Planning for Climate Change Adaptation

A Discussion Paper about Community Resilience *November 2015*

Brief: *Planners can play an essential role in preparing or adapting communities for future climatic conditions. It serves as an overview of the practice of climate adaptation and suggests several ways to incorporate adaptation planning in the comprehensive planning process. "Adaptation" is the practice of planning for future climate. "Mitigation" refers to efforts to reduce greenhouse gas emissions. Other briefs in Resilient Washington focus on how planners can develop communities in a manner that reduce greenhouse gas emissions. Planning for climate change – adaptation and mitigation - corresponds to the common steps in a typical planning process: data collection, SWOT analysis, development of alternatives and development of an implementation plan. The differences lie in the characteristics of the data to be considered and the critical role of interagency coordination and regional partnerships. While GMA also mandates that local jurisdictions coordinate with adjacent jurisdictions, planning for climate change adaption has several unique characteristics that make such coordination essential. Climate change has a far greater range of impacts that cannot be confined within the jurisdictional boundaries of a community; hence, effective climate change mitigation and adaptation requires greater regional and interagency coordination.*

Problem

The role of a planner is to guide their community through a series of long-term decisions that will support the residents, economy, and environment. These decisions cross a broad range of resources and sectors and require planners to work across multiple departments and agencies to provide guidance on how to meet the current and future needs of residents and businesses while maintaining environmental conditions that will support those demands.

Changing climate trends and patterns will result in a "new normal" for planners to consider in planning for the long term sustainability of their community, grow their economy, allocate their public services (e.g., public health investments), protect their population and natural resources, and prioritize their investments. Historic trends and past events may not provide sufficient data to make informed decisions as future climatic conditions change and affect your municipality. A multi-sectoral approach is necessary to effectively address the future impacts of climate change. Planners are experts in guiding communities through developing strategies and policies that will improve the vitality, livability, and attractiveness of a community to residents and businesses alike. Several local planning practices, such as comprehensive planning, hazards mitigation planning, and transportation planning are a natural fit for enhancing community resilience through strategies and policies that consider future climate. (See also the discussion brief on Addressing Climate Change through Disaster Planning Practices.

Fitting Climate Change into the Planning Process

Planning for climate change is at once familiar and new territory for planners. The very nature of hazard mitigation planning and floodplain management involves land use planning, so adaptation strategies, in the form of policies for preparing and responding to disasters, or mitigating for floods and wildfire, have already been adopted by most communities. Planning for climate change differs in that it requires consideration of future climate conditions, which will continue to vary.

There are three popular methods used by planners and climate adaptation professionals to integrate climate projections into decision-making. All three methods are valid and should be assessed for appropriateness in your community. Considerations on selecting an approach may be based on available staff resources, collaboration with neighboring communities, interest and buy-in among agencies or sectors, and current funding opportunities.

Integrate Future Climate Considerations into All Long-Term Projects. A community may decide to address climate change on a project-by-project basis. After selecting a set of climate change projections the community could require that all projects that have a lifespan of more than a certain number of years (e.g. 10 or 20 years) use future climate information in their planning process and project design.

Integrate Climate Change Adaptation and Resilience into Existing Planning Practices. Planners are already responsible for several community-wide multi-year, multi-sector plans such as comprehensive plans, hazards mitigation plans, climate action plans (typically aimed at reducing greenhouse gas emissions), etc. Climate change could be integrated into those plans as either a stand-alone section or as a lens through which to assess the validity of a policy or project.

Develop a Climate Adaptation/ Resilience Plan. Climate adaptation or resiliency plans have been developed by several communities in the State of Washington. These plans can provide a community with a road map by which to prepare a community for the impacts of climate change. A climate adaptation plan may establish a formalized process through which to engage a variety of sectors on the topic in a focused manner.
As communities wrestle with this issue, more examples of how to address climate change through policy, plans, and projects will emerge. Regardless of the approach that a community selects, one thing will be consistent – there will be a need to identify and select the appropriate set of climate projections.

