2017

Municipal Climate Adaptation Guidance Series: Overview

AN OVERVIEW AND INTRODUCTION TO GUIDANCE DOCUMENTS FOR MAINE MUNICIPALITIES

MUNICPAL PLANNING ASSISTANCE PROGRAM,
MAINE DEPT. OF AGRICULTURE CONSERVATION AND FORESTRY
LINCOLN COUNTY REGIONAL PLANNING COMMISSION
BLUE SKY PLANNING SOLUTIONS

This document is the introduction to a guidance series that was developed for the Municipal Planning Assistance Program, Maine Department of Agriculture Conservation and Forestry through a collaborative effort of the following regional planning organizations:

Androscoggin Valley Council of Governments
Greater Portland Council of Governments
Hancock County Planning Commission
Kennebec Valley Council of Governments
Lincoln County Regional Planning Commission
Midcoast Council of Governments
Midcoast Regional Planning Commission
Northern Maine Development Council
Southern Maine Planning and Development Commission

This guidance document was funded under awards CZM NA14NOS4190066 and NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

TABLE OF CONTENTS

I. INTRODUCTION

CHANGING CLIMATE CONDITIONS IN MAINE

Historical data show that Maine's climate conditions have changed over the last 100 years and models predict changing conditions into the future. Precipitation patterns have changed, extreme events occur more frequently, average temperatures are higher, and sea levels have increased. Regardless of what is causing these changes, the data clearly show that not only are these changes from historic levels measurable, the changes are occurring at a rate not seen in the recorded history of climate data.[1] The following figures are taken from Maine's Climate Future, 2015 Update and illustrate changes already occurring or predicted to occur in Maine; more details on each of these figures is found in the report.

Figure 1 plots recorded temperature information revealing that Maine's average annual temperature has increased 3 degrees between the late 1800's and the present. Using this historical data and projections of future conditions shows that temperature conditions across Maine will continue to rise as illustrated in Figure 2 below.

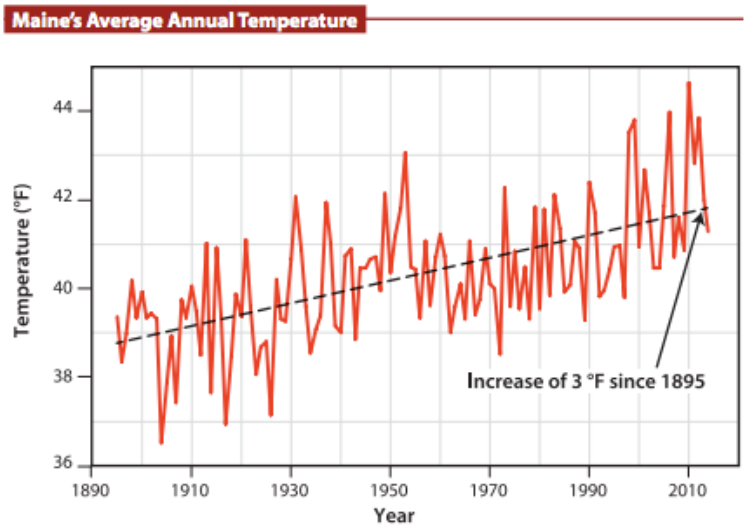


Figure 1. Mean annual temperature, 1895–2014, averaged across Maine from gridded monthly station records from the U.S. Climate Divisional Dataset (*ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php*). A simplified linear trend (black line) indicates that temperature increased 3 °F over the record period.

[1] Fernandez et.al.

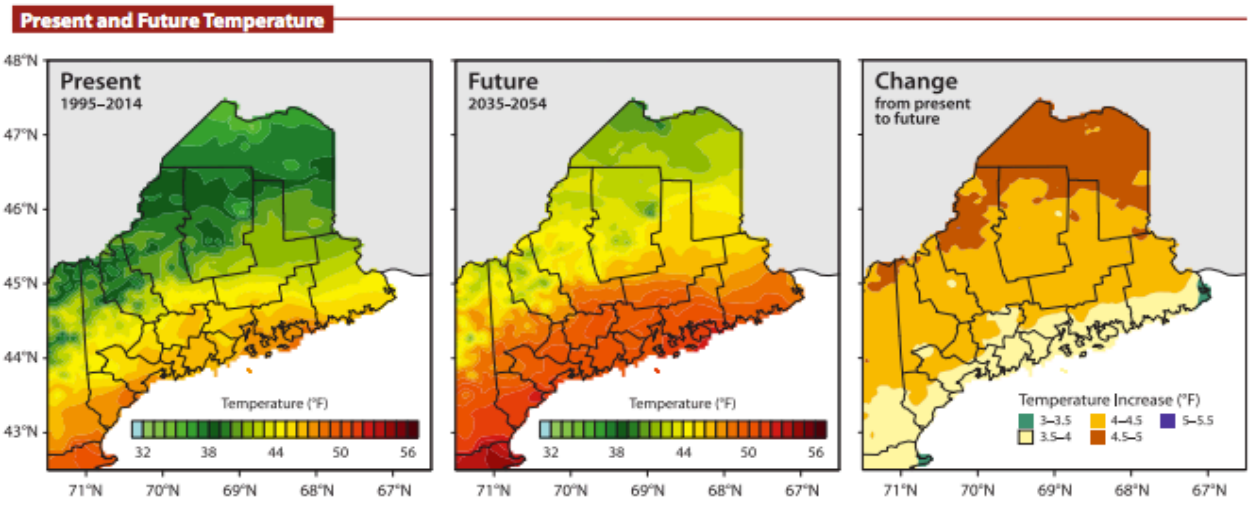


Figure 2. Maps showing mean annual temperature for 1995–2014 (left), 2035–2054 (center), and the predicted change or difference between the two time periods (right). The predicted rise in temperature by 2050 ranges 3.0–5.0 °F from the coast inland to the Canadian border. Maps derived from an ensemble simulation of the IPCC A2 emissions scenario.[1]

Increasing temperatures will have impacts on humans as well as natural systems. The number of days with a heat index over 95 degrees are predicted to increase across the state, as shown in Figure 4. Maine's housing stock and population are among the oldest in the nation. These factors in combination with the prediction of higher temperatures in general and more extreme high temperatures in summer months forecast increased stress on some of our most vulnerable citizens.

Maine's Climate Future, 2015 Update documents similar changes to precipitation – an increase in the overall amount of precipitation with more of it falling in extreme events (defined as 2' of precipitation falling in a 24-hour period). Scientists also predict a change to the pattern of precipitation with less snow overall.

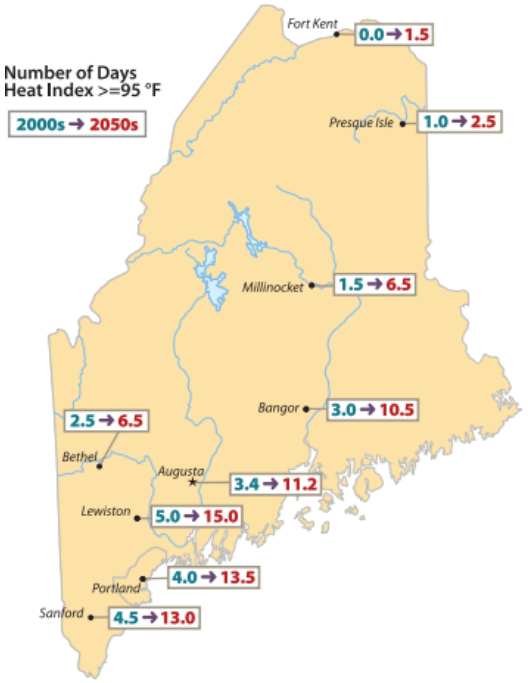
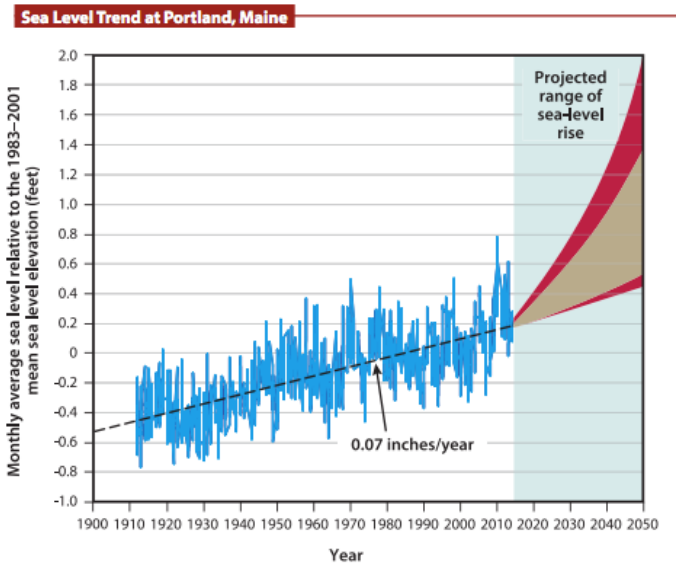


Figure 4. The average number of days when the heat index is greater than or equal to 95 °F at selected sites for 2000–2004 and 2050–2054. Predicted values derived from a 48-km downscale simulation of one ensemble member of the CCSM3 model for the IPCC A2 emissions scenario.

Coastal communities now experience and will continue to be vulnerable to the impacts of climate change on the ocean. Thermal expansion of the ocean in response to climbing temperatures is causing sea levels to rise. This is well documented through the historical record of tide gauges along the length of Maine's coast. Figure 14 shows the historical tide data from Portland with projected future tidal heights. Rising sea levels will result in storm surges traveling farther inland. Increased moisture captured by the warming atmosphere over the ocean will drive larger more dangerous coastal storms.



WHAT DOES THIS MEAN FOR MUNICIPALITIES?

1. Infrastructure built to withstand conditions based on historical data may not withstand future conditions.
2. Coastal development and its corresponding portion of the current tax base are at risk from increasingly severe and frequent storm events as well as from sea level rise.
3. Emergency management resources based on past events may be inadequate to meet future needs.
4. Reacting to emergencies without adequate preparation is more expensive than responding based on good preparation.
5. Economic disruptions from climactic events (e.g., floods, rain storms, ice storms, heat events) will become more frequent.

WHAT TO DO

The number of reports, studies, decisions support tools, and web tools on climate change has grown dramatically over the last five years. The situation has gone from too little information and guidance to an overload that can be difficult to sort through. Many of these tools were created to assist communities in dealing with climate change through entirely new planning initiative which is unrealistic for already busy staff, tapped out volunteers, and limited budgets. Few of these new tools are based on data that are useful for decision- making at the local level. Research in Maine has clearly shown that municipalities are most likely to undertake climate resilience and adaptation planning when that work can be integrated into existing municipal efforts and priorities and is based on data appropriate for use at the local scale.

"Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events." (National Academies, 2012)

Accordingly, the Maine Department of Agriculture Conservation and Forestry's Municipal Planning Assistance Program has worked with Regional Planning Organizations from across the state to develop a series of guidance documents to help Maine municipalities find ways to improve community resilience from sea level rise and increasing levels of precipitation by integrating climate change considerations into their existing plans, policies and regulations. (Note that there are other potential impacts of changing climate conditions for a municipality to consider (e.g., drought, increasing high heat days) that are beyond the scope of this series.)

This series of documents provides suggestions for integrating climate change considerations into Maine's most commonly employed land use tools, discusses key issues for community consideration, and provides links to Maine data appropriate for use in local decision making. New resources such as The Nature Conservancy Coastal Resilience Tool and the Maine Community Resilience Checklist provide Maine municipalities useful data and guidance on ways to increase resilience from the impacts of a changing climate.

`Impacts from climate change intersect a broad range of municipal issues. Finding solutions and adapting to the changes will be an on-going process in response to changing conditions.

HOW TO DO IT

To address impacts from climate change, a community first needs to determine its level of vulnerability. This is called a Vulnerability (or Impact) Assessment and there are many formats for them. The following five-step process from the U.S. Resilience Toolkit[2], is a straightforward approach to help a community go from identifying the problem to developing a solution. The American Planning Association offers a similar 6-step process[3]. Regardless of which method a community chooses to use, a successful process will be based on meaningful community involvement at all steps along the way. Links to helpful materials, both Maine-specific and more general, are provided in the Resources Table at the end of this section.

1. EXPLORE CLIMATE THREATS. A community first needs to understand how climate conditions are changing and which changing climate conditions are of most concern over a certain period of time. Then it needs to decide what degree of climate change to plan for. For example:

Decide on your timeframe and corresponding climate change during that timeframe - adapting to the impacts of climate change is not a one-time action.

