A Snapshot of Climate Change Adaptation Efforts in American Urban Planning & Development

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Abstract
Coupled with the increase in visibility, frequency and intensity of unprecedented climate-related disasters, political efforts spearheading climate action on the urban scale have created a more expansive breadth and depth of opportunity for adaptation in the United States. Transnational municipal networks have sparked an era of American cities taking the reins in integrating climate-smart initiatives through the creation of citywide climate action plans. However, climate change adaptation is still in its infancy in the United States. Research has centred on the discourse of climate action plans and barriers in formulation. But there are a lot of questions left unanswered regarding the gaps between plans, policy and practice. This thesis analyses the current dynamics and potentials of how cities "walk the talk" when it comes to adaptation by asking the question "*What effect do American city-wide adaptation efforts have on urban development trends?"* The methods cover both the breadth and depth of the subject by studying the placement of adaptation within the national climate action discourse as well as utilizing the cities of Los Angeles, Seattle and Washington, D.C. as case studies to analyse the level of receptibility between citywide adaptation discourse and urban development trends. The thesis provides a snapshot of the current landscape of American climate change adaptation efforts in the context of urban development. The discussion centres around the findings which display adaptation efforts having a minimal effect on urban development trends in an explicit sense, while illuminating the untapped potential urban development has in contributing to overall citywide climate resilience.

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1. Introduction

On June 1, 2017, the mayors of 407 American cities (Climate Mayors, 2017), collectively representing 70 million Americans, denounced President Donald Trump's decision to withdraw the United States from the Paris Agreement (BBC News, 2017). These mayors, alongside officials from both political parties, civil servants and the public made their firm opposition to this decision known. Their disobedience led to the formation of multi-state and transnational coalitions, such as the United States Climate Alliance and Climate Mayors. These entities were created with the mission to uphold the Paris Agreement's objectives inside state borders and cities regardless of the climate inaction of the federal government (Climate Mayors, 2017).

Although climate change is a hot button, isle-dividing topic within the American political arena, it has steadily integrated itself into the public's nationwide risk perception. In 2014, 63% of Americans believed climate change is happening, and only half of that percentage believed climate change is related to human activity (Yale Program…, 2014). Whereas, as of 2018, 70% of Americans believe climate change is happening, 57% believe climate change is caused by human activities and half the population believe climate change is already harming people in the US now or will do so within the next decade (Yale Program…, 2018). These figures indicate an increase in public acceptance that anthropogenic climate change is occurring and negatively impacting the United States. These trends are both reflected and influenced by the politically pivotal moment in 2017, when municipalities proved to be the drivers of American climate change response, countering the federal administration's denial of the existence of anthropogenic climate change.

There are several possible explanations for the increase in public acceptance of climate change's origins and potential harm. One is that the United States has begun to see an increase in both the frequency and intensity of disasters, which typically plague certain parts of the country. In 2018, the United States suffered from numerous unusually devastating events linked to a changing climate: exceptionally large forest fires in California (Nicas & Fuller, 2018), extreme winter storms in the Northeast (Resnick, 2018) and hurricane-induced flooding in the Southeast (Samenow, 2018). Thus far, in early 2019, this trend of unparalleled disasters has continued. The flooding in the Plains states (Di Liberto, 2019) and flash floods in Southern California following nearly a decade of drought are two examples of natural phenomena having unusually amplified consequences for local populations (Karimi & Almasy, 2019). Because these events are more visible than ever before, there is more acknowledgement of climate change impacts on the United States.

Now that there is an increase in understanding that anthropogenic climate change is occurring, along with multiple experiences of unprecedented disasters, what actions are being taken to address a changing climate? Are actions being taken? With a broader push from the public and transnational networks, the United States is already experiencing the palpable opportunity of integrating climate action efforts into public policy at the local level. Although American citywide climate action efforts are underway, the steps involved in formulating an effective adaptation strategy are particularly difficult due to the nascent status of climate adaptation in both its dispersal throughout and its depth within the country. Because this issue is relatively

new as a topic of public concern, there is a minimal amount of research available on how American states and cities should address, formulate and implement measures to strengthen their adaptive capacity. Therefore, there is a strong need to document, assess and revise American climate adaptation efforts, both in policy and practice.

The urban scale is as a breeding ground of novel economic, social and cultural ideas that disperse from cities to the country at large and impact how climate action is formulated, presented and implemented. Therefore, studying aggregate urban climate action efforts can paint a larger picture of the American landscape. Because cities are decision-making hubs where people from different sectors and backgrounds exchange ideas within the political urban network, the city scale showcases the marriage between policy and physical manifestation of climate action. Although adaptation is becoming formally integrated into climate action plans and policy, understanding how adaptation goals can be transformed into a formalized, physical reality is unknown.

A pioneer in analysing this unknown is by studying the built environment of urban centres and how it reflects adaptation strategies relevant to the city's well being. Urban planning and development is a medium of multi-sectoral processes, similar to how holistic adaptation planning should be. As a product of a variety of inputs, urban development reflects priorities within the municipality, depending on physical output, be it mass accommodation for new residents, car-centric transportation or environmental sustainability. As a litmus test of the current state of adaptation at the city-scale, urban development trends showcase the level of receptibility within processes crucial in executing adaptation plans. The relationship between adaptation efforts and urban development trends, as physically manifested in the built environment, can highlight drawbacks and potentials relevant in further understanding the climate adaptation efforts in the American context.

2. Literature Review

Climate adaptation planning is nascent in the United States. Therefore, there is limited research on citywide climate action plans and their implementation, particularly relating to adaptation. Adaptation planning on a local level is especially elementary for various reasons, one being political dissension and disagreement on the issue. Much of the research on the topic discusses the importance political partisanship plays in formulating and implementing climate action plans (Boussalis et al., 2019) (Carlson & McCormick, 2015). The research that historically supports this examination of urban climate adaptation and mitigation plans can be divided into three sub-topics related to American city climate action plans: formulation and content analysis, barriers to adaptation planning and transformational visions of adaptation planning.

Research on the topic of climate change consistently comments on how cities in the United States have devised climate action plans, and how only a few of these plans include strategies pertaining to adaptation (Koski & Siulagi, 2016). Regarding research on the rhetoric of climate action plans, findings in 2019 are consistent with findings in 2012; there is a limited number of U.S. cities actively taking steps to adapt to climate change (Stone et al., 2012). Research finds there are numerous factors associated with whether a city mainstreams adaptation efforts: swing factors pushing or deflecting efforts related to an action (extreme weather events, political culture), inhibitor factors slowing change (scientific uncertainty in modelling, politicization), and resource catalyst factors providing a rationale for change (political engagement and influential academic institutions) (Carlson & McCormick, 2015). Previous research confirms that in most, but not all cases, climate action efforts begin focusing on mitigation, or overall multi-sectoral sustainability, and then develop into adaptation. Therefore, within the American context of climate action plans, mitigation outweighs adaptation.

Barriers within climate action plans have become a popular topic of research within the United States. Research finds, although there are multiple strategies to adapt to climate change, many plans, as of 2016, fail to prioritize impacts and detail implementation processes (Woodruff & Stults, 2016). This “adaptation deficit” is a persistent gap between the voiced ability of communities to adapt to climate change and the measurable progress of their adaptation efforts (Ekstrom & Moser, 2014). The reasons for the so-called “adaptation deficit” vary. Ekstrom & Moser (2014) coined this phrase while studying San Francisco and its neighboring municipalities and found the most common barriers to adaptation are more related to institutional and governance issues, attitudes, values and motivations of involved stakeholders, and less on resources, funding and technical constraints.

Studying barriers leads to new approaches on how to evolve American municipal adaptation plans. The knock-on effect of improved planning at a city level could positively impact the rest of the country as cities are demonstrated to be the nodes from which new ideas diffuse. Research conducted in 2015 highlights how existing adaptation efforts often lack attention to equity issues, vulnerability and other socio-economic factors (Hughes, 2015). Hughes (2015) emphasizes adaptation planning may become more effective by coupling the motivation to

protect assets and reduce vulnerability. Articles focusing on transformations within adaptation planning highlight not only the need to ensure broader participation and the utilization of a multi-sectoral approach but recommend integrating social equity into the design and implementation processes to avoid maladaptation that exacerbates vulnerabilities (Shi et al., 2016) (Eriksen et al., 2011) (Long & Rice, 2018).

Transformational research has gone beyond simply suggesting planning must be multi-sectoral and scalar on a multi-departmental municipal level. It envisions specific types of collaboration within adaptation planning. Most relevant to this research are papers emphasizing the potential of the relationship between design and ecology, which can serve as a vision for urban development and city networks advocating for widespread adaptation planning. One article advocates for linking design, infrastructure and urban development to achieve urban climate resilience and sustainability, both environmentally and socially, by merging design with ecological studies (Childers et al., 2015). From a multi-scalar perspective, research notes networks build social capital and share information to identify and bridge gaps in adaptation planning (Funfgeld, 2015).

Recent research in 2019 shows an updated account of how climate action is communicated in American cities. Boussalis et al. (2019) highlight transnational networks have increased municipalities' focus on resilience and adaptation, lessening the divide between mitigation and adaptation, as there is a strong correlation between discussion of emissions and climate resilience in the discourse analysis. Boussalis et al. (2019) analyse press releases, searching for eight mitigation and adaptation themes: resiliency, renewable energy, energy efficiency, emissions, transportation, land use, water, and waste management. Land use is the most frequently used combination of words in these press releases, marking it as a touchstone for cities to optimally integrate adaptation through the redevelopment of public and private spaces. Given this evidence, studying how land use performs as a driver for adaptation implementation may indicate the most identifiable, physically-manifested, multi-sectoral process. The article suggests taking the research further by studying how municipalities "walk the talk" and actually implement their plans. Additionally, the article argues for studying climate adaptation at the urban scale, as urban politics are not immune to the larger scope of political or cultural trends, especially as the world becomes more interconnected through social media and transnational networks.

The nexus of climate change; resilience and urban scale are gaining attention due to the networks of cities in conversation to ensure the coordinated formulation and implementation of climate action. Previous research centres on discourse, barriers, network analysis and transformations of adaptation. The next step is to look at how action plans are to be implemented, a topic on the precipice of being analysed thoroughly. Land use planning and urban development seem to provide an optimal starting point for studying adaptation implementation in a sector that embodies physical, direct manifestations of how hazards, adaptation goals and practice interact. Additionally, the city-focus provides a concrete scale for studying microcosms of a larger, political and geographic picture, while providing depth in understanding of what is happening on the ground.

3. Methodology

The main question of "*What effect do American city-wide adaptation planning efforts have on urban development trends?*" is posed, drawn from three different justifications from the literature review: 1) adaptation is still in its infancy compared to mitigation and, therefore, adaptation needs to be researched further, 2) the urban scale is a framework that serves as both a realistic model that reflects a larger picture of adaptation formulation and implementation as well as a nuanced example of on-the-ground adaptation planning and practice, and 3) land use planning and urban development seem to be the most mentioned and viable sector to carry out city-wide adaptation based on recent research. Furthermore, urban development offers an exemplary perspective in analysing the multi-sectoral processes required to carry out adaptation efforts.

The objective of the research is to examine the relationship between adaptation and urban development, while highlighting what value urban development currently has in mobilizing adaptation. Understanding how adaptation efforts are currently being embraced at the urban scale, more specific to the urban development sector, is relatively unprecedented, as indicated by the limited amount of research found on adaptation in the American context, particularly regarding the implementation of adaptation plans. Therefore, a methodology was created to carry out this research through a combination of qualitative, quantitative, GIS and discourse analyses. Conceptually, the method is two-tiered, simulating a funnel: the first half analyses the landscape of American adaptation efforts, while simultaneously identifying the most appropriate case studies based on practicalities necessary to conduct the second half of the funnel, an in-depth case analysis of selected cities.

To understand on-the-ground relationship between adaptation efforts and urban development, a scoping method must be applied to establish the setting of the American context and identify what cities have the most appropriate qualifications for conducting a case study. Qualifications, like cities having strong adaptation components within their climate action plans, needed to conduct the case study analysis are identified and discussed further in the Methodologies sub-section regarding the *Aggregate Scoping.* The advantages to aggregate scoping offer two benefits to the research project: providing an overall depiction of what adaptation looks like in the American context, and investigating what cases are best fit to more thoroughly analyse the connection between municipal adaptation planning and urban development. Aggregate scoping can be applied in a variety of ways. Changing qualifiers can change results and illuminate nuance between cities with differing characteristics. The timing during this investigation did not allow for a more diverse group of cities due to restrictive practicalities needed to conduct case study analysis, but future research can continue this investigation. The main, consistent disadvantage of *Aggregate Scoping,* in anyway it is applied, is the lack of depth in studying the complexities and intricacies at the urban scale.

This disadvantage is why the *Aggregate Scoping Method* must be paired with a more in-depth analysis of cities, a *Case Study Analysis.* The research project reflects the breadth, studying the overall American context, and depth, detailed analysis of selected case studies, of the topic. The *Case Study Analysis* employed within this research takes on a more remote,

synthesized approach of qualitative, quantitative, discourse and GIS analyses to understand how particular urban developments are responding to climate-related hazards specific to each city. Through a synthesis of municipal documents, hazard maps, and a list of urban developments, the cases undergo a step-by-step data refinement process that is presented through concise profiles, as discussed in the Methodologies sub-section regarding *Case Study Analysis.* The table below depicts the purpose, advantages and disadvantages of each method.

Case Study Analysis Methods			
Method Type	**Purpose**	**Advantage**	**Disadvantage**
Qualitative Analysis	Establishes setting of cases through a review of urban development trends, climate action plans, hazard maps, laws related to hazard mitigation/adaptation etc.	• Allows for further insight on similarities and differences between case cities • Creates connections among various urban policy documents, urban demographic trends and adaptation visions of the city	Inherently subjective by nature of method. Replication of this method by another researcher may differ in terms of presentation and findings
GIS Analysis	Locates particular high-risk areas, either in terms of spatial hazard or socioeconomic characteristics	• Transfers hazards identified in the qualitative component to a concretized setting that paves way for more qualitative analysis	How GIS analysis is conducted is simplified within the time-scale of the research, as discussed in the *Limitations* section
Discourse Analysis	Identifies urban developments in high-risk areas and systematically analyses language that indicates adoption of adaptation (through hazard mitigation efforts) in associated plans	• Provides insight into if and how urban developments employ strategies to reduce the particular hazards mentioned and addressed in climate action plans and city-wide hazard mitigation plans • Identifies language that is "implicit," or risk-reduction strategies employed without directly referring to a climate-related hazard, and "explicit," or direct reference to a climate-related hazard and strategies to curb risk	Also inherently subjective by nature of method and execution, as the discourse analysis is dependent on language that is specific to particular hazards and researcher's judgement.
Quantitative Analysis	Tallies the number of urban developments that are implicit and explicit in adaptation efforts in order to note the prevalence of adaptation efforts within total developments studied	• Transfers results from discourse analysis into a more, normalized comparable platform to discuss similarities and differences between cities and their results of adaptation within urban development	Although it simplifies results into comparable numbers, the method alone does not capture the complexity of demands, actions and processes with urban developments

The overall method teeters back and forth between qualitatively analysing characteristics of the urban cases and quantitatively transferring them into a more comparable and identifiable platform. Inspired by previous work from studying urban developments and measuring their sustainability,[1] the method of analysing cases offers both a cumulative understanding of the overall picture of developments and their relationship to adaptation efforts, while qualitatively analysing adaptation's placement within the setting of the city. Because of the number of methods used, there are a variety of disadvantages to be aware: quantitative analyses tend to simplify a naturally complex system, and qualitative analyses are inherently subjective and dependent on the researcher and context of the research. However, when quantitative and qualitative analysis work together, a specific, nuanced, yet quantifiably comparable discussion is created, bringing the best of both worlds into play and minimizing disadvantages that stand alone.

[1] Previous work conducted at the Design & Advocacy Team at Casey Trees in Washington, D.C.

3.1. Questioning

The main question accomplishes the objective of providing a snapshot of the American urban adaptation context through the examination of potential patterns, trends and gaps within the relationship between citywide adaptation plans and urban development. The answer attempts to inform whether adaptation is being or has the potential to be transferred from concept into reality. The question is gradually answered in three tiers, nation-specific (aggregate scoping), case city-specific (case study analysis) and conclusive (analytic discussion and conclusion), as indicated by the following set of questions:

Nation-specific:

- *What is the prevalence of adaptation efforts within city climate action plans?*
  Dictates what cities to select as case studies and provides comparative information on how adaptation is integrated within the overall landscape of climate action plans

Case-specific:

- *What are the urban development trends the city is experiencing?*
  Answers how population/demographic shifts impact the current urban planning and development trajectory of a city
- *What is the general hazard profile of the city?*
  Presents the latest citywide hazard ranking to inform which climate-related impacts are relevant to the case and degree project
- *What is the vision of the city's adaptive capacity?*
  Analyses the city's adaptation plans, among other relevant sources, like comprehensive plans, to indicate how the city will respond to chosen climate impacts
- *How does the urban planning and development sector embrace citywide adaptation efforts?*
  Analyses open-source data provided by the municipality, among other urban development databases, to understand the intention and measures taken by urban developers and whether these measures relate to the hazard profile and vision of the city

Conclusive:

- *What is the relationship between citywide adaptation efforts and urban planning and development?*
  Specifies how adaptation efforts are framed in citywide climate action plans and whether that framing reflects itself through urban development trends, drawn from qualitative sections of the case analysis
- *Do current urban development trends hinder, allow for or accelerate adaptation efforts?*
  Overlays findings from the previous questions to examine how adaptation commitments are actually embraced, based on the quantitative findings from cases

- *What effect do American citywide adaptation planning efforts have on urban development trends?*
  Presents a succinct, finalized answer based on all of the above questions

3.2. Methodologies

Aggregate Scoping entails creating a database showing the status of all the American cities that have committed to upholding the Paris Agreement, as formalized by the Climate Mayors Network. This establishes the setting and progress of citywide adaptation planning in the American context and finds useful, supplementary case cities to understand how citywide adaptation efforts are being conducted in urban planning and development. Below are the following steps:

- *Cities committed to the Paris Agreement*
  - Cities against Trump's declaration of withdrawal from the Paris Agreement demonstrates a publicized commitment to embracing climate action on an urban scale. Because of its recency, it is a relevant starting point for identifying cities serious about climate action.
- *Cities that have climate action plans finalised*
  - It is important to note which cities have already adopted a climate action plan. If extensive adaptation planning is mentioned anywhere in municipal plans, it would be in a Climate Action Plan.
- *City-wide climate action plans that have adaptation mentions*
  - To carry out the study, cities with finalized climate action plans must have adaptation components to analyse.
- *Cities in states with a finalized climate action plan*
  - Relating cities to the climate action effort of their state is important as it identifies awareness of climate change at every hierarchical level and it provides more jurisdictional support toward municipal climate efforts.
- *Cities with thorough adaptation components in climate action plans*
  - To sort out researchable adaptation components within those plans, the adaptation component must be more than merely a few mentions or definition of adaptation. It must link to supplemental or measurable steps forward in implementing adaptation strategies.
- *Cities with thorough adaptation plans, in addition to accessible comprehensive/general plans and public planning/zoning records*
  - The analysis of how comprehensive plans and public zoning records relate to climate adaptation efforts is central to the research project.
- *Cities that have climate action plans enacted or finalised before or during 2015 along with single-standing adaptation plans*
  - The date enacted is important because development trends and progression of projects overtime are more visible. To minimize subjectivity in assessing if adaptation components are thorough, cities with single-standing adaptation plans, signifying ultimate importance and upmost thoroughness of adaptation efforts, are considered as cases.
- *Cities with similar ranking on risk/resiliency indices*

- The Notre Dame University's Global Adaptation Initiative is used to provide insight into city standing on a climate adaptation/readiness nexus (Notre Dame, 2016). The risk/readiness data is used to select the highest overall score, the lowest overall score and the median overall score for the cities narrowed down in the previous selection rounds. The cities with these three scores are selected as the case studies.

Case study analysis aims to create complete profiles of the city's combined demographics, emergency plans, adaptation efforts, and urban development dynamics to inform a case-specific analysis at the end of each profile, by answering the case-specific questions. The following steps are:

- *Gather general information and city plans*
  - Information is collected on the city's hazards, urban development trends and citywide plans relevant to adaptation initiatives.
- *Refine and analyse the most updated hazard list provided by the city's emergency services department*
  - The ranked hazard list authored by the respective emergency services department is used to guide description of the hazard, related laws/measures to addressing the hazard and where the hazard is most prominent in the city. The list is refined to include only hazards that are climate change related and non-technological disasters.
- *Gather measures or laws related to reducing of happenstance and impact of hazards*
  - Goals from adaptation plans and laws related to mitigating each hazard are introduced to set the parameters, requirements or lose expectations of urban developments in addressing a particular hazard.
- *Identify the 3 neighborhoods most impacted by each hazard*
  - Neighborhoods most impacted by each hazard are identified. Depending on the nature of the hazard, some neighborhoods are chosen by largest area of risk if the hazard is non-location specific, or some neighborhoods are chosen by the highest socioeconomic vulnerability if the hazard is more ubiquitous. An example of a location-specific example is landslides because there is available data to calculate the percentage of land exposed to the hazard in each neighborhood. For non-location specific hazards, extreme heat is an example as it tends to be location specific based on lack of vegetation connected with social vulnerability. Note, that the top three neighborhoods may not have enough information on urban development trends, therefore the fourth, fifth, etc. ranked neighborhood are sometimes included for analysis.
- *Identify and analyse major developments in each neighborhood since the city's climate plan was adopted*
  - Once neighborhoods are identified, major developments from the time the city-wide plan was adopted to current must be tracked:
    - Curbed.com is an urban development news and blog site that has city-specific sister sites for LA, Seattle and D.C. For all cities, the site filters

developments based on neighborhoods. Curbed.com typically covers more medium-major, mixed-use or massive developments, rather than small zoning changes or new single-homes. Because city planning file reporting is typically hard to navigate and distinguish small developments from large, Curbed.com provides a good alternative.

- After identifying developments, the development is cross-referenced by searching the case number on the city planning website to access site plans, environmental assessments, etc.
- The description of the development based on hazard is noted for implicit and explicit intention of mitigating the hazard. Implicit mentions refer to risk-reduction strategies employed without directly referencing the climate-related hazard to which these strategies could potentially address. Explicit mentions refer to a direct risk-reduction strategy to a curb the risk of an indentified climate-related hazard.

4. Limitations

Time constraint is the underlying factor that contributes to most limitations of the degree project. The largest simplifications within the research are: the sample size of cities studied, more homogenized case studies and emphasis on intent of urban development adaptation measures rather than a measurement of success of urban development adaptation measures.