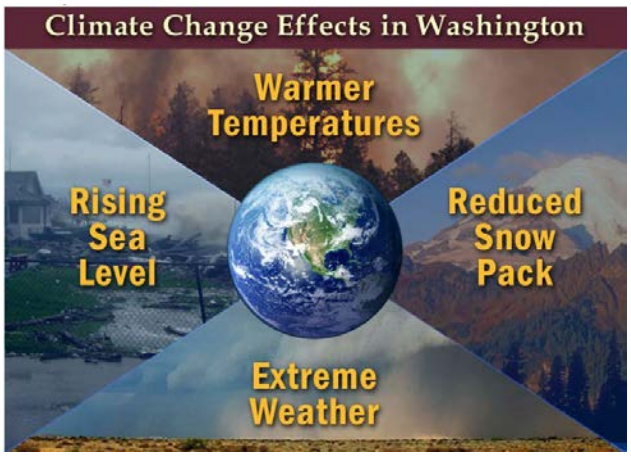

Image source: WA Dept. of Ecology

Climate Change Data

Planners regularly use projections to understand future economic and population growth conditions that are based on informed estimates. Similarly, climate projections provide planners with information that is more useful than projections based on historical data.

There are several sources of uncertainty in climate change data. These are introduced by estimating future levels of greenhouse

gas emissions (an important driver that can be significantly influenced by the way we design our communities); how the model treats the many complex interactions that create climatic conditions (climate modelers usually use ensembles that aggregate the results of many models), and how the data is localized (check out how projections vary by region in the *National Climate Assessment*.

The projections that are currently available provide useful information that is sufficient for planners to integrate into decision-making today.

The federal government[1] is the main source of climate data for the United States. To assist state and local governments in climate resiliency planning, U.S. Global Change Research Program[2] prepared the *National Climate Assessment* for the United States. The report provides climate change projections for 8 geographic regions in the U.S. The Northwest "Region" is specific to Washington, Oregon, and Idaho. The Coastal "Region" may be of interest to planners in coastal communities, but that information is not specific to the Northwest. Additionally, many climate change impact reports, including the *National Climate Assessment*, have sections of the report organized by sectors such as water, energy, land use, etc.

There are several factors to consider when using climate data.

- **Best Available Science.** Similar to other date used in planning, climate data are only as good as current technology allows for collecting them. Climate projections are regularly updated and new information and new methods of analysis become available. Hence, it is important to revisit the projections periodically and adjust your adaptation strategies as your community updates its plans.

- **Translate the Science to Be Accessible.** Most climate scientists represent their data in forms that are customarily used by other scientists and may not be intuitive to non-scientists. It behooves the planner to find alternative ways of representing the data so that the community can appreciate their impacts and make informed decisions for their community's future.

- **Select an Appropriate Timescale.** Climate data are often provided for a longer time scale than the data customarily used for comprehensive planning – even longer than the time-frame used for infrastructure planning. Planners will need to consider how adaptation policies and implementation strategies will need to be adjusted to fit within the shorter time frame of comprehensive plans.

- **Downscaled vs. Regional Data.** Localized models are created through a complex process of statistical or dynamical downscaling. While more specific data is tempting, these models can be expensive and will not always provide more actionable information than regional information. Regional data is often sufficient to provide useful information to planners for decision-making. For Washington, the Climate Impacts Group at the University of Washington provides regional data and localized information for specific topics.

- **Appropriate Data.** Annual averages do not necessarily provide sufficient information to make decisions. For instance, average annual precipitation may remain constant while precipitation

[1] National Oceanic and Atmospheric Agency (NOAA), U.S. Geologic Survey (USGS), National Aeronautics and Space Agency (NASA) and U.S. Army Corps of Engineers (USACE) provide climate data.

[2] U.S. Global Change Research Program is an umbrella group of 12 federal agencies and the Smithsonian Institution.

patterns shift drastically – with less precipitation falling in the summer and more precipitation falling in heavy downpours (and less snowfall) in the winter. Consider what data you use to make decisions currently (i.e. 24 hour rainfall or consecutive days of heat above 90°F) and then pull the data that most closely matches your needs.