[2] U.S. Climate Resilience Toolkit (https://toolkit.climate.gov/)

[3] APA

1 feet of sea level rise? 2 feet? In 25 years? 100 years? This should be done through an open and inclusive community conversation; these choices will determine the types of actions that a community considers and ultimately decides to take. Ultimately, this is a choice about how much risk the community is willing to accept from changing climate conditions much the same way that risk is considered in other community decisions such as the risk that a community will actually realize the predicted benefits from a TIF district. If the TIF district is approved, the community has determined that it is willing to accept the risk that the predicted benefits outweigh the possibility that those benefits will not accrue to the community. All decisions have costs and benefits and are made using information of varying degrees of accuracy– decisions about how to adapt to changing climate conditions are the same.

2. DETERMINE VULNERABILITY BASED ON STEP 1.

Once a community determines which climate conditions within a specified timeframe it is concerned about, the next step is to determine the community's level of vulnerability to those conditions based on various scenarios. This process can run the gamut from assessing impacts from a single climate element on a single asset (e.g., rising sea level on the municipal town hall) or to a group of assets (e.g. sea level rise impacts to culverts) to assessing impacts from multiple climate conditions (temperature, precipitation, sea level rise) on a variety of systems (built, economic, social, natural) using detailed methods with complicated equations. A community can also decide to act based on determining how much risk it is willing to tolerate and then adopting "no regrets" strategies based on that level of risk. That means that the actions the community takes, in and of themselves, will provide benefits in addition to increasing community resilience to climate change. The benefits could include, for example, improved economic conditions, increased protection from storm events (regardless of their severity), or improved conservation of natural systems that provide multiple benefits from recreational enjoyment to important habitat for commercial fish species to flood protection.

> A scenario-based approach to determining vulnerability identifies a range of potential impacts; this is the most realistic approach to determine how changing climate conditions will affect a community.

3. INVESTIGATE OPTIONS TO ADDRESS VULNERABILITIES IDENTIFIED IN STEP 2.

This is the point at which a community investigates what changes to their plans, regulations and policies will increase their resilience to changing climate conditions. Examples include changes to a zoning ordinance, adding language to a comprehensive plan, or changes to existing policies on culvert sizing.

> Determine the lifespan of your action and then determine what conditions the community expects in that period – e.g., are you considering culvert replacement or road maintenance? How long is a reasonable life span for that action?

Some of the more general climate tools included in the Resources Table can be helpful in identifying the link between climate impacts and possible responses.

4. PRIORITIZE ACTIONS. This is the time to tie the different options together to provide a logical path forward – a plan. To create that plan, determine which actions logically go together and can be implemented in a step-wise manner, which are the most important to the community, discuss how to fund them, and develop a projected timeline for implementation that includes milestones to allow you to measure progress.

> Are you making a change to a plan, policy or ordinance? Include a statement to revisit the change at specified intervals; evaluate it based on performance to date and review of current data at that time.

5. TAKE ACTION. Start working on the actions decided on in Step #4. Measure how effective the chosen options are as they are put in place– and don't hesitate to make mid-course adjustments.

II. KEY ISSUES FOR CONSIDERATION AT THE MUNICIPAL LEVEL

TRANSPORTATION INFRASTRUCTURE:

Maintaining a transportation network that can withstand rising sea levels and changing patterns and amounts of precipitation is essential to a community's ability to thrive. Transportation costs are frequently a large part of a community's budget. This is an area where determining the level of risk a community is willing to accept and long-term planning for transportation projects is essential to ensure that a community is aware of the trade-offs in costs and benefits to increase the resilience of its transportation network.

Key considerations for increasing resilience in transportation infrastructure:

- Analyze a range of climate impacts over a specified period of time (scenario-based approach);
- Understand the condition of existing roads, culverts and bridges;
- Identify the assets most at risk from changing climate conditions;

KEY BEST PRACTICES TO IMPROVE TRANSPORTATION NETWORK RESILIENCE

1. Improvements to hydraulic performance are examined and protection against scour is incorporated for every new crossing and for replacement of existing crossings.

2. Documentation of work performed including, labor, equipment, and materials, is maintained by road segment and crossing location; records are filed to facilitate identification of changes in conditions over time.

3. A formalized program of periodic inspection of waterways crossings to identify, document, and monitor, over time, conditions known to contribute to vulnerability to flood damage is essential.

4. Inter-jurisdictional partnerships are formed to cost- effectively co-operate to provide for the overall safe functioning of local road networks.

5. Provisions are made for some anticipated flood-related expenditures that exceed the normal budget so that funds are not diverted from routine maintenance and scheduled capital improvements.

- How would the temporary or permanent loss of an asset affect public health and safety and vulnerable populations;
- What would the economic impacts be of service interruption?
- Determine priorities for maintenance, repair, or upgrade;
- Use updated precipitation data when engineering is needed;
- Refer to the Maine Department of Transportation guidelines for upgrading culverts.
- Adopt Stream Smart Crossing principles

Examples:

Warren Case Study

WASTEWATER INFRASTRUCTURE:

Wastewater infrastructure is essential for protecting the public health from waterborne diseases and protecting the quality of our fresh and coastal waters. Evaluating the vulnerability of wastewater infrastructure should include not only evaluating the treatment plant but pumping stations and sewer lines as well. This is an area where engineering expertise is a worthwhile investment as part of the vulnerability assessment process. Treatment plants are frequently located at the 'low point' in town – it could be in a flood plain, it could be in an area at risk from sea level rise. Sewer lines may run along road ways and be at risk if culverts or bridges are damaged from increased amounts of precipitation which then creates risk of sewerage spilling into rivers and streams. Understanding the level of vulnerability of all the components of the system and possible adaptation strategies is essential to being able to make an informed determination on whether cost/effective options exist to increase its resiliency. Several Maine communities have gone through this analysis; see links below for case studies.

Communities with septic systems should consider mapping the location of these systems in relation to flood plains and areas at risk from inundation from sea level rise. Increased fresh water flooding or impacts from sea level rise are both stressors which can impact if and how well a septic system continues to function. Malfunctioning septic systems can impact drinking water supplies, natural resources, and pose a serious risk to human health.

Key considerations for increasing resilience in wastewater infrastructure:

- Analyze a range of climate impacts over a specified period of time (scenario-based approach);
- Assess the location and condition of all parts of the wastewater system relative to sea level rise and flooding risks;
- Determine if adaptation is needed and if strategies exist and are cost effective;
- Use planned maintenance and repair as opportunities to implement adaptation strategies;
- Investigate funding options for work beyond the scope of planned maintenance and repair.
- For septic systems: map current location of septic systems;

- Analyze location of septic systems relative to increased flood risks and sea level rise; Consider ordinance language to add performance standards for installation of new systems in vulnerable locations and inspection and decommissioning of existing systems in vulnerable locations when certain conditions arise.

Examples:

Ogunquit Project Proposal ; Ogunquit Presentation
Boothbay Harbor Case Study; Boothbay Harbor Impact Assessment
Wiscasset Case Study; Wiscasset Resilience Study

DRINKING WATER INFRASTRUCTURE:

Regardless of whether drinking water comes from a public system or a private well, it is one of the most crucial elements making an area habitable. Maine is fortunate to have high quality and quantity of drinking water throughout most of the state. However, both public and private drinking water systems may be at risk from changing climate conditions. This is another issue for which engineering expertise as part of the vulnerability assessment may be a worthwhile investment. Drinking water supplies may be at risk from salt water contamination due to sea level rise and/or storm surges regardless of the type of drinking water infrastructure. Increasing temperatures are likely to increase demand for water and draw down for irrigation is likely to impact low-flow conditions differently. Maintaining adequate quantity and quality of drinking water requires long-term planning and budgeting.

Key considerations for increasing resilience in drinking water infrastructure:

- Analyze a range of climate impacts over a specified period of time (scenario-based approach);
- Assess the location and condition of all parts of the drinking water system relative to sea level rise and flooding risks;
- Determine if adaptation is needed in the face of climate impacts and if strategies exist and are cost effective;
- Use planned maintenance and repair as opportunities to implement adaptation strategies;
- Investigate funding options for work beyond the scope of planned maintenance and repair.

Key Stormwater Best Management Practices

1. Sized to treat stormwater on-site, preferably for a 100-yr. storm event.
2. Must have formal equipment access.
3. Ease and minimal cost of cleaning.
4. Permanent maintenance easement.
5. Method and access for evaluation of maintenance.
6. Pretreatment devices strongly recommended to prevent clogging or sedimentation problems.
7. Provisions for groundwater monitoring and assessment of quantities of water removed along with estimates in the design of expected sediment quantities.
8. A detailed and reasonable Operations and Maintenance plan exists.

STORMWATER INFRASTRUCTURE

Increasing levels of precipitation and more frequent storm events stress existing stormwater management systems. Increased

runoff carries more sediments and pollutants into our water bodies impacting water quality and all the organisms that rely upon clean water – including us. Green Infrastructure and Low Impact Development are cost effective techniques to help to reduce the amount of stormwater that leaves a site. Treating water on-site and reducing the amount of water that needs additional treatment are two key approaches to address the impacts of climate change on stormwater management systems. In larger communities, tying stormwater fees to the percent of impervious cover on a parcel ties the fee structure to actual use of the system and also gives individuals the power to take steps toward improving water quality while they also realize financial savings.

Key considerations for increasing resilience in stormwater infrastructure:

- Inventory existing stormwater infrastructure for location and condition.
- Require Low Impact Development techniques for new development.
- Investigate Green Infrastructure opportunities.
- Require conservation subdivisions that protect and maintain open space.

Examples:
Portland Case Study; Portland Service Charge Website; Supporting Documents; Portland Press Article

III. OPTIONS TO INCREASE MUNICIPAL RESILIENCE TO CHANGING PATTERNS OF PRECIPITATION AND INCREASING SEA LEVELS USING EXISITING PLANS, POLICIES AND ORDINANCES

Maine municipalities have many existing tools to address resilience to changing climate conditions. Hazard mitigation plans, comprehensive plans, economic development plans, transportation plans, capital improvement plans, zoning ordinances, and site plan review ordinances all provide existing platforms. In fact, these plans and ordinances should be interconnected to ensure that the municipality's plans for growth and development along with effective hazard mitigation are supportive of one another. The following section provides brief descriptions of the municipal planning tools that are covered in more detail in individual sections of this toolkit.

THE COMPREHENSIVE PLAN:

Developing a comprehensive plan is an extraordinarily powerful process through which a community develops a vision for its future along with the strategies to implement that vision. The Land Use and Planning Regulation Act (30-A MRSA, Chapter 187) also known as the Growth Management Act (GMA) sets forth the State's goals for economic growth and natural resource protection. The State relies on municipal and regional plans to support those goals. Comprehensive plans are also a municipality's 'business plan'; strategies in the plan become the basis for a municipality's approach to governing along with other important elements such as zoning, economic development efforts, natural resource protection, capital improvement plans, transportation, recreation, community engagement and public safety. This is a logical and important place for a municipality to integrate concerns about the impacts from a changing climate. Climate change resilience and adaptation can be incorporated into a comprehensive plan as a separate chapter or integrated throughout the document. Maine's Community Resilience Checklist is a useful blueprint for crafting a discussion around resilience and adaptation.

How to use the comprehensive plan to increase resilience to climate change:

Including policies, strategies and implementation recommendations in a municipal comprehensive plan that address climate change impacts provides the basis for a municipality to budget for and take actions that increase resilience. For example, a policy in the Transportation section might state that all culverts are able to handle increasing levels of precipitation; the strategy could be that all culverts accommodate flows from a 50 – year storm; the implementation recommendation would be to initiate a study to inventory and document the community's existing culverts current condition including prioritization of culverts for upsizing and recommendations for inclusion of funding in the capital improvement plan or annual budget. Model language can be found in the Comprehensive Plan section of this toolkit.

Examples:

Bowdoinham Comprehensive Plan: Includes sea level rise and climate change chapter
York Sea Level Rise Case Study; York Comprehensive Plan includes a chapter on sea level rise

ORDINANCES:

Ordinances are used as a strategy to implement the comprehensive plan. A zoning ordinance is used by a municipality to guide and incentivize growth and natural resource protection. In Maine, In order to adopt a zoning ordinance a municipality must have a comprehensive plan consistent with the GMA . Additionally, Maine law requires each municipality have a municipal shoreland zoning ordinance (adopted either by the municipality or imposed by the state). And for a municipality to take part in the National Floodplain Insurance Program it must adopt a floodplain ordinance. These ordinances and others are tools that can be used to increase resilience to the impacts of climate change.

How to use different ordinances to increase resilience to climate change:

Zoning Ordinance:

The zoning ordinance is the logical tool to use to manage development in areas vulnerable to the impacts of sea level rise or increased levels of precipitation. Overlay zones can be created in high hazard areas that set different standards based on the type of hazard the area is vulnerable to.

Shore land zoning:

The model shoreland zoning ordinance that most Maine communities have adopted includes a requirement that new construction be elevated a minimum of one foot above the base flood. Several communities in Lincoln County are considering amendments to their shoreland zoning ordinance to increase the minimum elevation to three feet about the base flood.