The sample size of cities studied does not accurately capture the overall context of American adaptation planning. The small allotment of time, coupled with the level of detail needed for the case-specific analysis, allows for a select number of cities could be studied in sufficient detail. Therefore, the conclusions drawn from this study are more appropriate for the context of the cases selected. Additionally, the specific urban developments studied are not studied based on the exact location of the hazard. Rather, developments are studied based on a simplification of hazard-development location by studying the neighborhoods most potentially affected by the hazard, not the specific location of the hazard. As an example, developments studied in neighborhoods with a high area of flood risk may not address flood risk because they are not specifically located in a flood risk zone. A more accurate way of measuring this is by geographically locating all of the developments in the city and superimposing them over hazard maps of the city.

As found in the aggregate scoping method, there is a diverse array of various types of progress made and characteristics of cities that are determined to formulate and implement climate action. The answers from the study may differ greatly if other cities are selected as cases based on different grounds, such as cities residing in states without statewide climate action plans or political support for climate action. This limitation is also a by-product of time constraint and the sample size of the project.

Limitations do not only stop at the diversity and sampling restrictions of cases. The study does not consider whether the adaptation efforts mentioned effectively mitigate climate-related hazards or not. If there are explicit intentions and measures of adaptation within urban development plans, the results are considered positive in indicating the ability for urban development to embrace citywide adaptation efforts. For example, urban development can be situated in a flood zone but also can be LEED (Leadership in Energy & Environmental Design) certified and promise to address storm water quantity and quality on site. For the case of this study, this is a positive result. However, these specific measures may be maladaptive or not effective in reducing risk. Furthermore, the development, to onlookers or experts, may be hiding under the guise of being sustainable, when there actually may be a better alternative to mitigate the hazard. Measuring trade-offs of the specific adaptation tactics are outside the scope of this study. Although a study of the sort would supplement this degree project well, the study can only detect whether the development has the intention of mitigating a specific climate hazard, not whether the development actually reduces risk effectively. Furthermore, the study does not consider the discussion at play during the evolution of these urban developments and the stances various actors involved may have during the design and reviewal process. Instead, the focus of research is reliant on outcome and documented consideration of risk-reduction strategies.

5. Findings

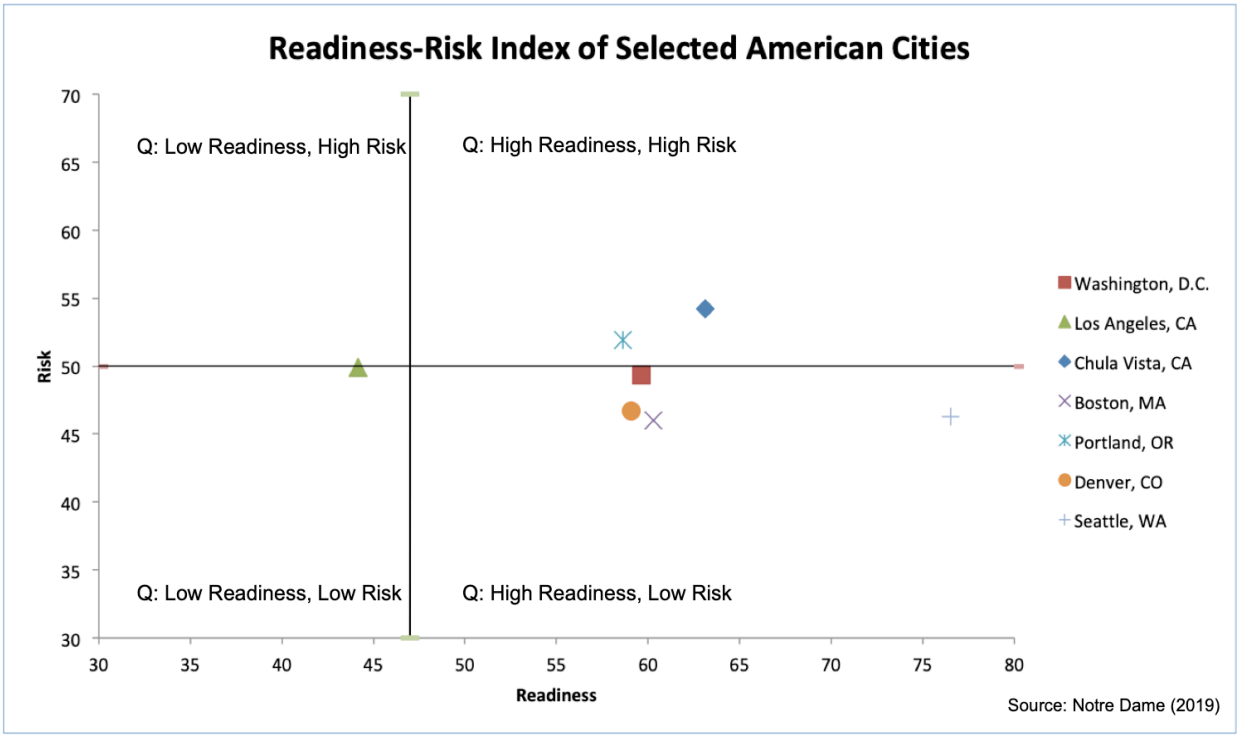
5.1. Aggregate Scoping

Aggregate scoping[2] analyses progress when it comes to American cities planning climate action plans- specific to adaptation. At the same time, aggregate scoping acts as a decision-making process that generates a justifiable and appropriate list of case studies suitable for research, as informed by the following qualifiers:

- *Cities committed to the Paris Agreement*
  412 cities claim to be committed to the Paris Agreement (Climate Mayors, 2017). 47 out of 50 states, plus Puerto Rico and Washington, D.C., have cities supporting the Paris Agreement.
- *Cities that have climate action plans finalised and presented to the public*
  138 cities (33.5%) have climate action plans finalised or publicly presented.
- *City-wide climate action plans that have adaptation mentions*
  87 cities (21%) have mentions of adaptation, whether descriptive or not.
- *Cities in states with a finalized climate action plan*
  17 states (Alaska, California, Colorado, Connecticut, D.C., Delaware, Florida, Massachusetts, Maryland, Maine, New Hampshire, New York, Oregon, Pennsylvania, Rhode Island, Virginia, Washington) have finalized climate action plans, narrowing down cases to **62 cities** (15%).
- *Cities with thorough adaptation components in climate action plans*
  23 cities (5%) have extensive mentions of adaptation in their climate action plans: Chula Vista, CA, Encinitas, CA, Laguna Woods, CA, Los Angeles, CA, San Diego, CA, San Francisco, CA, Santa Cruz, CA, Denver, CO, Lakewood, CO, Washington, D.C., Lewes, DE, Coral Gables, FL, Cutler Bay, FL, Sarasota, FL, Boston, MA, Gloucester, MA, Salem, MA, Dover, NH, Portsmouth, NH, Albany, NY, New York, NY, Portland, OR, and Seattle, WA.
- *Cities with thorough adaptation plans, in addition to accessible comprehensive/general plans and public planning/zoning records*
  17 cities have all three qualifications for this round, leaving out Laguna Woods, Lewes, Cutler Bay, Gloucester, Salem and New York. New York City is not qualified for this analysis because of no comprehensive plan due to the sheer size of the city, while the other cities are excluded due to limited access to public zoning and planning records.
- *Cities that have climate action plans enacted or finalised before or during 2015 along with single-standing adaptation plans*
  9 cities have two qualifications for this round, single-standing adaptation plans to provide enough content for analysis and plans enacted on or before 2015, allowing for enough time to look at trends. Cities at this stage are Albany, Boston, Chula Vista, Denver, Los Angeles, Portland, Portsmouth, Seattle, and Washington, D.C.
- *Cities with similar ranking on risk/resiliency indices*

[2] See Appendix I for corresponding data sets

Notre Dame's risk/readiness index includes 7 of the 9 cities, making Albany and Portsmouth, ineligible. 7 cities on the scatterplot occupy 4 different quadrants: High/Low Level of Climate Risk and Low Readiness (Los Angeles), High Level of Climate Risk and High Readiness (Portland, Chula Vista), and Low Level of Climate Risk and High Readiness (Washington, Denver, Boston, Seattle). There is more variation in readiness than risk. The climate readiness of the cities has a range of 44-77, while risk has a range of 46-54. In terms of readiness, the outliers were chosen: Los Angeles and Seattle. Los Angeles has a risk of 49.9 and a readiness of 44.14, the *lowest* readiness level out of all 7 cities. Seattle has a risk of 46.27 and a readiness of 76.51, the *highest* out of all cities. Calculating the median readiness level of all cities leads to Washington D.C., with a risk of 49.36 and a readiness of 59.63. Los Angeles, Seattle and Washington, D.C. are chosen as the case studies for the project.



5.2. Case Study Analysis

5.2.1. Los Angeles, California

What are the urban development trends the city is experiencing?

Los Angeles is the second-most populous city in the United States. The city proper is home to approximately 4 million people, making up 10% of the population of California (Sahakian, 2018). Like many major American cities, L.A. is experiencing growth in number of inhabitants, with an average increase of 0.9% in population per year (The Opportunity Atlas, 2019). The city is extremely dense, with about 3,275 people per square kilometre over 1,302.15 square kilometres (Sahakian, 2018).

As a part of a nationwide trend in American cities, L.A. is experiencing increases in rent price and mortgage rates. Limitations on space accompanied by an increase in population are one of many factors contributing to this phenomenon. In a recent study, L.A. mortgages are now the third most expensive in the country, right behind the cities of San Jose and San Francisco (Chiland, 2019). 2019 marks the most difficult year in the past decade to afford a home in Los Angeles, as indicated by the steep disparity between L.A.'s median household income of $54,000 per year, compared to the average salary needed to case in mortgage payments comfortability of $167,182 per year (Chiland, 2018).[3] These figures show urban living space is becoming costlier and more desired. Despite L.A. already having some of the most expensive zip codes in the country, new inhabitants are pushing for more space in economically vulnerable, downtown neighborhoods, Downtown, Pico Union, and Westlake (Pudlin, 2016).[4]

Vulnerability, especially in a country as diverse as the United States, is not only synonymous with economic hardship but other social factors, such as race and gender, that typically accompany economic strife in the US. Therefore, it is important to note the placement of vulnerable communities, not only based on economic pretences but also based on indicators that may mean communities with particular characteristics tend to face longer-lasting consequences from disasters. Based on the city's hazard mitigation plan, 9 of 10 vulnerable communities within the County reside in the city and were selected based on a combination of the following indicators: race/ethnicity and poverty, single parent head of household, educational attainment, limited English language proficiency, car-less households, age dependency ratio, population density, and accessibility to services (Sahakian, 2018). Westlake, Historic South-Central, South Park, Central-Alameda, Pico Union, Florence, Watts, Boyle Heights, and Koreatown are considered the most vulnerable neighborhoods of LA.

What is not considered in the vulnerability analysis is the potential of displacement. Like other major American cities, L.A.'s wealthy neighborhoods correlate with the high percentage of white population. In looking at neighborhoods with high median household income, Pacific Palisades, Beverly Crest and Hollywood Hills West are ranked as some of the wealthiest neighborhoods in the city as well as placed within the top ten whitest neighborhoods in the city (Los Angeles Times, 2019). Vulnerable neighborhoods, like Downtown, Westlake and Pico-Union, with a white population ranging from 3-16% are the top three neighborhoods experiencing the highest rate of neighborhood change and development. Little development is noted as occurring in wealthy neighborhoods. It is assumed that with more development, comes with the higher cost of living and mortgage/rental rates. Therefore, displacement of less-wealthy residents is most likely occurring due to the development surge.

What is the general hazard profile of the city?[5]

Five hazards are studied for the case of Los Angeles: Extreme Heat (2nd highest), Landslide (3rd), Wildfires (4th), Flood (6th) and Sea Level Rise (8th) (Sahakian, 2018). Earthquakes

[3] See Appendix IV, Los Angeles Median Household Income Map
[4] See Appendix IV, Los Angeles Rate of Neighborhood Change Map
[5] See Appendix IV, Los Angeles Hazard Maps

(1st) and Tsunamis (9th) were eliminated because these two hazards are directly related to seismic activity, and not climate change. Despite being a direct climate-related hazard, Drought (5th) was eliminated because how cities combat drought typically involves governmental direction of public utilities and water supply, rather than planning and development. Dam failure (7th) was eliminated, as multiple events such as flood, earthquake and, especially, technological failure can contribute to the occurrence of dam failure.

LA is subject to a variety of climate-related hazards due to the influential mixture of its geographic, topographic and meteorological properties. Surrounded by mountainous landscapes, such as the San Gabriel, Santa Susana and Santa Monica Mountains, the city is almost completely closed off by high elevation in the north and east, while bordering the Pacific Ocean on the west (Sahakian, 2018). The geographic features which bookend L.A. create the Santa Ana Winds, dry, warm and strong winds formed in inland deserts that heavily blow through mountain passes into Southern California, exacerbating fire suppression issues (Sahakian, 2018). The combination of drought and strong winds create the perfect condition to spread fire. Wildfires are typically caused by human error, but the impact of climate change altering ecological conditions allows for fires to spread over larger swaths of territory than before. The average number of acres burned in the Western United States has doubled since the 1990s (Sisson, 2019). There are 13,500 homes in L.A. located in areas of very high to extremely high fire risk (Collins, 2018), making it one of the most treacherous hazards in California.

Climate change accounts for anywhere between 8-27% of the cause for the most recent drought, which started in 2011 and recently ended in 2017 (Park Williams et al., 2015). 2012 to 2016 were the driest ever consecutive three years of statewide precipitation (2012 to 2014) and set new records for average temperatures and record-lows for water allocations. Tangential of drought, extreme heat has claimed more lives in California than all other disaster events in the state combined (Resilient Los Angeles, 2018). An example of extreme heat in L.A. was the 2006 heatwave that claimed up to 450 lives (Resilient Los Angeles, 2018). Changes in the climate mean L.A. is experiencing more heat waves and extreme heat days than is normal, with an increase of heat waves by more than three per century and extreme heat days by 23 per century (Sahakian, 2018).

Although heat and dryness are typically associated with Southern California are the obvious threats, these factors create further climate-related issues. Heavy bouts of moisture from the Pineapple Express, a strong, atmospheric flow of moisture from the Hawaiian Islands to the Pacific coast of the United States puts L.A. at risk for new natural disasters (US Department of Commerce, & National Oceanic and Atmospheric Administration, 2016). Flooding, snowfall and other precipitous events have been occurring more frequently in Southern California as a result (Finnegan, 2017) (Fry & Reyes-Velarde, 2019). These fluctuations between extreme drought and rainfall increase the level of risk by-products of L.A.'s geography, such as landslides.

What is the city's vision for adaptive capacity?

Los Angeles' vision for adaptive capacity is varied and presented through a number of plans. L.A.'s Sustainable PLAn (2015) is the focal point of the city's overall resilience strategy regarding topics of climate change response/adaptation, finance and quality of life. Most of the laws concerning climate change are related to mitigation. Despite this, the PLAn has continued to evolve through the use of annual progress reports as well as the delivery of a holistic approach through the release of more specific vision documents that work in tandem with the PLAn. The specific vision on disaster preparedness and adaptation is the recently released Resilient Los Angeles (2018), which guides a comprehensive approach to confronting the increasingly frequent and devastating disasters hitting the L.A. area. The plan strategizes protection of the economy, fortification of infrastructure and strengthening soft societal skills, such as tightening neighborhood bonds and interdepartmental relations. The guide provides measurable targets across a variety of different realms: Leadership & Engagement, Disaster Preparedness & Recovery, Economic Security, Climate Adaptation, and Infrastructure & Modernization. Climate Adaptation and Infrastructure & Modernization seem to be the two most relevant topics based on measurable indicators, as they are more physically concrete in terms of outcome and concerned with anticipation rather than the aftermath, as manifested in urban planning.[6]

In terms of urban development, L.A. is undergoing a thorough review of the General Plan and zoning code. The code has not been updated with a concern for a future vision of the city since 1946 (The City of Los Angeles, 2014). Additionally, L.A. is working on a vision that sets city-wide policies based on how certain elements, such as open space or transportation, can positively impact the city (The City of Los Angeles, 2017). Community Plans are being developed in tandem with these updates to the General Plan and zoning code, focusing on the needs specific to neighborhoods within the city. Currently, L.A. is in the process of refining these documents, with aims to conclude the process in 2020. Embedded in urban planning within California, is the California Environmental Quality Act, requiring new developments to go through a process defining environmental survey procedures and determines whether the project will have adverse environmental impacts (Sahakian, 2018). Additionally, L.A. is moving forward with a plan called Build Forward LA, a program launched in Spring 2017 to mainstream more resilient and sustainable buildings that can address short-term shocks, such as flash floods, and long-term climate stresses, such as drought.

[6] See Appendix II, Los Angeles: Adaptation Measures

How does the urban planning and development sector embrace citywide adaptation efforts?[7]

LOS ANGELES: URBAN DEVELOPMENT DISCOURSE RESULTS								
Hazard	**Rank**	**City Adaptation Measures Explicit in Mitigation**	**Neighborhoods Studied**	**Total Developments**	**Number of Developments with Implicit + Explicit Mentions**	**% of Developments with Implicit + Explicit Mentions**	**Number of Developments with Explicit Mentions**	**% of Developments with Explicit Mentions**
Extreme Heat	1	24	Boyle Heights, Central Alameda, Historic South-Central	9	7	78%	3	33%
Landslide	2	18	Pacific Palisades, Brentwood, Hollywood Hills	6	4	67%	2	33%
Wildfire	3	25	Pacific Palisades, Elysian Park, Montecito Heights	4	4	100%	4	100%
Flood	4	32	Elysian Valley, Atwater Village, Silver Lake	13	8	62%	8	62%
Sea Level Rise	5	2	Marina del Rey, Venice, San Pedro	5	3	60%	1	20%
Total				37	26	70%	18	49%

37 developments were studied for L.A. 18 (49%) developments explicitly addressed mitigation of a climate change-related hazard, compared to 26 (70%) implicitly including adaptation measures in plans. Mitigating extreme heat usually takes shape through an increase in planted vegetation and installation of reflective surfaces, among other cooling techniques. 78% of the developments for extreme heat mentioned these tactics. However, only 33% explicitly linked these actions to an overall effort of reducing urban heat island effect.

This great disparity between implicit and explicit mentions is completely non-existent when it comes to studying developments for floods. Not only does flooding have the highest number of developments studied for L.A.'s profile, but it also has a high explicit and implicit mention of mitigation tactics, both at 62%. Regarding flood, developments throughout the design and review process seem to be required to note recognition of placement within a flood zone, and if so, the developments must express measures to reduce flood risk and damage. Note that some developments did not have documents noting flood risk at all. What the study only accounts for is recognition of placement in regards to flood, as explicit. It is also explicit if the

[7] See Appendix III, Los Angeles: Urban Developments by Hazard

development is within a flood zone and there are measures to mitigate impact, such as elevation of residential floors, flood proofing of buildings, storm water management, etc. Despite flood having a low rank in the hazard mitigation plan, the hazard had the highest number of mentions in the climate adaptation plan, potentially leading to the creation of more opportunity for city-wide adaptation of flood.

Landslide, wildfire and sea level rise vary in terms of their urban development hazard mitigation results. Wildfire has 100% explicit understanding of complying with the Los Angeles Fire Department, even taking extra steps to prevent fires in their own hands, such as planting fire-retardant plants or removing dead debris. Similarly, some developments studied for landslides were put through a disclosure process noting whether or not the development was located in an area at risk for landslides. Other developments did not identify the risk of landslides at all. This could be due to ordinances that make geological survey and particular soil grading mandatory, but not necessarily a requirement to disclose or make public in the review process (Sahakian, 2018). Sea level rise accounted for mentions of whether the urban developer recognized placement within a flood zone, as implicit. However, it is taken a step further on whether the urban development actually recognizes sea level rise as an existing threat, characterised as an explicit mention. In turn, only one development had an explicit mention. The great disparity in results could be due to the limited perception of sea level rise as a concern, the need for integrating sea level rise projections into city planning, or sea level rise may not as much of a pressing climate hazard for LA, as extreme hear.

5.2.2. Seattle, Washington

What are the urban development trends the city is experiencing?

With a population of 730,000 residents in the city proper, and 3.7 million people in the metropolitan area (US Census Bureau, 2017, Population...), Seattle has been ranked as one of the fastest growing cities in the country since 2010, with a population increase of 18.7%, around 115,000 people, since the beginning of the decade (Balk, 2018). Construction and further housing development have created a housing boom in both urban and residential centres. As Seattle is also one of the most densely populated cities in the US, with 3,336.87 people per kilometres over a span of 367.96 square kilometres (US Census Bureau, 2017, Gazetter), housing and transit development have proved to be a priority for the city. With a strong tech industry fuelling the job market since the 1980s, Seattle is experiencing twice the amount of housing construction than booming San Francisco at the moment (Beyer, 2017). Major development booms are occurring in the neighborhoods of Downtown, First Hill/Capitol Hill, South Lake Union, Eastlake, University District, and other centrally located neighborhoods (Seattle City, 2019).[8] Similar to L.A. and D.C, Seattle is experiencing soaring housing prices accompanied by increasing median household incomes without enough money to cover the cost. With its newfound, more urban, identity, Seattle will be facing entangled, complex crises linked to a changing climate.

Because of the skyrocketing costs of housing, the average household income in Seattle is $83,000. This ranges from neighborhood to neighborhood. Some of the most expensive

[8] See Appendix IV, Seattle Neighborhood Change Map

neighborhoods have a median household income upwards of $200,000 while some of the least expensive neighborhoods right around the corner are at $10,000.[9] The current median housing price in Seattle is $754,000 (City Data, 2019). The average rent for a multi-room apartment is 80% above the national average (Wallace, 2018). Given these numbers, it is no surprise that Seattle is the third-most expensive city in the United States, following San Francisco and San Jose (Mudede et al., 2018). However, expense accompanies even a larger price to pay within some Seattle neighborhoods. Seattle is predominantly white, making up 66.3% of the population, compared to 13.7% Asian, 7.7% black and 6.6% Hispanic (Seattle, 2019). There is a direct correlation between highest median household income and white neighborhoods. Neighborhoods with a high percentage of persons of colour, such as Beacon Hill, Rainier Beach and Othello/Brighton, are experiencing higher rates of urban development within the past few years (Statistical Atlas, 2019).

Housing affordability is a major issue in Seattle. In March 2019, the mayor signed into law affordable housing requirements in 27 neighborhoods designed to minimize gentrification (Lloyd, 2019). Despite critiques of the affordable housing quotas, Seattle seems to be making strides in understanding the in-depth causes of and the alternative solutions to combating gentrification. The vulnerable communities identified in this analysis come from an in-depth socio-economic report by the city describing vulnerable communities with a high displacement risk and low access to opportunity (Seattle City, 2015). Based on this report, the most vulnerable communities in the Seattle area are South Park, Westwood-Highland, Rainier Beach, Othello, Bitter Lake Village, North Beacon Hill, North Rainier, 12th Avenue, Columbia City and 23rd & Union.

What is the general hazard profile of the city?[10]

Seattle is studied through the lens of five different hazards (City of Seattle, 2016): Winter Storms (ranked 2nd highest), Flood (8th), Extreme Heat (9th), Landslide (12th), and Sea Level Rise, which is not ranked, but mentioned in City of Seattle's Preparing for Climate Change (2017). Windstorms (3rd) was eliminated, as the climate adaptation plan identifies no clear trend between climate change and extreme wind events. Drought, ranked 14th in the hazard mitigation plan, was excluded for the same reasoning in the L.A. profile.