- **Data Ranges.** Climate data is presented in ranges. These typically show the high and low within the set of projections. Some projections will also present an average of the models. Depending on the data set it may be appropriate for a community to decide to use the average, the high, or the range. Note that this is different than selecting a greenhouse gas emissions scenario.[3]

- **Accept Uncertainty**. Although climate projections are typically given in ranges and there is uncertainty about exactly what precipitation levels or extreme storms will occur, many sources of data used in planning are given in ranges. The conservative approach is to assume the worst case, but each region and jurisdiction needs to be comfortable that it can afford the adaptation and mitigation strategies that result from this.

Characterizing Risks and Finding Opportunities (SWOT Analysis)

Planners customarily use some form of SWOT (Strengths, Weaknesses, Opportunities and Threats) for describing existing and projected conditions to inform comprehensive plan policies. Findings from vulnerability analyses and risk assessments can be incorporated into the SWOT analysis. The Puget Sound and Pacific Northwest has "Preparing for Climate Change: A Guidebook for Local, Regional and State Governments." Chapters 8 and 9 provide step-by step guidance in conducting a vulnerability assessment and risk analysis.

When setting priorities for climate adaptation strategies, consider the consequences of the climate change impacts and the likelihood of their occurrence. A good way to summarize your priorities is to identify the high risk/high vulnerability items at the top of your community's list.

Planners should also consider timing. Some changes will have incremental, but permanent, impacts to the ecosystem, land use and socio-economic conditions of a community. This means that the risk in the long term could be higher than in the short term and there is more time to plan for and mitigate the impacts of these gradual climate variables. On the other hand, extreme events are unpredictable. Extreme events are temporary, but cause traumatic damage to the physical and natural environment, loss of lives, and disruption to economic activities. They often require an urgent response. Planning for these extreme events has traditionally been conducted by emergency managers and through a community's multi-hazard mitigation plan.

While vulnerability assessments focus only on the negative impacts of climate variables on the community, it may be that there are opportunities and positive impacts that result from climate change. For example, a warmer climate in the Northwest could lead to production of new agricultural products and longer days of operation for seasonal

[3] The International Panel on Climate Change (IPCC) has used two types of scenarios to describe how much greenhouse gas emissions may be released into the atmosphere. Special Report Emissions Scenarios (SRES) were used in the earlier reports and included A2, A1B, B1. Around 2007 IPCC moved towards using Representative Concentration Pathways (RCP) in place of SRES. The more commonly mentioned projections are based on RCP4.5 and RCP8.5.

businesses that depend on warm weather. The community that devotes effort in identifying these opportunities can reap the benefits, as they also prepare for the harmful effects of climate change.

For an adaptation plan to be effective, the right set of stakeholders should be involved in setting priorities and identifying the alternatives. Climate change impacts many sectors of a community, some of which are not traditionally involved in providing input in the comprehensive plan process. Identifying and executing effective strategies often requires cooperation from external partners of the community. Planners should reach out to the business community, not-for-profit organizations, neighboring local governments, and regional government agencies that have key roles in helping the community implement its adaptation plan. Examples include disaster response and emergency responders, Continuity-of-Operations personnel (COOP), police and private security agencies, food distributors, hospitals, utility companies, and educational institutions. Interagency coordination has one additional benefit – leveraging funding and resources to implement a shared adaptation strategy.

Developing Adaptation Alternatives

In the case of climate adaptation planning, developing alternatives should consider the following factors:

Multiple Benefits

- Adaptation strategies that provide other benefits to the community should be given higher priority. For example, dune restoration in shorelines or creation of natural levees can also serve as parks and open spaces. The benefits need not be related to climate adaptation as long as they provide a community benefit.
- Strategies that accomplish both mitigation of greenhouse gas emissions and adaptation to climate risk should also be given priority. For example, the use of green roofs reduces the energy consumption of buildings in the summer (mitigation) and provides plants for water treatment during a storm, while reducing the heat island effect in urban areas and reducing the likelihood of urban flooding (adaptation). Similarly, the use of green energy technology for homes reduces the demand for electricity from the power grid (mitigation) and ensures redundancy of power supply for homes, in case the power grid fails during an extreme storm event (adaptation). See the discussion briefs for Mobility, Creating Compact Communities, and Encouraging Green Building Practices.

