- Mesa Water District
- Historical Preservation Committee
- Experian

Survey Questions

The city of Costa Mesa could ask survey questions to the wider community to gauge interest in urban forestry, and to evaluate the best way to move forward with urban forestry initiatives. Below are some possible survey questions:

1. Would you like having more trees in your neighborhood?
    - Yes; No
2. Would you be interested in attending workshops or receiving educational information about the benefits of trees in cities?
    - Yes; No
3. Would you prefer for the city to plant more trees on public property, or for your community to be involved in planting trees on your private property?
    - City; Community; Both
4. What is your preferred source to learn about what is happening in Costa Mesa?
    - Social media; Emails; Physical Mail ; Phone calls; City council meetings; Newsletters; Other
5. Do you know any local organizations which would be interested in helping plant trees in your community?
    - Open-ended
6. How can we best engage your community in efforts to plant trees in Costa Mesa?
    - Open-ended

Considerations

Urban forestry is a great way for cities to adapt to the realities of climate change in a way that includes many other benefits. Costa Mesa is a great candidate for expanding urban forestry because of the climate that makes it relatively easy to grow trees. With more data, more specific recommendations could be made about how the City can implement urban forestry. To move forward with these recommendations, information from the City about the trees that it already manages would be crucial. With this information, a story map could be developed outlining case studies Costa Mesa can model and specific places the city could implement urban forestry.

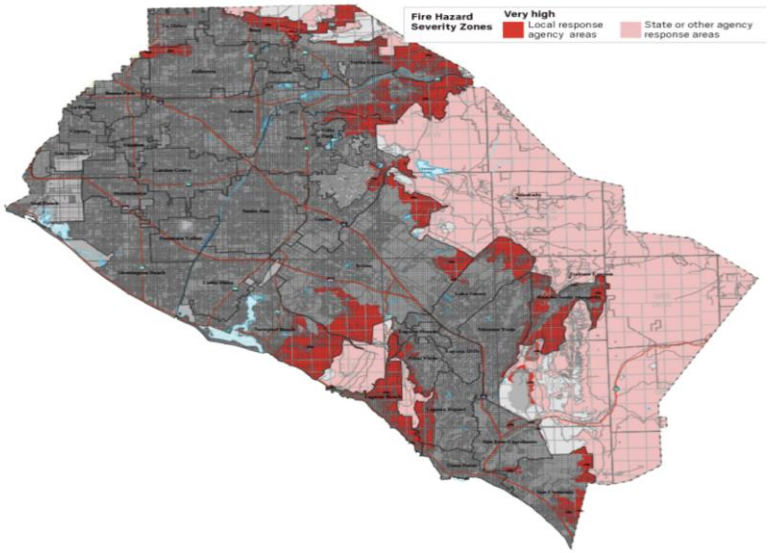
Wildfire Risk

Background

From 2017-2019, Costa Mesa had a record of approximately 12,000 fire incidents per year. Considering that the data includes false alarms and weather-related incidents, the fire statistics of Costa Mesa qualifies as a region with low risk of fire. This result seems reasonable because the data shows that for the past four years, the city of Costa Mesa has increased the spending on the community risk reduction revenue, which went from $177,000 to $560,000 (2016-2019). This spending goes towards fire system plan reviews, building inspections, and permit renewals.

The City truly understands the value of fire prevention and the safety of the community. Furthermore, the city of Costa Mesa actively reaches out to the community and educates the people in preparation for the crisis. Knowing that Costa Mesa is aware of the importance of fire prevention, the regulations on the implementation of green infrastructures, and NbS is well established. Working alongside other groups in this project, the goal is to reduce fire risks and preempt fire occurrence in Costa Mesa. This can be done while following the fire safety codes, finding the optimal balance in the amount of green infrastructure, and assessing potential risks that new infrastructure may bring. Ultimately, green buildings and spaces are important, and the main takeaways are methods for safely enhancing the natural environment in Costa Mesa.

The cities in Very High Fire Hazard Severity Zones:



Case Studies

CAL FIRE Grants

Looking at case studies from the award winners of CAL FIRE grants, Tree San Diego and Tree Fresno seem to share similarities in environmental factors. The project, Tree San Diego, runs its program in the city of San Diego, which is a low fire risk zone. The program had the specific goal of enhancing the environment and air quality in the

low socioeconomic communities by planting trees in those regions. The project planted 1,575 trees selected by the residents by communicating on the Trees community outreach that allows residents to communicate with those in the Tree community in efforts of helping all members of the city. Running a survey to bring interest and getting people to think about the types of plants available seemed like a smart and reasonable action. Another factor that made this project so outstanding is the educational component it had when planting these trees. Overall, the project was awarded $1,180,000 from the federal government and helped disadvantaged communities have access to healthier air and environmental conditions.

Similarly, Tree Fresno also planted around 750 drought tolerant trees in disadvantaged communities in Fresno. Planting native drought tolerant trees is essential due to California's climate and lack of water. Tree Fresno also had a training program teaching youth how to plant trees. The project was awarded $750,000. The projects in Tree San Diego and Tree Fresno have two commonalities: a robust community outreach to disadvantaged communities and an educational component.

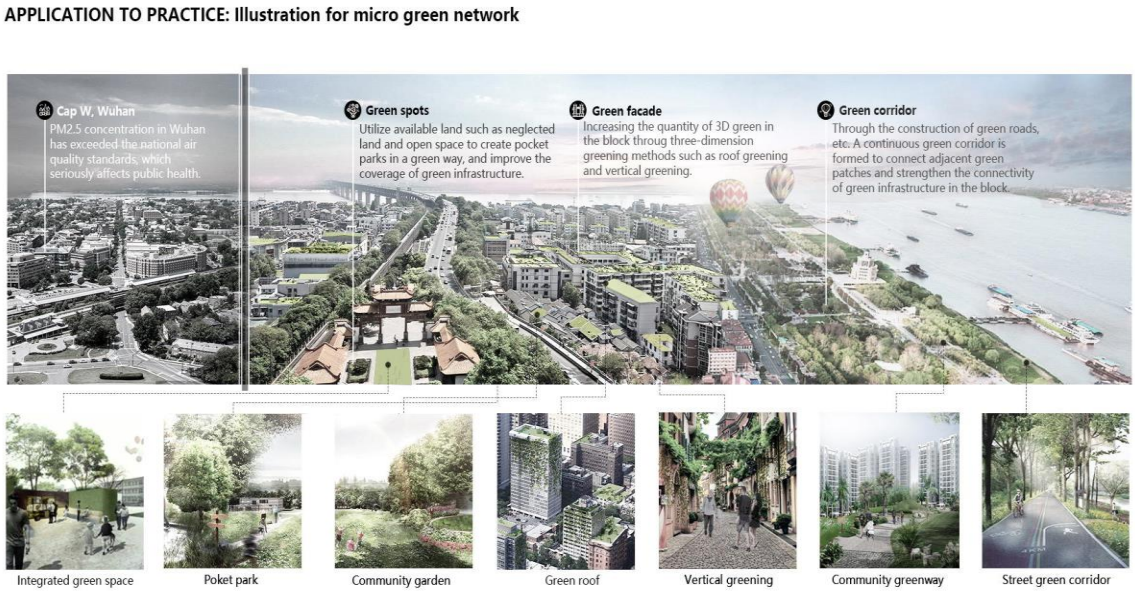
Boulder Case Study

Boulder, Colorado has been known for its systematic approach to preserving open spaces and growth management; they do this by limiting further encroachment on the Wildland-Urban Interface (WUI). The wildland urban interface acts as a nature-based solution as it minimizes fires from spreading onto urban areas. The state of Colorado also has site plan reviews that identify any risks of fires in site locations, building construction, design, landscape, defensible space, fuel management, and water availability. In 2015, an update helped mitigate fires by creating kiosks of information, installing wildfire danger signage, fuel breaks along roadways, and increasing the water system to allow for stronger water pressure for hydrants (Headwater Economics, pg. 21).

Particulate Matter using Urban Green Infrastructure Case Study

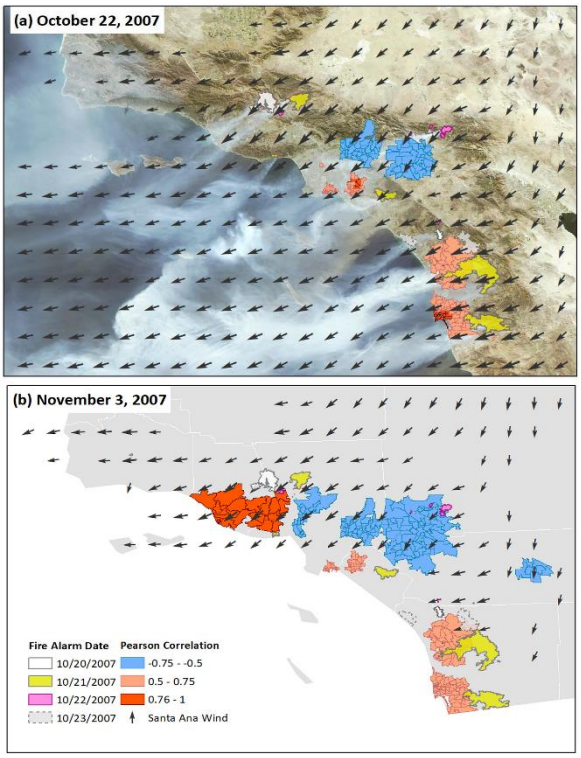
The Huazhong University of Science and Technology in China studied how particulate matter can be reduced using urban green infrastructure. The study found that with a 30% increase in green space coverage in urban areas is where there is maximum reduction of particulate matter 2.5. By increasing 3D green density (green roofs/buildings) to about 1.44 hectare per hectare land can maximize the reduction of PM2.5. It was recognized that plant shelterbelts, a line of trees or shrub, slow down winds and become a deposit for particulate matter which reduces fire from spreading.

Having an increased amount of green urban infrastructure reduces the amount of home fires as ash would land in these green spaces rather than on homes made of dry materials.



Infrastructure and Health Damages Caused by Fires

The 2018 Campsite Fire in the city of Paradise destroyed about 18,000 structures and took 85 lives, becoming one of the most destructive fires in California history. Researchers believe that if a wildland urban interface had been built, the City would have had more time to prevent structures from being damaged. They also recommend forest thinning to reduce the amount of dry shrub on the floor so fires cannot easily ignite. A preventative measure using NbS would be to consider using tree buffers, as they not only prevent the amount of particulate matter, they also help slow winds that increase the speed of fires spreading.



One case study, “October 2007 Firestorm (Santa Ana Winds),” looks into two dozen fires that burned approximately 972,000 acres across Southern California. As a result, about 3,200 structures were destroyed and led to about 1.8 billion dollars in damages in San Diego and San Bernardino. During the peak of these fires, the level of particulate matter exponentially increased. Consequently increasing emergency care activity by

about 50%. October 2007 Firestorm caused about 3.4 million dollars in healthcare costs. Overall, the study shows that more effort in fire prevention results in a reduced cost of damages from the fire.

Survey Questions

1. Do you know about the existing programs held by the Fire Department?
2. Should the community continue to participate in programs held by the Fire Department?
3. How can the city better ensure their safety against fires? (Select multiple)
   a. Provide more education about wildfire
   b. Planting more fire-resistant plants
   c. Other ideas _____
4. Are you interested in a phone application to submit requests for a fire hazard to be monitored?
5. Do you think Costa Mesa should implement more green infrastructure such as green roofs/walls, green spaces, green roofs etc.?