Seattle sits between two large bodies of water, Puget Sound and Lake Washington, and two mountain ranges, the Cascade Mountains and the Olympic Mountains. The city's land is comprised of mudflats, coastal lowlands and hills. The geography protects the city against both harsh hot and extremely cold climates, creating a temperate climate (Encyclopedia of Britannica, 2019). Seattle is considered to have a slight variation of a Mediterranean climate, but with more cool and wet overall characteristics than a typical Mediterranean dry-summer, cool-winter climate, such as much of California's coast (Kottek et al., 2006). The atmospheric currents of the Pacific Ocean heavily influence the precipitation in the region, creating light to moderate amounts of precipitation over a longer course of days when compared to other American cities (Kazi, 2019).

[9] See Appendix IV, Seattle Median Household Income Map
[10] See Appendix IV, Seattle Hazard Maps

Seattle can be influenced by overall temperature increase in a number of ways. The National Weather Service ranks Seattle as 15th among urban areas known for heat risk (City of Seattle, 2016). Extreme heat events will be experienced at a more frequent rate with 18 additional days of temperatures above 30 C within the area by the 2050s (City of Seattle, 2017). More extreme precipitation events will occur, particularly in the winter, with a precipitation increase of around 10% by the end of the century (City of Seattle, 2017). Flooding, already seen as a major problem in Seattle, coupled with the effects of sea level rise, snowmelt and severe weather, means that it is expected to get even worse. By 2100, the sea level is projected to rise about half a meter (City of Seattle, 2017). Through initial analysis of sea level rise impacts by the City, the current 100-year storm surge event will become a monthly event by 2060. Specifically, the city has three different kinds of floods: urban, riverine, and coastal. Although riverine floods are not as problematic as they are in other cities, atmospheric rivers, such as the Pineapple Express, cause heavy rain events that create urban flooding (City of Seattle, 2016). More recent data indicates that Seattle will see more intense rainfall in the coming decades. In turn, flooding and related hazards, such as erosion or landslides, will increase in frequency (City of Seattle, 2017).

What is the city's vision for adaptive capacity?[11]

The city's vision for adaptive capacity is showcased in the *Preparing for Climate Change* (2017) document by the City of Seattle Office of Sustainability and the Environment. The document focuses on actions to improve the climate preparedness of City infrastructure and services, as well as be a focal point in facilitating coordination across city government. Part of a larger series of changes to the city, this document is working in tandem with the upcoming Resilience Strategy, which considers climate change in the larger context of citywide goals and challenges (AECOM, 2017).

Prior to Preparing for Climate Change (2017), Seattle released its first Climate Action Plan in 2013, where it established the current 2017 document with the help and guidance of both municipal actors and civilians (City of Seattle, 2013). Through adaptation, Seattle aims to achieve resilience in the context of climate change through three interconnected realms: Equity, Co-benefits and Natural Systems. Equity considers vulnerability and populations at a greater risk to climate impacts. Co-benefits allow for linking adaptation strategies and design with ways to improve quality in urban environments, health and social wellbeing. Natural systems allow for studying and implementing nature-based solutions that foster natural system resilience.

The adaptation plan puts emphasis on land use planning and the built environment, where the City explicitly considers integrating climate impact consideration into the planning process and focuses on hazards such as urban heat, flooding, landslide, and cooling (City of Seattle, 2017). Parks, city buildings, water supply systems are also considered to be sector-specific ways that the City compartmentalizes how to integrate adaptation into citywide services. For each of the sectors, a vision is presented, along with specific actions that go along with sub-topics relevant to the sector.

[11] See Appendix II, Seattle: Adaptation Measures

Seattle updated its Comprehensive Plan (2005) for the year of 2015 and beyond, and is awaiting another update in 2035. The plan has no mention of climate change and is more concerned with the restructuring and creation of new urban villages within the city proper to help compact the city in response to growth and to curb environmental repercussions. Although the plan argues that environmental stewardship is one of the focal points of the planning vision, the 2015 document's subordinate goals are vague and not related to incorporating climate change adaptation, but more related to mitigation efforts.

How does the urban planning and development sector embrace citywide adaptation efforts?[12]

SEATTLE: URBAN DEVELOPMENT DISCOURSE RESULTS								
Hazard	**Rank**	**City Adaptation Measures Explicit in Mitigation**	**Neighborhoods Studied**	**Total Developments**	**Number of Developments with Implicit + Explicit Mentions**	**% of Developments with Implicit + Explicit Mentions**	**Number of Developments with Explicit Mentions**	**% of Developments with Explicit Mentions**
Winter Storms	1	1	South Park, Westwood-Highland, Othello	6	3	50%	0	0%
Flood	2	13	South Park, Alki, Sunset Hill	4	2	50%	2	50%
Extreme Heat	3	13	South Park, Othello, Columbia City	14	11	79%	4	29%
Landslide	4	5	Alki, Madrona, Leschi	5	4	80%	4	80%
Sea Level Rise	5	5	South Park, Westwood-Highland, Pioneer Square	10	5	50%	0	0%
Total				39	25	64%	10	26%

39 developments were studied, with only 10 (26%) developments explicitly mentioning tactics that reduce the impact of climate-related hazards. Overall, landslide ranked the highest in terms of implicit and explicit mentions. Seattle lies on mountainous terrain and landslide-prone areas are embedded throughout the city. Similar to LA, there seemed to be ordinances already in place within the reviewal process which accounted for most of the development studied for this hazard mentioned whether or not they were located in a landslide-risk area. Some of the developments studied were indeed located or close to a landslide-prone area, and discusses mitigation tactics of maintaining vegetation and trees in place, placing silt fences to capture disturbed soil as well as following soil grading/excavation guidelines.

Flood has no disparity between explicit and implicit mentions. Again, this is more than likely due to a mandatory mention of location within a floodplain during the reviewal process.

[12] See Appendix III, Seattle: Urban Developments by Hazard

Related to the flood study, was the sea level rise study having a much higher number of developments studied, compared to the flood-prone neighborhoods. Many of the developments for both the flood and sea level rise study mentioned location of whether the development was in a flood plain, body of water or in an environmentally critical area of not, which is a mitigation effort on its own terms. All of developments that presented their findings on flood placement were not located in a flood zone or close enough to a body of water. However, it must be noted that 7 of these developments for flood and sea level rise had zero public mention of if the development was located in a high flood-risk area.

Extreme heat maintained a relatively low explicit mention of mitigation techniques, but a uniquely high level of implicit mentions, such as an increase in vegetation, passive cooling and planting drought-resistant plants. With a high mention as a climate-related hazard in the city's adaptation plan and a high implicit mention rate within the urban developments studied, extreme heat has more potential to be well integrated into urban development in an explicit manner.

Despite winter storms being ranked highest in Seattle's hazard mitigation plan, it was ranked lowest in terms of mentions within measures in the climate adaptation plan. Similarly, urban developments have not explicitly mentioned ways of combating winter weather, aside from implying a generic use of "climate or weather proofing" the building, without going into specifics. This disparity between ranking in hazard mitigation versus climate adaptation mentions and urban development measures is curious. The steps taken by the city to deal with winter storms potentially are more in line with emergency response than climate change adaptation tactics on an urban development scale. However, with the climate adaptation plan mentioning winter as a getting warmer and wetter, there could be a lack of perceived need to invest in measures that address these storms in the future.

5.2.3. Washington, D.C.

What are the urban development trends the city is experiencing?

Washington, D.C. is the nation's capital, ranking as a relatively medium-sized city with over 700,000 people in the city's proper and a whopping 6 million people in the surrounding area (US Census Bureau, 2018). Ranked number 8 in the 2018 list of fastest-growing American cities, D.C. has had a population increase of 14.7% since 2010 (Balk, 2018). D.C.'s racial and ethnic makeup is 47% black, 36% white, 11% Hispanic, and 4% Asian (Census Profile: Washington, D.C., 2016). The per capita income is $50,187. However, the median household income is $75,628, contributing to the perception of D.C. being a wealthier U.S. city. D.C. has 37% of residents making under $50K household income, 25% making $100K-$200K, 24% making $50k-$100K, and 15% making over $200K annually.[13] These statistics depict diversity and municipal wealth, but that perception only extends when looking at the city as a whole entity, not analysing the city by ward or an East-West axis. Analysing the city by ward is more telling of the economic disparity, lack of integration, and the social rift within D.C. Ward 3, with the highest average family income at $253,774, has the lowest poverty rate at 9.8% and the least amount of racial diversity, with whites making up 78% of the population

[13] See Appendix IV, D.C. Median Household Income Map

(Ward 3, 2012). Whereas, Ward 8, a ward on the opposite side of the city, has an average household income at $45,249, the lowest in the city, and a poverty rate of 37%, the highest in the city (Ward 8, 2012).

Economic, socio-political disparity is vast. D.C. is one of, if not, the most rapidly gentrifying cities in the US. The populations that once lived there before a mass influx of new residents are being pushed out, demonstrating a clear example of displacement (Florida, 2015). As D.C. continues to gentrify, many of the impoverished populations will continue to be forced out of the city. As of 2016, the rent in Chevy Chase, a neighborhood in Ward 3 amounted to an average of $1,680 for a one-bedroom rent. This is compared to Anacostia, a neighborhood in Ward 8, rent price of $990 for the same rental (Chen et al., 2016). It is visibly clear that D.C. is becoming richer, whiter and younger even over the course of the last decade, especially in neighborhoods such as Navy Yard, Shaw and Bloomingdale (Rabinowitz, 2017), making it the 5th most expensive rental market in the nation (O'Brien et al., 2016). [14]

Vulnerable populations are still prevalent in the city. The city has conducted studies on both adaptive capacity and sensitivity toward climate impacts in various wards throughout the district. According to a study conducted by the University of Michigan, the most vulnerable neighborhoods in D.C. were calculated by looking at Neighborhoods Characteristics (tree canopy, impervious surface), Housing Characteristics (proportion of renters in neighborhood, units with less than 4 rooms), Social Disadvantage (poverty, minority, less than high school education, receiving supplemental security income), and Neighborhood Crime (total crime, property crime, violent crime) (Mallen, 2014). Overlaying the map of vulnerability by University of Michigan, with the neighborhood map in this study, the top three most vulnerable neighborhoods are Cluster 27 (Southeast, Navy Yard), Cluster 23 (Ivy City, Arboretum, Trinidad, Carver Langston) and Cluster 6 (Dupont Circle, Connecticut Avenue/K Street).

What is the general hazard profile of the city?[15]

Washington, D.C. will be studied through 4 hazards: Extreme Heat, Extreme Weather (Winter Storms and Wind Storms, as it is combined in the adaptation plan), all three of which are ranked "High Probability/High Impact," and Floods (which includes Hurricanes' by-product of storm surges), ranked "Medium Probability, High Impact" (District of Columbia, 2014). Sea level rise is included in the assessment, as it is also included in the two other cities and D.C.'s climate adaptation plan.

The city is a federal district between the two states of Maryland and Virginia. It is a low-lying city, built on swampland, with the Potomac and Anacostia rivers surrounding it. The city has a climate characteristic of the Mid-Atlantic and Southern states of subtropical temperate, humid climate zone, with hot summers and cold winters (District of Columbia, 2014). The city is notorious for its humidity that makes the city feel 2-5 degrees hotter than actual temperatures.

[14] See Appendix IV, D.C. Neighborhood Change Map
[15] See Appendix IV, D.C. Hazard Maps

D.C. will experience much warmer temperatures, increasing the summer average to about 89F from 87F over the past 50 years, with an expected increase to 93-97F by 2080s. This means extreme heat days will increase in frequency and heat waves will last much longer. Typically, extreme heat days in D.C. are around 30 days per year. However, by 2050, 30-45 days per year could be the new number, and by 2080, 40-75 days is expected (District of Columbia, 2016). In terms of flooding, more heavy rain events will occur along with higher tides and storm surges from rising sea level. Average annual precipitation in the D.C. area has increased by 5 to 10 percent in the last century, but precipitation from extremely heavy storms has increased by more than 25 percent across the eastern United States since 1958. Over the next century, average annual precipitation and the frequency of heavy downpours are likely to keep rising. Regarding sea level rise, D.C. is in a more precarious situation because the land is sinking. Already, the Potomac and Anacostia are rising 2.5 centimetres every eight years. Business as usual scenarios anticipate the city experiencing anywhere from 40 centimetres to 1.2 meters of sea level rise (Environmental Protection Agency, 2016). In terms of storms, D.C. has been facing heavy snowstorms more recently, as well as extreme derechos, tornadoes and also the occasional hurricane that exacerbates flood risk and severely impacts critical infrastructure (Department of Energy & the Environment, 2016, Vulnerability & Risk).

What is the city's vision for adaptive capacity?[16]

Climate Ready D.C. (2016) is a vision and plan for D.C.'s adaptation to climate change. Like many municipal adaptation plans, Climate Ready D.C. is part of a larger, more holistic and multi-sectoral plan to achieve economic, social and environmental resilience in the city, Sustainability D.C. (2012). In that plan, there was an explicit goal to make the District more resilient to future climate change impacts. Therefore, Climate Ready D.C. is the specific strategy for achieving the goal, while ensuring the city continues to grow greener and more liveable.

The plan is divided into four sectors: Transportation & Utilities, Buildings & Development, Neighborhoods & Communities and Governance & Implementation. The section that is most relevant to this study is Buildings & Development. It emphasizes the goal to upgrade existing buildings and design new buildings and development projects to withstand climate change impacts. The following actions hope to feed into and accomplish this goal: provide backup power for emergencies at the most critical facilities, improve thermal safety of buildings to increase resilience to extreme heat, especially in the event of a power outage, pursue deep energy and water efficiency for all buildings, incorporate climate resilience into development planning and review, leverage land-use planning to promote resilience (especially in flood and heat prone areas), and provide incentives to encourage private property developers to implement flood resilience measures.

The sustainability and climate readiness goals within D.C. have been more or less straightforward since 2013, with their climate adaptation plan, created alongside a few department-centric plans and efforts, such as the District Department of Transportation's

[16] See Appendix II, Washington, D.C: Adaptation Measures

Climate Plan (2013). Overall, D.C. has recently gone through, and technically, is still going through an overhaul with its comprehensive plan. Because the city is a federal district, the comprehensive plan must be amended in two parts: citywide, or district, elements, which is managed by the Office of Planning, and federal elements, which is managed by the National Capital Planning Commission. The federal elements must be reviewed and approved by Congress. Currently, the Comprehensive Plan is going through a review process, despite many of the elements of the plan, such as historic preservation or parks, recreation and open space, being approved already. Although in the process, the draft documents of the Comprehensive Plan (2011) aim to work in tangent with the newly updated Sustainable D.C. Plan (2018) and Climate Ready D.C. Plan (2016).

How does the urban planning and development sector embrace citywide adaptation efforts?[17]

WASHINGTON, D.C: URBAN DEVELOPMENT DISCOURSE RESULTS								
Hazard	**Rank**	**City Adaptation Measures Explicit in Mitigation**	**Neighborhoods Studied**	**Total Developments**	**Number of Developments with Implicit + Explicit Mentions**	**% of Developments with Implicit + Explicit Mentions**	**Number of Developments with Explicit Mentions**	**% of Developments with Explicit Mentions**
Extreme Heat	1	53	Ivy City, Trinidad, LeDroit Park	11	5	45%	2	18%
Extreme Weather (Winter Storms/Wind Storms)	2	50	Ivy City, Trinidad, LeDroit Park	11	0	0%	0	0%
Flood	3	58	Southwest Waterfront, Navy Yard, Buzzard Point	38	29	76%	29	76%
Sea Level Rise	4	53	Southwest Waterfront, Navy Yard, Buzzard Point	38	29	76%	1	3%
Total				98	63	64%	32	33%

Out of 98 developments studied for all of D.C., 32 (33%) explicitly presented an intention to mitigate climate-related hazards. A lower number of hazards were studied for the city, compared to Seattle and LA. However, the study clarified patterns that were also prevalent in the two other cases, such as the minimal disparity between implicit and explicit mentions regarding flood, low explicit mention regarding sea level rise, and large differences in implicit and explicit mentions of cooling techniques to mitigate heat.

Much of the developments studied for this case centred on flood and sea level rise, as D.C. is currently experiencing a development boom close to the city's Southwest waterfront. As the city is sinking and sea levels are rising, flood and sea level rise should be a concern now more

[17] See Appendix III, Washington, D.C: Urban Developments by Hazard

than ever. Although flood and sea level rise shared the same developments for the study, explicit mentions for the two hazards were very different in outcome. Flood had a high implicit and explicit mention, with no disparity. Most likely due to mandatory regulations of flood zone assessment, similar to L.A. and Seattle. Many of the developments did note their placement in flood zones, and in turn, they outlined specific tactics to mitigate flood impact through buffer zones, storm water quality and quantity management, elevation and flood proofing, among others. However, many of the developments were located on the shoreline and only one development had a mention of sea level rise as a threat only after the Department of Energy and Environment brought it to their attention and asked for a revision of the development proposal. Flood and sea level rise are one of the highest mentions within the city's climate adaptation plan. Urban developments, through their implicit mentions expressed a various number of innovative ways to mitigate flooding. However, the potential of urban development taking a well-demonstrated innovative lead of addressing flood is blocked by the minimal recognition of sea level rise as a threat.

Extreme weather had zero explicit or implicit mention of mitigation tactics. This could be for reasons similar to Seattle's winter storms outcome, where the immediate aftermath of the event is more efficiently taken care of through relevant city services rather than long-term urban adaptation development. Regarding a slower-onset event that is expected to increase in frequency and intensity in D.C., extreme heat was ranked as the top hazard for D.C. but it showed a lower percentage of urban development actually addressing extreme heat or urban heat island effect. Again, heat had a large disparity, like the other cases, between explicit and implicit mentions. More importantly, more developments studied for this hazard had zero mention of cooling techniques, both implicitly and explicitly, than developments that have tactics to mitigate heat. As the other cases show innovative tactics to mitigate heat, D.C.'s urban development has a deficiency is addressing the hazard, both implicitly and explicitly.

6. Analytic Discussion

The analytic discussion entails a comparative analysis of findings from the aggregate scoping method and case studies. The results are processed through the questions outlined in the methodology section to answer the overarching question of *"What effect do American city-wide adaptation efforts have on urban development trends?"* in the conclusion. *"What is the prevalence of adaptation efforts within city climate action plans?"* looks at how adaptation is positioned within the national context of climate action efforts, as indicated by the aggregate scoping method. *"What is the relationship between city-wide adaptation efforts and urban planning and development?"* compares the results of citywide adaptation plans and urban development trends in each of the three case studies. The answer extracts the qualitative findings from the city profiles to clarify the overall connection, relationships and patterns between adaptation planning and urban development. *"Do current urban development trends hinder, allow for or accelerate adaptation efforts?"* analyses the quantitative results from the city profiles. For each particular hazard, there is a discussion on the rankings of the hazard, the level of disparity between explicit and implicit results, and specific mitigation measures within urban development plans. These three aspects inform whether urban developments are embracing adaptation efforts and what is the potential of urban development addressing particular climate-related hazards. The combination of answers for the three questions informs the conclusive question.

What is the prevalence of adaptation efforts within city climate action plans?

Citywide climate action plans in the United States have a relatively low consideration of adaptation in overall climate change response. Only 87 (21%) out of the 412 cities have plans with mentions of adaptation, regardless of how big a role adaptation plays in those plans. Furthermore, only 23 cities in states with statewide climate action plans had single-standing adaptation plans or large adaptation components in their climate action plans. Overall, most plans were concerned with reducing GHG emissions rather than long-term climate change response. This is somewhat understandable since the United States has a relatively low worldwide vulnerability rank when it comes to climate change-related hazards (Notre Dame, 2019). However, not all regions of the country bare the same brunt of impact due to the country's diverse array of ecosystems, economies and other socio-cultural systems. As climate change-related hazards are anticipated to have the highest impact in southern states, relative to northern states (Plumer & Popovich, 2017), municipalities, even within states that are more politically conservative, are focusing on adaptation, such as New Orleans, Louisiana (City of New Orleans, 2017), St. Louis, Missouri (City of St. Louis, 2017), and Nashville, Tennessee (Nashville, 2013). But because climate change still impacts the United States universally, adaptation is a necessary component to be had in all climate action plans. In a transitory phase, a majority of American cities do not place much priority on adaptation compared to mitigation. California, arguably one of the most environmentally progressive states, is a quintessential example of the state of climate action and adaptation in the US. California produced the most cities (77), stepping forward to denounce the Paris withdrawal as well as having the most enacted (45) climate action plans. However, nearly half of these plans (43%) had minimal to no mention of adaptation.

Findings show there is still an "adaptation deficit." However, it seems like it is slowly being addressed through the invaluable connections provided by transnational municipal networks, led by model cities taking the lead in investing in more holistic resilience efforts, of which include adaptation. 17 states have statewide climate action plans, with 7 more states on the way to finalize their own plans. 34 cities were counted to have city-wide action plans in progress, with many finalized city-wide action plans highlighting the importance of the creation of a specific climate adaptation plan. Ultimately, the "adaptation deficit" seems like it is slowly being mended through a combination of internal and external drivers related to the city scale, addressing the discursive and conceptual gap that persists between mitigation and adaptation on the American city scale.

What is the relationship between citywide adaptation efforts and urban planning and development?

The nature of cities makes disaster impact, recovery and long-term risk reduction a more complex issue due to a variety of systems and actors that make up the fibre of a densely economic and populated urban area. Los Angeles, Seattle and Washington, D.C. share more similarities than differences when it comes to the relationship between adaptation efforts and urban development. The similarities these cities share are elaborated in the following paragraphs: climate adaptation plans integrating multi-sectoral approaches, the expression of opportunity for mobilizing adaptation efforts through the built environment and making way for continual urban development booms. These similarities feed into a discussion on the explicit relationships crucial to the urban planning and development process and what that means for adaptation integration.

The cities share how adaptation plans are proposed and presented within the grand scheme of multi-sectoral citywide resilience. All three cities' adaptation plans or components stem from a more holistic view of how the city needs to address and adapt towards, not only climate shocks, but other shocks that range from seismic to financial, as presented in Sustainable D.C. (2012), Seattle Climate Action Plan (2013) and Sustainability PLAn L.A. (2015). As holistic and sometimes vague as the initial climate action plans are, they provide a vision for how climate readiness can be integrated within the city. Ultimately, these holistic plans are being supplemented with a more specific and recent focus on climate adaptation: Climate Ready D.C. (2016), Seattle's Preparing for Climate Change (2017), and Resilient L.A. (2018). Discursively, the three cities vary in terms of how climate adaptation is structured and presented. What they have in common is that they all split up their adaptation efforts by sector. Los Angeles is concerned with overall multi-sectoral resilience and how to achieve stability through a combination of both short-term and long-term planning. Whereas Seattle and D.C.'s recent plans are entirely focused on adaptation, and split up their visions and actions in different ways, but the divide is sector-specific. Having a sectoral approach provides a more concrete visualisation of how adaptation strategies need to be holistically dispersed through the city, in a multi-sectoral fashion with a variety of actors supporting the effort.