Funding - Is there funding available to implement the strategy and sustain the program until successful implementation?

- The federal government is starting to revise the criteria for funding mainstream programs in transportation, disaster mitigation, housing and environmental protection to encourage and support communities in preparing for the impacts of climate change. While federal funding has diminished through the years, it can be used to leverage other funding sources.

- Actions that would have been taken by the community anyway, even without climate change, should be identified as part of the portfolio of adaptation measures, since these do not require additional funding, but have recognized benefits to address the impacts of climate change. These types of actions are often referred to as “no-regrets” strategies.

- Multiple actions that individually might address one impact, but can be combined to help address a larger impact should also be given a higher value. For example, rain gardens and green roofs can capture the first inch of rainfall and forestall local flooding. Storm water detention vaults are similar. When combined with the storm sewer system, as well as building armoring, this combination of strategies could be an effective way to reduce the risk of extreme flooding.

Effectiveness

- Consider adaptation strategies that prevent a consequence that could lead to other consequences or negative impacts. These are mostly related to sudden events related to extreme precipitation or heat. For example, extreme storms could lead to flooding, which would not only disrupt the transportation network but also the power supply. When the power supply fails, critical infrastructure and telecommunication systems will fail. So in analyzing the value of an adaptation alternative, a strategy that prevents flooding may be of a higher value ultimately than one directed to the telecommunication systems alone.

- Consider strategies that do not require human vigilance or depend on yearly maintenance to remain effective. For example, self-rising floodgates are a better option to protect buildings from flash flooding than those that rely on early warning devices or sandbagging by maintenance crews. Improving building code design standards for buildings to withstand strong winds is a better strategy than boarding up windows and strapping down parts of the structure before a major storm.

- Adaptation measures should be scaled appropriately to the impact to be addressed. System-wide impacts should be addressed by the service providers. In contrast, a neighborhood block resiliency plan or evacuation plan to ensure residents are safe during extreme weather events are best addressed locally.

Photo sources, top left: U.S. Dept. of Homeland Security; all else, FEMA

Including Climate Change & Adaptation in your Comprehensive Plan

The tables below illustrate how adaptation strategies for two climate variables can be incorporated into the community's comprehensive plan. Local communities will need to decide which impacts apply and what climate adaptation strategies are most important to them. The adaptation strategies provided in the tables below are not comprehensive, but provide a good starting point to consider. There are many available resources that identify adaptation strategies.

***Climate Variable*: Temperature/Heat - Increased summer temperatures, increases in number of very hot days and heat waves (multiple days of extreme hot days), and droughts**

Impacts to Community	Potential Adaptation Strategies	Comprehensive Plan Elements*
Species survivability; habitat degradation	Change species used for street trees and landscaping parks and public facilities; adopt crops appropriate to anticipated climate trends; adopt new fisheries and agricultural practices; reduce discharge of warmer waters/ fertilizers upstream, if applicable;	Park and Recreation; Rural; Economic Development (also consider adopting new policies in the community's critical areas ordinance)
Decrease in groundwater supply; low water level in lakes and rivers	Use predominantly drought-resistant plants for landscaping; encourage use of greywater where appropriate; close park facilities to the public at critical times; i.e. no swimming or fishing due to low water level in lakes; adjust agricultural practices	Park and Recreation; Utilities; Rural; Economic
Increased water and energy demand	Reduce energy and water consumption through regulations or conservation incentives; re-use water at a district scale through mixed use developments; use smart meters	Land Use; Utilities; Economic Development; Housing
Increased incidences and scale of wildfires	Increase buffers between settlements and forested areas; invest in effective land management practices	Land Use; Rural
Buckling of railroad tracks; overheating of engines and train equipment; melting airplane tires; thermal expansion of bridges; increased road pavement deterioration	Increase maintenance budget for repairs and replacements of equipment; roads and bridges; Plan for a shorter life span of infrastructure and more frequent replacement; Identify alternative means of transportation for travelers when trains are not running	Transportation; Economic Development
Increased cases of asthma, respiratory ailments and heat strokes; deaths	Provide cooling stations in public facilities such as libraries and schools; encourage teleworking to reduce exposure to extreme heat during commute; adopt air quality advisory system	Capital Facilities; Transportation