Floodplain ordinance:

Most towns with a floodplain management ordinance adopt the state's model floodplain management ordinance. Among other provisions it requires that new construction within certain flood zones be built to a minimum elevation of 1 foot above the base flood elevation (BFE). However, A municipality has the authority to adopt a higher minimum elevation above BFE to accommodate sea level rise and several Maine municipalities have done just that.

Examples:
York Floodplain Management Ordinance

Site Plan Review ordinance:

The SPRO can be used to encourage or require consideration of changing climate conditions in proposed projects. It can be used along a continuum from simply requiring that an applicant consider changing climate conditions to requiring an explanation of how the project proposal incorporates that consideration to requiring that projects meet certain specified standards related to changing climate conditions. Model language is provided in the Model Site Plan Review Ordinance guidance document.

IV. RESOURCES these are some of the resources that we think can be helpful

MAINE SPECIFIC RESOURCES

		Steps of a Vulnerability Assessment				
		1	2	3	4	5
	UMaine Climate Change Institute	X				
	Maine's Climate Future *This report includes details about what to expect in Maine for changing climate conditions.*	X				
	Maine's Climate Future 2015 Update *This update to the original report provides clear graphics and explanations of predicted changes to Maine's climate.*	X				
	The Nature Conservancy Coastal Resilience Tool*This tool is built on Maine-based data appropriate for use at the local level including the data developed by the Maine Geological Survey and Maine Natural Areas Program. It includes an easy to use inundation viewer and future habitats viewer. Data behind the tool is downloadable. Check back for new elements on this viewer.*	X	X			
	Maine Geological Survey Coastal Hazards*This viewer developed by the Maine Geological Survey includes data for sea level rise, storm surge, hurricane inundation, and marsh migration (developed in collaboration with Maine Natural Areas Program). Data is downloadable.*	X	X			
	University of New Hampshire Sustainability Institute *This report includes detailed assessments of historical climate changes and projected changes for Northern Maine and Southern Maine.*	X				
	Maine Coastal Program Coastal Resilience Checklist		X	X		
	Maine Coastal Program Case Studies (ADD LINK)			X		
	Comprehensive Plan			X	X	X
	Municipal ordinances and policies			X	X	X
	MaineDOT Culvert Sizing Guidelines		X	X	X	

GENERAL RESOURCES

	U.S. Climate Resilience Toolkit	X	X	X		
	National Climate Assessment	X				
	EPA Smart Growth and Climate Change	X				
	EPA Risk-based Adaptation Planning		X			
	EPA Stormwater Calculator			X	X	

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U.S. Climate Resilience Toolkit (https://toolkit.climate.gov/)

2017

Municipal Climate Adaptation Guidance Series: Transportation

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This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

Introduction

A local road system consists of a network of components (e.g., roadways, bridges, culverts, etc.) that is owned and maintained by a city, county or other municipal transportation agency with little or no federal funding. Local road systems invariably are part of a larger network and decisions by one entity may affect regional transportation capacity if a local road is affected by any natural or man-made hazard.

By their very nature, local road systems are exposed to flooding and rainfall-runoff. Roads traverse the landscape, sometimes following along waterways and sometimes striking out across country without regard to hills, valleys and streams. Road systems, composed primarily of paved and unpaved roads and various types of structures that cross waterways, experience a range of damage. Damage results from rising creeks and rivers as well as from runoff due to locally intense rainfall.

Flooding affects both the short and long-term performance of local road systems and can affect communities in many ways, including increasing the potential for life loss and injuries, creating shortfalls in community budgets, delaying planned maintenance work because manpower and funds are diverted to recovery, disrupting normal traffic patterns, and stranding residents. Local governments typically are organized to include agencies that are charged to manage the local road system.

Various engineering, system-enhancement, and emergency-response strategies can be implemented to reduce the impacts of flooding. Each risk-reduction strategy – referred to as mitigation – has implementation costs and some residual risk of unacceptable performance will always be associated with floods that are larger than the design flood. A minimal approach (e.g., the “do- nothing” strategy) will have relatively low implementation costs but the residual risk of unacceptable system performance may be relatively high (perhaps unacceptably high). At the opposite end of the spectrum, aggressively pursuing mitigation will have high (perhaps unacceptably high) implementation costs but the residual risk of unacceptable performance will be small.

Just what constitutes unacceptably high implementation costs and unacceptably high residual risk depends on the constraints (economic, political, and legal) under which the responsible agency operates. It is generally understood that acceptable risk is owner and stakeholder acceptance of that level at which additional costs to implement mitigation measures to further reduce losses and risks are no longer acceptable. There is no standardized method by which individual communities perceive and address risk associated with local road systems.

In a pure sense, quantitative estimates of how much it costs to provide any given degree of flood- resistance, and the direct and indirect benefits of doing so, can be developed for any risk- reduction strategy. However, as a practical matter, just how costs and benefits are taken

into consideration by local road departments when determining risk and selecting risk-reduction strategies differs from one community to another. This is because of variations in geographic, economic, capability, capacity, and regulatory influences.

Flood-related damage to paved and unpaved roads, road shoulders, ditches, culverts and structures over waterways may be caused in several different ways. The three general types of flooding are:

- River and Stream Flooding occurs when rainfall generates runoff such that the volume of water conveyed in waterway channels exceeds the capacity of those channels and flows into flood hazard areas, commonly called floodplains. The standard typically used for flood hazard area identification and land management is the 1%-annual chance flood, commonly called the 100-year flood.
- Coastal Flooding occurs from storm surges and sea level rise. Storm surges are event based and cause temporary flooding. Impacts from sea level rise start by causing more frequent occurrences of 'nuisance flooding' when high tides impact roadways on king or annual high tides or even monthly high tides and progress to more frequent flooding events and potentially to total inundation from higher overall sea levels.
- Heavy Runoff occurs when intense rainfall generates concentrated runoff that either exceeds the capacity of drainage roadside ditches and underdrains or that flows where ditches and drains are not provided.

Roads and Drainage

Many places within Maine are experiencing damage to roads and drainage elements from the general types of flooding described above. The term "damage" is used broadly and ranges from localized ditch scour to complete collapse of a length of road bed or embankment. The nature of damage to roads and drainage elements includes but is not limited to the following:

- Saturation and collapse of inundated road beds;
- Loss of paved surfaces through flotation or delamination;
- Washout of unpaved roadbeds;
- Erosion and scour of drainage ditches, sometimes to the extent of undermining shoulders and roadbeds;
- Damage to or loss of underdrain and cross-drainage pipes;
- Blockage of drainage ditches and underdrain by debris, exacerbating erosion and scour;
- Undermining of shoulders when ditch capacity is exceeded;
- Washout of approaches to waterway crossings; and
- Deposition of sediments on roadbeds.

Often, the total cost for repair of damage to side ditches, underdrain and cross-drainage pipes, shoulders, unpaved roads and paved surfaces and road beds exceeds the total cost of damage to bridges and culverts that cross waterways. Further, a large part of the damage does not occur in what are generally considered floodplains along rivers and streams, but is a result of locally intense rainfall-runoff.

Waterway Crossings

Roads over waterways are supported by bridges, culverts, and low-water crossings as described below:

- Bridges. Generally, a bridge is composed of abutments on both waterway banks that are designed to support the bridge deck, driving surface, traffic loads, and other loading conditions (e.g., wind, seismic, snow load, etc.) A bridge may have intermediate supporting piers.
- Culverts. Culverts may be rectangular box structures that are site-built, or prefabricated units that range in shape from circular, to oval, to arched (sometimes bottomless).
- Low-Water Crossings. Low-water crossings allow vehicle passage and are intended to be under water all or some of the time. There are two general types: permanent concrete slabs (with or without small diameter pipes) and gravel embankments (with small diameter pipes) which form the driving surface.

For the purposes of inspections required by the U.S. Federal Highway Administration, specific definitions that vary from the common usage are used. The federal definition of a "bridge" is a structure having an opening that is more than 20 feet wide and may include multiple pipe or box culverts. A "culvert" is a structure having an opening that is 20 feet or less in width. Because the definition is based on the width of the waterway opening, a structure that is built like a bridge (abutments and superstructure) may be called a culvert.

The nature of damage at waterway crossings can include, but is not limited to the following:

- Local scour at piers and abutments with and without permanent structural damage;
- Downcutting of streambeds, which may affect bridge abutments/piers and undercut culvert inlets and outlets;
- Washout of gravel low-water crossings;
- Deposition of bed load that restricts the hydraulic capacity of crossings;
- Debris accumulation that may contribute to backup of water and damage to adjacent properties;
- Shifting of bridge decks due to pressure of rising floodwaters; and
- Shifting or migration of waterway channel alignment

Factors that Influence Transportation Flooding Decisions

This section discusses how flood risk-reduction decisions are affected by flood hazard data/maps and past experience with flood damage. First, there is brief background on the 1%-annual chance (100-year) flood which is the basis for flood hazard maps that are prepared by the National Flood Insurance Program (NFIP). Whether shown on a map or simply known through experience, flood hazards influence a town's Public Works general operations, efforts to comply with regulations, and evaluation and selecting waterway crossing designs.

Flood Hazards

The Federal Emergency Management Agency creates maps showing areas at varying levels of flood risk from naturally occurring events. These delineations are based on watershed studies and analysis of historical storm events. The maps provide the basis of eligibility for the National Flood Insurance Program and are frequently used in transportation infrastructure design. Following enactment of the National Flood Insurance Act in 1968, the 1%- annual chance flood (commonly called the 100-year flood) became the basic standard for delineating areas at risk from flooding. However, these maps are based solely on looking at historical conditions and do not currently take projected sea level rise or increasing levels of precipitation into account in their portrayal of floodplain locations. With changing climate conditions, designing or regulating based on the 1% conditions shown on flood maps may not provide the intended level of protection. Using the floodplain of the 0.2 % storm (commonly called the 500-year storm) is becoming a more common design standard to increase the resilience of transportation to future flooding and storm conditions but data on the 0.2% storm is not available for all communities.

> Does a 100-year flood mean it only occurs once every 100 years?
>
> No. What it means is that there is 1% chance that a flood of that extent could occur in any particular year. A 25-year flood has a 4% chance of occurring in any particular year; a 500-year flood has a 0.2% chance of occurring in any particular year.

Actual flood experience also plays an important role is design considerations. This appears to be for two reasons. The primary reason is that Public Works professionals deal with some degree of flooding nearly every year and do not depend on an external source of information to tell them where flooding is likely. They know that any drainage way can experience the effects of high water, whether it is a river, perennial stream, ephemeral stream, or simply a drainage ditch. The second reason is that not all municipalities have FEMA flood hazard maps based on detailed engineering studies; these maps show approximate flood hazard areas without sufficient information to support actual design.

Flood Hazards and Experience: General Public Works

Local road systems may be exposed to flooding and damage due to rising rivers and streams, to intense storms that generate rapid runoff and, depending on location, to storm surge and sea level rise. The nature of flooding and the potential for damage is usually well understood by municipal Public Works departments, as is the objective of flood resistance. Actual flood experience exerts a very strong influence on decisions made by Public Works departments especially flooding that has occurred within the tenure of the current directors. Public Works departments also recognize that local roads will always be exposed to some degree of flooding, and therefore, flood resistance does not mean "damage-free." This is especially likely for the many existing flood prone waterway crossings where multiple constraints often do not allow them to achieve the desired degree of flood resistance even when a crossing is replaced.

Whether flood damage has been localized or widespread, some degree of flood resistance can "sell itself,". Decisions to incur incremental, though undefined, costs to improve flood resistance may be made without explicit approval from higher authorities depending on constraints within an agency's maintenance budgeting. Although these decisions are invariably moderated to some degree by budgetary and other constraints, the decisions demonstrate the desire of Public Works to achieve at least some minimum tolerable level of acceptable performance of the roadway system (corresponding to some maximum tolerable level of acceptable risk). These decisions may be thought of as equivalent to an "acceptable- risk" approach, although many Public Works departments do not officially set specific acceptable-risk levels.

Work that is done with state or federal funds (primarily structures with spans longer than 20 feet) must comply with certain conditions, including flood-resistance requirements. Work that is done without those funds typically accommodates a "target" flood discharge for improved flood resistance that may be less than would otherwise be specified in conditions attached to state or federal funding. Sometimes the degree of success is limited by other constraints, including budget, impracticality at specific sites or measures that cannot be constructed with in-house crews. However, even in cases where conveying the target flood discharge cannot be achieved, Public Works should take whatever steps are available to reduce the impacts of flooding to the greatest practical extent.

Flood Hazards and Experience: Roads and Drainage

The primary mission of a municipality's Public Works department is to serve the public by maintaining and improving the local road system. Improving flood resistance is an integral part of that mission –not only to save resources and time following future floods but also to provide future savings in the form of damage avoided.