Communications

Active communication and community outreach are an important aspect of these efforts. These efforts can reduce the overall heat within the City and the County,creating a better environment for the people of Costa Mesa. Education for the community is also valuable in reducing fire risk. Implementing NbS alongside educating the community can help Costa Mesa mitigate fire risk and maintain the status as a low fire hazard severity zone.

Considerations

When considering green infrastructure, the proposal ideas should follow the fire safety code recorded on the website of Costa Mesa’s fire department so the code is not violated resulting in a possible increase in fire risk. For instance, green spaces cannot be left dry due to their potential for fire risk. Green infrastructure needs to be able to withstand the dry climate of California without being a fire risk. There are many plants that have low fire risk per Cal Fire which are: French Lavender, Red Monkey Flower, California Fuchsia, Sage, California Lilac, Society Garlic, Ornamental Strawberry, Yellow Ice Plant, Coreopsis, and California Redbud. To ensure these plants don't become a fire risk, an annual monitoring or incentives can be implemented to take care of green space and infrastructure. The increase of plants that reduce the amount of particulate matter (PM2.5) created by wildfires can improve the health of the residents and lower the risk of fires spreading. Some examples of plants that do absorb particulate matter well per the Huazhong University of Science and Technology Case Study: Magnolia, Fragrans, Cedar, Privet, Ginkgo, Hibiscus, Camphor, Boxwood, Sycamore,and Locust. Increasing the amount of green quantity of 1.44 ha hectare of land can maximize the reduction of PM2.5 and simultaneously increasing urban green space by 30% can maximize the reduction of PM2.5. A buffer belt around the City could slow the wind speed and reduce the spread of a fire. A buffer belt can also reduce the

amount of particulate matter that spreads from city to city which can lower the amount of pollution from fire.

With the introduction of the bill AB-79, CA's Fire Prevention Plan, cities in California have a chance to increase fire security and make use of grants from governmental resources. AB-79 generated about $536 million to increase the efforts at firefighting and a variety of prevention measures. The breakdown of this bill includes substantial support for urban forestry, a nature-based solution. CA.gov also provides grants to projects that monitor low wildfire areas, which is optimistic for Costa Mesa. These grant winning projects included initiatives to help disadvantaged and low-income communities, educational components, and community outreach.

Urban Green Spaces

Urban green space is an innovative nature-based solution (NbS) that addresses the growing pressure of climate change on the world's increasingly urban population. Cities today are facing serious environmental and health challenges, including hazardous air pollution, extreme weather events, and limited access to natural spaces. As climate change worsens and the world's population continues to rapidly urbanize, it has become critical to address these various challenges facing urban communities (World Health Organization, 2018). Through expanding the presence of natural spaces in cities, urban green space represents an important approach to enhance local climate resilience, mitigate the impacts of extreme weather events, and improve the health and quality of life for urban residents. Green spaces can come in many forms, such as parks, nature reserves, and community gardens, and are therefore an important component of public open spaces that serve all members of the local community (World Health Organization, 2018). Considering the vast and ranging environmental and health benefits of this nature based solution, it is critical to ensure that urban green spaces are distributed equitably throughout cities and easily accessible for all residents!

Background

The majority of urban green spaces in Costa Mesa are public parks. The largest public parks in Costa Mesa are Fairview Park, Talbert Regional Park, Canyon Park, and Tewinkle Park. Larger parks with more open green spaces offer greater community and environmental benefits for the surrounding neighborhoods than smaller parks do. Additionally, larger parks usually have more amenities, such as sports fields and playgrounds. The greater, more prominent parks in Costa Mesa are located near the outer borders of the city, and are mostly in suburban residential, non-industrial areas. The more commercial and industrial regions in the center of Costa Mesa are not home to any larger parks, meaning residents of this area have less access to large open green spaces, as shown in *Figure 1*. These residents are therefore required to travel further distances to experience the physical and mental health benefits of spending time in nature, and their local environments are not afforded the same ecological benefits that are associated with quality green spaces. Furthermore, the central region of Costa Mesa is a highly developed industrial region bordering the 55-freeway. Freeways contribute to local air and noise pollution, meaning residents of this region are exposed to more hazardous environmental conditions than the outer suburban regions in the city that have more access to quality green spaces.

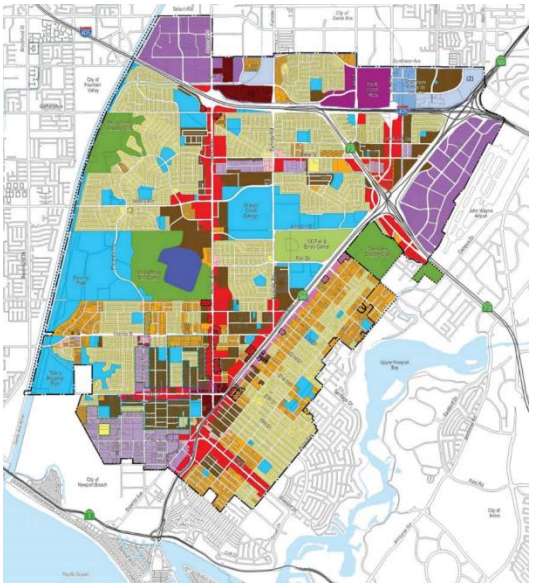


Figure 1. *Land use map from the City of Costa Mesa, 2020*

Considering the present disparity between regions within Costa Mesa, it is critical to understand which communities experience higher barriers to accessing green space and higher levels of environmental pollution. According to data from the United States Census on Race and Ethnicity, census tracts in the central region of Costa Mesa are made up of predominantly Hispanic communities, while census tracts in the outer regions are predominantly non-Hispanic white communities (Figure 2). Similarly, census tracts in the central commercial region of Costa Mesa have lower median household incomes according to data from the U.S. Census, while tracts in the outer regions have higher median household income values (Figure 3).

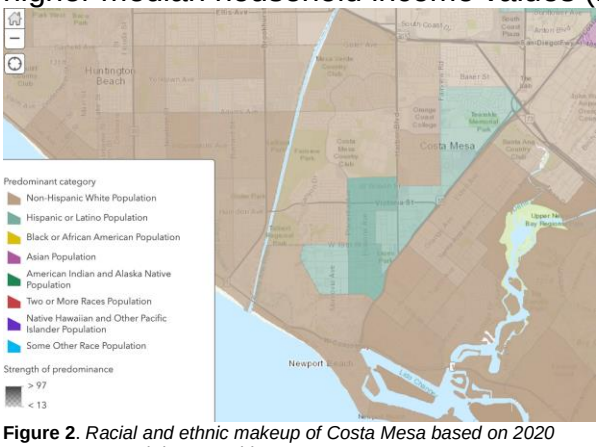


Figure 2. *Racial and ethnic makeup of Costa Mesa based on 2020 census tracts and demographics*

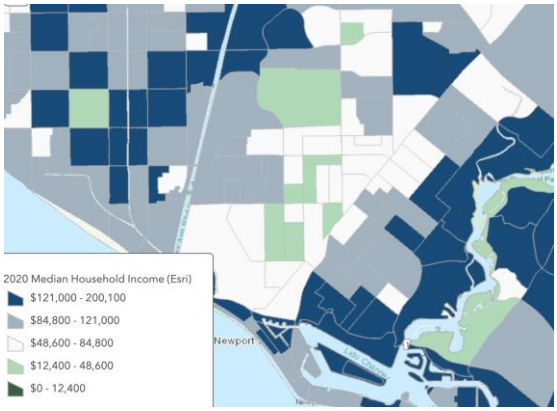


Figure 3. *Economic makeup of Costa Mesa based on median household income and 2020 census tracts*

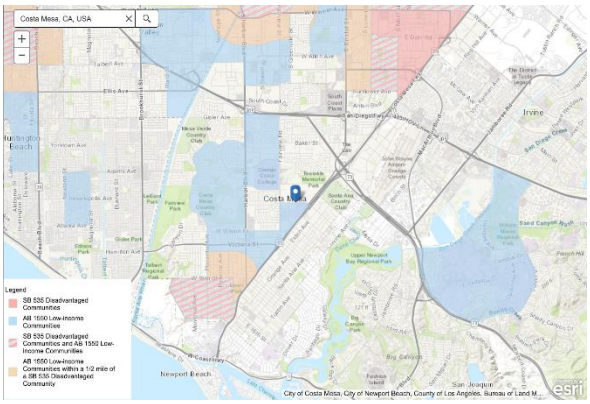


Figure 4. *Map of Costa Mesa by 2020 census tracts of disadvantaged communities, and low income communities as designated by SB 1550*

According to the data from the U.S. Census and S.B. 1550, these central regions of Costa Mesa have been classified by the U.S. Census as both Low-Income and Disadvantaged communities (Figure 4). Low-income communities of color in the central regions of Costa Mesa experience higher pollution levels and have less access to quality green space as compared to White communities with higher median household incomes in the suburban residential regions.

The United States Environmental Protection Agency- Office of Environmental Justice defines the concept of environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision- making process to have a healthy environment in which to live, learn, and work.” Considering the disparity in access to quality greenspaces in Costa Mesa,and the increased risk for environmental and health impacts on Disadvantaged, Low-Income communities as defined by S.B. 1550, communities located in the center of Costa Mesa are at risk of facing environmental injustice (Pulido, 2000). Often, the unequal access to green spaces and hazardous environmental conditions are linked to discriminatory

urban and city planning (Pulido, 2000). The impacts of climate change have further exacerbated these unequal environmental conditions, and efforts to address these disparities and achieve environmental justice as defined by the U.S. EPA must engage and center impacted communities throughout the solution-making process. In order to ensure that nature-based solutions are implemented to increase equity in the city of Costa Mesa, it is imperative that the City approaches these challenges with a Justice Framework.

A Justice Framework for Nature-based Solutions

Nature-based solutions are a growing field of technical solutions to address the effects of climate change and build climate resilience within communities. NbS encompass a wide variety of efforts, and therefore, they may require global, national, state, and local collaboration to achieve. While NbS are interdisciplinary by nature, requiring a wide variety of policies, technical solutions, and processes, it is imperative that these efforts are guided by a shared framework. A Justice Framework embraces the interdisciplinary and collaborative approaches to solving problems related to climate change, while centering those who are most impacted by these issues. This framework can be used as a guide to implement sustainable practices that achieve ecological goals, such as reducing greenhouse gas emissions, increasing biodiversity, and decreasing extreme weather events. It can also guide practices that achieve sociological goals, such as increasing community resilience, creating cleaner environments, and positively affecting people's health. A Justice Framework in this nature-based context centers the needs of communities - specifically communities that are most disadvantaged as a result of interlocking systems of oppression - and not only considers community needs, but works with communities to co-create solutions to the issues they face (UUCSJ, 2010). Specifically in the context of urban green space efforts, the issues communities face often manifest as inequitable access to quality urban green spaces and heightened pollution burdens. To address these effects, urban green spaces can be intentionally designed alongside community members, utilizing community recommendations to provide ecological and social aid as a tool for creating justice.