*based on RCW 36.70A.070, Comprehensive Plan, Mandatory Elements

***Climate Variable*: Extreme Precipitation and Larger Storms – chronic flooding, flash floods, erosion and landslides**

Impacts to Community	Potential Adaptation Strategies	Comprehensive Plan Elements*
Sewer system is overwhelmed; urban flooding; riverine flooding	Improve maintenance or upsize sewer systems; Incorporate low-impact development (LID), best management practices, and other design standards that promote onsite water retention that slows surface water runoff; require flood proofing of structures in flood prone areas; consider watershed level land use planning to avoid development in flood prone areas	Land Use, Capital Facilities
Power outage due to flooded transformers and wind-damaged power lines	Use mobile transformers as back-ups; Use of sensors on power grid to quickly respond to power outage and monitor areas prone to power outage; encourage local block-level preparedness and residential back-up systems; bury power lines in areas not vulnerable to flooding	Land Use, Capital Facilities; Housing
Landslides and erosion	Adopt more stringent regulations for development in and adjacent to steep slopes; improve land management practices in vulnerable areas	Rural, Land Use
Rapid deterioration of frequently flooded Infrastructure; increased maintenance costs of infrastructure	Invest in flood protection measures for infrastructure in low-lying areas, such as water treatment plants; provide redundancy in power supply and transportation networks; adjust Benefit-Cost Analysis to account for additional impacts of climate change to life cycle of infrastructure	Transportation, Capital Facilities
Loss of property; disruption to businesses	Adopt community early warning system; institute regular evacuation drills; adopt disaster clean-up plan, especially for hazardous materials;	

***Climate Variable*: Sea Level Rise and Storm Surge – Beach erosion, Coastal Inundation**

Impacts to Community	Potential Adaptation Strategies	Comprehensive Plan Elements*
Permanent inundation of settled areas	Limiting allowed uses in vulnerable coastal areas for recreation or habitat restoration; raising structures above the anticipated flood level; relocating properties out of floodplains	Land Use; Parks and Recreation
Rising groundwater levels	Adopt new building design and structural standards for application in vulnerable areas; protect subterranean assets from permanent inundation; prohibit basement in new homes; limit development in areas with poor soils and high groundwater	Capital Facilities, Housing, Land Use
Increased height of storm surge during storms	Update zoning to prohibit habitable structures and critical infrastructures in vulnerable coastal zones; relocate or protect critical assets such as railroads, major arterials, water treatment plants and power stations; consider recreational uses and habitat restoration for storm surge buffers	Land Use, Capital Facilities,

*based on RCW 36.70A.070, Comprehensive Plan, Mandatory Elements

Resources & References

National Climate Assessment Northwest Region provides a summary of climate data for Washington, Oregon, and Idaho http://nca2014.globalchange.gov/report/regions/northwest

National Climate Assessment Coasts Region provides a summary of climate change information for coastal areas in the United States http://nca2014.globalchange.gov/report/regions/coasts

Climate Change: Evidence and Causes. An Overview from the Royal Society and the U.S. National Academy of Sciences. Written for a layperson, this report provides an easy-to-understand explanation of the science of climate change, appropriate for educating anyone who is unfamiliar with climate change and dispelling criticisms about the anthropogenic causes of climate change. http://nas-sites.org/americasclimatechoices/events/a-discussion-on-climate-change-evidence-and-causes/

University of Washington Climate Impacts Group regularly updates their website with updated climate information for the Northwest. http://cses.washington.edu/cig/. Three that are relevant to local climate adaptation include:

- **Preparing for Climate Change: A Guidebook for Local, Regional and State Governments** – chapters 8 and 9 provide step by step guidance in conducting a vulnerability assessment and risk analysis. http://cses.washington.edu/db/pdf/snoveretalgb574.pdf