Improving flood resistance is implemented to different degrees and in different ways, largely as a function of the frequency of flooding, vulnerability to damage, the nature of past damage, constraints imposed by funding sources and permitting authorities, a community's resources, capabilities, and budget. It is standard civil engineering practice to design installations to handle a target flood discharge. The target flood discharge may be established by state regulations, as a condition of a permit, as a condition of a funding source, or by the Public Works internal objective to improve hydraulic performance. In the past, the target discharge used most frequently has been the 1% annual chance flood. Implicit in using runoff calculations based on frequent storms is that less frequent storms that produce more runoff will exceed the drainage capacity – although that, in and of itself, does not necessarily lead to damage.

Public Works departments make many decisions about their existing roads and drainage system components, and those decisions are influenced to some degree by consideration of runoff. For the most part, those decisions are not based on site-specific engineering; rather, they are based on common practice, experience and observations about what is effective. It is important to note that many such decisions are made by crew supervisors who have the authority to exercise judgment on such matters based on field conditions.

It is difficult to accurately delineate areas where runoff damage is likely to affect the road system drainage ditches and drainage pipes. Such damage may occur anywhere; it depends on where the heavy rainfall-runoff occurs, and not necessarily on where rivers and streams rise out of their channels. It also can be affected by conditions, not readily visible, that reduce culvert capacity such as impacted debris, beaver dams, etc. Sometimes drainage system components have been in place for decades and were not engineered for current site- specific conditions. Surrounding land use and land use changes can have dramatic effects on run-off and its associated impacts to roadways and drainage systems. Single developments with large cleared areas, increased area of impervious surface, and cumulative effects of development over time all result in an increase in the amounts of run-off that can cause devastating impacts on transportation systems that previously functioned without problem.

The Influence of Budgets

Sources and amounts of funding are factors that influence the ability of a municipality to maintain its local road system to the preferred level of functionality, including ability to restore safe functioning after flood damage occurs. Some communities may have significantly more funding options than others, but few are insulated from the unpredictability of internal budget processes and the variability of funding from external sources. When local funding is provided, the governing body usually specifies a target amount for the Public Works to plan for each year's budget. That amount is typically influenced by the department's reports of maintenance and capital project needs and does not include emergency repair and replacement needs.

The occurrence of flood damage places additional demands on the budget, since funding that was allocated for routine maintenance would instead need to be diverted to recovery operations. However, some Public Works departments establish special funds that are set aside for recovery, which moderates the adverse effect that floods have on the budget and should be considered a best practice to increase community resilience. In addition, departments that maintain good records of the extent of flood damage and the costs associated with damage repair can in some instances recover a portion of such costs from FEMA.

The Influence of Local Knowledge and Experience

The experience and knowledge of individual staff (both engineering staff and field crew supervisors) have an important influence on decisions about flood resilience issues. The past performance of individual bridges and culverts that have been exposed to flooding is another form of local experience that is very influential. Local knowledge and experience with flood-risk reduction measures that are implemented and subsequently tested during an actual flood are an important influence on subsequent decision making by municipalities.

The Influence of Staff and Equipment Capacity

Maine Public Works generally determine their current staffing levels (number and skill mix) and equipment requirements (types and sizes) based on their anticipated normal work load. Not surprisingly, budget constraints are a significant constraint on actual staff and equipment capacities such that staffing and equipment needs may fall short of those requested.

In-house capacity for engineering structural design of bridges and culverts varies due to the size of the community and budget. Some Maine communities have in-house engineering capacity while most do not. Those communities with engineering capacity have the ability to do site-specific designs. Communities without in-house engineering capacity contract out for the service when needed or rely on generic structural designs prepared by others.

The Influence of Inspections

Periodic inspections of roads and crossings yield data that, in large measure, guide decisions about road and drainage maintenance, as well as decisions about rehabilitation and replacement of waterway crossings. Bridges and culverts with spans longer than 20 feet are inspected every other year, in compliance with federal requirements. The resulting sufficiency and condition ratings should also be used to influence decisions on work other than routine maintenance. However, it is notable that, although inspections will identify scour and erosion that could affect structural stability during a flood, the purpose of the inspections is not to determine the adequacy of hydraulic performance. Culverts less than 20 feet tend to receive

much less scrutiny. The results of these inspections strongly influence the selection of structures for rehabilitation and replacement. When a structure is selected for rehabilitation or replacement for any reason, it is a good time to consider measures for improving performance under flood conditions.

The Influence of Immediate Post-Flood Recovery

The primary mission of local Public Works is to provide good local roads for the safety of the traveling public. This mission is unchanged when flooding affects the system, but the efficiency and thoroughness with which recovery is accomplished can be challenging.

Particularly challenging are the short and long-term impacts on the budget. Paying for flood recovery, if not specifically planned and budgeted beforehand, results in diversion of funds from routine maintenance and planned capital projects. If this diversion of funds is not compensated by an infusion of other local funds and reimbursement from state and federal sources, previously scheduled maintenance and projects will be delayed. If multiple damaging floods occur within a short period of time, or if adequate funding is not restored, then the net result is an overall reduction in the quality of the local road system.

Flood and runoff damage to local road systems can occur with regularity, and most of these events may not qualify for federal disaster assistance. This experience, and the expectation that flooding will likely cause some degree of damage every year, should influence municipalities to budget for flood recovery in the form of a special account that can accrue from year to year.

Quick and efficient post-flood response by a Public Works departments can conflict with the expectations of some state and federal inspectors. Some inspectors may challenge re imbursement requests or limit approved amounts for two reasons: either the work was performed prior to inspection, or documentation of the extent of damage is inadequate. As a result, the communities can perceive that they are penalized for having capable and responsive workforces. Furthermore, efforts to increase the capacity of replacement structures may conflict with state or FEMA reimbursement guidelines.

The Influence of Implicit Consideration of Costs and Benefits

There is no standardized method by which individual communities perceive and address risk, nor is there a standardized method for considering all costs and all benefits. However, most places include some implicit assessment of costs and benefits when making decisions about specific capital projects and routine maintenance. Due to dwindling budgets, they are keenly aware of the need to invest wisely. Given the many factors that influence decision making, including political pressures, decisions may not always be based solely on measurable costs and benefits.

For any given capital project to upgrade or replace a waterway crossing, a full accounting of direct costs can be developed. Direct costs are those associated with the engineering for design and with the labor, equipment, and materials for construction. Indirect costs are other costs that are associated with a project, such as increased di stance and time traveled if a detour is required. For local roads that are important to local industries, indirect costs may be significant.

Another component of a cost/benefit determination can be the identification of damages avoided. Thus, a structure or road segment that experiences flooding but does not sustain damage may accrue a benefit, the value of which is the avoided costs to repair flood-induced damage. It should be noted that a full accounting of such benefits may be difficult.

Many communities do not perform – and do not express interest in performing – rigorous analyses to estimate all costs and all benefits. This is partially due to the perception among the municipalities that these methods may possibly limit their ability to balance the many factors that influence all their decisions.

Although the Public Works departments usually develop some form of cost estimate for capital work, most of these estimates are not prepared in great detail – particularly when the work is to be performed in-house. In those cases, the estimates are simply based on the costs of similar work performed recently (which are available due to their detailed record keeping). However, cost estimates are typically prepared after decisions have been made regarding the desired level of performance (e.g., elevation of approach road, width of the road surface, waterway opening size to convey the target discharge, etc.). In some projects, cost estimates for different configurations are prepared. However, these will pertain to, say, comparing a bridge to a box culvert, rather than comparing incremental costs of different degrees of flood resistance. Thus, it would be difficult to separate out costs specifically associated with flood resistance.

In addition, cost estimates that are prepared before departments fully understand state and federal permitting requirements may, in some cases, substantially underestimate full project costs. Structures that are used by migrating or protected fish species, for example, may need to be larger or of a more rigorous and expensive design than would otherwise be suggested simply on a hydraulic basis.

Most communities do not attempt to quantify the myriad benefits of a safe and fully functional local-road system. Nor do they make a full accounting of all direct and indirect costs associated with improving flood resistance – much less all direct and indirect benefits. Municipalities mostly factor economic importance into their long-term planning for road and crossing improvements, but any balancing of costs and benefits is done is based on experience rather than detailed calculations.

A municipality essentially decides about cost effectiveness related to improving flood resistance when it finds that the incremental cost of the next larger size pipe or a somewhat

longer bridge superstructure is small, while the labor costs do not vary significantly. However, the degree of improvement associated the next larger size or the somewhat longer bridge is not quantified.

2017

Wastewater Management and Changing Climate Conditions

A GUIDANCE DOCUMENT FOR MAINE MUNICIPALITIES

LEE JAY FELDMAN, SOUTHERN MAINE PLANNING AND DEVELOPMENT COMMISSION

This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

Introduction

Modern wastewater infrastructure is a vital part of everyone's daily lives, protecting Americans from waterborne diseases and preserving the nation's waterways as ecological, recreational, and commercial assets. But Americans' preference to keep their minds out of the gutters, sewer mains, and treatment plants that comprise this system makes it easy for political leaders to neglect this infrastructure—at least until catastrophes cause unpleasant spills and costly cleanups. As climate change exacerbates extreme weather events and speeds sea-level rise, deficiencies in wastewater infrastructure will get harder to ignore—and increasingly costly to clean up after failures. To protect public health, the environment, and the economic gains provided by good water quality, local, state, and federal officials must act quickly to repair and upgrade the nation's rapidly aging wastewater infrastructure. This action must accommodate both contemporary and future levels of service demand and be constructed to withstand effects of climate change.[1]

Wastewater Infrastructure is one of the most important and likely largest pieces of community infrastructure. Long range planning, maintenance and replacement considerations are complicated even without adding the consideration of changing climate conditions. Climate change is playing a major role in how municipalities need to look at these issues moving forward. Regardless of the location of the wastewater plant itself, consideration needs to be given to sea-level rise, storm surge and increased storm intensity. This section will provide basic guidance to coastal communities with respect to the steps in assessing the vulnerability of the wastewater infrastructure in your town and the next steps to follow once that determination has been made.

Vulnerability Assessment

The place to start is with a vulnerability assessment of the wastewater treatment plant. This process should be undertaken by a committee of stakeholders that, at a minimum, includes members of the public, municipal staff, and wastewater treatment plant staff. While it is possible to conduct this assessment with in-house expertise, most coastal Maine communities will find it necessary to hire a consultant to help them through this process.

[1] Rising Waters, Rising Threats Center for American Progress

Recent examples of wastewater treatment plant assessments include those in Wiscasset and Boothbay Harbor (see http://lcrpc.org/coastal-projects-planning/wisc-bbh-waste-water-treatment-plants).

The municipality first needs to decide what climate change scenarios it wants to incorporate into the vulnerability assessment. This should be reflective of the community's level of risk tolerance. Using the most current and best available local data, the vulnerability assessment should look at a series of:

- Sea-Level Rise scenarios and
- Storm Surge scenarios

WWTP Looking North Between the Process Building and SBRs – BFE +4

Followed by:

- Analysis of the potential impacts to the wastewater system for each scenario;

- Development of alternative scenarios for each one of the baseline assumptions and impacts;
- A cost benefit analysis for each scenario.

This will help the community understand at what point the infrastructure will be impacted and to what extent. From that point, decisions can be made on what approach is the most cost effective for the community. There are three basic courses of action beyond a 'do nothing' choice:

- Protect in place
- Retreat by re-aligning the wastewater system location
- Retreat by consolidating systems with a neighboring community

The Vulnerability Assessment should include all elements of the wastewater system; those include:

Pump Stations

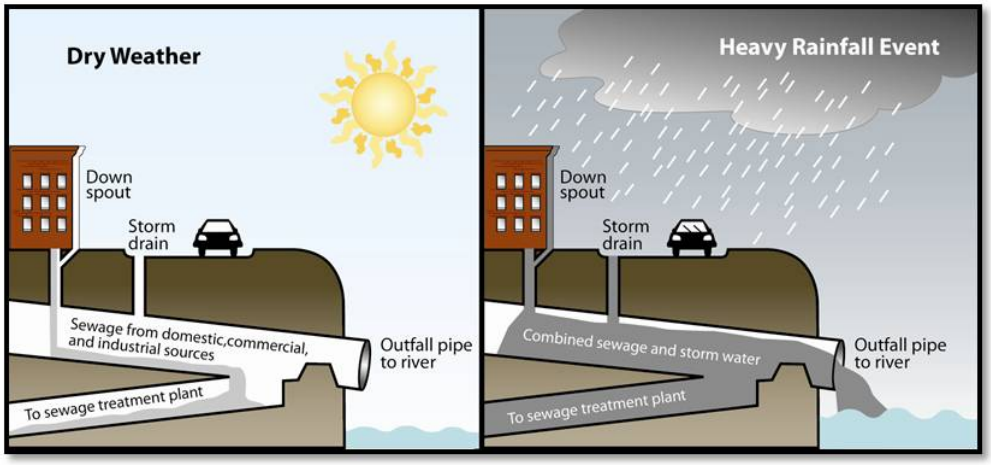
The only way to move the effluent through the system is by strategically placed pump stations. In some cases, those are located at low points and may be vulnerable to flooding regardless of the storm scenario. As part of the assessment, identify those locations that are vulnerable to impacts, assess the structural integrity of those locations and make a determination as to the best alternative solution for the system.