This framework also makes clear the fundamental difference between viewing equitable access to urban green space as either a right or simply a need (UUCSJ, 2010). In this context, equitable access to urban green space functions as a form of aid. Viewing aid from a 'rights-based' approach has been adopted and utilized by major organizations, including the United Nations General Assembly through their Declaration on the Right to Development. This declaration states that those receiving have the *right* to "participate in, contribute to, and enjoy economic, social, cultural, and political development" that allows their rights and freedoms to be actualized (United Nations, 1986) . It is imperative to treat access to urban green spaces as a right, as we do with access to clean air, water, and land, rather than a need that is not yet fulfilled. Viewing urban green space from a 'rights-based' lens allows for justice to be achieved not as a byproduct of fulfilling a need, but as a guiding principle in creating solutions.

This approach of using NbS, and specifically urban green spaces, as a means to achieve both sustainability and justice has also been emphasized and driven by policy

on multiple levels. On a global level, The United Nations' Sustainable Development Goals. Specifically, goal 3, 10 and 13 can be addressed utilizing urban green space as a nature based solution (United Nations, 2015).

Goal 3: Good Health and Well-being
Goal 10: Reducing Inequality
Goal 13: Climate Action

NbS, like urban green spaces, have been proven to create many health benefits and ensure well being through providing spaces for people to exercise with parks and access healthy, fresh food through community gardens. Additional health benefits include the lessened effects of urban heat island from creating green spaces and reduced air and noise pollution through creating green space barriers and oxygen emission. Similarly, using urban green spaces with a justice framework allows for unequal access to green space and pollution burden on historically oppressed communities to be addressed. Finally, NbS also address climate change through their potential to increase biodiversity and add in natural spaces and plants to highly developed areas. This can mitigate the effects of air pollution while reducing the amount of industrial land use and subsequent pollution possible in an area.

NbS considered through a Justice Framework have been prioritized in many national and state policies and goals. On a national level, the United States has begun to address climate change, specifically calling for unique solutions that address issues of environmental injustice across the country. In the executive Order on Tackling the Climate Crisis at Home and Abroad (EO. 14008 Sec. 219) it's outlined that "It is therefore the policy... to secure environmental justice and spur economic opportunity for disadvantaged communities that have been historically marginalized and overburdened by pollution and underinvestment" (The White House, 2021). NbS are a method of achieving the current administration's plan, as outlined above and additionally through the creation of the Advisory Council on Environmental Justice. Similarly, on a state level, California has specifically called for the innovation and use of NbS through the California executive order N-82-20 which is to "expand NbS to achieve California's climate change and biodiversity goals" (Office of Governor Gavin Newsom, 2020). On a local level, expanding communities access to urban green spaces aligns with the goals outlined by the Costa Mesa City Council for the 2021 year through direct ability to address the infrastructure goal to "provide an update to the City Council on the development of Community Center, Shalimar Park and Ketchum-Libolt Park improvements and other strategies to increase park access". Additionally, Costa Mesa's sustainability statement of commitment to sustainability also includes "environmental, social and fiscal considerations in decision-making and operations, while prioritizing equity and community resilience"- all of which follows this pathway of community building.Utilizing a Justice Framework when considering and implementing NbS, especially efforts related to urban green space, is beneficial for the city of Costa Mesa and all of its residents.

Case Studies

Utica New York Community Garden

Project Overview

Utica city in New York is a smaller city located on the Mohawk River that has a large population of Black and Hispanic people as well as low-income folks (Jennings et al., 2017). The Community Garden in Utica was set up as a means to provide natural spaces as well as fresh accessible food to community members. This project was also created in connection to the Utica Municipal Housing Authority which provides affordable or subsidized housing for low-income communities. After identifying the need for public green spaces and fresh affordable food, a community garden project was initiated by both a local university and a local conservation organization. This garden was up and running after a year of planning, however, in its first year struggled to be maintained through volunteer and community support.

Community Involvement and Process

Though this project was initiated by locally based organizations, the project did not take into consideration community input or involve community members in the creation, planning, and execution of the garden in the beginning. As a result, the garden failed to garner community support and involvement in the first year. Though the garden did provide the ecological benefits associated with creating an urban green space, the garden created very few of the social benefits as a result of little community interaction and engagement. Additionally, the maximum ecological benefits were not reaped, as there wasn't enough volunteer support to harvest and grow food. After the first year, community engagement increased after creating a community engagement plan to better understand the needs and wants of the local community in the context of urban gardening. Community members were able to provide input on what should be planted and grown, and a local community member was even hired to manage the garden space. This rooted the garden enough in community life, attracted community members to use the space, and has been a successful nature based effort to provide both ecological and social benefits to the community of Utica, NY (Jennings et al., 2017).

The Natural Park at Ramona Gardens, Boyle Heights, Los Angeles, CA

Project Overview

Ramona Gardens is a neighborhood in the Boyle Heights area of Los Angeles that rests between the fifteen-lane I-10 freeway and unincorporated LA county industrial zones (The Planning Report, 2020). The Natural Park, initiated by the youth of Ramona Gardens, is an ongoing nature-based solution project that utilizes ecosystem science, innovative engineering, and a community-driven design process to expand resident's access to green space and improve community health. With children suffering from asthma at twice the state average, the air in Ramona Gardens is some of the most polluted in Los Angeles. Considering the location of this project and the present community health threats, the goals of this project are to create a noise and sound buffer from the freeway, grow native plants, recycle stormwater, build climate resilience, and provide a healthy and safe green space for residents to enjoy (The Planning Report, 2020).

Photo Credit: SWA and Community Conservation Solutions

Community Involvement and Process

What is now the Natural Park project is located on what used to be the Ramona Gardens Housing Development, a large public owned plot of land next to the I-10 freeway with an underground culvert that carries stormwater and urban runoff. This site was identified by Community Conservation Solutions (CCS), an organization that recognizes potential project sites on public land, particularly land in the Los Angeles River Watershed that can capture urban runoff, provide carbon storage, improve community access to green space, and address air quality concerns. Initiated by CCS and Legacy LA, a local community based organization focused on youth development, this project has been shaped and informed by the communities it serves throughout the planning and implementation processes (Community Conservation Solutions, 2018) . According to the detailed Community Outreach and Engagement Report from CSS, community input was the driving force behind the development and concept design of the Nature Park. The community and stakeholder engagement processes are listed in the report as follows:

- Two community workshops at the Boys and Girls Club at Ramona

Gardens, each attended by nearly 100 people
- Legacy LA's door-to-door survey of 500 Ramona Gardens residents
- Legacy LA's youth leader training
- Field trips with Legacy LA to example natural parks
- Distribution of materials in both English and Spanish
- Posting fliers throughout the community
- Legacy LA's weekly presence at the Ramona Gardens swap meet

Following the excited community participation in the meetings and door-to-door survey, CSS and Legacy LA applied for the AB-617 Grant, which is the Community Air Grant from the California Air Resources Board. There is also maintenance and operations funding coming from the LA County Measure A fund (The Planning Report, 2020), (Community Conservation Solutions, 2018).

Avalon Green Alley Network Project, Los Angeles, CA

Project Overview

The Avalon Green Alley Network is a project that is transforming underutilized allies in South Los Angeles into green, multipurpose public spaces that provides a vast array of community and environmental benefits (Avalon Green Alley Network, 2014). The network consists of six interconnected alleys, streets, and sidewalks that create a connection between residential homes and community amenities, including local schools, parks, and grocery stores. Bordering the 110 Harbor Freeway to the west, this project spans across an approximately 35 acre neighborhood, creating a combined total of 1.8 acres of new urban green space. The Avalon Green Alley Network project is the first alley revitalization in South Los Angeles and represents an innovative reuse of existing infrastructure to improve public health and meet climate resilience needs (Avalon Green Alley Network, 2014).

Community Involvement and Process

This project was initiated by the Trust for Public Land (TPL), an organization that works to ensure communities have meaningful involvement in the development of natural spaces. The project was divided into four phases: Research and Pre-Design

Studies, Political Municipal Support, Ongoing and Integrated Community Outreach and Engagement, and Partnerships and Funding (Avalon Green Alley Network, 2014). The first research phase was conducted by TPL providing the context of the community and environmental benefits of the project. Following the initial research phase of the project and fueled by concerns for stormwater runoff pollution, the City of Los Angeles responded by coordinating efforts within City departments and outside stakeholders. These efforts led to the creation of the Green Alleys Subcommittee of the City's Green Streets Committee in 2008 and an ongoing partnership between the City of Los Angeles, TPL, Equipo Verde (a local community environmental justice group), and other local residents. Additionally, the project has become a focal point in the South Los Angeles Green Alley Master Plan created by Trust for Public Land and adopted by the LA city council in 2017. The previously mentioned ongoing partnership with the city of Los Angeles and subsequent municipal involvement comprised the second phase (Avalon Green Alley Network, 2014).

While the third phase of the project was dedicated to community involvement, community members have been engaged with the project since its conception. According to TPL, "[community outreach and engagement] is an integral component to the entire project; ongoing and integrated community outreach is seen as the process of building community around the Avalon Project". The community outreach by TPL began with the formation of the Avalon Green Alley Team, which mobilized community members to engage with the alley project by participating in alley clean-ups, community art projects, and tree planting. Additionally, TPL as well as city departments have coordinated community input and education sessions for receiving feedback and teaching residents about the goals of the project. Additionally, outreach consisted of an extensive community survey, tabling at events, interactive flip books, and canvassing door-to-door. This comprehensive strategy for community involvement has allowed TPL and the City of LA to gather a wide variety of input about community concerts and ideas, as well as hopefully fostering ongoing stewardship and placemaking (Avalon Green Alley Network, 2014).

Madison West Park and the East Hollywood Garden Achievement Center, Los Angeles, CA

Project Overview

The Madison West Park and East Hollywood Garden is a nature-based urban green space renovation project that has transformed a vacant plot of land into a vibrant park and community garden, providing access to natural space for the over 12,000 East Hollywood residents that live within a ten minute walk (Los Angeles County, 2019). The plot of land that is now the Madison West Park had been vacant for over twenty years. Following community-driven renovation and design, guests of the park are now able to enjoy two sections of the space: a natural park for gathering, playing, and exercise, as well as a community garden with over 31 plots for neighbors to grow food. With community involvement at the forefront of this effort, the park includes community selected features to meet the specific needs of local residents. These features include

sports courts, picnic tables, and outdoor fitness equipment. Additionally, the garden includes a classroom where community members can sign up for gardening, landscaping, nutrition, and cooking classes. In order to increase local climate resilience and combat environmental hazards such as air pollution, native trees, shrubs, and perennials have been planted throughout the park. The Madison West Park and East Hollywood Community Garden are both examples of effective community led processes to build local climate resilience and address park access disparity, representing inclusivity and function by allowing local residents to connect with nature and each other.

Community Involvement and Process

This project was initiated with a partnership between TPL and the Los Angeles Community Garden Council (LACGC), an organization that creates and maintains community gardens throughout LA County (Los Angeles County, 2019). TPL transformed the front half of the lot, approximately 12,000 square feet, into the park area. The funding for this section of the project is provided from Proposition 84, the California Statewide Park Development and Community Revitalization Program. The back half of the lot, another 12,000 square feet, was developed into the community garden section by the LACGC. Funding for this section of the green space came from the City's Parks First Trust Fund for open space in the SNAP Specific Plan Area, Community Development Block Grant (CDBG), and private funds raised by the LACGC (Los Angeles County, 2019).