- **Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities** - this report provides a good discussion of key climate change issues and identifies key risks of climate change facing the Northwest. http://cses.washington.edu/db/pdf/daltonetal678.pdf

- **Planning for Climate Variability and Change,** University of Washington Climate Impacts Group – the webpage provides a good overview of issues inherent to climate data and how it affects the political will to plan for climate change. http://cses.washington.edu/cig/fpt/planning.shtml

Lessons Learned on Local Climate Adaptation from the Urban Leaders Adaptation Initiative, Center for Clean Air Policy, (February 2011) – succinct report that includes a summary of lessons learned on page 5. The information from this resource should be supplemented with more recent studies, if available. http://ccap.org/assets/LESSONS-LEARNED-ON-LOCAL-CLIMATE-ADAPTATION-FROM-THE-URBAN-LEADERS-ADAPTATION-INITIATIVE_CCAP-February-2011.pdf

Ask the Climate Question: Adapting To Climate Change Impacts in Urban Regions, Center for Clean Air Policy (2011) – this report includes a summary of lessons learned from local governments that have developed adaptation plans. The list could serve as a guide in prioritizing adaptation goals and evaluating the best strategies. http://ccap.org/resource/ask-the-climate-question-adapting-to-climate-change-impacts-in-urban-regions/

Pacific Northwest Climate Change Vulnerability Assessment – a partnership between the University of Washington and key collaborators to develop a digital database of inherent climate-change sensitivities for species and habitats of concern throughout the Pacific Northwest

and will promote convenient analysis and illustration of possible effects at various landscape scales. This assessment will provide resource managers and decision makers with some of the most basic and important information about how species and ecological systems will likely respond to climate change. http://www.climatevulnerability.org/?page_id=341

Using Smart Growth Strategies to Create More Resilient Communities in the Washington, D.C. Region, U.S. EPA (2013) - This report identifies Smart Growth strategies that can be used as adaptation or climate resiliency strategies. http://www2.epa.gov/smartgrowth/smart-growth-and-climate-change

Green Resilience: Adaptation + Mitigation Synergies, Center for Clean Air Policy (2015) – this report discusses the advantages of thinking about both adaptation and mitigation benefits when considering infrastructure investments. The report includes four sector examples in Energy, Transportation, Building and Water. http://ccap.org/assets/Green_Resilience_Overview_CCAP-January-2015.pdf

Summary of Potential Climate Change Impacts, Vulnerabilities, and Adaptation Strategies. A synopsis of lessons learned from the Metropolitan Washington Council of Governments' climate adaptation planning initiatives from 2010 – 2012, Metropolitan Washington Council of Governments, Washington, DC (July 2013). http://www.mwcog.org/store/item.asp?PUBLICATION_ID=460

Information Clearinghouses

The following are websites serve as clearinghouses for climate adaptation reports and studies.

Washington Department of Ecology Clearinghouse – In addition to resources on climate change impacts to human health and natural resources, this website includes reports on the economic impacts of climate change. Resources are organized by topics: Human Health; Fish, Wildlife and Plants; Coastal Hazards; Ocean Acidification; Water Resources; Agriculture; Forests; Infrastructure and the Built Environment. http://www.ecy.wa.gov/climatechange/ipa_resources.htm

Climate Adaptation Knowledge Exchange (CAKE)
CAKE is a free, innovative, online resource created to help you navigate the world of climate change adaptation (how we prepare for and respond to climate change). CAKE includes **Case Studies** of on-the-ground adaptation efforts, a **Virtual Library** of useful resources to support adaptation action, a **Directory** of individuals and organizations rich with adaptation knowledge, a Tools section full of useful online resources for adaptation action, and a **Community** section with an expert advice column and more.
http://www.cakex.org/about-cake

Georgetown Climate Center Adaptation Clearinghouse
This website includes an interactive map that tracks the status of all local and state adaptation planning efforts in the United States.
http://www.georgetownclimate.org/adaptation/clearinghouse