As demonstrated by the holistic nature of adaptation planning, there is a variety of ways a city can introduce climate adaptation goals and strategies. However, there is a concept that all three examples share and that is the inclusion of the built environment and planning as a mode of adaptation implementation. Seattle uses “City Buildings” and “Land Use & the Built Environment” as two sectors to address hazards such as urban heat island effect, flood, sea level rise and landslides through a number of actions. Some of the most relevant measures include: evaluating design standards of facilities (city buildings) against future climate projections, utilizing passive cooling retrofits and vegetation throughout the city to reduce urban heat island effect. L.A.'s Resilience plan emphasises Climate Change Adaptation and Infrastructure & Modernization as two sections, that share responsibility in updating climate and vulnerability risk assessments and advancing a coordinated approach to infrastructure and city planning by the early 2020s, among other specific actions. D.C.’s Climate Ready Plan has a sole section on Buildings & Development that pushes for an overall upgrade of existing buildings to withstand climate impacts. The sub-actions noted for this sector vary from city to city, sharing some similar goals, such as reducing urban heat island effect or integrating updated flood plains into urban plans. However, all three cities demonstrate how crucial the built environment is for carrying out adaptation efforts.

The world is urbanizing, and so is the United States. All three examples show similar urban development trends, opportunities and drawbacks that frame the scope and potential for current and future climate adaptation endeavours within urban planning. Cities are experiencing an influx of new residents that creates a need for more utilization of space reserved for dense, residential and mixed-use buildings to accommodate such large population growth. The push for more space creates a higher cost of living due to new, reliable and state-of-the-art amenities, businesses and residences in the city. Higher cost of living may indicate a general higher quality of living for the urban space. However, the huge problem of displacement and gentrification seems to be ubiquitous throughout many major American cities. Generally, it seems that the populations for all three cities are becoming whiter, wealthier and younger. New residents seem to be encroaching on neighborhoods that are cheaper, threatening populations that have lived in these neighborhoods to become displaced through steadily growing rent prices from newly formed developments. This development trend emphasizes that resilience is not only concerned with the science and engineering behind climate-related hazards but the social characteristics and groupings that identifies more vulnerable populations impacted by disaster. Gentrification may allow the city to become more equipped to combat climate impacts in a geographic sense due to increase in quality of amenities, life and built environment. However, gentrification also causes displacement of vulnerable populations, leading to a possible continuation of facing disproportionate impacts from climate-related disasters. It is important to note that urban development has the opportunity to combat socio-economic disparities that play an inherently critical role within climate change adaptation.

The discussion of these citywide plans and trends come together in studying relationships that create the urban planning and development sector. The built environment demonstrates itself as an opportunity for addressing a multitude of issues, ranging from social justice to environmental resilience. Not only is it multi-sectoral, but it is holistically indicated by a variety of specialised actors that play a part in the planning and development processes.

Anything but simplistic, urban planning and development is more nuanced through the shared responsibility held by public actors, such as the municipality's Office of Planning, private actors, like urban developers, and citizens. Citizens play the role of the service receivers, and occasionally, the role of reviewers of development if there is enough public clout to push for or against particular developments. Cities, in turn, act as overall directors of how the city is planned and how to address particular issues through the lens of the built environment. Private developers provide funding and services that carry out these plans managed by the city. The public and municipal review have the opportunity to input processes toward any new plan or development offered by both the city and private developers. It is a system that reflects the overall socio-economic and environmental trends of the city and indicates the level of importance of particular topics, such as adaptation.

How adaptation efforts are integrated into this process largely depends on how the city directs private actors to develop projects. The city has demonstrated the pressing need for climate change adaptation, particularly within the built environment. Private developers, on the other hand, can range anywhere between being supportive or ignoring these strides in advancing citywide adaptation. Urban developments are physical manifestations of joint decision-making by city-elected officials and developers. Because urban planning and development have the opportunity to address multiple issues faced by the city, such as the need for affordable housing, public transportation or accommodating new residents, how urban development create their plans and publicly justify design decisions reflect the thought-processes, priorities and intentions of actors involved. Whether these intentions relate to hazard reduction can depend on a variety of factors, such as the existence of mandatory laws based on particular hazards in place, continual research on hazards, differing levels of vulnerability and state-of-the-art technological advancement to mitigate these hazards. Whether the relationship between citywide adaptation efforts and urban development allows for or hinders adaptation efforts is dependent on the quantitative findings as discussed in the response to the next question.

Do current urban development trends hinder, allow for or accelerate adaptation efforts?

Development booms bring invaluable economic opportunities to cities. However, economic and environmental benefits historically have the tendency to be at odds with one another when it comes to city planning. Despite this, urban development provides the opportunity to be both an economically and environmentally resilient nexus if enough consideration and research are done in weighing environmental, social and economic trade-offs. Urban development has a niche to serve, as praised by citywide climate adaptation plans. This section analyses whether the reduction of particular climate-impacts is considered within city projects and what this means for the overall relationship between urban development and adaptation.

Extreme Heat

Extreme heat is one of the most pressing climate-related hazards all three cities face. It is considered a top hazard for L.A. and D.C. and ranked third for Seattle. Compared to other hazards, extreme heat had a similar pattern shown in all three case studies.

Addressing extreme heat was ranked the 2nd highest hazard addressed by urban developments, respective to combining both implicit and explicit efforts. With a relatively high percentage of intention to mitigate the hazard, extreme heat also faced another similar pattern in all case studies. There is a grand disparity between implicit and explicit mentions of mitigating heat. Despite the high ranking, extreme heat ranked as one of the lowest hazards explicitly addressed by urban developments.

This great disparity demonstrates that urban developments are already taking a few tried and true measures to ensure the reduction of heat, such as increasing vegetation or using reflective material. However, reducing urban heat island effect may not be the top priority for these developments, as indicated by lower results for explicit measures. It is undetermined how appropriate and extensive measures to reduce extreme heat should be per development. However, it is clearly demonstrated that urban development can easily take on the role of using a variety of passive and active cooling techniques, particularly in the vulnerable areas studied. Tactics can entail increasing tree canopy or reducing impermeable surfaces and asphalt. There are various examples of developments in all three cities both implicitly and explicitly curbing heat by increasing the amount of vegetation on-site. The variety of cooling techniques and the amount to which they range within one development varies. Some developments were more thorough than others in integrating heat reduction mechanisms. One particular example of explicit heat mitigation is a community-driven development in an L.A. neighborhood highly susceptible to urban heat island effect. The development proposed a park and open space to help combat a multitude of urban issues: gentrification, climate change impacts, safety and childhood development, which emphasises the opportunity the built environment has to take on complex, multi-sectoral adaptation efforts.

Despite the well-meaninged example, the explicit development seemed more of an exception than a rule. Considering the neighborhoods studied for this hazard are some of the most vulnerable communities in the city, of which are particularly susceptible to heat island effect due to limited vegetation, as demonstrated by city documents (Resilient Los Angeles, 2018), urban development efforts should be more explicit in cooling the built environment. With a few examples of development plans that are thorough and explicit in reducing heat, such as Ramona Gardens (2018),[18] Othello Station North (2014),[19] and Howard University Barry Place (2015),[20] urban developments have a much bigger potential to actively and explicitly reduce heat.

Flood & Sea Level Rise

Flood and sea level rise are two hazards discussed in tandem with one another because of their interconnected nature in contributing to the creation of flood projections and similar high flood-risk neighborhoods. The hazard rank for flood varies for each city,

[18] Found in Appendix III under Los Angeles- “Extreme Heat”
[19] Found in Appendix III under Seattle- ”Extreme Heat”

[20] Found in Appendix III under Washington, D.C.- “Extreme Heat”

while the ranking for sea level rise maintains the lowest position in hazard ranking for all cities. Across all cases, the results for sea level rise show high implicit results and very low explicit results, ranging between 0-1%. Similarly, all cities experience the same results for implicit and explicit flood mitigation measures.

High implicit results, even similar in terms of percentage, for efforts in addressing flood and sea level rise are due to requirements of the developer notifying whether some developments are placed in a flood zone throughout the design and reviewal process, either through an environmental assessment or in the design plan. This is an example of citywide measures being enforced, and in turn, making developments require acknowledgement of climate impacts and addressing them. Floodplains and mapping are the reasons why the results for explicit and implicit measures to mitigate flood are so high. Developments, within floodplains, are to take extra precautionary steps in ensuring the reduction of damage to the building in the event of a flood, through measures like flood-proofing, elevating floors, installing permeable surfaces and creating buffer zones.

Many events can cause flooding, such as declining snowpack, atmospheric rivers, and storm surges. Sea level rise is one of them. Therefore, the extremely high implicit result for sea level rise is also indicated through a mention of whether the development is placed within a flood zone, near a body of water or in an environmentally critical area. However, the large disparity between explicit and implicit results is due to the limited recognition of sea level rise as a threat, particularly by coastal developments. Although it plagues all three cities, some more than others, sea level rise had a consistently low outcome in explicit mentions. The low number can be because some developments are located outside flood zones. However, the ones that are located in them generally do not consider sea level rise as a concept to be integrated into the design and reviewal process. Despite two instances of considering sea level rise in all studied proposed plans, urban developments have no accelerated sea level rise adaptation efforts thus far.

An example that directly ties in flood and sea level rise hazards, is the development boom of Washington, D.C.'s Navy Yard, Buzzard Point and Southwest Waterfront neighborhoods. The highest group of developments within the entire study, 38 projects are placed in or close to an either 100 or 500-year floodplain, many of them near a waterfront. Sea level rise was studied for the same developments. And similar to the L.A. and Seattle cases of sea level rise, only 1 of the developments explicitly included sea level rise as a consideration throughout the reviewal process. It is important to note that the development included sea level rise within the reviewal process due to pressure from the city's Department of the Environment, not out of the developers' own volition. Many of the waterside developments in the neighborhoods studied utilize sustainability checklists, such as LEED, to publicise their efforts in making the development environmentally friendly. Although this is a good strategy to mainstream sustainability within urban development projects, it is concerning whether these checklists are enough to mitigate imminent phenomena, such as sea level rise, through merely stating the development will mitigating storm water quantity and quality. This

is concerning when future climate projections are still yet to be mainstreamed and integrated into city planning. City adaptation plans highlight the sense of uncertainty and need for updates on flood plains due to climate change projections (Sahakian, 2018) (District of Columbia, 2016). With at least 38 new developments since 2013 being built in waterside neighborhoods, further retrofitting of the multi-billion dollars neighborhood revamp, will be even more costly. Therefore, this conundrum sheds light on whether merely looking at the intention of developments is enough.

Other Hazards

Wildfire, landslide and extreme weather are hazards that do not apply to all the case studies. These hazards had different outcomes. Addressing wildfire in L.A. is the most robust in terms of intention to reduce impact out of all the hazards in all cities studied. Landslides had no disparity between implicit and explicit mention, most likely due to ordinances calling for geological survey. Extreme weather, including winter storms, had no implicit or explicit mention of hazard mitigation.

Wildfire risk only plagues L.A. at the moment. However, this hazard study was the most successful at demonstrating urban developments are embracing citywide adaptation and preparedness efforts when it comes to wildfires. 100% of developments studied addressed concerns of wildfires through explicit agreement toward fire department standards compliance. It seems that the measures associated with this hazard fall outside the primary role and responsibility of urban developers and into public services (PLAn, 2015). However, it is important to note there were instances of developments taking a step further than merely agreeing to fire standards or recommendations, but by continually maintaining debris and placing fire-lanes and fire-retardant plants on site.

Landslides are relevant to both Seattle and LA. Many of the urban developments studied included mandatory procedures during the design and review process, in terms of analysing the site in relation to landslide-risk. Urban development is encroaching on landslide-prone areas in both cities. However, there seem to be already many systems in place regarding the evaluation of the site and city-funded educational awareness programs. The developments admitting the project location is landslide-prone, tend to take extra measures to not only implement grading recommendations, but other innovative processes like vegetation maintenance, silt fence placement, and building around landslide areas.

Extreme weather is more prevalent in D.C. and Seattle in this study. Although both cities experience these storms more regularly, there was minimal to no mention of mitigating storms within the climate adaptation plans. In fact, the only mention of these storms was in Seattle's plan, where it was specifically addressed that winter storms and snowfall will become wetter and less frequent. Therefore, the cost of snow removal and other services that cater to the aftermath of snowfall is anticipated to go down. None of the developments studied for this hazard explicitly addressed extreme weather. If implicitly addressed, measures of reducing impact entail vague "weather-

proofing" of materials on site. This may imply that city services that address storms are already in place for the cities that consider cold spells a hazard.

Based on this analysis, urban development embraces adaptation efforts dependent on the type of hazard, the laws in place, and where responsibility and accountability of adaptation efforts fall. Because all cities are in a transition state when it comes to adaptation formulation and implementation, urban developments are not pressured to integrate climate change impact knowledge into new developments at the moment. However, hazards that have specific associated laws and measures to mitigate impact, such as flood and landslides, are more likely to have a stronghold on how developments address these issues due to regulation. Wildfires and extreme weather seem to place more responsibility for city services, such as transportation, utilities and emergency response, in order to mitigate impact. Therefore, there may be less of a requirement for developments to take on the responsibility to mitigate these particular hazards of wildfires, extreme weather, landslides and floods. What seemed to be the most concerning is how urban developments address sea level rise and extreme heat. Both phenomena are more slow-onset hazards and do not have as many associated mandatory measures that shape the planning process yet. Therefore, urban developments located in areas with extreme heat or coastal zones tend to ignore addressing the two hazards. Although both hazards ranked high in implicit measures, the lack of explicit concern demonstrates lower priority of considering climate change-related hazards.

Overall, the quantitative findings for all three case studies show that some developments tend to integrate strategies that happen to mitigate hazards regardless of whether it is explicitly their intention or not. All cities totalled around a 64-70% majority of developments implicitly addressing climate-related hazards. Percentages for explicitly addressing hazards were all lower, compared to implicit results, but ranged from 49% (LA), 26% (Seattle) and 33% (D.C.). This demonstrated that explicit mention of mitigating hazards is less common within plans or supplementary documents presented to planning commissions. Although the urban planning and development process thoroughly integrates public and private actors, recognition of climate hazards as a priority within private urban developments is not common. Only 60 (34%) out of 174 developments studied showed explicit consideration of climate change impacts during the design and reviewal process. Therefore, because the city has a role to play in approving and inputting oversight onto these developments, the findings identify a gap within municipal enforcement of molding the urban development sector to address climate-related hazards.

7. Conclusion

Understanding how climate adaptation efforts are implemented within the city scale is difficult to analyse as adaptation planning and implementation is so nascent within the United States. Ultimately, studying the direct link between official adaptation planning and urban development is too early to tell. However, studying the current urban development landscape shows the multi-sectoral relationships, processes and trends that highlight how cities are currently executing adaptation efforts. As the city-scale provides a microcosm of a larger scale, findings from the aggregate scoping method and the case study analysis paint a picture of where the relationship between adaptation planning and urban development is now and what value urban development has in moving adaptation forward within the city scale.

To the question, *"What effect do American city-wide adaptation efforts have on urban development trends?"* city-wide adaptation efforts recognize the invaluable potential urban development has in being a mode of delivering equitable adaptation efforts. However, a majority of urban development plans and projects have not tapped into the great opportunity they possess to explicitly integrate adaptation efforts, or climate-related hazard reduction techniques, into their respective project proposals. Therefore, regarding the current status of the United States, citywide adaptation efforts have had a minimal impact on urban development trends.

Although minimal effect is the answer today, it may not be the case in the future. Timescale must be considered, as adaptation is still in its infancy in the American context. Many of the cities studied in the aggregate scoping section were found to have very little recognition of adaptation as a means of climate action, focusing more on mitigation instead. Despite this "adaptation deficit," some major American cities are investing in climate action plans with large adaptation components. Out of these cities, L.A, Seattle and D.C. were studied to understand the current relationship between adaptation efforts and actors that influence the built environment.

The case cities analysed are in a close finalisation phase in the adaptation formulation process or are beginning to implement strategies. Therefore, the adaptation planning impact on urban development has not yet occurred on a formal level. Despite the timescale, adaptation has long been in discussion within LA, Seattle and D.C. The discourse surrounding multi-sectoral adaptation planning has formally circulated within these cities 2015 or earlier, allowing room for other city departments and private actors, like urban developers, to integrate explicit adaptation discourse into new city projects. Regardless of the early days within the adaptation timescale, it is important to note the landscape of urban development and how these climate-related hazards are already being addressed by city projects.

In studying a variety of urban developments, there was a great disparity in looking at implicit versus explicit intent to mitigate climate-related hazards. 66% of all developments studied had measures that imply risk-reduction strategies in limited detail or without reference to a particular climate-related hazard. Whereas, only 34% of developments studied demonstrated direct intent to reduce climate change-related hazards through strategies that have the purpose

to curb risk. The disparity between the two forms of intent demonstrate developments can and have employed strategies, but less so in a direct manner specific to addressing climate-related hazards. These findings illuminate the potential of adaptation techniques within urban development to become even more mainstream.

The findings of how urban development embraces climate-related hazards are more nuanced and dependent on the particular hazard itself. The developments studied found the levels of integrating adaptation efforts and mitigation of hazards as largely dependent on a few factors. Depending on the hazard, urban development can embrace the prevalence of these hazards and their potential harm to the city. These hazards that are addressed more frequently in terms of implicit and explicit terms, such as landslides and floods, have associated regulations or ordinances requiring the inclusion of risk within the design and reviewal process of the development. Hazards that are more fast-onset, like extreme weather and wildfires, seem to be more associated with other city services, such as emergency planning, and therefore, relieves a lot of the responsibility on other municipal actors. The largest and most pressing take-away from this study was understanding how hazards that are less visible, such as sea level rise and extreme heat, have very little consistent, explicit consideration of addressing these hazards within urban development projects. Although urban development implicitly expressed a variety of techniques in addressing sea level rise or heat, the explicit discourse was very minimal. However, the disparity between direct and indirect means of addressing hazard only highlights the level of potential mobility urban development has in thoroughly mitigating these hazards of sea level rise and heat.

A grand disparity between implicit and explicit discourse surrounding measures addressing climate impacts parallels the placement of the United States within climate adaptation planning. The American context currently demonstrates a limited discussion on adaptation on a national level and from the perspective of urban development. Whereas future adaptation potentials are highlighted within specific citywide adaptation efforts and implicit strategies adopted by some, but not all, urban developments in achieving climate resilience. In the American context, citywide adaptation efforts are not yet transforming plans into a physical reality just yet. However, the untapped potential of urban developments demonstrate a mobilizing resource in carrying relevant adaptation efforts forward within the built environment.

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Appendix I. Aggregate Scoping Tables

**Yellow boxes indicate states with finalized state-wide climate action plans*

CLIMATE ACTION STATUS OF CITIES WITHIN THE CLIMATE MAYOR NETWORK			
CITY	**STATE**	**CITY CLIMATE ACTION PLAN?**	**ADAPTATION COMPONENT?**
ALASKA			
Anchorage	AK	In Progress	N/A
Fairbanks North Star Borough	AK	N/A	N/A
ALABAMA			
Birmingham	AL	N/A	N/A
ARKANSAS			
Fayetteville	AR	N/A	N/A
Little Rock	AR	N/A	N/A
ARIZONA			
Bisbee	AZ	N/A	N/A
Flagstaff	AZ	Yes	Yes
Phoenix	AZ	Yes	N/A
Tempe	AZ	In Progress	N/A
Tucson	AZ	N/A	N/A
CALIFORNIA			
Alameda	CA	In Progress	N/A
Albany	CA	N/A	N/A
Arcata	CA	N/A	N/A
Arvin	CA	N/A	N/A
Belmont	CA	N/A	N/A
Berkeley	CA	Yes	Yes
Beverly Hills	CA	N/A	N/A
Brisbane	CA	Yes	Yes
Burlingame	CA	Yes	Yes
Carson	CA	Yes	N/A
Chula Vista	CA	Yes	Yes
Claremont	CA	N/A	N/A
Corte Madera	CA	Yes	Yes

Cotati	CA	N/A	N/A
Culver City	CA	N/A	N/A
Cupertino	CA	Yes	Yes
Daly City	CA	Yes	N/A
Davis	CA	Yes	N/A
Dublin	CA	Yes	N/A
El Cerrito	CA	Yes	Yes
El Monte	CA	N/A	N/A
Emeryville	CA	Yes	Yes
Encinitas	CA	Yes	Yes
Fort Bragg	CA	N/A	N/A
Fremont	CA	Yes	Yes
Glendale	CA	Yes	Yes
Goleta	CA	Yes	N/A
Half Moon Bay	CA	N/A	N/A
Hayward	CA	Yes	Yes
Healdsburg	CA	N/A	N/A
Imperial Beach	CA	In Progress	N/A
Laguna Woods	CA	Yes	Yes
Long Beach	CA	In Progress	N/A
Los Altos	CA	N/A	N/A
Los Altos Hills	CA	N/A	N/A
Los Angeles	CA	Yes	Yes
Los Gatos	CA	N/A	N/A
Malibu	CA	N/A	N/A
Manhattan Beach	CA	Yes	N/A
Martinez	CA	Yes	Yes
Menlo Park	CA	Yes	N/A
Millbrae	CA	N/A	N/A
Morro Bay	CA	Yes	Yes
Mountain View	CA	N/A	N/A
Napa	CA	N/A	N/A
Oakland	CA	Yes	Yes
Ojai	CA	N/A	N/A
Palo Alto	CA	Yes	Yes
Petaluma	CA	N/A	N/A
Rancho Cordova	CA	N/A	N/A

Redwood City	CA	Yes	N/A
Richmond	CA	Yes	Yes
Sacramento	CA	Yes	N/A
Saint Helena	CA	N/A	N/A
San Carlos	CA	Yes	Yes
San Diego	CA	Yes	Yes
San Fernando	CA	N/A	N/A
San Francisco	CA	Yes	Yes
San Jose	CA	Yes	N/A
San Leandro	CA	Yes	N/A
San Luis Obispo	CA	N/A	N/A
San Mateo	CA	Yes	N/A
Santa Ana	CA	Yes	N/A
Santa Barbara	CA	N/A	N/A
Santa Clara	CA	Yes	N/A
Santa Cruz	CA	Yes	Yes
Santa Monica	CA	Yes	N/A
Santa Rosa	CA	Yes	Yes
Sonoma	CA	N/A	N/A
Stockton	CA	In Progress	N/A
Sunnyvale	CA	Yes	N/A
Torrance	CA	Yes	N/A
Ventura	CA	N/A	N/A
Watsonville	CA	Yes	Yes
West Hollywood	CA	Yes	Yes
West Sacramento	CA	Yes	N/A
Windsor	CA	Yes	Yes
Woodland	CA	Yes	N/A
COLORADO			
Aspen	CO	Yes	N/A
Boulder	CO	Yes	N/A
Breckenridge	CO	N/A	N/A
Denver	CO	Yes	Yes
Edgewater	CO	N/A	N/A
Fort Collins	CO	Yes	N/A
Frisco	CO	N/A	N/A
Golden	CO	In Progress	N/A