Community involvement in the process and design of the park and community gardens were at the forefront of the TPL, LACGC, and municipal departments' efforts (Los Angeles County, 2019). This community involvement consisted of ten separate community events, including meetings at the local library, school presentations, and numerous community input and design sessions at the East Hollywood Neighborhood Council. Community members helped to plan the layout of the space, selected the playground and exercise equipment, decided upon native plants, and chose community artists to design the murals that would decorate the park (Los Angeles County, 2019).

Current Status

Data

The most major sites of urban green spaces already in use, and mostly easily adapted for community and climate impact in Costa Mesa, are parks and nature reserves. Existing data for the demographic use of parks and more specifically nature reserves in Orange County can be utilized to understand the context of these surrounding spaces and accessibility. A study conducted in 2019 found that the majority of visitors to nature reserves in Orange County are white, making up 60% of visitors, and the next largest group being Hispanic/Latino, who make up 20% of visitors (Figure 4) (Monz et al, 2016). This stands in contrast to the racial and ethnic makeup of Orange county which is 34.2% Latino, 19.5% Asian, and 41.4% White (Table 1) (Monz et al,

2016). There are many reasons that can be attributed to this disparity. One way to begin to address it is through creating accessible and usable green spaces such as parks through working with communities that currently are underserved by park systems in Orange County, such as those with nature reserves and Black, Indigenous and people of color (BIPOC) communities. Similar research still needs to be done to understand where these gaps exist within the city landscape of Costa Mesa, but will be imperative in targeting communities that need to be centered while creating green spaces. Additional research and the current status and community feelings and use of current green spaces as well as re-imagination of new spaces will also be beneficial to guide site location and project goals.

Existing Partners

An essential aspect of working to build community through implementing green spaces is involving community partners and participation through different avenues. This can be done by engaging grassroots and community based organizations that are already run by, and working to serve those communities most marginalized such as the Orange County chapter of association of latino professionals for america, and Churches. Additionally nonprofits and NGOs within the environmental space which emphasize both conservation and community resilience building will be essential in gaining expert field knowledge in the application of creating and maintaining ecological spaces in California such as Orange County Conservation Corps, OC native plant society, and community conservation solutions. Additionally in order to create thriving socio-ecosystems, imploring Indigenous led NGOs and nonprofits to better understand the ecological needs of the area and how to better foster relations between the land and the community members, partnerships with organizations like Tzicatl Community Development Corporation should be utilized. Tzicatl Community Development Corporation’s mission is to “regenerate positive community among Indigenous Peoples through the stewardship of land and facilities for the educational, cultural and ceremonial practices and needs of Indigenous People", and have experience managing large portfolios of community assets in Los Angeles, which similar to Costa Mesa is also on Tongva- Gabrielino land. Creating partnerships with youth centered programs such as Resilience Orange County, and K-12 schools in the Newport-Mesa school district will also allow for educational programs and opportunities in ecology, climate change, and gardening to be offered alongside environmental curriculum while creating Earth stewards who can share and pass along information to their families in communities otherwise difficult to reach. Partnerships with secondary schools similarly can allow for educational programs and even mentorship programs to be developed as well as possible volunteer and funding opportunities.

Funding Opportunities

Funding opportunities for urban green spaces, because of its community-based nature, can be leveraged from both community partners and organizations as well as government agencies and programs. Other projects such as in the aforementioned case studies utilize community partnerships with local businesses such as grocery stores, retail outlets, churches, and local conservation groups to help generate funds. These

groups are usually vested in community health and wellness as well as community building and have been listed in the previous potential partner section. There is also a plethora of opportunities for funding when combined with funds from similar groups or from grants. Since, on a national and state level, there have been recent initiatives to address environmental justice through climate change, work grants are becoming more readily available.

One such grant is the Urban Green Grant from the California Natural Resources Agency. This grant is funded by California Climate investments and would be an excellent candidate for justice and community centered urban green projects since the investment group is " a statewide initiative that puts billions of Cap-and-Trade dollars to work reducing greenhouse gas emissions, strengthening the economy, and improving public health and the environment — particularly in disadvantaged communities." The grant requires that the urban greening project reduce greenhouse gas emissions through creating enhancing or expanding community parks and green spaces, which is possible through urban green space projects where communities can help target new needs or green spaces or the most effective areas to enhance or expand.

Additionally special priority will be given to projects that are either proposed by a critically underserved and disadvantaged community or community builds through creating partnerships with local organizations that outreach with these communities. By utilizing a Justice Framework, a community based and led urban green space would match well with funding for this grant since the inner city area of Costa Mesa has already been identified through the grant guidelines in SB-535 as both a Disadvantaged and Low-Income community.

Survey Questions

To better understand what green spaces would provide the most comprehensive ecological and social benefits to the communities of Costa Mesa, comprehensive community survey questions are outlined below. Some questions are specific to Costa Mesa, while others questions are from the National Parks System's 2020 Programmatic Clearance Process (National Parks Service, 2020). From this, we have created 6 different categories of questions: Background on Costa Mesa Green Space, Emotional Motivations to Visit Green Spaces, Feelings about natural spaces, Important features of natural spaces, Level of concern of pollution and climate change impacts in Costa Mesa, Ranking Personal Benefits from Natural Spaces.

1. Background on Costa Mesa Green Space
    a. Do you know what an urban green space is?
        - Y/N
    b. Are there parks near you?
        - Y/N
    c. How comfortable do you feel going to parks?
        - Scale of 1-5
    d. Do you enjoy spending time in natural spaces in Costa Mesa?
        - Y/N
    e. What Green Spaces (parks, gardens, natural landscapes, or water features) could be changed or restored to be more useful to you?

        - Fill in the Blank

1. Emotional Motivations to Visit Green Spaces
    a. Indicate how important fostering connection with nature is
        - (scale of 1-5)
    b. Indicate how important remoteness and solitude is in your natural spaces
        - (scale of 1-5)
    c. Indicate how important fostering a spiritual connection is in natural spaces
        - (scale of 1-5)
    d. Indicate how important a pristine natural environment is to you
        - (scale of 1-5)

1. Feelings about natural spaces
    a. Indicate how much you agree: Wilderness areas are important to protect because they contribute to better air quality
        - (scale of 1-5)
    b. Indicate how much you agree: I support protecting wilderness areas just so they will always exist in their natural condition
        - (scale of 1-5)
    c. Indicate how much you agree: I believe the trees, wildlife, free flowing water, rock formations, and meadows that wilderness protects have value themselves whether or not humans benefit from them
        - (scale of 1-5)
    d. Indicate how much you agree: I enjoy knowing that future generations can will be able to visit and experience natural spaces
        - (scale of 1-5)
    e. Indicate how much you agree: I enjoy knowing that other people currently are able to visit and enjoy natural spaces
        - (scale of 1-5)

1. Important features of natural spaces
    a. Rank your level of importance for this resource in natural space: vegetation (trees, plants, wildflowers)
        - (Scale of 1-5)
    b. Rank your level of importance for this resource in natural space: the scenery in daylight
        - (Scale of 1-5)
    c. Rank your level of importance for this resource in natural space: The cultural history of the park
        - (Scale of 1-5)
    d. Rank your level of importance for this resource in natural space: The sounds of nature in daylight
        - (Scale of 1-5)
    e. Rank your level of importance for this resource in natural space:Wildlife
        - (Scale of 1-5)

1. Level of concern of pollution and climate change impacts in Costa Mesa
    a. Rank your level of concern for the following: noise pollution from cities, roads, etc
        - (scale of 1-5)
    b. Rank your level of concern for the following: water pollution from cities, roads, etc
        - (scale of 1-5)
    c. Rank your level of concern for the following: changes from climate change caused by CO2 emissions from cities, roads, etc
        - (scale of 1-5)
    d. Rank your level of concern for the following: Air pollution from cities, roads, etc
        - (scale of 1-5)

2. Ranking Personal Benefits from Natural Spaces
    a. What are the values you gain from visiting a natural space: learning about the natural world
    b. What value do you gain from visiting a natural space: Spending a lot of time in natural settings makes me happy
    c. What value do you gain from visiting a natural space: I think of myself as a part of nature not separate from it
    d. What value do you gain from visiting a natural space: when I am upset or stressed i feel better by spending time outdoors
    e. What value do you gain from visiting a natural space: i believe learning about the natural world should be an important part of every child's upbringing
        - All questions are answered on a scale 1-5 from strongly agree to strongly disagree

Conclusions and Considerations

Considering the powerful ecological and social impacts of natural spaces in cities, urban green space as a nature-based solution is a vital tool that Costa Mesa can implement to meet its climate resilience goals. Additionally, expanding access for communities in Costa Mesa that currently lack sufficient green spaces and face disproportionate environmental impacts will improve the health and quality of life for residents, as well as address critical equity concerns. Considering the ranging types of urban green space projects that Costa Mesa can consider from the case studies section, as well as the imperative Justice Framework that guides this study, it is important that the city centers the needs, input, and expertise of local communities in the creation and process of such projects. Community engagement is a vital piece of effective urban green space expansion and renovation projects. It is imperative that local residents are involved throughout the entirety of projects, including the design, implementation, maintenance, and beyond.

Urban Farming

Urban farming increases the health of communities through reducing food waste by providing a local compost facility, reducing the urban heat island effect, reducing food miles of food consumed by community (reduces greenhouse gas emissions and chemical inputs), inspiring connection and collaboration within the community, sequestering carbon, building topsoil through biointensive and regenerative organic practices.

This chapter outlines considerations for the implementation of community farms and gardens within the City of Costa Mesa. This includes recommendations for city established community farms and gardens, partnerships, funding, case studies, and suggestions for the allocation of resources for community members interested in growing their own food. Additionally, this chapter provides suggestions for how the community can be engaged throughout the planning and implementation processes of food infrastructure to ensure equity and properly serve the community. Along with supplying fresh produce to the community and mitigating climate change, farms and gardens serve as an educational resource for the community. Partnerships with local organizations and individuals can also be leveraged in providing access to resources and information to students and community members about growing food. The goal of this chapter is for this information to inform policy implementation within the City of Costa Mesa that encourages urban farming, ensures equity of access to fresh and affordable food, and improves ecosystem function.

Background

According to the book, *Nature-based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice,* urban farming and gardening are nature-based solutions (NbS) that look to fight climate change. Ultimately, urban gardens provide food which can increase food insecurity as well as be healthy by providing fresh, organic produce. These gardens can also provide ecosystem services such as cooling, air circulation, and water cycle regulation. Like blue and green infrastructure, urban gardens combat the heat island effect. In addition, urban farms and gardens can provide habitats for wildlife and lead to community engagement against climate change (Kabisch et al., 237).

In this paper, *Urban agriculture in the transition to low carbon cities through urban greening*, by Mary Thornbush of the University of Oxford, Thornbush details how urban agriculture is a “mitigation-adaptation approach to climate change adaptation” that employs “vegetation as a carbon capture and storage system” while “contributing to food resources as well as working to alleviate pressing social issues like poverty” (Thornbush 2015). This article, *Agriculture, Climate Change and Carbon Sequestration*, by the National Sustainable Agriculture Information Service posted on the USDA website explains why climate change is a threat to our main food sources, the importance of creating a more resilient system, and how agriculture can actually be a solution for climate change. Locally grown food is one of the biggest ways communities can be more resilient to climate change while actively mitigating the effects and strengthening the health of the community.