PS #12 Electrical / Controls Panel Looking South - BFE +4

Old Pipes

Remember, not all the infrastructure is visible. There may pipes lurking underground that must be considered. A street washed out during a storm event can raise havoc with the pipes below. If the pipes are impacted, repairs may keep the entire system down until appropriate repairs can occur. This is another reason to understand the vulnerability and condition of the entire system before it is impacted – emergency repairs are always more expensive than scheduled repairs.

Old pipes are also often leaking pipes that allow groundwater to infiltrate and result in additional treatment plant load. In addition, many communities still have some combined sewer lines. That is, the stormwater and sewage systems may not be fully separated, allowing stormwater flows to enter sewage lines via catch basins. This is especially problematic during storm events when treatment facilities can get overwhelmed by the volume of combined stormwater and sewage entering the plant, sometimes resulting in the direct discharge of untreated waste into receiving water bodies, as illustrated by this graphic from Akron Waterways Renewed.



Chemical Storage

Wastewater facilities utilize a great deal of chemicals in the process of decomposition. Questions to consider during the vulnerability analysis include:

- How are they being stored?
- Where are they being stored?
- Are they stored out of harm's way now?
- Will they remain safe in the climate change scenarios evaluated through the Vulnerability Assessment process?
- In the case of a catastrophic event, assuming chemical storage is not impacted, how long can the system operate with the chemical supply on-hand? Is there a plan in place for emergency resupply?

Additional Considerations

- Changing Regulations- A community faced with making changes to its wastewater treatment system in response to changing regulations also has an opportunity to increase resilience to the impacts of climate change at the same time.

- Growth & Increased Demand- If the community is considering modifications to the facility to increase resilience to climate impacts, projected population growth and business expansions should be incorporated into the design process as well.
- The Coastal Barrier Resource System (CBRS)[2]- a facility located within a CBRS is covered by regulations that could affect funding for any proposed work. In accordance with the Coastal Barrier Resources Act (CBRA) of 1982, certain activities to develop or rebuild within CBRSs cannot be funded using federal subsidies. Consultation with the U.S. Fish and Wildlife Service may grant the use of federal monies for certain exempted activities within a CBRS, such as emergency assistance. Additionally, if the facility attained federal flood insurance before 1982, the policy may not be renewed upon substantial improvements or damages to the facility.

  The State of Maine recently accepted the federal designation of a CBRS, and created Maine Revised Statute Title 38, Chapter 21: Coastal Barrier Resource System. The governing statute prohibits state funding or financial assistance for any development activities within the Coastal Barrier Resource System (CBRS), unless the project involves the maintenance, replacement, reconstruction, repair, or in limited circumstances, expansion of state-owned or state-operated structures, facilities or roads identified in §1903(1)(A) of the Act. For maps and more information on CBRS in Maine, check the Maine Geological Survey site: http://www.maine.gov/dacf/mgs/explore/marine/facts/barrier.htm.

Outcomes of Not Addressing the Issue

First, many of the rivers, lakes, and seashores in Maine that receive wastewater runoff also happen to be top American vacation destinations. As a result, sewage-fouled waterways and beach closures following major storms result in substantial economic losses for recreation- and tourism-based businesses that depend on healthy coasts. Studies in Southern California and Michigan both found that the daily economic cost of closing just one beach due to pollution was about $37,000. In 2012, there were 5,634 days of beach closures and beach advisories nationwide due to storm-water runoff; in 2011, which was a significantly wetter year, there were 10,780 days of closures and advisories. Although a national average economic cost per day of beach closures is not available, these findings suggest that the impact of inadequate wastewater management to coastal businesses and communities is considerable.[3]

Second, sewage spills also carry significant health costs, exposing people to pathogens and toxins. Another Southern California study found that the fecal contamination of ocean waters in Los Angeles and Orange counties alone causes as many as 1,479,200 gastrointestinal illnesses every year, with a public health cost of between $21 million and $51 million. The EPA

[2] Woodard & Curran August 2012 Preliminary Engineering Report Town of Ogunquit
[3] Rising Waters, Rising Threats Center for American Progress

estimated in 2011 that 3.5 million people around the nation contract illnesses each year after contact with raw sewage from SSOs.[4]

[4] Rising Waters, Rising Threats Center for American Progress

2017

Municipal Climate Adaptation Series: Drinking Water

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This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

Table of Contents

Introduction

Climate Change is affecting communities both on the coast as well as inland. Regardless of whether it is Sea Level Rise, Storm Surge or more powerful storm events, these changes are affecting our municipal infrastructure. While local and regional predictions of future climate can be imprecise, problematic, and often contradictory, making it difficult to plan for specific predicted changes in the climate, general trends all indicate thperiod of greater variability in our climate: more intense summer storms and extreme winter weather, flashier discharge of surface water with higher frequency of floods and droughts, and generally higher temperatures in all four seasons.

If global temperatures continue to rise, increases in the number and severity of storms, floods, droughts, and other weather extremes, will have serious impacts on the environment and on society. Societies that are unable to deal with these extreme events will experience more disasters. Climate simulations to predict seasonal temperature and precipitation show a strong trend in Maine toward warmer and wetter conditions. Reports project increases in both temperature and precipitation, which tend to be greatest in the north and least along the coast. The warming trend implies a significant shift in northern part of the state, from a snowmelt-dominated regime to one that shows significant runoff during winter. This shift will likely pose challenges in managing water supplies, flood mitigation, and understanding of the ecosystem.

Coastal communities are experiencing flooding damage, erosion, and landslides more frequently. The coastal damage will have negative economic effects as well as the obvious hazardous consequences. According to the Federal Emergency Management Agency (FEMA), in southern Maine, a 1” rise in sea-level will make all storms more damaging with serious economic and ecosystem consequences to the region. Fishermen have already noticed significant changes in the lobster fishery. Changes in the lobster fishery have serious implications for Maine’s coastal communities where

thousands of licensed lobstermen and women support numerous related industries such as boatbuilding, lobster trap production, and bait distribution and transportation.

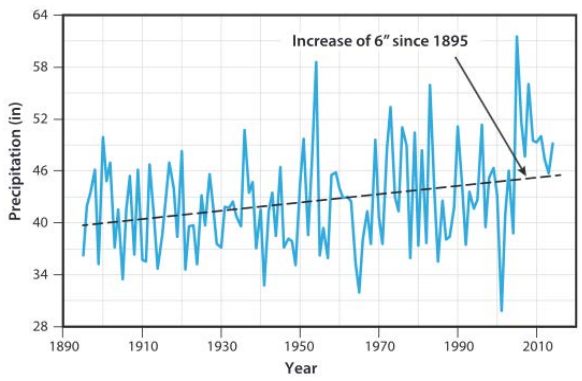
Climate Change and Drinking Water

"Maine has 2200 public water systems which serve drinking water to half a million people by drawing water from more than 2600 individual water sources (wells and surface water intakes)."[1] "A public water system is defined as any publicly or privately owned system of pipes and facilities through which water is served to 15 or more service connections or to 25 or more persons per day for at least 60 days per year."[2] These systems range "in size and function from large community systems serving entire cities or towns to seasonal restaurants and camping facilities which serve only a few hundred people for the summer. The vast majority of these water systems utilize one or more wells drilled in fractured bedrock. However, most large community water systems are supplied by a well or wells installed into loose, unconsolidated materials such as sand and gravel or by water drawn through an intake in a lake or pond."[3] Public water systems are required to have their water quality monitored on an annual basis. The remainder of Maine's residents gets their drinking water from a private source, usually a dug or drilled well. Water quality monitoring on private systems however is up to the individual owner.

Sebago Lake

Source water for Maine's largest drinking water provider, Portland Water District, serving over 15% of the state's population.

Maine's Total Annual Precipitation



Total annual precipitation, 1895-2014, averaged across Maine from gridded monthly station records from the U.S. Climate Divisional Datbase. A simplified linear trend (black line) inches, or about 13%, during the recording interval. (http://cci.siteturbine.com/uploaded_files/climatechange.umaine.edu/files/MainesClimateFuture_2015_Update2.pdf)

Impacts of a changing climate pose threats to Maine's drinking water quality. Maine is experiencing, and current predictions indicate continued increases in rainfall amounts with changes in timing and intensity of precipitation as well as increases in sea level. Over the last century precipitation has increased by more than 10% in the Northeast,[4] the greatest increase of any region in the

[1] Maine Department of Human Services Drinking Water Program. (2000). *Maine Public Drinking Water Source Water Assessment Program.* Augusta, Maine. P.2 (http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/wrt/documents/swapforweb.pdf)

[2] Ibid. P.9

[3] Ibid. P.3

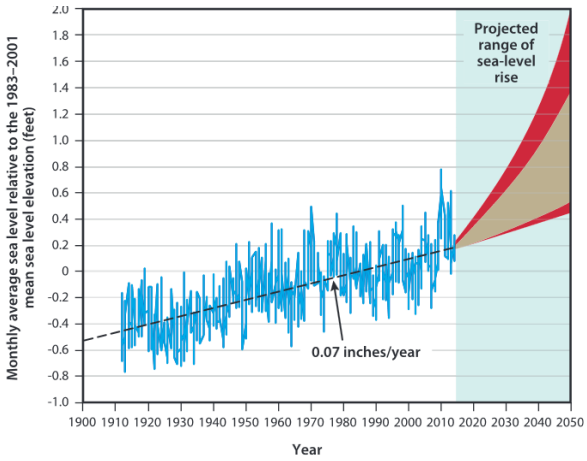
[4] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: *Climate Change Impact in the United States: The Third National Asessment.* U.S. Global Change Research Program 841 pp. dio: 10.7930/J0Z31WJ2. P.373

country. This translates to a precipitation increase of about 6 inches per year[5]. Of greater concern is that over the last 55 years precipitation quantity has increased 70% during extreme precipitation events (events in which 2 or more inches of precipitation fall within a 24 hour time period)[6]. Although these extreme events occur more frequently along the coast and western mountains of Maine, their frequency is increasing statewide. Extreme precipitation events often lead to flooding. Flooding with these events may be short in duration and confined to small geographies but brings increased risk for contamination to drinking water. Flood waters wash sediments, pathogens, pesticides, and salt into surface water bodies. When precipitation events are more extreme less water is absorbed into the ground. For example, during a rain event in which 2 inches falls over 48 hours much of the water will be absorbed because the rate of precipitation is slow enough to allow soils to absorb it. In contrast, a rain event in which 2 inches falls over only 12 hours much of the water will wash away as storm water into surface water bodies and other storm water conveyance systems because the rate of precipitation is too great to allow soils to absorb it. This scenario leads to greater recharge of surface waters but reduced recharge of groundwaters.

Despite overall increases in precipitation, snow fall in Maine has decreased by about 15% since the late 1800s[7]. Changes in the timing of precipitation – wetter spring and fall with longer dry spells during summer months – coupled with decreases in snow fall and groundwater recharge during extreme precipitation events, referenced above, may lead to decreases in groundwater recharge necessary to maintain underground aquifer sources and the wells dependent on them. Shallow wells will be the most influenced by these changes.