Lafayette	CO	In Progress	N/A
Lakewood	CO	Yes	Yes
Longmont	CO	N/A	N/A
Manitou Springs	CO	N/A	N/A
Nederland	CO	N/A	N/A
Telluride	CO	N/A	N/A
Vail	CO	In Progress	N/A
Westminster	CO	N/A	N/A
Wheat Ridge	CO	N/A	N/A
CONNECTICUT			
Bridgeport	CT	N/A	N/A
Hartford	CT	Yes	Yes
Middletown	CT	N/A	N/A
Milford	CT	N/A	N/A
New Haven	CT	Yes	Yes
Stamford	CT	N/A	N/A
West Hartford	CT	N/A	N/A
West Haven	CT	N/A	N/A
DISTRICT OF COLUMBIA			
Washington	D.C.	Yes	Yes
DELAWARE			
Lewes	DE	Yes	Yes
Rehoboth Beach	DE	N/A	N/A
FLORIDA			
Apalachicola	FL	N/A	N/A
Coconut Creek	FL	N/A	N/A
Coral Gables	FL	Yes	Yes
Cutler Bay	FL	Yes	Yes
Delray Beach	FL	N/A	N/A
Fort Lauderdale	FL	N/A	N/A
Gainesville	FL	N/A	N/A
Gulfport	FL	N/A	N/A
Hallandale Beach	FL	N/A	N/A
Hollywood	FL	N/A	N/A
Kissimmee	FL	N/A	N/A
Lauderhill	FL	N/A	N/A
Miami	FL	Yes	Yes

Miami Beach	FL	Yes	Yes
Miramar	FL	N/A	N/A
North Bay Village	FL	N/A	N/A
North Miami	FL	Yes	Yes
Orlando	FL	Yes	N/A
Pembroke Pines	FL	N/A	N/A
Pinecrest	FL	Yes	Yes
Pompano Beach	FL	N/A	N/A
Sarasota	FL	Yes	Yes
Satellite Beach	FL	Yes	N/A
South Miami	FL	Yes	Yes
St Petersburg	FL	N/A	N/A
Sunrise	FL	Yes	Yes
Surfside	FL	N/A	N/A
Tallahassee	FL	N/A	N/A
Tampa	FL	N/A	N/A
Venice	FL	N/A	N/A
West Palm Beach	FL	Yes	N/A
Weston	FL	N/A	N/A
GEORGIA			
Atlanta	GA	Yes	Yes
Clarkston	GA	N/A	N/A
Macon-Bibb County	GA	N/A	N/A
HAWAI'I			
Hawai'i	HI	N/A	N/A
Honolulu	HI	In Progress	N/A
Kauai	HI	N/A	N/A
Maui	HI	N/A	N/A
IOWA			
Des Moines	IA	In Progress	N/A
Dubuque	IA	Yes	N/A
Fairfield	IA	N/A	N/A
Iowa City	IA	Yes	Yes
Windsor Heights	IA	N/A	N/A
IDAHO			
Bellevue	ID	N/A	N/A
Boise	ID	N/A	N/A

Ketchum	ID	N/A	N/A
ILLINOIS			
Bloomington	IL	N/A	N/A
Champaign	IL	N/A	N/A
Chicago	IL	Yes	Yes
DeKalb	IL	N/A	N/A
Elburn	IL	N/A	N/A
Elgin	IL	N/A	N/A
Evanston	IL	Yes	Yes
Highland Park	IL	N/A	N/A
Montgomery	IL	N/A	N/A
Normal	IL	N/A	N/A
Rockford	IL	N/A	N/A
Savanna	IL	N/A	N/A
Skokie	IL	N/A	N/A
Urbana	IL	Yes	Yes
Waukegan	IL	N/A	N/A
Woodstock	IL	N/A	N/A
INDIANA			
Bloomington	IN	Yes	N/A
Carmel	IN	N/A	N/A
Fort Wayne	IN	N/A	N/A
Gary	IN	N/A	N/A
South Bend	IN	N/A	N/A
West Lafayette	IN	In Progress	N/A
KANSAS			
Lawrence	KS	Yes	Yes
Pittsburg	KS	N/A	N/A
KENTUCKY			
Louisville	KY	In Progress	N/A
LOUISIANA			
New Orleans	LA	Yes	Yes
MASSACHUSETTS			
Beverly	MA	N/A	N/A
Boston	MA	Yes	Yes
Cambridge	MA	In Progress	N/A
Gloucester	MA	Yes	Yes

Holyoke	MA	N/A	N/A
Malden	MA	N/A	N/A
Medford	MA	Yes	N/A
Melrose	MA	N/A	N/A
New Bedford	MA	N/A	N/A
Newburyport	MA	N/A	N/A
Newton	MA	Yes	Yes
Northhampton	MA	In Progress	N/A
Salem	MA	Yes	Yes
Somerville	MA	Yes	Yes
Springfield	MA	Yes	Yes
Worcester	MA	N/A	N/A
MARYLAND			
Baltimore	MD	Yes	Yes
Greenbelt	MD	N/A	N/A
Hyattsville	MD	N/A	N/A
Laurel	MD	N/A	N/A
Salisbury	MD	N/A	N/A
Takoma Park	MD	N/A	N/A
MAINE			
Portland	ME	Yes	Yes
MICHIGAN			
Ann Arbor	MI	Yes	Yes
Buchanan	MI	N/A	N/A
Detroit	MI	Yes	Yes
East Lansing	MI	Yes	N/A
Ferndale	MI	N/A	N/A
Flint	MI	In Progress	N/A
Grand Rapids	MI	In Progress	N/A
Hamtramck	MI	N/A	N/A
Kalamazoo	MI	Yes	N/A
Lansing	MI	N/A	N/A
Lapeer	MI	N/A	N/A
Pleasant Ridge	MI	N/A	N/A
Rockwood	MI	N/A	N/A
Royal Oak	MI	N/A	N/A
Traverse City	MI	Yes	N/A

Westland	MI	N/A	N/A
Ypsilanti	MI	Yes	N/A
MINNESOTA			
Bloomington	MN	N/A	N/A
Burnsville	MN	In Progress	N/A
Carver	MN	N/A	N/A
Duluth	MN	N/A	N/A
Eden Prairie	MN	N/A	N/A
Edina	MN	N/A	N/A
Falcon Heights	MN	N/A	N/A
Maplewood	MN	In Progress	N/A
Minneapolis	MN	Yes	N/A
Saint Paul	MN	In Progress	N/A
MISSOURI			
Columbia	MO	In Progress	N/A
Kansas City	MO	Yes	N/A
Maplewood	MO	In Progress	N/A
St Louis	MO	Yes	N/A
St Peters	MO	N/A	N/A
St. Joseph	MO	N/A	N/A
University City	MO	N/A	N/A
MONTANA			
Bozeman	MT	Yes	Yes
Missoula	MT	Yes	Yes
Whitefish	MT	Yes	Yes
NORTH CAROLINA			
Asheville	NC	In Progress	N/A
Carrboro	NC	Yes	N/A
Chapel Hill	NC	In Progress	N/A
Charlotte	NC	N/A	N/A
Durham	NC	N/A	N/A
Franklin	NC	N/A	N/A
Greensboro	NC	N/A	N/A
Highlands	NC	N/A	N/A
Hillsborough	NC	N/A	N/A
Mooresville	NC	N/A	N/A
Pittsboro	NC	N/A	N/A

Raleigh	NC	N/A	N/A
Statesville	NC	N/A	N/A
Winston Salem	NC	N/A	N/A
NEBRASKA			
Crete	NE	N/A	N/A
NEW HAMPSHIRE			
Concord	NH	N/A	N/A
Dover	NH	Yes	Yes
Manchester	NH	N/A	N/A
Nashua	NH	N/A	N/A
Portsmouth	NH	Yes	Yes
Somersworth	NH	N/A	N/A
NEW JERSEY			
Cape May Point	NJ	N/A	N/A
Cherry Hill	NJ	N/A	N/A
East Brunswick	NJ	N/A	N/A
Fanwood	NJ	N/A	N/A
Glen Rock	NJ	N/A	N/A
Highland Park	NJ	N/A	N/A
Hoboken	NJ	Yes	Yes
Jersey City	NJ	N/A	N/A
Long Branch	NJ	N/A	N/A
Marlboro	NJ	N/A	N/A
Morristown	NJ	N/A	N/A
Newark	NJ	N/A	N/A
North Brunswick	NJ	N/A	N/A
Plainsboro	NJ	N/A	N/A
Princeton	NJ	In Progress	N/A
Secaucus	NJ	In Progress	N/A
South Orange Village	NJ	N/A	N/A
Swedesboro	NJ	N/A	N/A
Trenton	NJ	Yes	N/A
Union City	NJ	N/A	N/A
Verona	NJ	N/A	N/A
West New York	NJ	N/A	N/A
NEW MEXICO			
Albuquerque	NM	N/A	N/A

Las Cruces	NM	N/A	N/A
Santa Fe	NM	N/A	N/A
NEVADA			
Reno	NV	Yes	N/A
West Wendover	NV	N/A	N/A
NEW YORK			
Albany	NY	Yes	Yes
Ardsley	NY	N/A	N/A
Binghamton	NY	Yes	Yes
Brighton	NY	N/A	N/A
Buffalo	NY	N/A	N/A
Cooperstown	NY	N/A	N/A
Cortland	NY	N/A	N/A
Hastings-on-Hudson	NY	N/A	N/A
Hudson	NY	N/A	N/A
Irvington	NY	N/A	N/A
Ithaca	NY	N/A	N/A
Kingston	NY	Yes	N/A
Marbletown	NY	N/A	N/A
New Paltz	NY	N/A	N/A
New York City	NY	Yes	Yes
Niagara Falls	NY	N/A	N/A
Nyack	NY	N/A	N/A
Ossining	NY	Yes	N/A
Rochester	NY	Yes	N/A
Saratoga Springs	NY	Yes	N/A
Sleepy Hollow	NY	N/A	N/A
Syracuse	NY	N/A	N/A
Tarrytown	NY	N/A	N/A
Village of Lake George	NY	N/A	N/A
White Plains	NY	N/A	N/A
Whitney Point	NY	N/A	N/A
Yonkers	NY	N/A	N/A
OHIO			
Amesville	OH	N/A	N/A
Athens	OH	N/A	N/A
Bexley	OH	N/A	N/A

Cincinnati	OH	Yes	N/A
Cleveland	OH	Yes	Yes
Columbus	OH	Yes	Yes
Gambier	OH	N/A	N/A
Lakewood	OH	N/A	N/A
Toledo	OH	N/A	N/A
OKLAHOMA			
Norman	OK	N/A	N/A
OREGON			
Albany	OR	N/A	N/A
Beaverton	OR	N/A	N/A
Corvallis	OR	Yes	Yes
Eugene	OR	Yes	N/A
Gladstone	OR	N/A	N/A
Hood River	OR	N/A	N/A
Milwaukie	OR	N/A	N/A
Mosier	OR	N/A	N/A
Portland	OR	Yes	Yes
Rockaway Beach	OR	N/A	N/A
Salem	OR	In Progress	N/A
Tualatin	OR	N/A	N/A
West Linn	OR	N/A	N/A
PENNSYLVANIA			
Allentown	PA	N/A	N/A
Ambler	PA	N/A	N/A
Bethlehem	PA	In Progress	N/A
Downingtown	PA	N/A	N/A
Erie	PA	N/A	N/A
Lancaster	PA	In Progress	N/A
Milford	PA	N/A	N/A
Mount Pocono	PA	N/A	N/A
Philadelphia	PA	In Progress	N/A
Pittsburgh	PA	Yes	Yes
State College	PA	N/A	N/A
Swarthmore	PA	N/A	N/A
PUERTO RICO			
Camuy	PR	N/A	N/A

RHODE ISLAND			
Pawtucket	RI	N/A	N/A
Providence	RI	In Progress	N/A
SOUTH CAROLINA			
Anderson	SC	N/A	N/A
Charleston	SC	Yes	Yes
Columbia	SC	N/A	N/A
Greenville	SC	N/A	N/A
TENNESSEE			
Chattanooga	TN	Yes	Yes
Knoxville	TN	N/A	N/A
Memphis	TN	N/A	N/A
Nashville	TN	Yes	Yes
TEXAS			
Austin	TX	Yes	Yes
Dallas	TX	Yes	Yes
Houston	TX	In Progress	N/A
San Antonio	TX	Yes	Yes
San Marcos	TX	In Progress	N/A
Smithville	TX	N/A	N/A
UTAH			
Millcreek	UT	N/A	N/A
Park City	UT	In Progress	N/A
Salt Lake City	UT	Yes	Yes
VIRGINIA			
Alexandria	VA	Yes	Yes
Blacksburg	VA	Yes	N/A
Charlottesville	VA	N/A	N/A
Fairfax	VA	N/A	N/A
Falls Church	VA	N/A	N/A
Newport News	VA	N/A	N/A
Richmond	VA	N/A	N/A
VERMONT			
Burlington	VT	Yes	Yes
Montpelier	VT	N/A	N/A
WASHINGTON			
Bellingham	WA	Yes	Yes

Edmonds	WA	N/A	N/A
Everett	WA	Yes	Yes
Kirkland	Wa	Yes	N/A
Lynnwood	WA	N/A	N/A
Olympia	WA	Yes	Yes
Port Townsend	WA	Yes	N/A
Redmond	WA	Yes	N/A
Seattle	WA	Yes	Yes
Snoqualmie	WA	N/A	N/A
Tacoma	WA	Yes	N/A
Vancouver	WA	N/A	N/A
WISCONSIN			
Bayfield	WI	N/A	N/A
Dunn	WI	N/A	N/A
Glendale	WI	N/A	N/A
Kenosha	WI	N/A	N/A
La Crosse	WI	N/A	N/A
Madison	WI	Yes	N/A
Middleton	WI	N/A	N/A
Milwaukee	WI	N/A	N/A
Monona	WI	N/A	N/A
WEST VIRGINIA			
Charles Town	WV	N/A	N/A
Morgantown	WV	N/A	N/A
WYOMING			
Jackson	WY	N/A	N/A

CITIES WITH ADAPTATION COMPONENTS IN STATES WITH FINALIZED ACTION PLANS						
CITY	**STATE**	**CITY CLIMATE ACTION PLAN?**	**ADAPTATION COMPONENT?**	**YEAR OF ENACTMENT**	**ADAPTATION MENTION EXTENT**	**INDIVIDUAL STANDING ADAPTATION PLAN?**
CALIFORNIA						
Berkeley	CA	Yes	Yes	2009	Partial	No
Brisbane	CA	Yes	Yes	2015	Partial	No
Burlingame	CA	Yes	Yes	2009	Minimal	No
Chula Vista	**CA**	**Yes**	**Yes**	**2010**	**Thorough**	**Yes**
Corte Madera	CA	Yes	Yes	2016	Minimal	No
Cupertino	CA	Yes	Yes	2015	Partial	No

El Cerrito	CA	Yes	Yes	2013	Minimal	No
Emeryville	CA	Yes	Yes	2016	Partial	No
Encinitas	CA	Yes	Yes	2018	Thorough	No
Fremont	CA	Yes	Yes	2012	Partial	No
Glendale	CA	Yes	Yes	2012	Minimal	No
Hayward	CA	Yes	Yes	2014	Minimal	No
Laguna Woods	**CA**	**Yes**	**Yes**	**2014**	**Thorough**	**Yes**
Los Angeles	**CA**	**Yes**	**Yes**	**2015**	**Thorough**	**Yes**
Martinez	CA	Yes	Yes	2009	Partial	No
Morro Bay	CA	Yes	Yes	2014	Minimal	No
Oakland	CA	Yes	Yes	2012	Partial	No
Palo Alto	CA	Yes	Yes	2016	Partial	No
Richmond	CA	Yes	Yes	2016	Partial	No
San Carlos	CA	Yes	Yes	2006	Minimal	No
San Diego	CA	Yes	Yes	2015	Thorough	No
San Francisco	CA	Yes	Yes	2017	Thorough	No
Santa Cruz	**CA**	**Yes**	**Yes**	**2017**	**Thorough**	**Yes**
Santa Rosa	CA	Yes	Yes	2012	Minimal	No
Watsonville	CA	Yes	Yes	2015	Partial	No
West Hollywood	CA	Yes	Yes	2011	Minimal	No
Windsor	CA	Yes	Yes	2012	Partial	No
COLORADO						
Denver	**CO**	**Yes**	**Yes**	**2014**	**Thorough**	**Yes**
Lakewood	CO	Yes	Yes	2015	Thorough	No
CONNECTICUT						
Hartford	CT	Yes	Yes	2017	Partial	No
New Haven	CT	Yes	Yes	2018	Partial	No
DISTRICT OF COLUMBIA						
Washington	**D.C.**	**Yes**	**Yes**	**2013**	**Thorough**	**Yes**
DELAWARE						
Lewes	**DE**	**Yes**	**Yes**	**2011**	**Thorough**	**Yes**
FLORIDA						
Coral Gables	**FL**	**Yes**	**Yes**	**2016**	**Thorough**	**Yes**
Cutler Bay	**FL**	**Yes**	**Yes**	**2016**	**Thorough**	**Yes**
Miami	FL	Yes	Yes	2008	Partial	No
Miami Beach	FL	Yes	Yes	2008	Partial	No

North Miami	FL	Yes	Yes	2008	Partial	No
Pinecrest	FL	Yes	Yes	2016	Partial	No
Sarasota	**FL**	**Yes**	**Yes**	**2017**	**Thorough**	**Yes**
South Miami	FL	Yes	Yes	2008	Partial	No
Sunrise	FL	Yes	Yes	2018	Minimal	No
MASSACHUSETTS						
Boston	**MA**	**Yes**	**Yes**	**2014**	**Thorough**	**Yes**
Gloucester	**MA**	**Yes**	**Yes**	**2015**	**Thorough**	**Yes**
Newton	MA	Yes	Yes	2018	Partial	No
Salem	**MA**	**Yes**	**Yes**	**2014**	**Thorough**	**Yes**
Somerville	MA	Yes	Yes	2018	Partial	No
Springfield	MA	Yes	Yes	2017	Minimal	No
MARYLAND						
Baltimore	MD	Yes	Yes	2013	Partial	In Progress
MAINE						
Portland	ME	Yes	Yes	2008	Minimal	No
NEW HAMPSHIRE						
Dover	**NH**	**Yes**	**Yes**	**2018**	**Thorough**	**Yes**
Portsmouth	**NH**	**Yes**	**Yes**	**2013**	**Thorough**	**Yes**
NEW YORK						
Albany	**NY**	**Yes**	**Yes**	**2012**	**Thorough**	**Yes**
Binghamton	NY	Yes	Yes	2011	Partial	No
New York City	**NY**	**Yes**	**Yes**	**2013**	**Thorough**	**Yes**
OREGON						
Corvallis	OR	Yes	Yes	2015	Minimal	No
Portland	**OR**	**Yes**	**Yes**	**2015**	**Thorough**	**Yes**
VIRGINIA						
Alexandria	VA	Yes	Yes	2011	Partial	No
WASHINGTON						
Bellingham	WA	Yes	Yes	2009	Minimal	No
Everett	WA	Yes	Yes	2011	Minimal	No
Olympia	WA	Yes	Yes	1991	Partial	No
Seattle	**WA**	**Yes**	**Yes**	**2013**	**Very Thorough**	**Yes**

Appendix II. Adaptation Measures Relevant to the Built Environment by Case City

LOS ANGELES: ADAPTATION MEASURES (Resilient Los Angeles, 2018)			
Sub-Action	**Hazards**	**Partners**	**Timeframe**
SECTOR: CLIMATE ADAPTATION			
STRONGER & CONNECTED NEIGHBORHOODS			
Develop an urban heat vulnerability index and mitigation plan to prepare for higher temperatures and more frequent extreme heat	Extreme Heat	Not identified	Short
Develop and launch a neighborhood retrofit pilot program to test cooling strategies that prepare for higher temperatures	Extreme Heat	Not identified	Short
Plant trees in communities with fewer trees to grow a more equitable tree canopy by 2028	Extreme Heat	Not identified	Medium
PREPARED & RESPONSIVE CITY			
Expand and protect water sources to reduce dependence on imported water and strengthen the city's local water supply	Extreme Weather, Extreme Heat	Not identified	Medium
Prioritize key neighborhoods for storm water capture, urban greening and other community benefits	Extreme Weather, Extreme Heat	Not identified	Short
Proactively address flood risk through policy, communication and infrastructure planning	Landslide, Extreme Weather	Not identified	Medium
PIONEERING AND COLLABORATIVE PARTNERSHIPS			
Incorporate sea level rise modeling into local plans	Extreme Weather, Sea Level Rise	Not identified	Medium
Develop a strategy to sustain the region's biodiversity and tree health to support long-term ecological resilience	Wildfire, Landslide, Extreme Weather, Extreme Heat	Not identified	Short
Identify strategies to reduce pollution in the Los Angeles River system	Extreme Heat, Extreme Weather	Not identified	Long
Integrate new and emerging science into policy through partnerships with academic, local, state and federal scientists	All	Not identified	Short
SECTOR: INFRASTRUCTURE MODERNIZATION			
STRONGER & CONNECTED NEIGHBORHOODS			
Increase stability through investments in affordable housing, jobs, and open space in communities adjacent to the Los Angeles Rise	Extreme Weather, Extreme Heat	Not identified	Medium
PREPARED & RESPONSIVE CITY			
Integrate resilience and sustainability principles into city capital planning	All	Not identified	Short
Innovate more resilient and sustainable buildings by advancing building forward LA	All	Not identified	Short
Leverage flood mitigation infrastructure to enhance local water availability	Flood, Landslide, Extreme Weather	Not identified	Long
PIONEERING AND COLLABORATIVE PARTNERSHIPS			
Implement storm water projects that reduce pollution and capture local water supply	Flood, Extreme Heat, Landslides	Not identified	Medium
SECTOR: LEADERSHIP AND ENGAGEMENT			
STRONGER & CONNECTED NEIGHBORHOODS			
Integrate resilience into community plan updates including risk and vulnerability analysis and policies and implementation measures that address them	All	Not identified	Medium
PREPARED & RESPONSIVE CITY			
Make resilience-building a permanent part of the city of L.A.'s systems and services	All	Not identified	Short
Require resilience as a guiding principle for land use decisions in the	All	Not identified	Short

L.A. general plan and zoning code update			
PIONEERING AND COLLABORATIVE PARTNERSHIPS			
Ensure climate resilience and adaptation planning is robust and consistent with the Paris Climate Agreement	All	Not identified	Short