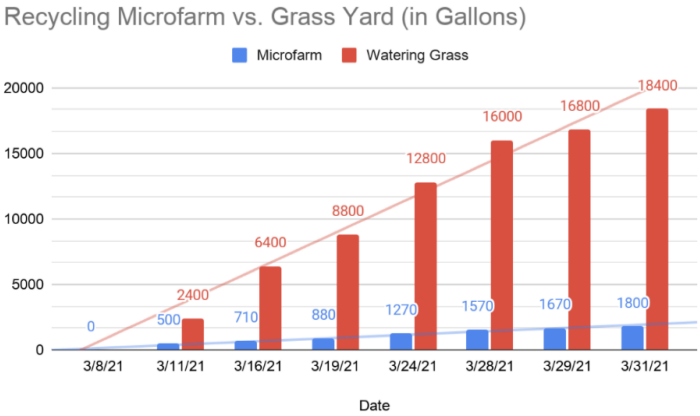
There are two types of community gardens: allotments and community gardens. Allotment gardens “are mostly larger estates divided into plots that are allocated under rental payments to a single person or a family for non commercial cultivation of fruits, vegetables, and ornamental plants and recreational purposes” (Kabisch et al., 238). The area can be owned by different organizations or associations, but not by the person or family. Community gardens are defined as, “having a permanent or temporary character, and are often characterized by informal claims of urban voids with the purpose of local community development” (Kabisch et al., 238). There are many other ways to encourage urban farming and gardening such as providing community members with their own resources to grow food in their yards, revising policy that allows food to be grown on public land (sidewalk strips, city land, under-utilized greenspace), incentivizing private landowners to utilize their spaces to grow food, creating food distribution infrastructure, and increasing access and resources for individuals and organizations working to grow food within the community.

There are already two established allotment gardens in the City of Costa Mesa run by the city. These gardens are the Hamilton Community Garden and Del Mar Community Garden. Combined, these gardens have 102 parcels and one member can be assigned to each parcel. The renewal and regulations of the garden are determined by the city and can be found in the renewal documents here Policies for Renewal of Costa Mesa Community Gardens 2018. These community gardens are primarily funded by taxpayer money. The breakdown of funding can be found at Costa Mesa Budget. It is possible to fund more projects through these avenues by reallocating funds and increasing efficiency and community engagement. Additionally, grants, partnerships, and existing resources can be utilized which will be detailed below. The existing structure of allotment gardens could also be made more accessible by removing barriers of access such as proof of citizenship, fees, and increasing communication/outreach. Ultimately, by prioritizing food access and food sovereignty by increasing community farms and gardens and increasing access to locally grown food, the City of Costa Mesa will be more resilient to climate change by not relying on insecure supply chains, strengthening local ecosystems, and improving the health of community members, leading to greater prosperity for all,

Case Studies

Crop Swap LA - Asante Microfarm

Crop Swap LA aims to grow food in underutilized spaces to create jobs and hyper-local nutrient rich food. They are a model for creating food security and smart water usage. Assante Microfarm is the first of many microfarms they plan to install. The water recycling infrastructure reduced water use by 92% while growing 600 edible plants and feeding 35 families weekly. They distribute the food hyper-locally, within 2 miles of Asante Microfarm. The Asante Microfarm was funded by the LA2050 Grants Challenge.



This figure shows the reduction of water usage at the Asante Microfarm from a grass lawn (red) to growing food crops (blue).

Orange Home Grown, Orange, CA

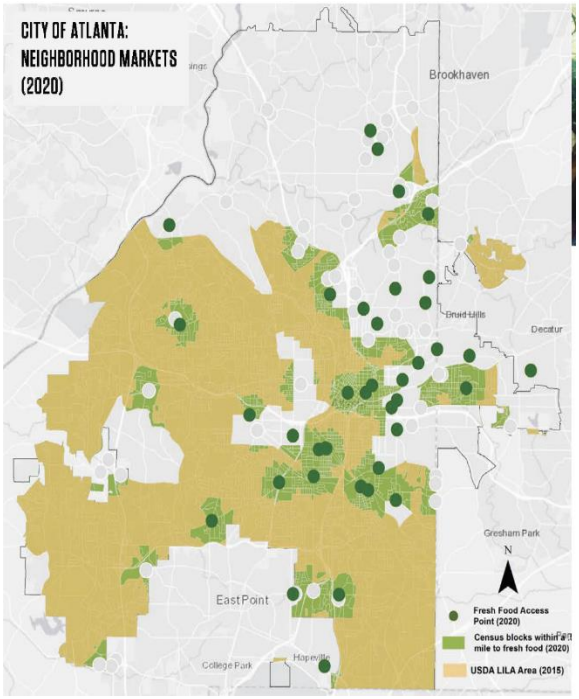
Orange Home Grown is a nonprofit organization who leases their land from Chapman University at no cost. Megan Penn started the Orange Home Grown Farmers' Market in 2011 and the Orange Home Grown Farm in 2016. The nonprofit runs entirely from the profit of the farmers' market, donations, and very occasional grants. The nonprofit organization is nearly entirely run by volunteers. On the farm, there are Friday volunteer days where community members can volunteer for the day, learn how to garden, and take home free produce.

Top of the World Elementary: Giving Garden Program, Laguna Beach, CA

Top of the World Elementary is a school in Orange County, CA with an environmental education program through their school garden. Through their Giving Garden Program, they have received the title "Green Achievers" (only four in the state) for the sustainability and environmental program. They received funding through a grant from the Seeds of Change Grant Program. Using the money from the grant, they were able to start the Giving Garden Program and put a geodesic dome greenhouse into place. Top of the World is a public school that receives city funding for a paid position at the school to develop curriculum based in the school farm. The farm was developed alongside the school curriculum.

Atlanta Urban Food Forest at Browns Mill

The Atlanta Urban Food Forest at Browns Mill is the nation's largest free food forest. The food grown at the food forest is free and accessible to all. During the planning phase, more than two years of outreach was conducted to familiarize the community with the concept of a food forest. More information about this can be found in their Community Engagement Activities. Community councils were created to plan and design the entire food forest to best fit the needs of community members. This included what types of food should be grown and visiting other food forests so community members could familiarize themselves with different operations and choose the ones they liked best. Volunteers and interns from local schools were used in the building processes. They engaged local businesses and organizations for mutual support by participating in volunteer days and receiving their input. Now that the food forest is established, they have regular volunteer days and workshops for community education. Their ongoing goal is for 85% of Atlanta residents to be within ½ mile of fresh and affordable food by 2022, now with the food forest they are well on their way. These plans do more than just establish a food forest, they also engage local grocery stores and markets. They conducted studies defining low-income and low-access food access areas. This research can be found at the Atlanta Fresh Food Access Report.



The City of Atlanta's map of Low-Income and Low-Access (LILA) areas as well as fresh food access points.

Urban Agriculture Policy

Urban Agriculture State Legislation

- AB551 (2013): According to the National Conference of State Legislation, Urban Agricultural State Legislation looks to create policies around urban agriculture. One policy that has been enacted is the Agriculture Incentive Zones (UAIZ) in California. The policy allows cities and counties to enter into contracts with landowners to restrict their use of land for small-scale agricultural production. In return, the landowners have their land assessed at a lower rate based on the per-acre value of cropland. Under this link lists different policies in different states in the United States that have dedicated their efforts to urban agricultural policies.

Laws, Zoning, and Regulations

- Seeding the City
  - Under Change Lab Solutions "Seeding the City: Land Use Policies to Promote Urban Agriculture" which is a toolkit to help develop and model language for land use policies for urban agriculture.
- Good Laws, Good Food
  - Under Harvard law this toolkit, "Good laws, Good food: Putting Local Food Policy to Work in our Communities" allows food council members to learn the basic legal concepts around local food systems.
- Ground Rules
  - "Ground rules" is another toolkit from Change Lab Solutions that helps to develop community gardens and the legality that comes with creating a community garden.
- Dig Eat and Be Healthy
  - Change Lab Solutions created this toolkit in order to explain the policies and processes that can be helpful when trying to use public land for urban agriculture.
- Growing Urban Agriculture
  - "Growing Urban Agriculture: Equitable Strategies and Policies for Improving Access to Healthy Food and Revitalizing Communities" is a document that gives information on how to improve, face challenges, and how to work towards financial stability in urban agriculture along with policy recommendations.
- *American Planning Association: Urban Agriculture*
  - This page gives in depth links to background resources, articles, reports, briefing papers, guides, web pages, model ordinances and plan language, standalone policies, comprehensive plans, functional plans, regulations, and related collections on urban agriculture.
- *Policies for a Shareable City #11: Urban Agriculture*
  - This paper gives an idea about policies that can be created around urban gardening. Some of these examples are tax incentives, using city-owned land,

defining “community gardens” and “personal gardening” in zoning code, and creating simple permitting applications.

Communication

Community engagement and outreach are the most important aspects of creating food infrastructure to ensure that the needs of the community will be met and that resources are put to good use. Communication includes all members of Costa Mesa, particularly those with an interest or need for a community garden and those near prospective community garden locations. Surveys made as accessible as possible, and provided in spanish, english, and other languages spoken within Costa Mesa would be most effective. Flyers posted throughout Costa Mesa with a QR code linked to the survey. Community meetings held to develop plans for community farms and gardens. Engagement through Facebook groups, flyers (local markets, shops, bulletins), and canvassing at farmers markets (booths).

Avenues of Implementation

- Policy implementation that incentivizes land use for small, organic farms and gardens
- Using city land for urban farming and gardening (Accepting proposals from community members to be able to farm the land for free)
- Partnerships with local schools, land owners, and food-centered landscaping orgs to convert under-utilized space to grow food
- Food distribution plans including partnering with local grocery stores and markets, Community Supported Agriculture (CSA) boxes from local farms, community fridges/food boxes/tables (LA Fruit Share).

Organizations for Urban Agriculture

- American Community Gardening Association
    - The American Community Gardening Association is a grassroots non profit organizations that look to build community through community gardening and greening. They link over 2100 gardens in the United States and Canada.
- National Gardening Association
    - The Nation Gardening Association is a social media website that looks to teach how to start gardening and improving already established planting skills. They have tools online so that people are able to teach, learn, educate, and trade.
- American Public Garden Association
    - The American Public Garden Association is a professional organization for the field of public horticulture. They encourage better practices, offer education and networking, and advocate for their communities.
- Roots of Change
    - Roots of change is a “think and do tank”. They have analyzed the food system from farm to table, and they work with entrepreneurs, policy makers, and foody system advocates to make communities healthier.
- GrowGood- Los Angeles based
    - GrowGood is a 1.5 acre community garden that has been working with the Salvation Army for residents of the Bell Shelter.

Possible Partnerships for Collaboration, Education, and Land Use

- Orange County Organic Gardening Club
    - The OCOGC is a group that meets at the Orange County FairGrounds the second tuesday of each month at 7 pm to discuss education, gardening tips, techniques, and local resources.
- Master Gardeners of Orange County
    - The Master Gardeners of OC looks to provide Orange County with up-to-date, practical and sound gardening advice that they can use. They look to staff at different events, seminars, and websites.
- Crop Swap LA
    - Crop Swap LA was established in 2018 and is an organization providing Los Angeles local gardener's with the Los Angeles community to provide fresh produce and other goods.
- Centennial Farm
    - Centennial Farm is a local farm located at the Orange County Fairgrounds that has both agriculture and livestock.
- Orange Home Grown
    - Orange Home Grown is a community garden located in Orange, CA that is a non-profit that provides education and food to their community.
- Costa Mesa based farmers and gardeners
- Schools in Costa Mesa (build into curriculum)
    - Classes on how to grow crops/integrate animals/compost/reduce waste/low water usage open to the community
- Mutual aid and food networks in Costa Mesa
- Costa Mesa Farmers' Markets
    - Costa Mesa Certified Farmers Market
    - SOCO Farmers Market
        - These farmers markets take place once a week. The SOCO Farmers market takes place every Saturday from 9-2pm.
- Greywater Corps
    - Greywater Crops is a Los Angeles community that educates and installs water recycling infrastructure for communities in hopes of reducing water usage.