Sea level has risen nearly 8 inches over the past 100 years, the rate it is rising is increasing, and conservative estimates project it will rise another 6 to 24 inches over the next 35 years.[8] "Storm surges can add 3 to 4 feet of

Sea Level Trend at Portland, Maine



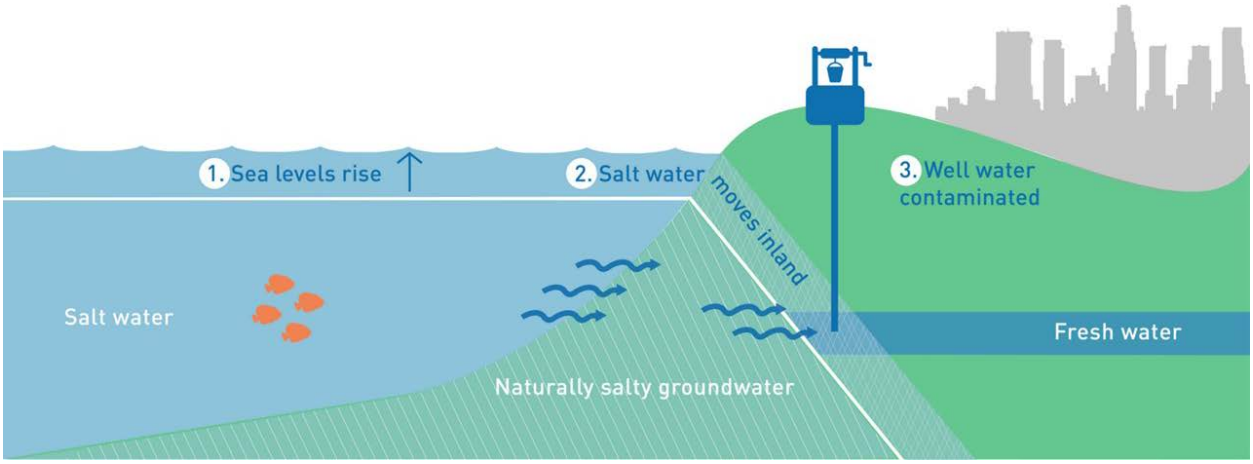
Sea level rise at Portland provided by NOAA Center for Operational Oceanographic Products and Services. The mean sea level trend is 0.07 inches per year based on monthly mean sea level data from 1912 to 2013, which is equivalent to a change of 0.62 feet in 100 years. The projections reflect the range of possible scenarios based on other scientific studies. The current projected range of sea level rise of 0.5 to 2.0 feet by 2050 falls within a larger range that incorporates uncertainty about how glaciers and ice sheets will react to the warming ocean, the warming atmosphere, and changing winds and currents.(http://cci.siteturbine.com/uploaded_files/climatechange.umaine.edu/files/MainesClimateFuture_2015_Update2.pdf)

[5] Fernandez, I.J., C.V. Schmitt, S.D. Birkel, E. Stancioff, A.J. Pershing, J.t. Kelley, J.A. Runge, G.L. Jacobson, and P.A. Mayewski. 2015. Maine's Climate Future: 2015 Update. Orono, ME: University of Maine 24pp. P.12.
[6] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: *Climate Change Impact in the United States: The Third National Asessment.* U.S. Global Change Research Program 841 pp. dio: 10.7930/J0Z31WJ2. P.373
[7] Fernandez, I.J., C.V. Schmitt, S.D. Birkel, E. Stancioff, A.J. Pershing, J.t. Kelley, J.A. Runge, G.L. Jacobson, and P.A. Mayewski. 2015. Maine's Climate Future: 2015 Update. Orono, ME: University of Maine 24pp. P.14.
[8] Ibid. P.20.

water on top tidal heights.[9]" Rising sea level affects salt marshes, beaches, and flood zones. Salt marshes serve to protect coastal areas from storm surge, and their utility diminishes as they are lost to rising seas. Existing development along beaches becomes vulnerable to coastal land slides as beaches erode under rising seas. And coastal flood zones move further and further inland as sea level rises.

Sea level rise threatens coastal wells in 2 ways. First, expanding flood zones put more and more well heads at risk for salt water intrusion from storm surge and coastal flooding. Second, rising sea level changes the interface between salt water and coastal fresh water aquifers. As sea level rises the depth of fresh water within the aquifer shrinks. Maine's islands and many penninsulas are especially at risk.

Higher Sea Levels Can Contaminate Wells



http://www.clearpath.org/content/clearpath/en/why-clean-energy/impacts-and-risks/sea-level-rise-impacts-beaches/_jcr_content/cp-content-parsys/column_control_4/par2/image.img.jpg/1434643178436.jpg

Adaptation and mitigation strategies to address the effects of climate change will need to include both supply-side and demand-side strategies. Policy development will need to incorporate a variety of stakeholders as water is critical to many sectors – energy production, health, food, and ecosystem integrity.

Ways to address threats to drinking water

A growing number of tools exist to assist communities and infrastructure owners/operator in assessing and planning for climate impacts to drinking water supplies. The following sections provide overviews of a few of the tools available:

- EPA Climate Ready Water Utilities Initiative
- EPA Community-Based Water Resiliency (CBWR) Tool
- EPA CREAT Tool

[9] Ibid. P.21

- Resilience Measurement Index
- Water Safety Plan Manual

Tool: EPA Climate Ready Water Utilities Initiative

Background

Created by the US Environmental Protection Agency, the Climate Ready Water Utilities initiative provides a clearing house of resources for water utilities, inclusive of wastewater and stormwater, for addressing climate change impacts. Resources include climate change science and data, tools, and trainings; and are intended to increase understanding of climate change and decision making around adaptation.

Intended Users

The broad diversity of resources available offer options for a variety of users with differing levels of knowledge. Trainings are available for both those seeking to increase their understanding of the issues and related tools, as well as how to increase understanding and engagement of others around the issues.

Using the Tool

The Climate Ready Water Utilities initiative is broken into three categories: home, tools and resources, and training. Home is where users will find an overview of the initiative, a video of water utilities that are undertaking action and its importance, announcements of new resources, and a place to register to receive email updates on news and new resources. Tools and resources provides links to tools, data, information, and case study resources for evaluating and understanding vulnerability, planning for impacts, and adaptation strategies. Two of the available tools, the Community-Based Water Resiliency Tool and the Climate Resilience Evaluation and Awareness Tool are outlined below. Training offers a library of webinars and announcements of training events. Additionally, links to general information on drinking water and related education, funding opportunities, regulations, pollution, science, infrastructure, and public engagement are also available.

Accessing the Tool

The Climate Ready Water Utilities initiative is housed online and available at: http://water.epa.gov/infrastructure/watersecurity/climate/index.cfm. All downloadable resources are available for free. Additional information on the initiative can be obtained by contacting the US Environmental Protection Agency either through the Contact Us link available on the website or at:

U.S. Environmental Protection Agency
Office of Water (4100T)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Tool: Community-Based Water Resiliency (CBWR) Tool

Background

Developed by the US Environmental Protection Agency the Community-Based Water Resiliency Tool is a user friendly tool that guides users through a self-assessment, provides tailored recommendations on tools and resources, offers a Water Resiliency Action Plan kit to help users plan community meetings and workshops, and access to hundreds of tools and resources.

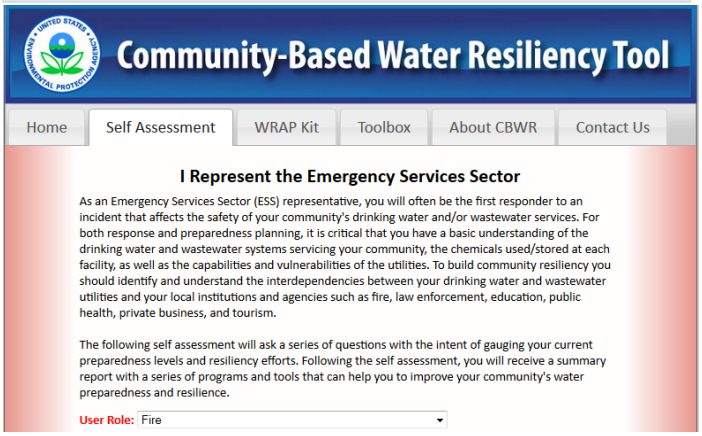
Intended Users

The Community-Based Resiliency Tool can be used by a wide variety of stakeholders. It offers preloaded self-assessments for use by water utilities, healthcare and public health providers, state / tribal authorities, emergency service providers, and local officials and community partners.

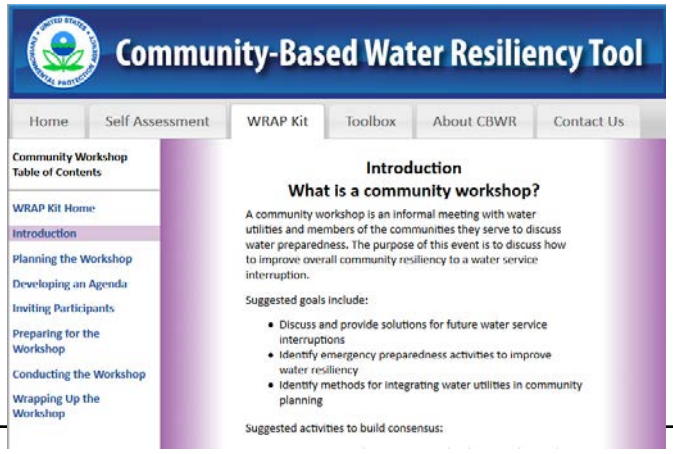
Using the Tool

The Community-Based Resiliency Tool is composed of self-assessments, the Water Resiliency Action Plan (WRAP) kit, and a toolbox of tools and resources. The self-assessments can be completed by individuals or groups of stakeholders and are intended to identify those tools and resources best suited to the stakeholder(s). Self-assessment questions are accompanied by menus of standard answers, and options for submitting more specific answers. The more time a user, or set of users, takes to specify responses the more targeted the report of tailored resources will be.

Sample Self Assessment



Water Resiliency Action Planning



The Water Resiliency Action Plan (WRAP) kit provides guidance on hosting a community workshop or community meeting. Community meetings are intended to educate and raise awareness of local water resilience challenges, and community workshops are designed to set goals and responsibilities around

water emergency preparedness. For organizing either a community meeting or workshop the kit provides step-by-step suggestions for meeting/workshop planning, setting the meeting/workshop agenda, identifying and inviting stakeholders, preparing for and conducting the meeting/workshop, and post-meeting/workshop activities. The kit includes presentations, videos, document templates, and tips for success.

The Toolbox of tools and resources can be viewed in several ways: by stakeholder group (water utilities, healthcare and public health providers, state / tribal authorities, emergency service providers, and local officials and community partners), all tools, or those related to hosting public meetings and workshops. Tools and resources are further broken into seventeen issue categories.[10]

Accessing the Tool

The Community-Based Resiliency Tool is web-based and can be downloaded for free. Additional tool and program information can be obtained by contacting the US Environmental Protection Agency:

Email: wsd-outreach@epa.gove
Telephone: (202) 564-3779
Mailing Address:
USEPA Headquarters
Water Security Division, CBWR
Ariel Rios Building
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

[10] Issue categories include: aging infrastructure, asset management, communication and outreach, contaminant detection, drinking water systems, emergency preparedness and response, funding, general water security, ICS/NIMS, laboratory support, local emergency planning committees, mutual aid assistance, protective practices and funding resources, training and exercises, vulnerability assessments/emergency response plans, wastewater systems, and water sector interdependencies.

Case Study

St. Clair County, Michigan implemented the Community-Based Water Resiliency Tool in May of 2012. A day long round table session was hosted by the St. Clair County Homeland Security-Emergency Management Office. The day-long event featured speakers, breakout sessions, and an emergency response panel session. A full description of the event can be found at: http://water.epa.gov/infrastructure/watersecurity/communities/upload/epa817s13001.pdf

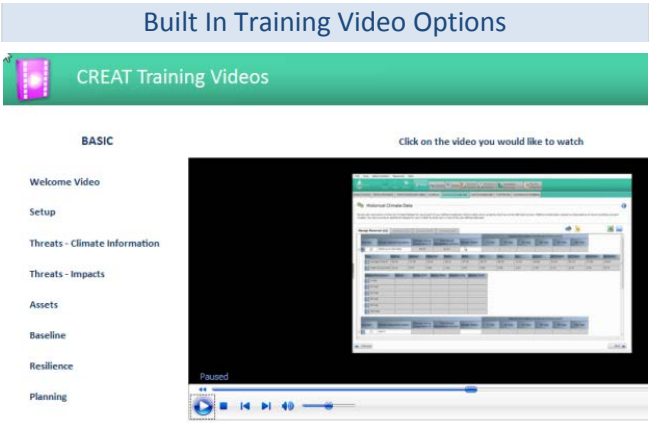
Tool: EPA Climate Resilience Evaluation and Awareness Tool (CREAT)

Background

Created by the US Environmental Protection Agency and released for public use in 2015 the Climate Resilience Evaluation and Awareness Tool is a downloadable software application to assist water utilities in understanding threats and vulnerabilities, options for adaptation, and impacts of adaptation strategies. Evaluations and planning can be tailored to a utility's unique infrastructure. The software includes a series of training videos to help users conduct an analysis and the ability to conduct and refine multiple analyses for one or more utilities.

Intended Users

The tool's application is intended for water utilities, but the application is available to all interested users. Given the more complex nature of the application utilities may want to have an individual or organization well versed in climate change, adaptation, and planning assist with completion of the analysis.



Using the Tool

To begin users will need to familiarize themselves with the tool via the available trainings contained in the software download. Trainings are broken into two series, Basic and Advanced. The Basic series is comprised of eight training videos that walk users through an overview of the application's analysis components – setup, climate threats, climate impacts, assets, creating a baseline, resilience options, and planning. The Basic series of training videos takes a little more than one hour to complete. The Advanced series is comprised of nine training videos that build on the components covered in the Basic series but with more detail on how to complete each component of an analysis, plus a training specific to sea level rise. The Advanced series of training videos takes about an hour to complete. However, completion of the training videos themselves is not sufficient to have proficient skills in completing an analysis. Users should be prepared to return to the training videos while completing an initial analysis and it is suggested that a mock analysis be completed to more fully understand the analysis components and process.