SEATTLE: ADAPTATION MEASURES (Preparing for Climate Change, 2017)			
Sub-Action	**Hazards**	**Partners**	**Timeframe**
SECTOR: LAND USE & THE BUILT ENVIRONMENT: Buildings and neighborhoods are planned, designed, and constructed to be resilient to the impacts of climate change while moving toward the City's goal of achieving carbon neutrality by 2050. Policies and programs should ensure an equitable distribution of benefits and burdens.			
PLANNING & PROGRAMMATIC ACTIONS			
Mitigate the urban heat island effect through programs that cool the urban environment, including planting and maintaining trees, increasing green space, and employing green infrastructure, particularly in EEI focus areas.	Extreme Heat	Not identified	N/A
Explore further opportunities to incentivize or require existing building upgrades to improve preparedness for future climate conditions. This may include improvements to passive or active building cooling,energy storage, daylighting, flood protection, storm water management, and passive survivability.	All	Not identified	N/A
Develop mechanisms to incorporate climate preparedness and passive survivability into the planning and development processes for new development, including zoning, building codes, design review and permitting.	All	Not identified	N/A
Consider the disproportionate impacts of climate change on communities of color and lower income communities in planning, policies, and programs, and prioritize programmes and incentives to mitigate those impacts.	All	Not identified	N/A
FLOOD-RELATED REGULATIONS & PROGRAMMES			
To reduce flood risk and reduce flood insurance rates, evaluate the benefits and costs of participating in the National Flood Insurance Community Rating System program.	Flood, Sea Level Rise	Not identified	N/A
Evaluate the requirements of the Floodplain Development Ordinance to identify additional opportunities to reduce flood hazards, including the base flood elevation threshold, the definition of a substantial improvement, and the regulation of footbridges and other potential obstructions to stream flow.	Flood, Sea Level Rise	Not identified	N/A
Regularly update flood prone area maps to incorporate the latest data near creeks, shorelines, and other emerging urban flooding areas.	Flood, Sea Level Rise	Not identified	N/A
Conduct a detailed coastal study of the Duwamish River to better delineate the current and increasing risk of flooding and identify a range of strategies (e.g. hard infrastructure, natural system solutions, etc.) to mitigate the risk. Engage community as partners in determining which strategies to pursue.	Flood, Sea Level Rise	Not identified	N/A
Assess the benefits of incorporating rolling easements into the next update of the Shoreline Master Plan.	Flood, Sea Level Rise	Not identified	N/A
Continue to incorporate Green Stormwater Infrastructure (GSI) into development regulations through mechanisms such as The Green Factor program.	Flood, Sea Level Rise	Not identified	N/A
Evaluate options to encourage or require significant on-site rainwater storage vaults, both to mitigate the impact of heavy winter rainstorms on the City storm water system and to provide non-potable water for summer irrigation and toilet flushing.	Flood, Sea Level Rise	Not identified	N/A
LANDSLIDE HAZARD AREAS			
Maintain a citywide repository for landslide data, including the locations and dates of slides, and observations about factors that may have contributed to their occurrence.	Landslide	Not identified	N/A
Update the Seattle Public Utilities Landslide Study to reflect current and projected climate conditions.	Landslide	Not identified	N/A
Evaluate mechanisms to support private property owners in making drainage improvements on their property in landslide prone areas, prioritize the needs of communities of color and lower income residents in the analysis.	Landslide	Not identified	N/A

ENERGY MANAGEMENT & COOLING			
Evaluate code mechanisms to encourage or require new and renovated buildings to minimize the energy required to operate the building under extreme weather conditions or power loss, particularly using passive building envelope strategies such as high performance fenestration, insulation, daylighting, natural ventilation and exterior shading.	Extreme Weather, Extreme Heat	Not identified	N/A
Evaluate current ASHRAE cooling temperature design standards to ensure they are sufficient to meet projected temperatures which impact cooling peaks and durations.	Extreme Weather, Extreme Heat	Not identified	N/A
Encourage the use of shade trees to provide additional summer protection for lower floors of building facades and green roofs to reduce heat island effect while providing comfortable exterior environments, and prioritize EEI focus areas.	Extreme Weather, Extreme Heat	Not identified	N/A
Support the adoption of energy efficiency, insulation, and good windows which reduce energy needs in both winter and summer, and heat pumps to improve energy efficiency and provide cooling capacity during extreme heat events. Prioritize upgrades for EEI populations.	Extreme Weather, Extreme Heat	Not identified	N/A
Identify opportunities to support the adoption of electric heat pumps in buildings used as community gathering spaces, particularly in EEI focus areas to improve energy efficiency and provide cooling capacity during extreme heat events.	Extreme Weather, Extreme Heat	Not identified	N/A
SECTOR: CITY BUILDINGS: City-owned buildings are designed, operated, and maintained in ways that reduce the impacts of climate change on City services and residents and ensure that the benefits of adaptation measures and burdens of climate change are equitably shared.			
Evaluate facility design standards against projected future climate conditions including changes to summer temperature, increased precipitation, and sea level rise and identify changes needed to address these changing conditions, including, evaluating how design standards could be modified to allow for a larger heat load transfer out of buildings through passive cooling approaches, and when those standards should be applied, evaluating design standards for the sizing and slope of lateral drainage systems, onsite detention, and other drainage infrastructure, and evaluating if and how design standards for overhangs, which prevent water damage by reducing the amount of water coming down the face of buildings, should be modified.	All	Not identified	N/A
Include more shade trees and appropriate soil volumes in facility design, where possible, to help reduce building temperatures and to provide shade for the public while using facilities and public spaces.	Extreme Heat	Not identified	N/A
Assess the need for passive and active cooling and resilience retrofits by considering the impacts of increasing heat events and higher nighttime temperatures on operations and maintenance budgets, as these circumstances can require HVAC equipment to run 24 hours per day.	Extreme Heat	Not identified	N/A
Evaluate City facilities in areas at risk of landslides and flood including the likelihood and consequences of additional climate- related impacts to these properties and identify additional actions to enhance resilience.	Landslide, Flood	Not identified	N/A

WASHINGTON, D.C: ADAPTATION MEASURES (Climate Ready DC, 2016)			
Sub-Action	**Hazards**	**Partners**	**Timeframe**
SECTOR: BUILDINGS & DEVELOPMENT: Upgrade existing buildings and design new buildings and development projects to withstand climate change impacts.			
Action: Provide back up power for emergencies at all identified critical facilities. Ensure that existing backup power systems are located above projected flood elevations.			
Evaluate the most critical facilities to identify those with or without existing back up power systems; determine if they are above flood elevations, in good working order, and provide the appropriate capacity for that facility type.	All	Emergency Management, General Services, Energy & Environment	Medium
Flood proof the most critical facilities to protect against future events accounting for sea level rise and increasingly severe precipitation events.	Sea level rise, Flood	Emergency Management, General Services, Energy & Environment	Long

Action: Improve thermal safety + indoor building temperatures to increase resilience to extreme heat, especially in the event of a power outage.			
Incorporate recommendations/requirements for improving thermal safety in residential and building codes through the use of passive cooling strategies.	Extreme Heat	Health Energy & Environment, Consumer & Regulatory Services	Short
Identify existing residential building typologies (e.g. high rises, garden style) where residents are at highest- risk during extreme heat events and develop policies to support and encourage retrofits and upgrades.	Extreme Heat	Housing, Energy & Environment, Consumer & Regulatory Services, Housing & Community Development	Medium
Expand existing incentive programs to include thermal safety and urban heat island mitigation measures such as cool roofs, solar shading, and shade trees.	Extreme Heat	Sustainable Energy Utility, Energy & Environment	Short
Evaluate the public housing portfolio for vulnerability to extreme heat and flooding and incorporate resilience in future capital improvement plans.	Extreme Heat, Flood, Extreme Weather	Housing, Energy & Environment	Short
Action: Pursue deep energy and water efficiency for all buildings.			
Continue to pursue energy efficiency for all commercial and residential buildings through incentive programs, building codes, and financing to increase grid stability by reducing energy demand at peak periods and during extreme events.	Extreme Heat	Consumer & Regulatory Services, Sustainable Energy Utility, Energy & Environment	Short
Consider developing a post occupancy energy optimization and retro-commissioning program for new and existing buildings to provide training and incentives to ensure the actual efficiency potential constructed into buildings is realized.	Extreme Heat	Consumer & Regulatory Services, Sustainable Energy Utility, Energy & Environment	Medium
Develop incentives, training and technical assistance programs for significant water use reductions including rainwater and greywater harvesting and onsite blackwater treatment.	Extreme Weather	Energy & Environment, Water, Transportation, Consumer & Regulatory Services	Medium
Action: Incorporate climate resilience into development planning and review processes.			
Develop climate resilience guidelines for new development projects.	All	Economic Development, Planning, Consumer & Regulatory Services, Energy & Environment	Short
Evaluate sequencing of agency approvals for new building development projects to determine the best point at which to incorporate flood review.	All	Energy & Environment, Planning, Consumer & Regulatory Services	Short
Assess feasibility of district energy and/or micro grids and district storm water management for all large development projects.	All	Planning, Energy & Environment, Economic Development	Medium
Require all planned unit developments, large tract review, and publicly financed projects to complete an adaptation checklist based on climate resilience guidelines.	All	Planning, Energy & Environment, Economic Development, Transportation, Zoning	Medium
Action: Leverage land-use planning to promote resilience.			
Conduct a citywide analysis of flood zones to understand the impact of setbacks, buffers, and zoning and land use policies on existing and future developments.	Sea level rise, Flood	Planning, Energy & Environment	Short
Incorporate climate resilience into the District's Comprehensive Plan.	All	Planning, Energy & Environment, Emergency Management	Short
Propose amendments to floodplain regulations and zoning and land use policies to ensure that waterfront setbacks and buffers allow for future sea-level rise, changes in precipitation patterns, sustainable landscaping practices, erosion, and reduce flood risks.	Sea level rise, Flood	Planning, Energy & Environment, Consumer & Regulatory Services	Medium
Develop a set of flood resilience guidelines for the 500-year floodplain in addition to those existing for the 100-year floodplain for new development and substantial improvements.	Sea level rise, Flood	Planning, Energy & Environment, Consumer & Regulatory Services	Medium
Propose regulations that limit the development of new critical facilities including hospitals, emergency services, shelter facilities and critical infrastructure systems within the 500-year floodplain.	Sea level rise, Flood	Planning, Energy & Environment, Consumer & Regulatory Services	Medium
Identify buildings in the current 500-year floodplain and	Sea level rise,	Energy & Environment,	Medium

create design guidelines for retrofitting the various typologies of buildings.	Flood	Consumer & Regulatory Services	
Action: Provide incentives to encourage private property owners and developers to implement flood resilience measures.			
Increase public awareness of flood risks and flood insurance. Offer rebates or grants for flood- resilience measures such as removable flood barriers, dry and wet flood proofing (for nonresidential buildings), elevation (for residential buildings) in vulnerable areas, and wastewater backup valves.	Flood	Energy & Environment, Emergency Management	Medium
Explore the use of buyouts and relocation for flood-prone properties in order to minimize flooding threats to residents and to facilitate the restoration of natural floodplains, as well as to account for future sea level rise. As a first step, assess potential areas through the update of the District's All Hazard Mitigation Plan.	Flood	Energy & Environment, Emergency Management, Federal Emergency Management	Medium
Explore the use of tax credits for conservation of floodplains and natural buffers, such as wetlands and riverbank tree planting, in vulnerable areas.	Flood	Energy & Environment, Insurance	Medium
Provide guidelines and encourage developers to consider resilience measures as community benefits for planned unit developments, large tract developments, and projects.	All	Planning, Energy & Environment	Short
SECTOR: NEIGHBORHOOD & COMMUNITIES: Make neighborhoods and communities safer and more prepared by strengthening community, social, and economic resilience.			
Action: Reduce risks of extreme heat and the urban heat island.			
Develop thermal mapping of the District to identify urban heat-island hot-spots, vulnerable residents, and areas with the greatest potential for cooling.	Extreme Heat	Energy & Environment, Technology	Short
Reduce the heat-island effect and related increase in outside air temperatures with cool and living roofs, expanded green space, tree planting, and tree protection efforts, prioritizing hotspots and those areas with the greatest number of heat vulnerable residents. Incorporate heat-island mitigation into planning for green infrastructure, tree canopy, and public space initiatives.	Extreme Heat	Planning, Transportation, Energy & Environment, Parks & Recreation	Medium
Evaluate existing cooling centres based on location, accessibility and needs of vulnerable residents. Consider areas for pets, security, sign-language interpreters, child friendly amenities, accessible restrooms, medical assistance, back-up power, sleeping areas, drinking water, and proximity to transit.	Extreme Heat	Health, Energy & Environment, Emergency Management	Short
Evaluate and revise existing heat-emergency plan and warning system with community input. Leverage health and temperature data from past events to determine the best activation and warning thresholds. Consider implementing a tiered warning system to account for the increasing severity and duration of heat events.	Extreme Heat	Health, Energy & Environment, Emergency Management	Medium
Action: Develop eco-resilience districts and community resilience hubs.			
Leverage ongoing work with neighborhood planning to begin to implement neighborhood-scale resilience solutions including district energy and micro grids, and district storm water and water reuse systems.	All	Planning, Energy & Environment	Medium
Explore the creation of Community Resilience Hubs which would locate emergency preparedness and response supplies and training in resilient community facilities, be they privately or publicly owned (e.g., churches, community centres, etc.).	All	Health, Economic Development, Emergency Management	Medium
Provide technical and financial assistance to private entities that provide essential services, including universities, hospitals and affordable housing so that these entities may conduct their own risk assessments. Work with these entities to integrate their risk assessments into the larger plan for the District.	All	Emergency Management	Medium
SECTOR: GOVERNANCE & IMPLEMENTATION: Establish the policies, structures, and monitoring and evaluation procedures to ensure successful implementation of the adaptation plan.			
Action: Align Climate Ready D.C. with related planning efforts including hazard mitigation, comprehensive land-use, comprehensive energy, and capital budget planning.			
Integrate climate change adaptation into the District’s Hazard Mitigation Plan and related emergency planning efforts.	All	Energy & Environment, Emergency Management	Short

Develop climate change resilience guidelines for all capital projects to ensure that public facilities are resilient to extreme heat, floods, and severe weather. Incorporate climate impact assessments into the planning, design, and engineering of capital projects.	All	General Services, Energy & Environment	Short
Add resilience as an element to the Comprehensive Plan for the National Capital: District Elements.	All	Planning, Energy & Environment	Short
Revise engineering and building standards and codes to address climate change.	All	Energy & Environment, Consumer & Regulatory Services	Short
Engage with the Historic Preservation Review Board, Zoning Commissioning, and Public Service Commission, etc. to ensure that projects are allowed/encouraged to incorporate greater resilience during design and permitting.	All	Energy & Environment, Planning, National Capital Planning Commission, Public Service, Historic Preservation	Short

Appendix III. Urban Developments Studied by Case City

LOS ANGELES: URBAN DEVELOPMENTS BY HAZARD

HAZARD: EXTREME HEAT

Neighborhood	Name	Year	Address	Case Number	Development Type	Implicit Mitigation Measures	Explicit Mitigation Intention
Boyle Heights	Sears Complex	2015	2650 E. Olympic Blvd.	la.curbed	Mixed-use	Appearance of vegetation in place	N/A
Boyle Heights	Lorena Plaza	2015	3401 E 1ST ST	ENV-2014-2392-MND	Mixed-use	Appearance of vegetation and reflective surface	N/A
Boyle Heights	La Veranda	2017	2420 Cesar E. Chavez Avenue	ENV-2016-4670-CE	Mixed-use	Mitigating glare, green space, reflective material	Yes
Boyle Heights	Adelante Eastside Redevelopment Project	2018	100 S Boyle Ave	CPC-2018-998-DB-CU	Mixed-use	N/A	N/A
Boyle Heights	Sixth St. Bridge Park	2017	Whittier Blvd. & E. Sixth St	la.curbed	Open space	Open space, lots of greenery	N/A
Boyle Heights	Ramona Gardens	2018		la.curbed	Open space	Green space, shade trees, explicitly understanding the community is one of the worst impacted by environmental stressors	Yes
Central-Alameda	Artist Lofts	2019	4851 S Alameda St.	ENV-2018-7558-EAF	Residential	N/A	N/A
Historic South-Central	Adams & Grand	2017	2528 S Grand Ave.	ENV-2016-3313-MND	Mixed-use	Yes, mitigating glare through building materials	Yes
Historic South-Central	The Reef (Broadway Square Development)	2016	1900 S Broadway	ENV-2008-1773-EIR	Mixed-use	Mention of some vegetation in place, but not specific to mitigating heat	N/A

HAZARD: LANDSLIDE

Neighborhood	Name	Year	Address	Case Number	Development Type	Implicit Mitigation Measures	Explicit Mitigation Intention
Pacific Palisades	Palisades Villages	2018	15247 West Sunset Boulevard	ENV-2015-2715-MND	Commercial	Addressing loss of trees on site by replacing them at a 2:1 ratio	N/A
Pacific Palisades	Sea View Villas	2018	17325 Castellammare Drive	ENV-1997-0248-CDP	Residential	Project site has a history of landslide occurrences. Prior to construction, landowner sent a geologic and soils engineering report to the city, and it was approved, under conditions that include sequence of construction and site preparation, including excavation, fill and compaction, foundation design, drainage and waterproofing.	Yes
Brentwood	Veterans Affairs West L.A. Campus	2018	11301 Wilshire Blvd	Los Angeles VA Campus	Government Housing Facility	N/A	N/A
Brentwood	Berggruen Institute	2018	1901 N Sepulveda Blvd 90049	la.curbed	Educational Facility	Described as an open-air campus with minimal development, only 10% of space dedicated to	N/A

						built structures. Water management system for soil and planting & maintaining trees mentioned.	
Brentwood	Landmark Apartments	2017	11770 Wilshire Boulevard	ENV-2013-3747-EIR	Residential	Placement of the project is in any area where there is little risk of causing or accelerating geologic hazards, such as landslide	Yes
Hollywood Hills	3077 Cahuenga Blvd	2018	3077 Cahuenga Blvd	ENV-2014-4280-EIR	Residential	N/A	N/A
HAZARD: WILDFIRE							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
Pacific Palisades	Palisades Villages	2018	15247 West Sunset Boulevard	ENV-2015-2715-MND	Residential	Incorporate fire safety recommendations from Fire Department to approve the building permit	Yes
Pacific Palisades	Sea View Villas	2018	17325 Castellammare Drive	ENV-1997-0248-CDP	Commercial	Incorporate fire safety recommendations from Fire Department to approve the building permit	Yes
Elysian Park	LA River Revitalization (Bending the River Back into the City)	2005-onward	Throughout the city, specific to Elysian Park is in parentheses	Master Plan	Open Space	Master Revitalization Plan notes fire hazard areas and risk in the Environmental Assessment Report and use of non-motorized passage ways as firelanes	Yes
Montecito Heights	Rose Hill Courts	2018	4446 Florizel Street	CEQA Assessment	Residential	Integrating "fire-wise" landscaping, including planting fire-retardant plants, continually removing dead plants/debris, and placing buildings further apart.	Yes
HAZARD: FLOOD							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
Elysian Valley	Maker Place	2019	3022 N. Coolidge Street	ENV-2016-0586-MND	Residential	Not located in a flood plain	Yes
Elysian Valley	Blake Avenue Riverfront Project	2018	1771 W. Blake Avenue	DIR-2014-953-SPR	Mixed-use	Not located in 100-year flood plain, but plain with a .2% chance of flooding	Yes
Atwater Village	2800 Casitas	2017	2750 W Casitas Ave	ENV-2016-2862-EIR	Residential	Not located in a 100 year or 500 year flood plain, and next to flood control channel	Yes
Atwater Village	3409 N Fletcher Dr	2019	3409 N Fletcher Dr	ENV-2018-1631-CE	Residential	N/A	N/A
Atwater Village	Central Service Yard	2018	3900 Chevy Chase Drive	Council File No. 14-0528	Open space	Notice location on a 100-year flood plain and promises to be in compliance with local, state and federal requirements	Yes
Silver Lake	Vica	2018	3400 Sunset Blvd	ENV-2008-2432-MND	Mixed-use	Project to comply with Flood Hazard Management Specific	Yes

						Plan	
Silver Lake	4141 Santa Monica Blvd Hotel	2018	4141 Santa Monica Blvd	ENV-2018-1572-CE	Hotel	Project located in an area of minimal flooding, with a .2% chance of annual flooding	Yes
Silver Lake	Sunset-Silver Lake Project	2018	4000 Santa Monica Blvd	ENV-2011-3299-EIR	Mixed-use	Project located outside of a 100-year flood plain, with a .2% chance of annual flood and downstream from a dam	Yes
Silver Lake	The Griffith	2016	1933 Griffith Park Blvd	ENV-2013-3374-MND	Residential	N/A	N/A
Silver Lake	3160 Riverside Drive	2016	3160 Riverside Drive	ENV-2016-1600-MND	Residential	N/A	N/A
Silver Lake	1201 N Myra Ave	2018	1201 N Myra Ave	ENV-2018-3472-CE	Residential	N/A	N/A
Silver Lake	738 N Parkman Ave Homes	2018	738 N Parkman Ave	ENV-2016-1672-CE	Residential	Project located outside of a 100 year and 500 year flood zone	Yes
Silver Lake	Silver Lake Reservoir Master Plan	2019		Master Plan	Public	N/A	N/A
HAZARD: SEA LEVEL RISE							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
Marina del Rey, Venice	Ballona Wetlands	2017	N/A	California State Clearinghouse No. 2012071090	Open space	Restoration of wetlands to create new habitats for local wildlife and improve tidal circulation and water quality in the wetlands area, including absorption of rising seas	Yes
Marina del Rey	G8 Apartments	2017	4040 Del Rey Avenue	ENV-2015-3277-MND	Mixed-use	Yes, location of project site- out of flood plain zone	N/A
San Pedro	550 South Palos Verdes Street	2016	550 South Palos Verdes Street	ENV-2016-625-MND	Mixed-use	Yes, location of project site- out of flood plain zone	N/A
San Pedro	San Pedro Public Market	2018	Berth 75 - 79, San Pedro	la.curbed	Commercial	Not identifiable	N/A
Venice	Venice Place Project	2016	1051 Abbot Kinney Blvd	ENV-2016-4321-EIR	Commercial	Not identifiable	N/A

SEATTLE: URBAN DEVELOPMENTS BY HAZARD							
HAZARD: WINTER STORMS							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
South Park	Cloverdale Village	2016	817 Cloverdale St	3017859 and 3017856	Residential	Recommendation of "climate appropriateness"by city	N/A
Westwood-Highland	Vesseliye Apartments	2017	9051 20th Ave SW	3012787	Mixed-use	N/A	N/A
Othello	Mercy Othello Plaza	2017	6940 MLK Jr. Way S	3018112	Mixed-use	N/A	N/A
Othello	Low Income Housing Institute Property	2017	12705 30th Ave NE	3024131	Residential	N/A	N/A