Local Organizations for Private-Public Partnerships and Community Outreach

- Earth Resource Foundation
    - Costa Mesa based environmental-education non-profit targeting youth, communities, and businesses for environmental issues.
- Fermentation Farm
    - Costa Mesa based hand crafted fermentation classes, supplies, and locally-sourced products.
- The Water Brewery
    - Costa Mesa health food store in support of the local community.
- Meet the Source
    - Costa Mesa based organic bakery.

Grants

- Growing Spaces
    - Growing spaces offers links to different grants that are based on school garden grants, community garden grants, veterans and disability garden grants, and organic farming and horticulture grants
- Public Gardens Association
    - The Public Gardens Association also lists different grants from the Environmental Protection Agency (EPA), Urban Agriculture Resilience Program, Annie's Grant for Gardens, and National Science Foundation on their page.
- Alternative Farming Systems Information Center
    - The EPA lists different grants gifted to community gardens and urban agriculture on this list.
- LA2050 Grants Challenge
    - A total of $1,000,000 to various community-based proposals. Utilized by the Crop Swap LA - Asante Microfarm.

Other applicable grants:

- *Garden Grants and Crowdfunding: Community Gardens*
- *Learning Garden Grants for Schools*
- *Kids Gardening Grant for Schools*
- *USDA Grants*

Possible Partnerships for Land Use:

- OC Fairgrounds
- Orange Coast College
- The LAB Anti-Mall/The Camp
- Public Parks
- Golf courses
- South Coast Plaza
- South Coast Repertory

Survey Questions

All populations of Costa Mesa are targeted with the survey, however, there is a priority placed on communities suffering from food apartheid and/or a need for fresh, organic produce. Surveys targeting these priority communities as well as those living near potential garden sites such as schools and green spaces are most integral. These surveys provide a sense of community interest in care of the gardens as well as community need. If there is a need for a garden/fresh produce in communities without enough time to care for a garden, infrastructure can be established to create volunteer programs and better food distribution systems. The survey will ultimately help the City learn if people are interested or able to care for a garden, if they are in need of fresh

produce, if they want more education about growing their own food, and will help spark community interest in urban farming.

1. Can you walk to your local grocery store? (Yes; No)
    - Is organic food available in your local grocery store? (Yes; No)
    - What is the nearest place to your home to access food? (Grocery store with fresh produce; Grocery store without fresh produce; Liquor store; Other)
2. Do you have access to fresh, organic produce? (Yes; No)
    - If no, why not? (Lack of local availability; Too expensive; Other)
3. Do you visit farmers' markets regularly? (Yes; No)
    - Is the farmers market accessible to you and others in your community? (Yes; No)
        - If not, why not? (Too far; Don't have the time; Covid; Other)
4. Did you know what a community garden was prior to this survey? (Yes; No)
    - Would you be interested in attending a meeting to learn more about creating a community garden in your neighborhood? (Yes; No; Not able)
        - If not able, why not? (Transportation to the meeting; Lack of time; Other)
    - Do you have an interest in participating in a community garden? (Yes; Already do; No; Need more information)
        - Name of neighborhood (Open-ended)
        - What would incentivize you to participate in a community garden? (Free produce; Ability to sell produce at farmers' market; Not interested; Other)
5. Do you see a need or desire for more education and community engagement events around growing food in your community? (Yes; No)
    - Are you interested in attending educational events about learning how to grow food? (Yes; No; Not able)
        - If not able, why not? (Don't have the time; Other)
6. Do you or someone in your household grow your own food? (Yes; No)
    - If not, why not? (Don't have time; Don't know how; Don't have the resources; Not interested)
7. Do you have children? (Yes; No)
    - Are they interested in learning how to garden? (Yes; No; N/A)
8. Do you have access to a computer and/or internet? (Yes; No)
9. Would you benefit from access to fresh, local eggs? (Yes; No)
10. Would you be interested in a community fridge? (Where fruits and vegetables are stored along with any other goods of surplus or near expired free for the community) (Yes; No)

Considerations

Urban agriculture offers many benefits to the community - social and environmental. Urban agriculture provides ecosystem services by improving air quality, regenerating life above and below the soil, and increasing the overall health of all populations within the community. Additionally, urban agriculture can be utilized to

increase the community's access to fresh and affordable foods, decreasing food insecurity and increasing food sovereignty. Urban agriculture, and the benefits it provides, can counteract climate change and food apartheid. Everybody eats, it is a matter of where and how that food is grown and what food the community has access to that will determine how this food sustains and nourishes the community and environment.

In working with current infrastructure, the existing gardens within Costa Mesa could be made more accessible through removing barriers of access such as proof of citizenship, fees, and through increasing communication and outreach with community members. Receiving community input through surveys and meetings identify the needs of the community and ensure that vulnerabilities can be seen and met through the goals and actions of the City. Additional research such as defining low-income and low-access (LILA) areas, defining fresh food access points, and conducting community meetings will further identify the needs of the community. Finding partnerships in local businesses, urban agriculture organizations in Southern California, and environmental nonprofits will illuminate avenues of funding, increase community participation, and encourage collaboration and the sharing of knowledge throughout the course of these projects. Lastly, stable and sufficient funding plays a key role in the success of these goals. Funding can be found through grants, partnerships, and donations. These considerations can be informed by the case studies, policies, grants, policies, and other information presented in this chapter.

Encouraging community agriculture through prioritizing food access and food sovereignty will ensure that the City of Costa Mesa will be more resilient to climate change by creating local supply chains, strengthening ecosystems, and improving the health of community members. These considerations rely on community input and acknowledging the needs of the community. Research can be done through surveys, community meetings, and gathering data to identify low-income and low-access (LILA) areas and fresh food access points. Identifying goals for the City of Costa Mesa in terms of food accessibility and ecosystem restoration through community gardens is an important next step to solidify a plan of action. Creating goals that are applicable and practical will ensure success of the project and ensure the needs of the community are met.

Green Infrastructure

Background

Nature-based solutions (NbS) involve using and working with nature as a method of addressing the environmental and social challenges brought on by anthropogenic climate change (1). Green infrastructure is a nature-based solution that encompasses a sustainable approach to managing stormwater with green materials such as trees, lawns, forests and more (2). Blue infrastructure is also an approach used to address the same issues (3). It refers to water related NbS including ponds, rivers, wetlands, etc (3). These methods are cost effective long term all while providing benefits to the community (2). Currently, gray infrastructure is what is in use throughout cities; it consists of human made infrastructure, generally concrete, and includes sewer systems, piped drainage, water treatment systems, and more (4). Stormwater flows over all of the impervious grey infrastructure surfaces present in the city, and eventually ends up in local streams, rivers and oceans (5). Along the way, the stormwater picks up pollutants, trash, and toxins from the roads and buildings that it encounters; this can pollute water supplies (5). Overall, the mismanagement of stormwater can also lead to a myriad of other issues such as flooding, land erosion, and other costly issues (5). The implementation of green infrastructure allows for reducing the amount of stormwater that reaches waterways which reduces water pollution and reduces flooding (5). The increase in the greenery that comes with green infrastructure also helps to reduce temperatures in an urban area like Costa Mesa as well as increasing property values all while being less expensive than current gray infrastructure (5).

In Costa Mesa, the city has already achieved LEED Gold certification (6). This shows that the City is committed to these values and making progress in terms of the LEED criteria (7). In order to be LEED certified, the city must accumulate and maintain enough ‘points,’ which are earned by demonstrating sustainability in multiple project areas, including metrics relating to energy, water, waste, transportation, and quality of life (7). This shows the City’s commitment to sustainability, but does not address the problem of stormwater management directly. In 2018, the city of Costa Mesa experienced flooded streets caused by heavy rain, exposing the vulnerability of the City to handle rain events of this magnitude (8). The current Green Building page from Costa Mesa’s official website has not been updated since 2008, but it did create a task force, “Green Team”, that was meant specifically to look into sustainable buildings, but has since been disbanded (9). When it comes to stormwater management, Costa Mesa has been deemed “Tree City USA”, but the planting of trees and other greenery has not been identified as a stormwater management method in the “Streetscape and Median Development Standards” from 2008 (10).

The first goal is gathering information on case studies in cities where green infrastructure has been successfully implemented, and particularly in cities that have a similar rainfall amount and climate to Costa Mesa. Since Costa Mesa is currently working on a project regarding stormwater management, this is an important time to look at ways green infrastructure can play a part in this implementation. The second goal is to look at the current incentive programs in place in Costa Mesa for incentivizing business and homeowners and compare this to other incentive programs to look for improvements and potential expansion to make information about

these solutions as accessible as possible. The third goal is to provide potential survey questions for the community so that Costa Mesa is prepared and able to gather the community input they need to pick the optimal green infrastructure solutions. This input could provide insight for Costa Mesa in choosing the methods that will work best and allow for achievement of their specific goals.

Case Studies

San Francisco

The Visitacion Valley Green Nodes Project (VVGN) was completed by the San Francisco Public Utilities Commission in 2018, and was one of the first public green infrastructure projects constructed in the city of San Francisco (11). It was done in partnership with the San Francisco Recreation and Parks Department and San Francisco Public Works. This project has rain gardens that span 3,745 square feet and can manage 780,000 gallons of stormwater per year. It is part of the Sewer System Improvement Program (SSIP), which is a sustainable, seismically safe sewer system upgrade (12). The SSIP was a multi-billion-dollar citywide investment that was aimed at upgrading the aging sewer system. One of the rain gardens is in McLaren Park, and the other is along a street. The rain gardens improve community spaces and provide educational opportunities while managing stormwater. The water will run from the impervious roadways into the vegetated planters that can filter and capture the rainwater in the soil, easing the amount of water that goes to the sewer system (20). In order to complete this project, there was a level of public engagement through two public workshops and multiple community group meetings where residents could give feedback on the project. There were also feedback boxes placed at the project locations before it was built. In terms of maintenance, the San Francisco Public Utilities Commission is responsible for monitoring the facilities including removing trash and debris, and plant establishment and care.

Fig. 1 Before and After images of the Visitacion Valley Green Nodes rain gardens (SF Water Power Sewer, 2018)

Fig 2. Close-up of a rain garden next to a road (Lotus Water, 2018)

San Jose

In San Jose, California, the City of San Jose Environmental Services Department (ESD) did a $1.29 million pilot project that created 6,500 feet of curbside rain gardens and replaced 2,800 feet squared of asphalt with permeable pavements that guide stormwater into the gardens during heavy rain (21). This has been created to prevent motor oil and grease from washing into the Guadalupe River and into the South San Francisco Bay. The project partners included the City of San Jose Department of Public Works and the California State Water Resources Control Board. The plants put into the gardens were chosen because they were drought-tolerant, could filter soil, and could also handle a lot of water. The project cost about $1,288,000 (21).