Once a user has familiarized themselves with the Climate Resilience Evaluation and Adaptation Tool, they are ready to begin an analysis. The Setup component of an analysis initiates with having the utility complete worksheets to assist in filling out the necessary contextual information. Worksheets include Pre-Assessment Discussion where goals, choice of participants, and asset categories are considered; Climate Data where data resources, locally

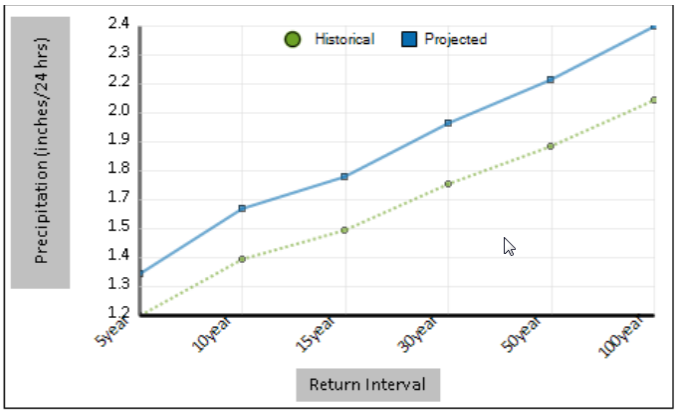
collected data, and climate scenarios are considered; Setup Data where asset locations, scenario time periods, climate related event likelihood, and event consequences are considered; and Adaptation Preparation where adaptation strategies, implementation, and actions are considered. These worksheets do not need to be completed before initiating an analysis but are helpful in thinking about the analysis ahead of its completion.

CREAT Process Diagram

The Setup component continues with having a utility enter:

- General Utility Information - contact information, ownership, population served, basic financial information;
- System Information – system identification, average household water costs, miles of mains;
- Locations – latitude/longitude/elevation of infrastructure, and descriptions for each piece of infrastructure entered;
- Historical Climate Data – select or upload a climate data set, data can be edited and customized;
- Likelihood Approach – opt to either conduct an analysis on the likelihood that all threats will occur, or assess the likelihood of individual threats;
- Time Periods – select CREAT provided planning time periods of year 2035 and year 2060, or enter customized time periods; and
- Consequence Weighting – weight the consequences of threats to selected assets

Geographic Specific Climate Data



Once Setup is complete, a user then steps through the Threats component that includes climate information to help users in their decision making; the ability to edit selected climate scenarios in terms of temperature, precipitation, and if applicable sea level rise; select climate change related threats such as altered demand and increased flood frequency taking into consideration location and climate change drivers such as increasing temperatures and changing storm intensity; add desired parameters to threats; and assess likelihood of threats. The Threats component is followed by the Assets component of the analysis. A user selects natural and built assets such as flood

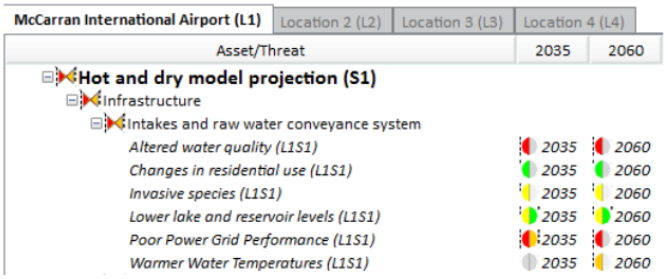
protection, surface water, treatment plant, and distribution system. Selected asset information can be customized providing specific locations, descriptions, and photos.

With the next component a user begins the actual analysis. A Baseline Analysis is generated by a user choosing adaptation strategies or measures if applicable already in place for each asset/threat pair created during the Threats and Assets components. Users choose measures from the categories of alternative strategies such as green infrastructure, expanded capacity such as new construction, and expanded operating flexibility such as research and development. Building on the Baseline Analysis users then complete a Resiliency Analysis choosing new adaptation strategies they might implement for each asset/threat pair. The tool informs a user of the likelihood of a threat occurring, the degree of consequence to the asset, and the degree of change in consequences between current strategies or measures already in place and selected strategies for consideration.

Scenarios and Threats

	Likelihood (Hot & Dry)		Likelihood (Central)		
Threats	2035	2060	2035	2060	20
Changes in SNWA energy use and availability	n/a	High	n/a	Medium	n/
Changes in residential use	Medium	Medium	Medium	Medium	Mec
Poor power grid performance	Medium	Medium	Medium	Medium	Mec
Runoff timing	n/a	n/a	Medium	Medium	Lo
Reduced snowpack	High	High	Medium	High	Mec
Lower lake and reservoir levels					

Choosing Adaptation Strategies



To help a user further determine what new adaptation strategies to consider the next component is Adaptation Planning. This component allows a user to create packages of adaptation strategies including the ability to add strategies not available in the CREAT library of strategies. Details like cost can be added to give each package the necessary specificity to compare them. The tool can generate a spreadsheet report so data can be reviewed, saved, and input into other documents.

Finally, once a user is satisfied with all data and decisions incorporated into the CREAT analysis, a report can be generated. The tool is able to self-generate a written report in Microsoft Word that a user can edit if desired. The report contains methodology and contextual information as well as data and results from the analysis.

Again, although the tool includes resources to increase understanding of climate change, assets, threats, and adaptation strategies, it is recommended that use of the tool be facilitated by someone experienced in climate change adaptation.

Accessing the Tool

The Climate Resilience Evaluation and Awareness Tool is web-based and can be downloaded for free. Additional tool and program information can be obtained by contacting the US Environmental Protection Agency:

Email: CREAThelp@epa.gov
Mailing address:
U.S. Environmental Protection Agency
Office of Water (4100T)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Case Study

In 2013 the Southern Nevada Water Authority (SNWA) worked with the US Environmental Protection Agency to conduct an analysis and identify adaptation strategies using the Climate Resilience Evaluation and Awareness Tool. Population growth and drought had routinely presented challenges for the SNWA, but climate change added a level of uncertainty that called for a proactive approach in planning for future water supply. SNWA's work with EPA resulted in a full risk assessment determining the potential impacts of climate change on its operations and identifying adjustments to management of future water supplies. Via two webinars EPA introduced SNWA staff and others to the CREAT software and analysis process. Subgroups then met to collect and refine data. Finally, a two day exercise was held to complete the analysis and build an adaptation package. A full description of the process can be found at:
http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817s13002.pdf

Tool: Resilience Measurement Index

Background

The Resilience Measures Index was developed in 2013 by Argonne National Laboratory for the US Department of Homeland Security. It is used to determine the resilience of critical infrastructure through evaluating preparedness, mitigation measures, response capabilities, and recovery mechanisms. The evaluation allows infrastructure operators to "compare their level of resilience against the resilience level of other similar facilities nationwide and guide prioritization of improving resilience."[11]

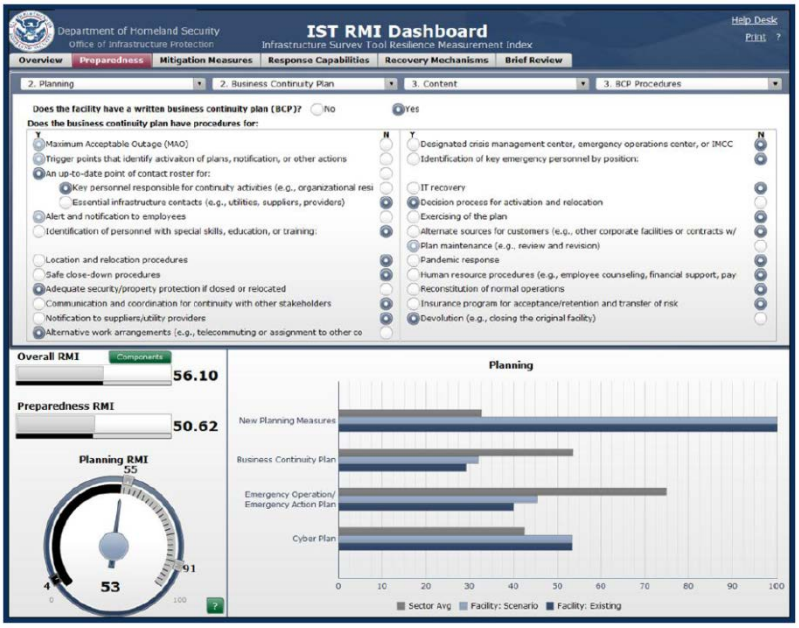
Intended Users

This tool is limited to infrastructure owners/operators.

Using the Tool

In order to be eligible to utilize the Resilience Measurement Index, a drinking water utility must have previously participated in the Enhanced Critical Infrastructure Protection Initiative and have had data entered into the Infrastructure Survey Tool. The Infrastructure Survey Tool is a web-based tool for data collection and analysis. Data collected from the Resilience Measurement Index builds on that of the Infrastructure Survey Tool allowing for use of an interactive web-based dashboard. The dashboard includes a Facility Scenario function allowing operators to see the potential impacts of resilience strategies (polices, procedures, or operational methods). Following a Resilience Measurement Index assessment operators are then eligible to take advantage of both the Protective Measures Index (determines physical infrastructure vulnerabilities) and the Consequences Measurement Index (determines the maximum potential consequences of an adverse event). Combined these indices allow "for a

RMI Dashboard Overview Screen



RMI Dashboard Selections: Planning/Business Continuity Plan/Content/Procedures (illustrative)

[11] Argonne National Laboratory Decision and Information Sciences Division. (2013). *Resilience Measurement Index: An Indicator of Critical Infrastructure Resilience* (p.x). Oak Ridge, TN: US Department of Energy

comprehensive assessment of risk that can support decision-making about protection, business continuity, and emergency management of critical infrastructure."[12]

Other than the Infrastructure Survey Tool requirement, use of the Resilience Measurement Index is straightforward. Data is collected on-site by Homeland Security staff. The on-site data collection takes approximately four hours. The data is then uploaded to the Infrastructure Survey Tool where operators can then access it.

Accessing the Tool

Use of the tool is free and available through the Maine Office of Homeland Security. Interested drinking water providers should contact:

William DeLong, Maine Protective Security Advisor
US Department of Homeland Security
William.delong@hq.dhs.gov

Case Study

The U.S. Protected Critical Infrastructure Information Act prevents the sharing of those utilities that have completed the Resiliency Measurement Index. However, a few common themes have emerged from those Maine utilities that have completed the index. The greatest of these being the costs associated with infrastructure upgrades necessary for improved resiliency. Although utilities can request a rate increase from the Public Utilities Commission to cover costs of maintenance, it may be difficult to request rate increases to cover the costs of upgrades to infrastructure that has not met its anticipated life expectancy. An additional concern shared among utilities who are dependent on surface waters for supply is contamination from non-point source pollution, particularly from agricultural and residential uses.

[12] Ibid.

Tool: Water Safety Plan Manual

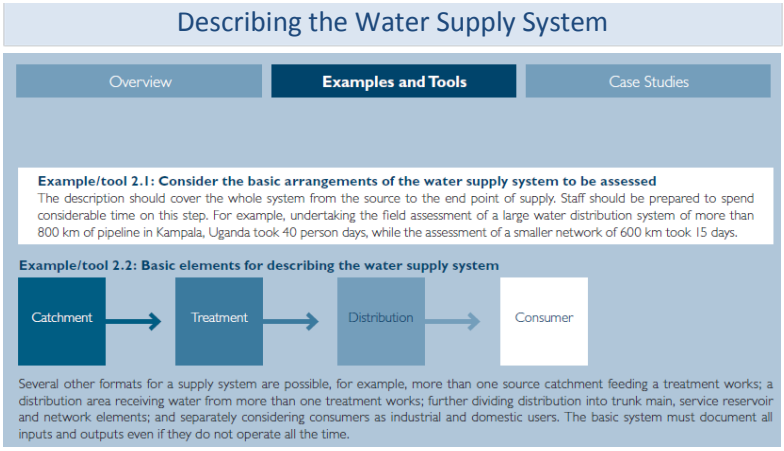
Background

The Water Safety Plan Manual is an in-depth, step-by-step risk management tool for drinking water providers of all sizes. Developed by the World Health Organization and the International Water Association, the manual walks users through 11 learning modules that both produce a water safety plan as well as procedures for monitoring implementation and success of a plan.

Intended Users

Although drinking water infrastructure operators are intended to lead the effort, they will require the assistance of other key stakeholders in order to complete a thorough and robust water safety plan. Other key stakeholders might include local elected officials, municipal public works staff, county emergency management staff, or large land owners.

Using the Tool



The Water Safety Plan Manual is composed of 11 modules that walk an infrastructure operator through development of a plan. The modules have been constructed in a manner that allows the user to develop an approach to producing a plan appropriate to the operator. As it is an in-depth process, producing, implementing, and maintaining a plan will cost money, but can result in long term savings. Additionally, a knowledgeable team must be assembled to produce a successful, robust plan – smaller infrastructure operators may need to bring in more outside expertise than their larger counterparts.