Othello	PATH Othello	2014	7343 Martin Luther King Jr. Way S.	3027345	Mixed-use	Variety of heating obtained from electricity grid, and a heat-recovery ventilation system as well as solar powered energy. Mention of weather protection, but not explicit	N/A
Othello	Othello Station North	2014	4200 S Othello St	3016131	Mixed-use	Mention of incorporating weather protection, but not explicit	N/A
HAZARD: FLOOD							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
South Park	Cloverdale Village	2016	817 Cloverdale St	3017859 and 3017856	Residential	N/A	N/A
Alki	Harbor Avenue Campus	2017	1307 Harbor Ave SW	3015628	Mixed-use	Not located in a floodplain	Yes
Alki	Alki Ave Southwest Condos	2017	1118 Alki Ave SW	3023625	Mixed-use	Not located in a floodplain	Yes
Sunset Hill	Sunset Hill Live/Work	2016	6312 32nd Ave NW	3018777	Mixed-use	N/A	N/A
HAZARD: EXTREME HEAT							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
South Park	Cloverdale Village	2016	817 Cloverdale St	3017859 and 3017856	Residential	Only recommendation of "climate appropriateness" by city	N/A
Othello	Mercy Othello Plaza	2017	6940 MLK Jr. Way S	3018112	Mixed-use	Increase tree canopy to reduce heat	Yes
Othello	Low Income Housing Institute Property	2017	12705 30th Ave NE	3024131	Residential	Increase of vegetation	N/A
Othello	PATH Othello	2014	7343 Martin Luther King Jr. Way S.	3027345	Mixed-use	Sun studies though that promote use of larger tree canopy and reflective surfaces	N/A
Othello	Othello Station North	2014	4200 S Othello St	3016131	Mixed-use	Yes, use of greening outside spaces and courtyards to explicitly mitigate urban heat island effect	Yes
Columbia City	4801 Rainier Ave S	2013	4801 Rainier Ave S	3013008	Mixed-use	Mention of vegetation planting	N/A
Columbia City	Columbia City Apartments	2014	4730 32nd Avenue South	3015157	Mixed-use	Lot of mention of increasing tree canopy on site and using drought-resistant plants	N/A
Columbia City	3525 S Oregon Street	2015	3525 S Oregon Street	3015884	Mixed-use	Lot of mention of increasing tree canopy on site and using drought-resistant plants	N/A
Columbia City	Cascade Built Hudson	2017	3700 S Hudson St	3020443	Mixed-use	Yes, discussion of innovative passive heating system, allows for insulation as well as shading to provide consistency of temperature all year	Yes
Columbia City	4525 Rainier Ave S	2016	4525 Rainier Ave S	3020050	Mixed-use	Some mention of planting on site and using drought-resistant plants	Yes

Columbia City	BDR Sonata East	2017	3000 S Alaska St	3017382	Mixed-use	Mention of maximizing sunlight and placing low canopy trees and street trees on site	N/A
Columbia City	3902 Ferdinand St	2016	3902 Ferdinand St	3011960	Mixed-use	N/A	N/A
Columbia City	4716 38Th Ave S	2018	4716 38th Ave S	3022891	Mixed-use	N/A	N/A
Columbia City	Kin On Assisted Living Facility	2017	214 42nd Ave S	3019337	Mixed-use	N/A	N/A
HAZARD: LANDSLIDE							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
Alki	Harbor Avenue Campus	2017	1307 Harbor Ave SW	3015628	Mixed-use	Study showed landslide impact SW and NW of the property, not on the property itself. However, there is mention of intention to leave trees as is on the western portion of the site	Yes
Alki	Alki Ave Southwest Condos	2017	1118 Alki Ave SW	3023625	Mixed-use	Project located on landslide prone area. Mitigation tactics include, using silt fences to capture disturbed soil on downslopes as well as grading/excavation requirements.	Yes
Leschi	Coleman Mixed-use	2013	1366 31st Ave S	3013904	Mixed-use	Project located outside of landslide risk area	Yes
Madrona	1141 MLK JR Way	2016	1141 MLK JR Way	3015747	Mixed-use	Project located outside of landslide risk area	Yes
Madrona	1435 34th Ave	2013	1435 34th Ave	3007213	Mixed-use	N/A	N/A
HAZARD: SEA LEVEL RISE							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
South Park	Cloverdale Village	2016	817 Cloverdale St	3017859 and 3017856	Residential	N/A	N/A
Westwood-Highland	Vesseliye Apartments	2017	9051 20th Ave SW	3012787	Mixed-use	Not located near a body of water	N/A
Pioneer Square	Colman Tower	2013	888 Western Ave	3011428	Mixed-use	N/A	N/A
Pioneer Square	80 S Main Street	2016	80 South Main Street	6378214	Mixed-use	N/A	N/A
Pioneer Square	201 South King Street	2014	201 South King Street	3009251	Mixed-use	N/A	N/A
Pioneer Square	Hirabayashi Place	2016	424 South Main Street	3011764	Mixed-use	Not located near a body of water	N/A
Pioneer Square	Gridiron	2018	589 Occidental Avenue	3014360	Mixed-use	Not located in a Seattle environmental critical areas map	N/A
Pioneer Square	Canton Lofts	2018	222 Washington South Street	3020830	Mixed-use	Not located near a body of water	N/A
Pioneer Square	304 4th Ave South	2017	304 4th Ave South	3016463	Mixed-use	N/A	N/A
Pioneer Square	Hana	2017	101 6th Ave South	3020974	Mixed-use	Not located near a body of water	N/A

WASHINGTON, D.C: URBAN DEVELOPMENTS BY HAZARD

HAZARD: EXTREME HEAT

Neighborhood	Name	Year	Address	Case Number	Development Type	Implicit Mitigation Measures	Explicit Mitigation Intention
Ivy City	Crummell School	2016	1900 Gallaudet St NE	dmped.gov	Mixed-use	Mention of placing garden and open, green space on site.	N/A
Ivy City	1515 New York Ave	2018	1515 New York Ave NE	19752	Commercial	N/A	N/A
Ivy City	Hecht's Warehouse Development	2014	1401 New York Avenue NE	18821	Commercial	N/A	N/A
Ivy City	New City D.C.	2018	1923 New York Avenue NE	06-15	Mixed-use	N/A	N/A
Ivy City	Pappas Tomato Factory	2018	1401 Okie Street NE	19200B	Commercial	Mention of green space embedded in plans as well as covered awnings	N/A
Trinidad	1723 Montello Avenue NE	2019	1723 Montello Avenue NE	19982	Residential	N/A	N/A
Trinidad	1126 Florida Avenue NE	2015	1126 Florida Avenue NE	18987	Residential	N/A	N/A
LeDroit Park	2021 4th Street NW	2019	2021 4th Street NW	19958	Mixed-use	N/A	N/A
LeDroit Park	LeDroit Park Green Infrastructure Project	2017	LeDroit Park Neighborhoods	ddot.D.C..gov	Open space	Increasing green space	N/A
LeDroit Park	Howard University Dorm at Barry Place	2015	907 Barry Place NW	14-21	Residential	Yes, efforts to reduce heat island effect by greening rooftops	Yes
LeDroit Park	LeDroit Park Renovation	2019	LeDroit Park	ddot.D.C..gov	Open space	Yes, discussion of combatting lack of shade	Yes

HAZARD: EXTREME WEATHER

Neighborhood	Name	Year	Address	Case Number	Development Type	Implicit Mitigation Measures	Explicit Mitigation Intention
Ivy City	Crummell School	2016	1900 Gallaudet St NE	dmped.gov	Mixed-use	N/A	N/A
Ivy City	1515 New York Ave	2018	1515 New York Ave NE	19752	Commercial	N/A	N/A
Ivy City	Hecht's Warehouse Development	2014	1401 New York Avenue NE	18821	Commercial	N/A	N/A
Ivy City	New City D.C.	2018	1923 New York Avenue NE	06-15	Mixed-use	N/A	N/A
Ivy City	Pappas Tomato Factory	2018	1401 Okie Street NE	19200B	Commercial	N/A	N/A
Trinidad	1723 Montello Avenue NE	2019	1723 Montello Avenue NE	19982	Residential	N/A	N/A
Trinidad	1126 Florida Avenue NE	2015	1126 Florida Avenue NE	18987	Residential	N/A	N/A
LeDroit Park	2021 4th Street NW	2019	2021 4th Street NW	19958	Mixed-use	N/A	N/A
LeDroit Park	LeDroit Park Green Infrastructure Project	2017	LeDroit Park Neighborhoods	ddot.D.C..gov	Open space	N/A	N/A
LeDroit Park	Howard University Dorm at Barry Place	2015	907 Barry Place NW	14-21	Residential	N/A	N/A

LeDroit Park	LeDroit Park Renovation	2019	LeDroit Park	ddot.D.C..gov	Open space	N/A	N/A
HAZARD: FLOOD							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
Southwest Waterfront	The Bard	2019	501 Eye Street SW	16-04	Residential	Located outside 100-year floodplain	Yes
Southwest Waterfront	The View at Waterfront	2014	1100 6th St SW	05-38C	Mixed-use	Appears to be located outside of 100-year floodplain, but outside push from District departments to increase storm water capture mechanisms into plan	Yes
Southwest Waterfront	Riverside Baptist Church Redevelopment	2015	680 Eye Street Sw	15-05	Mixed-use	LEED Gold building explicitly uses cisterns, other on-site storm water management systems to hold up to a half meter of rainfall onside	Yes
Southwest Waterfront	Randall School Redevelopment	2017	65 I Street SW	07-13F	Mixed-use	LEED checklist indicates intention of storm water management and water control design	Yes
Southwest Waterfront	1000 4th Street	2019	1000 4th Street SW	02-38H	Mixed-use	Located outside of floodplain, and introduce green roofs and paving areas to mitigate and capture storm water	Yes
Southwest Waterfront	375 and 425 M	2018	425 M St SW, 374 M St SW	02-38E, 02-38C	Mixed-use	Use of landscaping techniques and green roofs to reduce storm water runoff	Yes
Southwest Waterfront	St Matthews Redevelopment	2016	222 M St SW	11-13A	Mixed-use	FEMA imposed mitigation revisions to the development based on flood insurance maps, ordering flood gates to parking and raising the western portion of the building by 60 cm	Yes
Southwest Waterfront	Southwest Public Library	2018	900 Wesley Pl SW	19707	Public facility	Including elevation of floor to prevent harm from flooding	Yes
Southwest Waterfront	Canopy by Hilton (The Wharf)	2015	975 7th St SW	11-03	Hotel	N/A	N/A
Southwest Waterfront	Intercontinental Hotel (The Wharf)	2015	801 Wharf St SW	11-03	Hotel	LEED plans indicate storm water control and quality control	Yes
Southwest Waterfront	Vio (The Wharf)	2015	45 Sutton Square SW	11-03	Residential	LEED plans indicate storm water control and quality control	Yes
Southwest Waterfront	Incanto (The Wharf)	2015	770 Maine Ave SW	11-03	Residential	LEED plans indicate storm water control and quality control	Yes
Southwest Waterfront	The Channel (The Wharf)	2013	950 Maine Ave SW	11-03	Residential	LEED plans indicate storm water control and quality control	Yes
Southwest Waterfront	The Anthem (The Wharf)	2013	901 Wharf St SW	11-03	Public	LEED plans indicate storm water control and quality control	Yes
Southwest Waterfront	Wharf Marina (The Wharf)	2017	600 Water Street SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace	Yes

						and underground collection	
Southwest Waterfront	Pier 4 (The Wharf)	2015	101 District Square SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace and underground collection	Yes
Southwest Waterfront	Parcel 8 (The Wharf)	2017	Water St SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace and underground collection	Yes
Southwest Waterfront	Parcel 9 (The Wharf)	2017	Water St SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace and underground collection	Yes
Navy Yard	100 K	2017	100 K Street SE	19586	Mixed-use	N/A	N/A
Navy Yard	Squares 759 - 882 (D.C. Housing Authority)	2015	125 I St SE	03-12	Mixed-use	LEED scorecard mention of storm water drainage to be embedded in the sites	Yes
Navy Yard	816 Potomac Ave SE	2018	816 Potomac Ave SE	19867	Residential	N/A	N/A
Navy Yard	818 Potomac Ave SE	2018	818 Potomac Ave SE	19616	Mixed-use	N/A	N/A
Navy Yard	Parcel O (Forest City)	2014	308 Tingey St SE	17-12	Mixed-use	N/A	N/A
Navy Yard	The Estate (Forest City)	2016	225 Tingey St SE	17-12	Mixed-use	LEED scorecard shows efforts in reducing storm water quantity and a lot of green landscaping and roofing	Yes
Navy Yard	Parcel I (Forest City)	2019	N St SE	17-12	Mixed-use	Draft LEED scorecard shows efforts to management storm water efficiently, by thorough landscaping and green roofing	Yes
Navy Yard	1333 M Street SE	2014	1333 M Street SE	13-12	Mixed-use	LEED scorecard shows efforts to manage storm water quality more so than quantity. Development is located in a flood zone, Department of Energy and Environment recommends storm water management is updated to higher standards	Yes
Navy Yard	West Half Street Project	2017	70 N St SE	Plan	Mixed-use	LEED scorecard includes water-efficiency and capturing landscaping as well as cisterns to control storm water	Yes
Navy Yard	950 South Capitol St SE	2018	950 South Capitol St SE		Mixed-use	Discussion with Department of Environment over landscaping and capturing storm water, as it is on a 500-year floodplain	Yes

Navy Yard	2 I St SE	2018	2 I St SE	19175	Mixed-use	N/A	N/A
Navy Yard	1000 South Capitol Street SE	2015	1000 South Capitol Street SE	19113	Mixed-use	N/A	N/A
Navy Yard	1250 Half Street SE	2013	1250 Half Street SE	06-46	Mixed-use	N/A	N/A
Navy Yard	125 O Street SE (Forest City)	2013	125 O Street SE	17-12	Mixed-use	Mention of protecting runoff and quality of the adjacent Anacostia River as well as providing thorough landscaping, buffer zones and other bio-infiltration measures to also manage storm water	Yes
Navy Yard	Dock 79	2017	79 Potomac Ave SE	04-14	Mixed-use	N/A	N/A
Buzzard Point	D.C. United Stadium	2016	156 Q ST SW	16-02	Public	LEED Gold certified, managing storm water for both quality and quantity	Yes
Buzzard Point	River Point	2017	2100 2nd Street SW	17-05	Mixed-use	Located in a 100-year flood zone, recommended by the Department of Environment. The developers modified the development to include a flood emergency plan as well as elevating the building with flood proof materials to about 4 meters.	Yes
Buzzard Point	1900 Half Street SW	2016	1900 Half Street SW	16-06	Mixed-use	FEMA and Department of Environment collaborated with developers to ensure that the project, which is located within a 100 year floodplain, increases elevation of residential units to 4.3 meters as well as including and extending a proposed bioretention area between the shoreline and the building	Yes
Buzzard Point	Peninsula 88	2016	88 V St SW	10-21	Mixed-use	Project is located within a 100-year floodplain. The project had issues at the start without a proper flood mitigation study. The Department of Environment urged the property developers to meet flood requirements such as flood proofing, structural design, dry-floodproofing, flood gates, storage of equipments and materials, emergency plans, and protection of utilities and elevators.	Yes
Buzzard Point	1542 First Street SW	2016	1542 First Street SW	16-01	Mixed-use	LEED scorecard shows efforts to address storm water	Yes

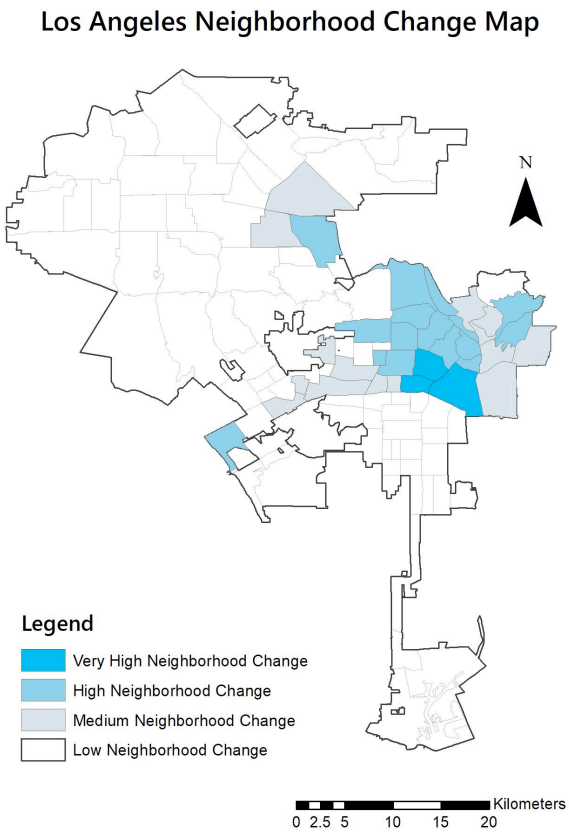
HAZARD: SEA LEVEL RISE							
Neighborhood	**Name**	**Year**	**Address**	**Case Number**	**Development Type**	**Implicit Mitigation Measures**	**Explicit Mitigation Intention**
Southwest Waterfront	The Bard	2019	501 Eye Street SW	16-04	Residential	Located outside 100-year floodplain	N/A
Southwest Waterfront	The View at Waterfront	2014	1100 6th St SW	05-38C	Mixed-use	Appears to be located outside of 100-year floodplain, but outside push from District departments to increase storm water capture mechanisms into plan	N/A
Southwest Waterfront	Riverside Baptist Church Redevelopment	2015	680 Eye Street Sw	15-05	Mixed-use	LEED Gold building explicitly uses cisterns, other on-site storm water management systems to hold up to a half meter of rainfall onside	N/A
Southwest Waterfront	Randall School Redevelopment	2017	65 I Street SW	07-13F	Mixed-use	LEED checklist indicates intention of storm water management and water control design	N/A
Southwest Waterfront	1000 4th Street	2019	1000 4th Street SW	02-38H	Mixed-use	Located outside of floodplain, and introduce green roofs and paving areas to mitigate and capture storm water	N/A
Southwest Waterfront	375 and 425 M	2018	425 M St SW, 374 M St SW	02-38E, 02-38C	Mixed-use	Use of landscaping techniques and green roofs to reduce storm water runoff	N/A
Southwest Waterfront	St Matthews Redevelopment	2016	222 M St SW	11-13A	Mixed-use	FEMA imposed mitigation revisions to the development based on flood insurance maps, ordering flood gates to parking and raising the western portion of the building by 60 cm.	N/A
Southwest Waterfront	Southwest Public Library	2018	900 Wesley Pl SW	19707	Public facility	Including elevation of floor to prevent harm from flooding	N/A
Southwest Waterfront	Canopy by Hilton (The Wharf)	2015	975 7th St SW	11-03	Hotel	N/A	N/A
Southwest Waterfront	Intercontinental Hotel (The Wharf)	2015	801 Wharf St SW	11-03	Hotel	LEED plans indicate storm water control and quality control	N/A
Southwest Waterfront	Vio (The Wharf)	2015	45 Sutton Square SW	11-03	Residential	LEED plans indicate storm water control and quality control	N/A
Southwest Waterfront	Incanto (The Wharf)	2015	770 Maine Ave SW	11-03	Residential	LEED plans indicate storm water control and quality control	N/A
Southwest Waterfront	The Channel (The Wharf)	2013	950 Maine Ave SW	11-03	Residential	LEED plans indicate storm water control and quality control	N/A
Southwest Waterfront	The Anthem (The Wharf)	2013	901 Wharf St SW	11-03	Public	LEED plans indicate storm water control and quality control	N/A
Southwest Waterfront	Wharf Marina (The Wharf)	2017	600 Water Street SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace and underground collection	N/A

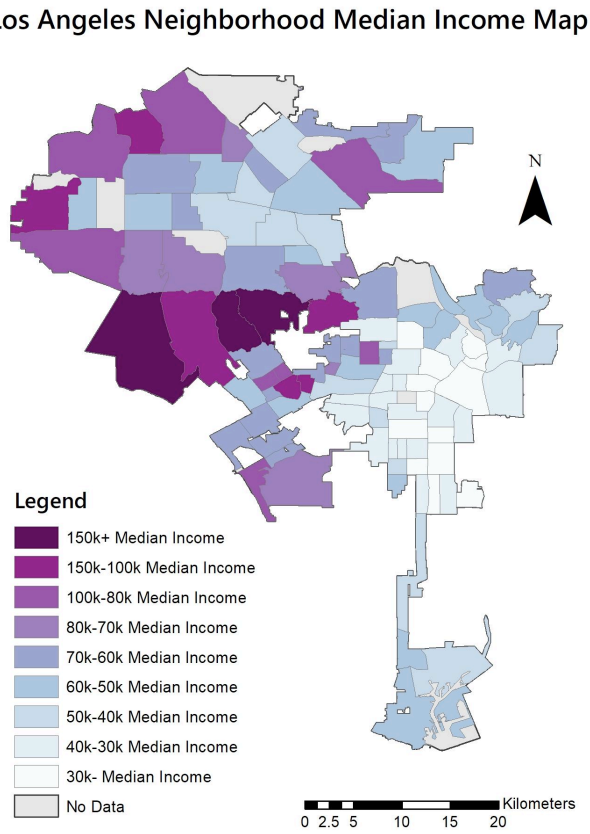
Southwest Waterfront	Pier 4 (The Wharf)	2015	101 District Square SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace and underground collection	N/A
Southwest Waterfront	Parcel 8 (The Wharf)	2017	Water St SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace and underground collection	N/A
Southwest Waterfront	Parcel 9 (The Wharf)	2017	Water St SW	11-03	Public	Plans suggest flood risk is avoided and storm water will be managed through more greenspace and underground collection	N/A
Navy Yard	100 K	2017	100 K STREET SE	19586	Mixed-use	N/A	N/A
Navy Yard	Squares 759 - 882 (D.C. Housing Authority)	2015	125 I St SE	03-12	Mixed-use	LEED scorecard mention of storm water drainage to be embedded in the sites	N/A
Navy Yard	816 Potomac Ave SE	2018	816 Potomac Ave SE	19867	Residential	N/A	N/A
Navy Yard	818 Potomac Ave SE	2018	818 Potomac Ave SE	19616	Mixed-use	N/A	N/A
Navy Yard	Parcel O (Forest City)	2014	308 Tingey St SE	17-12	Mixed-use	N/A	N/A
Navy Yard	The Estate (Forest City)	2016	225 Tingey St SE	17-12	Mixed-use	LEED scorecard shows efforts in reducing storm water quantity and a lot of green landscaping and roofing	N/A
Navy Yard	Parcel I (Forest City)	2019	N St SE	17-12	Mixed-use	Draft LEED scorecard shows efforts to management storm water efficiently, by thorough landscaping and green roofing	N/A
Navy Yard	1333 M Street SE	2014	1333 M Street SE	13-12	Mixed-use	LEED scorecard shows efforts to manage storm water quality more so than quantity. Development is located in a flood zone, Department of Energy and Environment recommends storm water management is updated to higher standards	N/A
Navy Yard	West Half Street Project	2017	70 N St SE	Plan	Mixed-use	LEED scorecard includes water-efficiency and capturing landscaping as well as cisterns to control storm water	N/A
Navy Yard	950 South Capitol St SE	2018	950 South Capitol St SE	17-25	Mixed-use	Discussion with Department of Environment over landscaping and capturing storm water, as it is on a 500-year floodplain	N/A
Navy Yard	2 I St SE	2018	2 I St SE	19175	Mixed-use	N/A	N/A