San Diego

One great example of a city adopting green infrastructure into their plans to protect waterways and promote sustainable development is San Diego. In order to combat stormwater runoff and the fact that about 25% of urban land is roads, San Diego implemented green streets (22). They used the opportunity of upgrading their standard streets with many added features to reduce the urban heat island effect, protect water quality, and improve the overall design to make safer streets for drivers and pedestrians (22). These green streets consist of permeable pavement in medians and sidewalks, gutters directed to trees, rain gardens, vegetative bioswales, and tree canopies as a means of mitigating stormwater (23). They also included features such as benches, LED lighting, and informational signage that also make the street a usable area for pedestrians (22). It was also noted that “Planting more trees and landscaping in public spaces cleans the air, cools the land, provides more habitat for wildlife, adds green maintenance jobs, increases property values and promotes a better, healthier quality of life” by a project manager who worked to create these green streets (23). The funding for the green infrastructure project came from Proposition 1 Water Resource Planning and Project Development and Alternative Compliance Credit Banking Systems (22). The city was also able to get transportation related funding from city and county allocations, competitive grant programs, and developer impact fees (22).

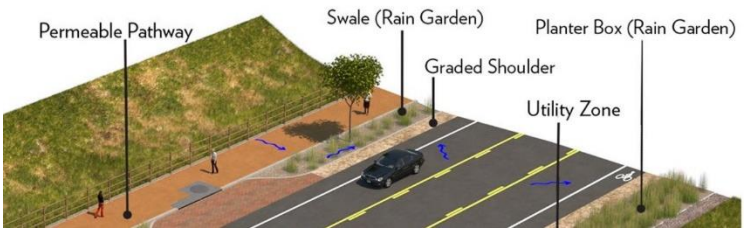


Fig 3. Plans for San Diego green streets (WSP, 2018)

Funding

Looking to the future for Costa Mesa, grants are a potential source of funding for green infrastructure projects. Federally, the Environmental Protection Agency (EPA) lists sources of funding opportunities for these as the National Fish and Wildlife Foundation who currently has their National Coastal Resilience Fund, the Environmental Justice Small Grants (EJSG) program, the Environmental Justice Collaborative Problem-Solving (EJCPS) Cooperative Agreement Program, the Sewer Overflow and Stormwater Reuse Municipal Grants

Program, and using the EPA Water Finance Clearinghouse, which is a database for further financial assistance (24). Within California, the California Stormwater Quality Association also lists many grant opportunities specifically geared towards water quality projects (25).

Incentive Programs

Providing information and incentives to homeowners and businesses is a potential way to get community involvement in green infrastructure. Costa Mesa had a Financial Incentive Program targeting commercial, industrial, and residential buildings (13). This program was effective from September 17, 2008 to June 30th 2009, and the initiative offered a fee waiver for building permit fees for green installations as well as a rebate for the cost of green building certification (13). This program was meant to encourage homeowners and businesses to include green installations such as garden roofs, wind turbines, high performance doors and windows, and other installations approved by the Building Official (13). Currently, Costa Mesa is not providing this program, however, looking to other cities with such programs may provide an opportunity to create and implement a successful incentive program.

San Diego County is a great example to recognize for their green building efforts with their adoption of The Green Building Program in efforts to protect the environment by encouraging environmentally sound building practices (14). While this program does not directly incentivize green infrastructure, it does enforce strict energy, water, and natural resource conservation to qualify (15). The program rewards those who qualify by following the conservation measures with a reduction of building permit and plan check fees by 7.5%, grant expedited plan checks that speed up the project timeline by seven to ten days, as well as no fees for the building permit and plan check of residential photovoltaic systems (16). These incentives could be modified and applied similarly to green infrastructure projects, which would allow for money saving by the builder and thus the home/business owner. The city of San Diego contributes with their Sustainable Building Expedited Permit Program, which allows any new residential, commercial, or industrial projects that qualify as sustainable building, by means of either generating a certain percentage of energy via solar or achieving LEED certification, to speed up their permitting process (16).

In New York City, there is a Green Infrastructure Grant Program which focuses on private property owners specifically in combined sewer areas, which are designed to collect stormwater, waste water, and sewage and transport to treatment facilities (17). This program came to be through a partnership between NYC Parks and the NYC Department of Transportation that started as a greenstreet program and eventually expanded to become the Green Infrastructure Unit - that now works closely with the NYC Department of

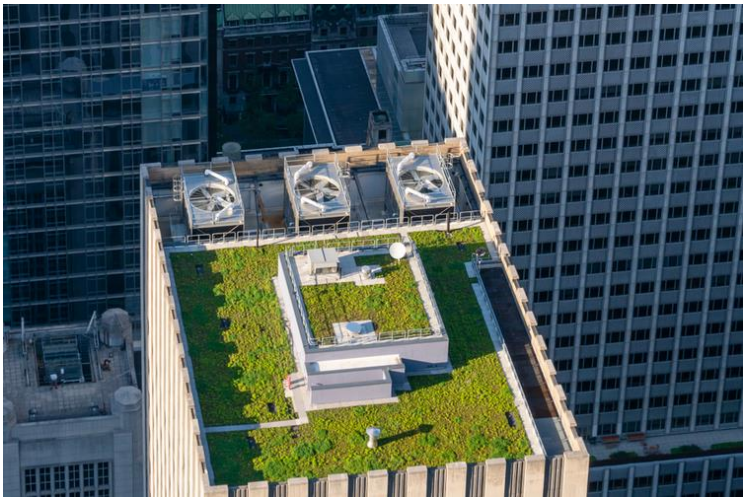


Fig 4. Green roof in New York City (ThomasNet, 2019)

Environmental Protection (26). The program was implemented to help reach New York City's goal of installing green infrastructure on 8,000 acres by 2030 (18). In these areas, grants of up to $5 million can be received for funding projects that mitigate storm water including blue roofs, rain gardens, green roofs, porous pavement and rainwater harvesting (17). The program also emphasizes the importance of upkeep by requiring a commitment of twenty years of maintenance for these projects (17). This program, between 2011 and 2016, provided over $13 million to private owners, and money for grant programs comes from sources such as the EPA, the National Fish and Wildlife Foundation, New York City Department of Environmental Protection, the U.S. Forest Service, and others (19).

Looking at other cities' plans and success is an important way of deciding how to incentivize those who live in Costa Mesa and encourage community interest and involvement in this process.

Survey Questions

The target population for the survey is adults living in Costa Mesa in order to gain insight into how the implementation of green infrastructure can best improve the communities members lives and the city as a whole. Keeping most questions to multiple choice or yes/no to maximize participation. From these questions, the interest in green infrastructure from the community can be gauged, and valuable information on where green infrastructure can be best implemented could be provided based on the experiences of the community. The survey should also include pictures and background information on green infrastructure in order to ensure that the community has knowledge of the benefits and are aware of what green infrastructure looks like. Potential questions include:

- Have you ever been personally affected by flooding in Costa Mesa due to heavy rains?
- Have you noticed areas in particular that experience any flooding during the rainy season? If so, where?
- Would more trees and greenery in your area be something you would want?
- Would you be interested in information regarding sustainable upgrades that could be made to your home and in your city that would save money and be good for the environment?
- Do you think that the city of Costa Mesa is currently doing enough to protect itself and everyone who lives here from flooding?
- Would you ever consider collecting rainwater yourself to use for landscaping?
- Streets could be improved with the addition of environmentally friendly green infrastructure elements such as bioswales, planter boxes, and permeable pavements, would these additions be important and beneficial to you?

Communication

Effective communication is needed with those who would be benefiting from the implementation of green infrastructure, including people living in areas where the city decides to implement green infrastructure and people who could be pushed to add green infrastructure to

their own homes and businesses. It is believed that this can be accomplished by creating posters/infographics that could be mailed or emailed as well as social media posts containing information about what green infrastructure is, how it can benefit individuals and the environment, and how people could contribute to this process and get involved. It is also important that information is provided to the wider community about green infrastructure by means of a website or a section on the current Costa Mesa website with information on what green infrastructure is and its variety of positive effects. A GIS map of any current green infrastructure that exists and future projects in the surrounding areas of the city already could be another helpful resource.

Considerations

Important considerations include which methods of green infrastructure have been beneficial in other cities similar to Costa Mesa in terms of climate or sustainability goals, information on successful incentive programs for businesses, homeowners, and commercial buildings, and potential survey questions to be used in the future for community input. These considerations can provide information to help Costa Mesa make decisions regarding green infrastructure. We would highly suggest the city of Costa Mesa consider creating rain gardens because it prevents flooding and water pollution, as well as manages stormwater. It has also already successfully been implemented in many cities. We would also recommend using our survey questions we've created to gain insight from the community.

Green Buildings

Background

Green buildings are a nature-based solution that is developed from green infrastructure technology. Using green infrastructure, buildings can become more environmentally friendly. These nature-based technologies vary in effectiveness and applicability depending on where they are being utilized.

By replacing conventional buildings with vegetated surfaces, insulation is provided, resulting in less energy being necessary to cool the inside of buildings. Along with aiding the building's climate, these surfaces can also help regulate humidity and temperature around the building. The benefits of green solutions include building utility cost savings, increased property values, and an extended lifespan of building materials.

Green roofs also have a great return on investment both financially and environmentally. Maintenance costs less than $20 per square meter for over 1000 square meters over the span of 40 years. They serve as buffers from weather such as direct sunlight and rain, allowing water to re enter the climate cycle. Green roofs are effective in all weather conditions, including arid conditions, as is present in Costa Mesa.

The aim of this chapter is to provide meaningful information to the city of Costa Mesa. To make the implementation and planning process easier, we have created an outline explaining the best way to go about constructing roofs including strategy, feasibility, and productivity.

Survey Questions

With survey questions, leading answers are provided to supply background information on green roofs. We also wanted to target topics that provide the city of Costa Mesa with an understanding of the communities' wishes regarding green roofs, as well as how community organizations can best be incentivized to partake in this nature-based solution.

It is necessary to make sure that we can provide the information needed to the city to "sell" the idea to property owners, those who are looking to make a good investment outside of it being good for the environment. On the other hand, if we are looking to have the city create more incentives or opportunities for owners, it is important to keep in mind that the solution is cost effective as well. Potential survey questions are as follows:

1. What do you think are the best benefits of a green roof?
    a. Reduce heat islands
    b. Reduce heating / cooling costs for a building

    c. Reduced noise pollution
    d. Humidity regulation
    e. All of the above
2. Where would you like to see a green roof?
    a. City building
    b. Your own house
    c. Company buildings
    d. All of the above
3. If a building in Costa Mesa was going to build a green roof, would you support the implementation of it?
    - Strongly agree, agree, neutral, disagree, strongly disagree
4. For property owners - would you invest in a green roof to make your building infrastructure more environmentally friendly?
    - Yes or no; If yes, why : _____
5. What incentives could be provided by the city to encourage you to incorporate green infrastructure into your buildings? _____

Case Studies and Incentives

Case studies for areas that show similar characteristics as Costa Mesa were researched; warm and dry metropolitan areas with a Mediterranian climate prone to drought. Through research, case studies were found for Northern California and San Diego County.

Located in Northern California is Korematsu Middle School in El Cerrito. The company LiveRoof implemented three green roofs for the school. Typically, LiveRoof combines three methods to achieve their desired product. The first method is by using built-in-place living roofs which reduce the costs of waiting for plant maturation. Second, green roof modules are installed providing quick installation and no need for grid lines or soil compartmentalization. Third, carpet or mat systems are introduced supplying a higher plant diversity, without excessive watering or maintenance. In 2016, LiveRoof paired up with Meadowland Nurseries LLC to develop a personalized landscape of full-grown drought-tolerant sedum plants for the middle school. Utilizing fully developed plants allowed the green roof to start functioning immediately, without the consideration of time or financial costs in supporting the plants to adulthood.

In implementing the three green roofs, many benefits were reaped by the middle school, and incentives were highlighted for future use of green roofs. A financial benefit provided by the green roof is extra insulation, reducing the school's heating and cooling cost by 14%. Immediate health benefits are found in having the extra layer of insulation, diminishing noise pollution within the buildings by 40 decibels, among other health benefits. Environmental advantages include minimizing urban heat island effects and benefits from having more plants around. The green roofs allow rainwater to return to

the natural environment through evaporation and transpiration of the soil and plants. The inclusion of drought-tolerant plants allows for the air to be purified. When the plants take in rainwater they simultaneously filter out air pollutants, resulting in cleaner air and water. The green roof also provides fire protection through adherence to local fire protection codes.

A green roof was also implemented in San Diego County, which has a climate similar to that of Costa Mesa. Specifically, the green roof was added onto CSU San Marcos' University Student Union. It was built in 2014 and included a 2,540 square food LiveRoof system. The cost of the green roof was $66,040, in other words $26 per square foot. Additionally, the roof is about 27 to 50 pounds per square foot, ensuring a building can support the weight of the roof. Included in the roof are 16 species of native plants and grasses to the Southern California region. Overall, the specific goals of the green roof were to provide an outdoor aesthetic, increase water conservation by helping stormwater management, and increasing energy efficiency by increasing insulation and reducing the need to cool the building.

It is concluded that the green roof on CSU San Marcos saves the university $2,500 in cooling costs every year, absorbs almost all of the rain that falls, and pays for itself after 12.5 years of service. This green roof is successful even in an arid climate while benefiting the University aesthetically, environmentally, or financially.
Given the success of green roofs at Korematsu Middle School and CSU San Marcos, green roofs are a great nature-based solution to mitigate climate change and its effects for the city of Costa Mesa. If the city of Costa Mesa chose to apply similar methods to city owned buildings, great climate change mitigation could be attained.

Communication

It is important that the city of Costa Mesa communicates with the public as well as private business owners about the importance of green building infrastructure, specifically green roofs. For the general public, they can be informed about the City's goal of having more green buildings through mayor announcements or on the City's website or even social media if there is a green roof they should check out. Social media can be a great tool to market a green roof, especially if it is open for the public to visit. Fliers are another option to keep the public informed about the city's work in green building infrastructure. Another aspect of communication can be focused on private building owners.

Sending emails or making phone calls to business owners to see whether or not they are open to the idea of having a greener building can be effective. Additionally, surveys are a tool that can be utilized to gauge interest in owners willingness to invest in green infrastructure.

Funding

Funding for a green roof can come from a variety of sources. The non-profit Green Roofs for Healthy Cities released a 2019 Green Roof and Wall Policy in North America Report. This report includes a section focused on incentives and funding for green roofs in North America. The types of funding include grants, rebates, and subsidies. Additionally, the report includes different types of incentives such as stormwater fee credit and tax credits. Specifically, the report lists different cities in North America and the type of funding they have received. The only California city in this report is Palo Alto. The city of Palo Alto only received stormwater fee credit as an incentive for building a green roof.

An important funding option is grants. Grants can be provided by a variety of organizations. For example, the Environmental Protection Agency (EPA) offers a program named Greening America's Communities which has a focus on aiding towns to implement green infrastructure. This is completely funded by the EPA. Other types of grants can be discovered in the Grants.gov website, a home for hundreds of grants including those focused on green buildings.

Considerations

Green roofs can assist in reducing current and future climate related issues. A large part of climate change in Southern California is temperature increase especially in infrastructure dense areas which will continue if action is not taken. Urban areas, like Costa Mesa, trap even more heat because buildings absorb and reflect heat. This phenomenon is known as the urban heat island effect. Green roofs are found to reduce heat island effects, mitigating effects of temperature increases both now and in the future.

Green roofs can also help to develop a community that can withstand changing climate impacts without sacrificing any of the community's current functions. The tops of buildings are currently bare and do not serve a major purpose, aside from providing a ceiling and infrastructure support. With a green roof, the building will become functioning pieces of community climate mitigation without relinquishing any primary functions.

A major goal of climate change mitigation is to prepare response plans and structures before impacts arise. A possible outcome of climate change is prolonged droughts and increased precipitation when rain does fall. Implementing green roofs and allowing the plants to reach maturity enables the roof to have a higher capability of water absorption, minimizing building damage due to precipitation. The implementation of green roofs will allow the city of Costa Mesa to prepare for and anticipate the worst case scenarios, prior to severe climate change impacts, ensuring a safe and prepared community.

Conclusion

The Nature-based Solutions (NbS) discussed in this document can help the city of Costa Mesa mitigate climate change and foster a healthier environment for the community. This report includes suggestions for federal grants, partnerships, and considerations that could assist in future climate changes for the city of Costa Mesa. This information can help the City of Costa Mesa implement NbS. Each chapter included resources to help educate and guide the City of Costa Mesa staff and community as it considers what NbS might be the most viable and provide the best results to the climate change challenges the city is experiencing.

One of the most important findings from this study is around the topics of community engagement, equity/ access, partnerships, case studies and research. The most important step the City can take when planning implementation of NbS is community outreach and education. Each section has recommended survey questions to help the city of Costa Mesa foster community input and increase community engagement with the local government. These possible survey questions can assist the city in receiving meaningful feedback, data, and other input about the proposed nature-based solutions. The best way to mitigate climate change impacts is through collaboration and partnership with local community groups. To this end, public outreach is a key aspect in the process of establishing any one of these nature-based solutions.

Ultimately, utilizing the research and recommendations provided, the city of Costa Mesa can mitigate the harmful effects of climate change while creating a healthier environment and serving as an example for other cities in the United States and throughout the world.

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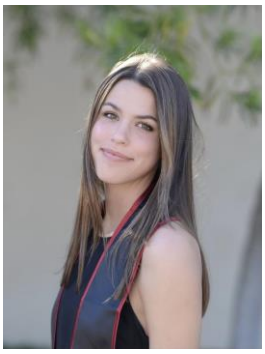
Meet the Team

Alyssa Berry is an Environmental Science & Policy major with an emphasis in policy. She is passionate about sustainability management, ocean science and environmental education. Upon graduation in the spring of 2021 she is looking forward to finding a job where she can become more experienced in the field of environmental sciences.

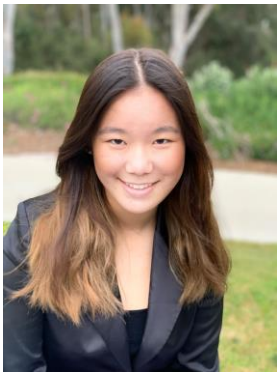
Kyle Bryan
Kyle is an Environmental Science and Policy major with an emphasis in ecology. He is also minoring in Psychology. He is interested in pursuing a career in primary education and hopes to instill an appreciation for environmental stewardship and sustainability practices in kids of all ages.



Lauren Burokas is an Environmental Science & Policy major. She is currently working on ecological restoration at a local water district. She worked on a water quality project by macroinvertebrate population sampling and working with the invasive argentine ant. She is passionate about ecology, habitat restoration, and water conservation.

Laurenz Dodge is an Environmental Science & Policy major with a minor in Documentary Film. She currently has a farm and garden consulting business, Earth Cake. Upon graduating in May of 2021, she will work as an apprentice on Flying Coyote Farm in Sandy, OR. Laurenz is passionate about ecosystem regeneration and the healing of community through creating relational food systems.

Joanna Falla double majors in Political Science and Environmental Science with a Policy emphasis. She currently works for a nonprofit that hopes to make the Bay Area carbon neutral by 2045. She has spent her undergraduate career doing research on public opinion of climate change and climate change skepticism, and hopes to continue work in environmental policy analysis and nonprofit work.



Sereena Gee is an Environmental Science and Policy major with an emphasis in policy. She currently works as the marketing director of her startup business and as a legal marketing assistant for an immigration investment company. She is interested in applying her environmental science knowledge in a career focusing on both human rights and social justice.

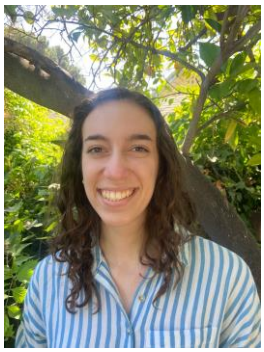
Steven Gonzales is majoring in Environmental Science and Policy with an emphasis in policy, simultaneously, he is minoring in Law, Justice and Social Control. For the past two years Steven has been working at the Santa Ana City Jail as a Correctional Service Officer and completed 4 years in the Santa Ana Police Explorer Program. Upon completing his degree in the Fall of 2021 he plans on joining a law enforcement agency.

Nikki Heredia is an Environmental Science & Policy major with a minor in Data Analytics. She is excited about utilizing her skills and passion for sustainability and climate change mitigation to help make impactful changes in her community.

Lexi Hernandez
Lexi is a eco-communicator who utilizes her Environmental Science and Policy, and Sociology double major to conduct research and tell the stories and strategies of resistance in environmental injustices. She currently works as the environmental justice research coordinator at intersectional environmentalists, and upon graduation plans to continue working within the education and research field.

Jin Young Hong
Jin Young is an Environmental Science and Policy major with an emphasis in policy. He is passionate about chemistry and marine biology. Upon graduation in the Spring 2021, he plans on volunteering at his homeland, South Korea to teach disadvantaged and sick children about sustainable practices.

Lauren Lynam is a double major in Environmental Science and Policy and Economics, with a certificate in Applied Statistical Analysis. She is passionate about climate change mitigation and ecosystem restoration. She hopes to go to law school to become an environmental lawyer, enabling her to help businesses become more environmentally friendly and develop innovative sustainability practices.



Juliana Medan is an Environmental Science and Policy major with an emphasis in policy and a minor in English. She is passionate about science communication, sustainability, and environmental justice, and hopes to utilize her love of writing and the natural environment to inspire people to act on the issue of climate change.

Annie Ng is an Environmental Science and Policy major with an emphasis in ecology. She also is minoring in Sociology. She is currently working for a plant ecology research project that focuses on drought resistant plants in the Southern California hills. She is interested in continuing her education in wildlife biology and hopes to eventually have a career in wildlife conservation management.

Monroe Roush is an Environmental Science and Policy major with a minor in Political Science. She currently works as a legal assistant at a law firm in Orange County, and hopes to eventually attend law school to advocate for environmental justice.

Laurel Tamayo is an Environmental Science & Policy major and Documentary Film minor. She is currently an impact producing intern on Hulu's *I Am Greta* film campaign. She is passionate about using film to educate people about environmental issues and connect them with resources and actions they can take. After graduation, she will be working as an impact producer on multiple films focused on social and environmental justice.

Mallory Warhurst is an Environmental Science & Policy and Political Science double major. She has spent her undergraduate career exploring the power of Geographic Information Systems as it relates to environmental injustice and storytelling. In June of 2021, she will be continuing her experience in the realms of environmental justice and food sovereignty by working with kids at an urban farm in Oakland, CA.