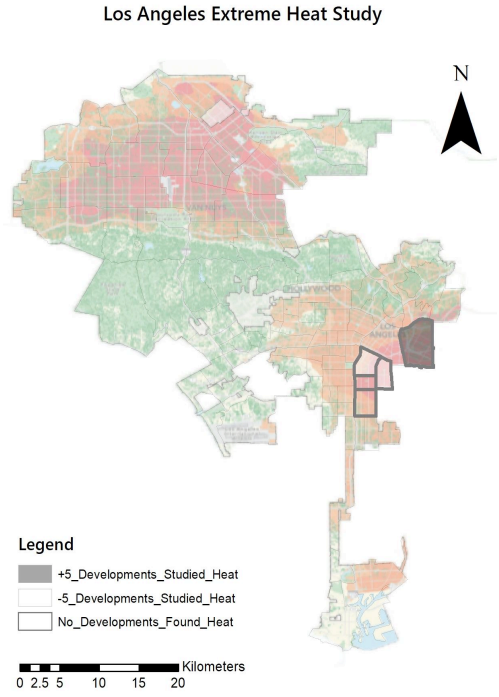
Navy Yard	1000 SOUTH CAPITOL STREET SE	2015	1000 SOUTH CAPITOL STREET SE	19113	Mixed-use	N/A	N/A
Navy Yard	1250 Half Street SE	2013	1250 Half Street SE	06-46	Mixed-use	N/A	N/A
Navy Yard	125 O Street SE (Forest City)	2013	125 O Street SE	17-12	Mixed-use	Mention of protecting runoff and quality of the adjacent Anacostia River as well as providing thorough landscaping, buffer zones and other bio-infiltration measures to also manage storm water	N/A
Navy Yard	Dock 79	2017	79 Potomac Ave SE	04-14	Mixed-use	N/A	N/A
Buzzard Point	D.C. United Stadium	2016	156 Q ST SW	16-02	Public	LEED Gold certified, managing storm water for both quality and quantity	N/A
Buzzard Point	River Point	2017	2100 2nd Street SW	17-05	Mixed-use	Located in a 100-year flood zone, recommended by the Department of Environment. The developers modified the development to include a flood emergency plan as well as elevating the building with flood proof materials to about 4 meters.	N/A
Buzzard Point	1900 Half Street SW	2016	1900 Half Street SW	16-06	Mixed-use	FEMA and Department of Environment collaborated with developers to ensure that the project, which is located within a 100 year floodplain, increases elevation of residential units to 4.2 meters as well as including and extending a proposed bioretention area between the shoreline and the building	N/A
Buzzard Point	Peninsula 88	2016	88 V St SW	10-21	Mixed-use	Project is located within a 100-year floodplain. The project had issues at the start without a proper flood mitigation study. The Department of Environment urged the property developers to meet flood requirements such as flood proofing, structural design, dry-floodproofing, flood gates, storage of equipments and materials, emergency plans, and protection of utilities and elevators.	Yes
Buzzard Point	1542 First Street SW	2016	1542 First Street SW	16-01	Mixed-use	LEED scorecard shows efforts to address storm water	N/A

Appendix IV. Maps Associated by Case City

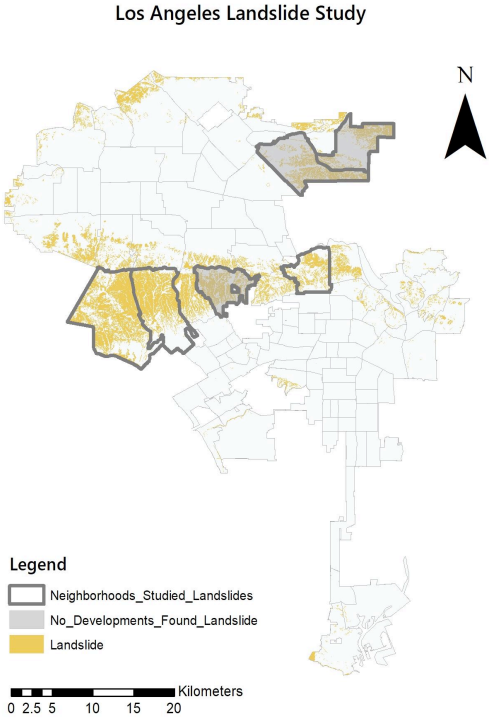
**Neighborhoods bolded in hazard maps are studied for adaptation measures*



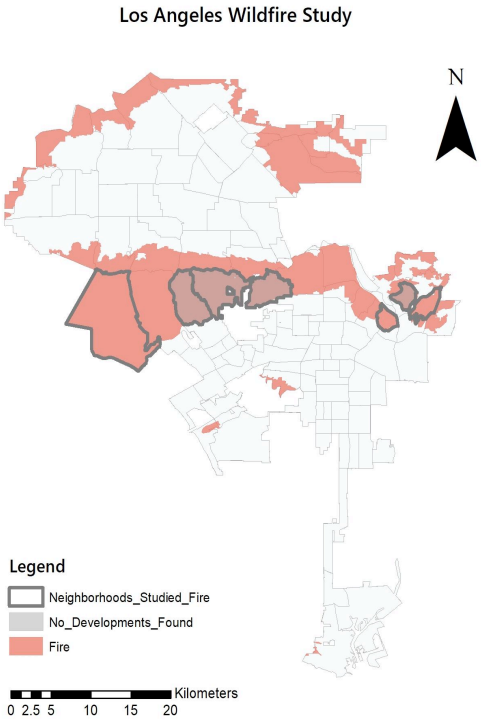




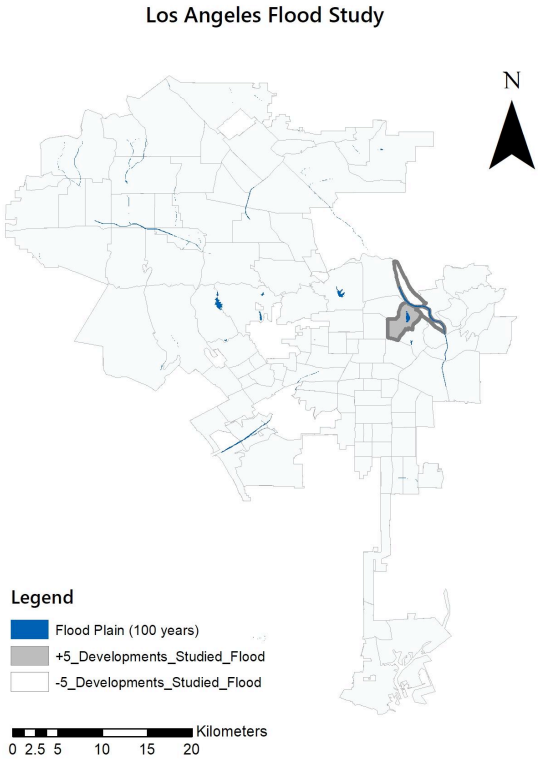
Neighborhoods Studied: **Boyle Heights, Central-Alameda,** Florence, **Historic South-Central**, South Park



Neighborhoods Studied: Beverly Crest, **Brentwood, Hollywood Hills, Pacific Palisades,** Shadow Hills, Tujunga

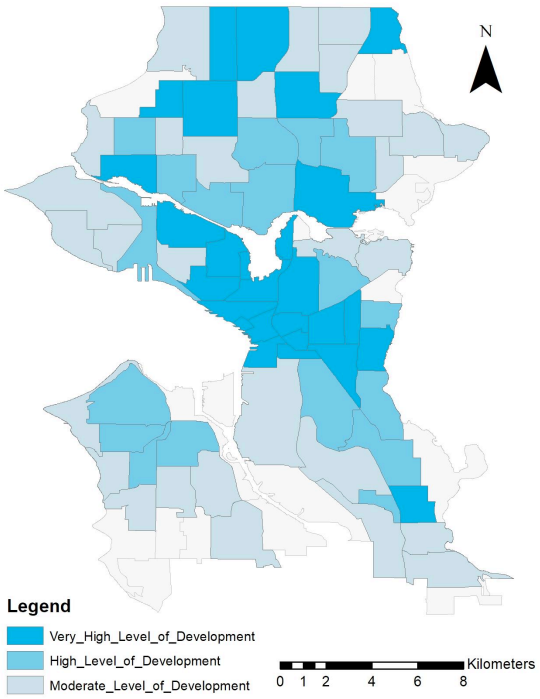


Neighborhoods Studied: Bel-Air, Beverly Crest, **Elysian Hills,** Hollywood Hills West, **Montecito Heights,** Mount Washington, **Pacific Palisades**

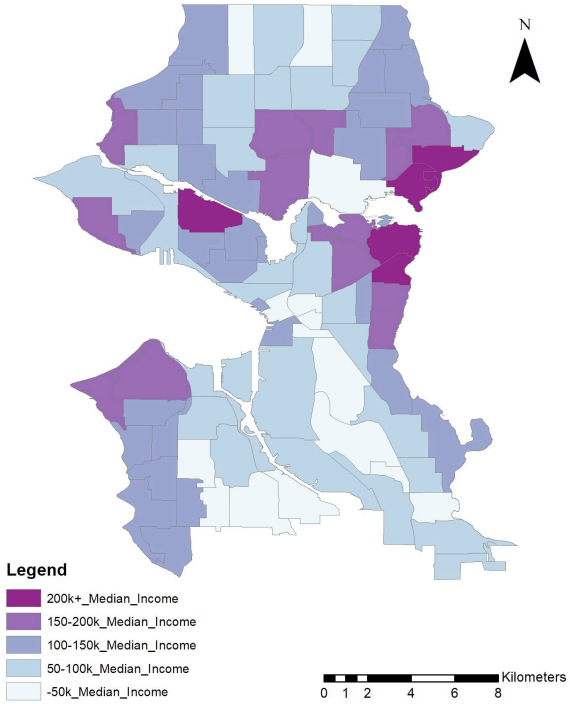


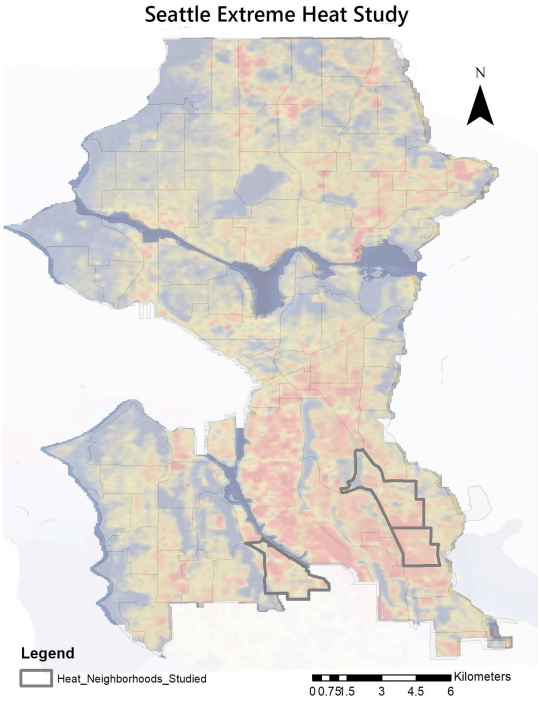
Neighborhoods Studied: **Atwater Village, Elysian Valley, Silver Lake**

Seattle Level of Development Map (2010-2019)

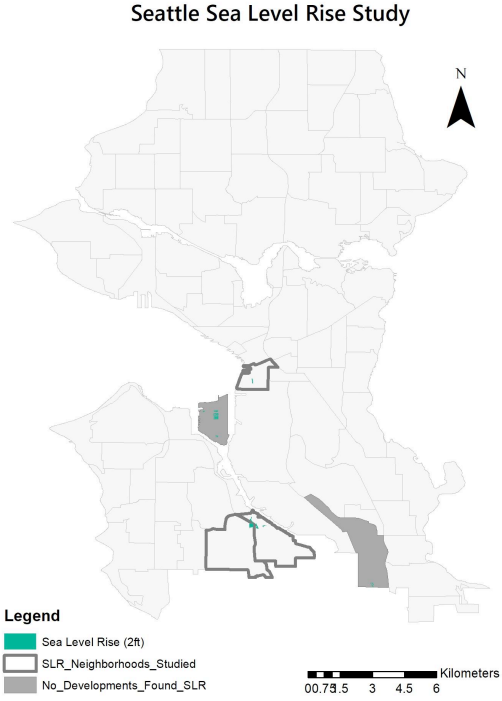


Seattle Neighborhood Simplified Median Income Map

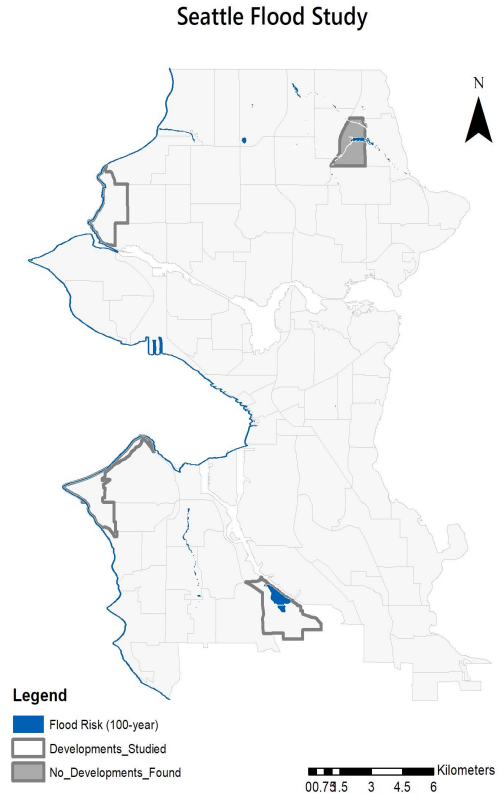




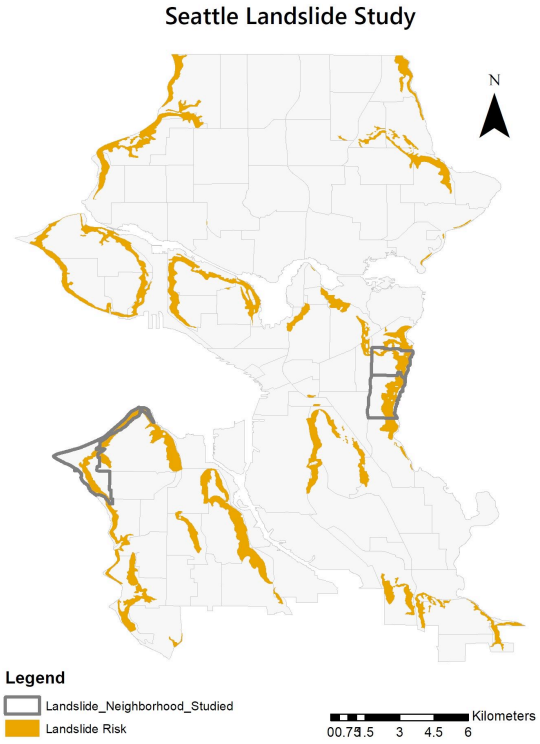
Neighborhoods Studied: **North Beacon Hill, Othello, South Park**



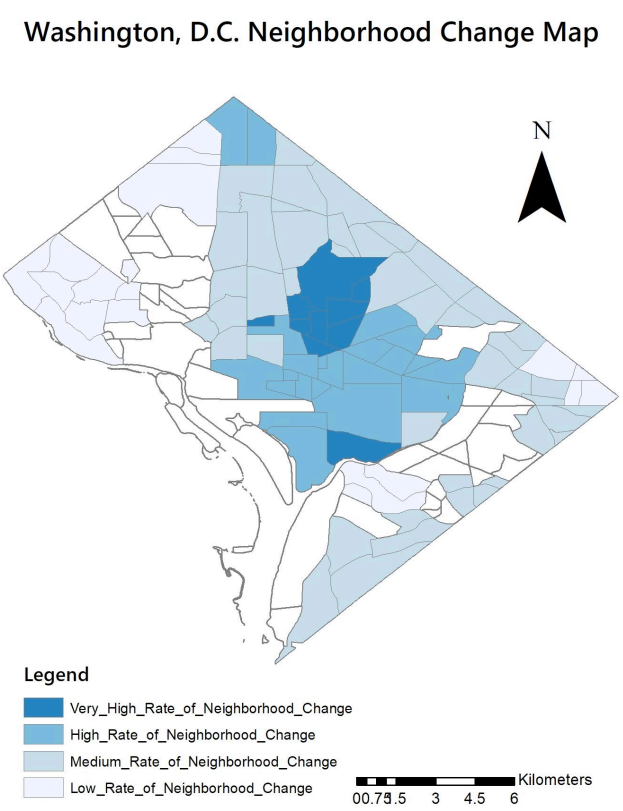
Neighborhoods Studied: Harbor Island, **Pioneer Square,** South Beacon Hill, **South Park, Westwood-Highland**

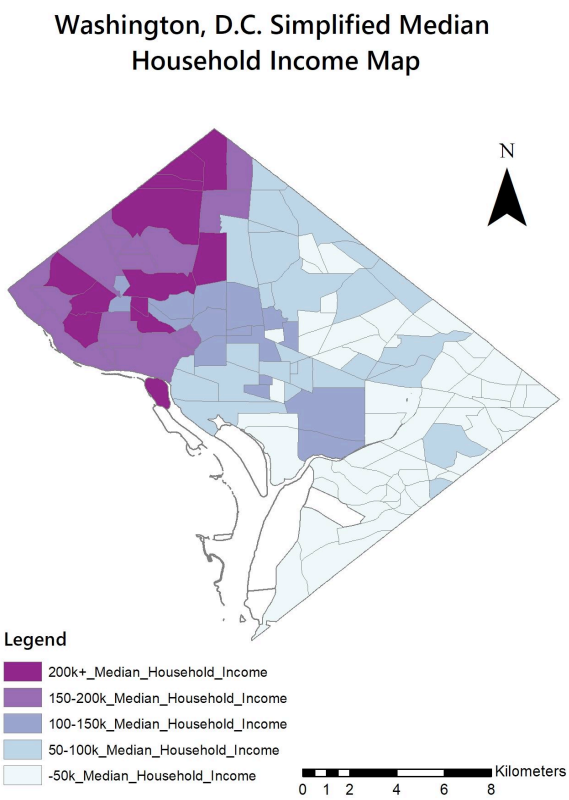


Neighborhoods Studied: **Alki**, Meadowbrook, **South Park, Sunset Hill**

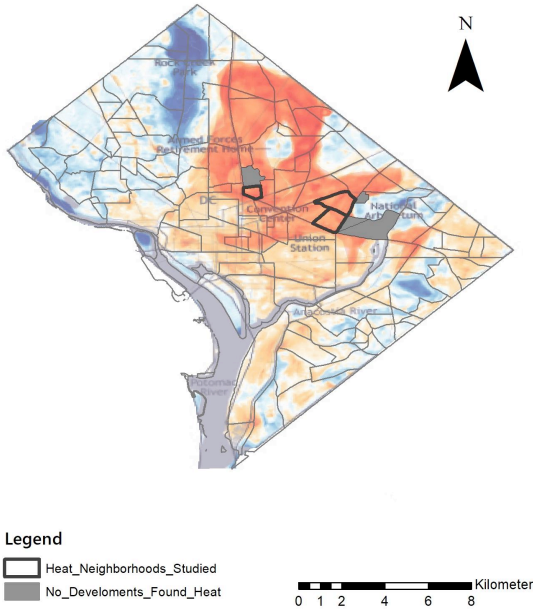


Neighborhoods Studied: **Alki, Leschi, Madrona**


Washington, D.C. Neighborhood Change Map
N
Legend
Very_High_Rate_of_Neighborhood_Change
High_Rate_of_Neighborhood_Change
Medium_Rate_of_Neighborhood_Change
Low_Rate_of_Neighborhood_Change
Kilometers
0 0.75 1.5 3 4.5 6

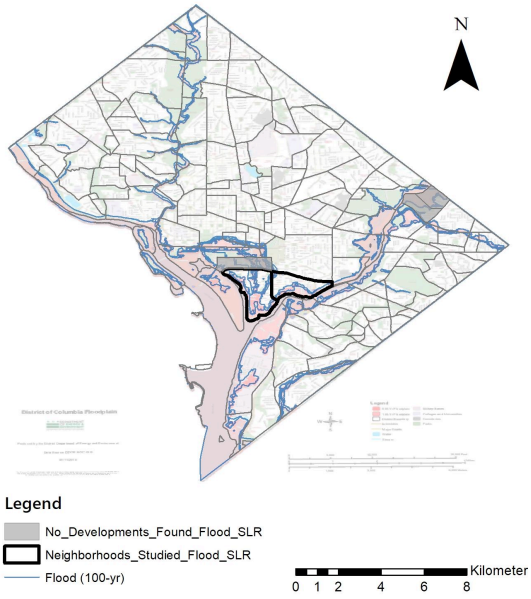

Washington, D.C. Simplified Median Household Income Map
N
Legend
200k+_Median_Household_Income
150-200k_Median_Household_Income
100-150k_Median_Household_Income
50-100k_Median_Household_Income
-50k_Median_Household_Income
Kilometers
0 1 2 4 6 8

Washington, D.C. Extreme Heat Study



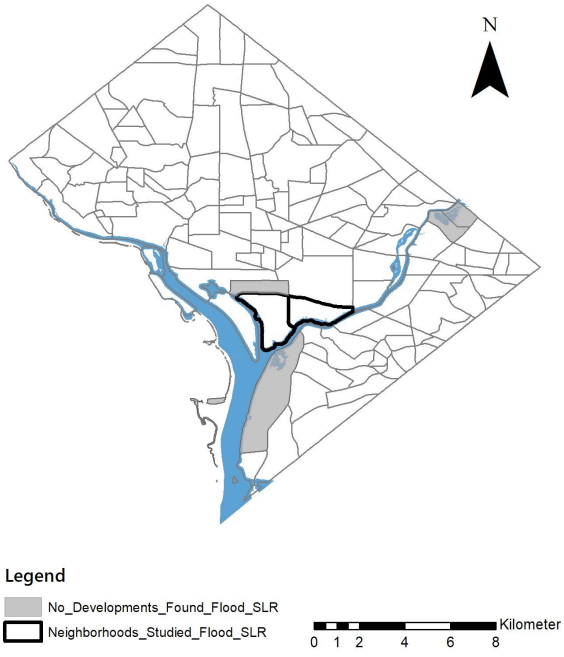
Neighborhoods Studied: **Ivy City, LeDroit Park, Trinidad**

Washington, D.C. Flood Study



Neighborhoods Studied: **Buzzard Point, Navy Yard, Southwest Waterfront**

Washington, D.C. Sea Level Rise Study



Neighborhoods Studied: **Buzzard Point, Navy Yard, Southwest Waterfront**