Each of the 11 modules includes an overview of the module, examples and tools to assist with plan development, and case studies related to the particular module. Modules include:

1. Assembling the Water Safety Plan team
2. Producing a detailed description of the water supply system
3. Identifying hazards and hazardous events and assessing the risks or vulnerability
4. Determining and validating existing control measures, their effectiveness, and identifying gaps
5. Developing, implementing and maintaining an improvement plan

6. Defining and validating the monitoring of control measures and procedures for evaluating their effectiveness
7. Verifying the effectiveness of the Water Safety Plan – compliance monitoring, auditing of operational activities, and consumer satisfaction
8. Preparing normal and emergency/incident management procedures
9. Developing supporting programs to ensure continued skills, knowledge, and commitment to the Water Safety Plan
10. Planning and carrying out periodic review of the Water Safety Plan
11. Revising the Water Safety Plan following unforeseen emergencies or incidents

Accessing the Tool

The Water Safety Plan Manual can be downloaded for free. Additional materials to assist with development, implementation and maintenance of a water safety plan area also available on the World Health Organization's Water Safety Portal.

Case Study

Use of the Water Safety Plan Manual is undocumented in the United States. However, a case study prepared for the World Health Organization's Water Safety Portal discussing its use in England and Wales provides transferable lessons regardless of overarching political structure or water system size (some of these water suppliers provide water to populations as small as 2,500). Preparing Water Safety Plans was mandated on the privately-operated organized pipe water suppliers by a regulating body. The regulator then wrote the case study focusing on the challenges encountered by the regulator and private operators with the intent of helping others in their efforts to prepare and implement Water Safety Plans. Common challenges included:

- planning buy-in and appropriate staffing;
- data collection;
- broadening the understanding of risk;
- assessing risk before and after control measures;
- prioritizing investments;
- lack of authority over source water recharge water quality;
- revising and monitoring operations and compliance with a plan; and
- long-term commitment to the plan and regular plan updates

2017

Municipal Climate Adaptation Guidance Series: Stormwater Management

LEE JAY FELDMAN, SOUTHERN MAINE PLANNING AND DEVELOPMENT COMMISSION

This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

Introduction

Climate models predict, and recent experience shows, that storm events will become more severe and more frequent resulting in more extreme weather conditions. When stormwater is discussed by a community, flooding is often part of the conversation. Flood probabilities are typically expressed using terms like "10-year" or "100-year flood". What this means is that every year there is a 10% chance of a 10-year flood, a 1% chance of a 100-year flood and a 0.02% chance of a 500- year flood. The fact that both a 100-year and a 500-year flood hit York County within one twelve- month period in 2006 and 2007 serves to emphasize the importance of robust stormwater management that takes changing climate conditions into account. It can be difficult to decide where to start when a community is faced with the inevitability of weather events that will produce significant stormwater; with local roads and areas that already have stormwater management problems; and with multiple high priority needs, many of which require significant funding, to address the problem.

This section will introduce low impact development, a method to manage stormwater on-site; green infrastructure, using natural features to help manage stormwater; the Stream Smart Crossings program, a program that helps design road crossings that increase resilience to stormwater and that also supports aquatic connections to improve stream habitat; along with Best Management Practices for handling stormwater.

Natural or Green Infrastructure

Because Maine has both low density development (in many areas) and dense urban development, sometimes within the same community, the inadequacies and expense of centralized water systems and the need for strategies to remove pollutants from water before discharge into local waterways is forcing many towns and cities to realize that constructing conventional stormwater systems or repairing roads that are damaged repeatedly cannot be the entire solution. Instead stormwater can be managed through a careful combination of building and not building new infrastructure. When Maine communities consider stormwater management, use of natural infrastructure, like forests and wetlands, should be among the strategies considered.

Natural infrastructure can be described in terms of ecosystems like forests, meadows and wetlands. Putting these natural systems to work in tandem with built systems can be both cost-effective and highly efficient. For example, a community could decide to evaluate land to determine where it may be best to avoid development rather than to have to build infrastructure to control stormwater. As Colgan, Yakovleff, and Merrill's *Economics of Natural & Built Infrastructure Report*, 2013, states, cost-benefit analysis of this scenario shows that benefits fall into two categories: 1) avoided costs (not having to build costly infrastructure, no degradation to water quality) and 2) non-market benefits (such as value of wildlife habitat, scenic lands and healthy ecosystems). The costs would be those involved with not developing particular lands utilizing one or both of these methods: 1) Protection of riparian (waterway and lake) and wetland buffers through zoning and/or purchase of the land or development rights of the land and 2) Conservation easement (purchase of land or development rights of the land) of forested areas and meadows.

So how do natural systems actually work to control floodwater?

Forests slow runoff through friction and interception especially when trees are in leaf. Water that reaches the forest floor flows in different ways; some of it infiltrates directly into the ground, some evaporates, some is taken up by the plants in the forest, and some runs off to nearby wetlands, waterways or waterbodies. A mature forest can absorb up to 14 times more water than the equivalent area of grass.

Wetlands and vegetated riparian floodplains moderate flooding by buffering water flows and probably most importantly, by storing the runoff and releasing it slowly, which also aids in purification of the water. The case of Rutland and Middlebury, Vermont, as presented in the Colgan, Yakovleff, and Merrill 2013 report, is an interesting example of where wetlands worked to protect a community. During Tropical Storm Irene in 2011, a large wetland between the two towns protected Middlebury from flooding even though it was further downstream and could have seen even higher flows than Rutland which did experience much damage due to flooding. Wetlands and riparian areas also provide critical wildlife habitat which while not directly related to stormwater management are nonetheless assets and beneficial to Maine communities throughout the state.

Meadows, for the purposes of this document, are areas not dominated by trees that contain mostly grasses and herbaceous plants. Meadows are not a natural evolutionary state in Maine since they will be succeeded by forest if not maintained. However, meadows that are maintained (by annual mowing or other means) can provide stormwater storage and infiltration far beyond the ubiquitous mown turf grass which is nearly as impervious as pavement. Meadows provide settling of sediments through frictional resistance as water moves through the grasses, biofiltration (storage of materials containing pollutants within the plants' structure) and infiltration (improving water quality through absorption of water into groundwater which also decreases the volume of water exiting the site). Like wetlands, meadows also provide critical wildlife habitat.

Stream characteristics are also significant natural infrastructure factors when considering storm water management. Streams in their natural state meander and contain debris, both of which slow and buffer flood events. Natural streambeds also enhance biodiversity. Unfortunately, in order to control streams near developed areas, many waterways have been artificially straightened and lined with impervious materials like concrete to limit their natural tendency to migrate laterally over time. Straight channels allow water to move more quickly and to peak at a higher level than a natural channel would permit. As development of a waterway's watershed increases, natural infrastructure is lost and more area is covered with impervious surface, thus decreasing infiltration and increasing runoff into streams and rivers. This decreases the water quality of the river or stream and increases its 'flashiness' or response to flood events.

Numerous studies have shown the relationship between open space conservation and mitigation of downstream flooding. As noted in the Colgan, Yakovleff, and Merrill 2013 report, FEMA

data used by Brody & Highfield's 2013 report for Land Use Policy show that communities that used open space conservation as a flood mitigation tool saved $200,000 in annual avoided flood damage. In addition, the types of costs associated with conserving land from development are typically less than building infrastructure to perform the same stormwater management and protection functions.

Low Impact Development (LID)

When building new infrastructure, communities can invest in Low Impact Development (LID) which mimics natural systems using smaller decentralized built systems. LID is now an important part of EPA stormwater regulations and can achieve comparable or better results than conventional stormwater systems. LID is the most cost effective when done during new construction but it can be retrofitted into older development with good results as well.

According to the United States Environmental Protection Agency, LID is "an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product." While LID (or IMP, Integrated Management Practice, which employs similar strategies) will not entirely replace the need for centralized treatment and disposal of stormwater, it can reduce the amount of water moving through the system in any given timeframe. In addition, it can provide solutions to site-specific needs. LID methods include:

- Innovations in roof designs such as green (vegetated) and blue (retains water and releases it slowly) roofs.
- Porous paving materials, such as permeable pavement or permeable pavers that allow water to infiltrate
- Biological water retention areas including rain gardens and artificial wetlands
- Vegetated buffer strips, dry or wet swales
- Level spreaders which are designed to disperse stormwater over a level shallow area to prevent erosion and capture sediment, often dispensing it evenly into a vegetated area for further treatment
- Stormwater planters or tree box filters
- Rain barrels or dry wells

Besides providing stormwater management, biological water retention areas also provide benefits like small-scale urban wildlife refuges and aesthetically pleasing landscapes. Street trees and vegetated buffer strips placed beside roads and within parking lots allow water infiltration, cool the air in summer and reduce air pollution. Permeable pavement and pavers allow infiltration and reduces formation of ice. LID can be simple like rain barrels that collect water off a roof for later use or rain gardens sized for a single site. Rain gardens collect runoff, detain it, and allow it to infiltrate with only high volume events experiencing runoff. They also serve as snow melt holders and are aesthetically pleasing.

In Maine, winter nearly always brings snow, which when climate change is factored in, can mean more extreme snowfall in shorter periods of time. The ability of communities to remove snow efficiently from roads, sidewalks and parking lots is always a concern of municipal officials. Adopting LID strategies can assist by providing places to store snow (vegetated buffer strips, rain gardens, swales) which will also infiltrate once the snow begins to melt.

Communities should follow these guidelines when considering LID:

- Minimize impervious areas (lower minimum street widths in residential areas, reduce parking requirements)
- Ensure adequate on-site snow storage is planned for and clearly designated on development plans prior to approvals
- Limit areas of clearing and grading when developing land (follow natural topology, restrict tree cutting to immediate building envelope and protect desirable trees)
- Minimize directly connected impervious areas (drain impervious areas as sheet flow to natural systems such as vegetated buffers, break up flow directions from large paved surfaces such as parking lots by utilizing breaks in curbing that empty into vegetated buffers or swales, collect roof runoff in dry wells or rain gardens)
- Manage stormwater at its source (break up drainage with numerous small systems to fit in with natural topology and drainage conditions)

Stream Crossing Structures and Culverts

Culverts are of particular concern in Maine; The New England Environmental Finance Center's 2011 report, *A Financial Impact Assessment of LD 1725 Stream Crossings*, indicates a very large number of culverts throughout the state are undersized and unable to accommodate peak water flows during flood events and therefore are prone to failure. When culverts fail, roadways are washed away. Tropical Storm Irene caused the failure of 960 culverts in Vermont; damage to Vermont roads and bridges was estimated to exceed $700 million. Field surveys of road crossings in Maine also show that many Maine's culverts currently act as barriers to fish passage and other natural stream processes. Increasing the resilience of these structures to flood events not only protects important infrastructure it also helps to improve and maintain the habitat values of Maine's aquatic network.

Vermont's experience during Hurricane Irene provides a cautionary tale showing why Maine communities should carefully assess culverts in light of changing climate conditions when planning for stormwater control. Increasing levels of precipitation and increasing numbers of extreme precipitation events will overwhelm structures designed for historic climate conditions. Increasing amounts of impervious surface will also magnify the effects of stormwater. An inventory of the size, condition and location of culvert provides important baseline information for determining which culverts are the most important to repair, upgrade, and replace. Even without a systematic inventory of culverts and road crossings, local knowledge can probably offer up some chronic problem areas where culverts fail to handle current levels of precipitation and either overtop during storm events or fail completely and wash out. Either of these situations will cause disruptions to community life, economic conditions and emergency management services. Much of the state is covered by an inventory of road crossings on public roads done for the main purpose of assessing the crossings' impacts on fish passage. The inventory is available on-line and includes details such as size and condition along with pictures for each crossing. Inventory work is ongoing so if your town is not currently included, it may be soon; more information and the available data can be found here .

Tools to Help with Culvert Sizing

1. StreamStats in Maine:
StreamStats is a Web application that incorporates a Geographic Information System (GIS) to provide users with access to an assortment of tools that are useful for a variety of water-resources planning and management purposes, and for engineering and design purposes.

2. Extreme Precipitation in New York and New England Tool: provides precipitation data for a given location including estimates for extreme precipitation. This tool can be used to find out how many inches of precipitation will fall during different storm events.

3. MaineDOT Culvert Sizing Guidance

There are many different ways to sort and prioritize culverts. You can prioritize based on the design perspective to determine which culverts should have diameters updgraded or from the management perspective to determine which crossings should be inspected or repaired first or a

combination of approaches. Culvert and crossing prioritization should also include impacts to vulnerable populations from a disruption in service should a road become impassable because of a crossing failure. Some kind of inventory and prioritization will help with planning and funding for the needed work to create more resilience in the stormwater management infrastructure.

STREAM SMART CROSSINGS (see Stream Smart Section for more detail on this approach)

Maine Audubon, in partnership with the Maine Department of Inland Fisheries and Wildlife and many other organizations including the Maine Department of Environmental Protection, has developed a program of workshops and materials for Maine's Stream-Smart program. Much of the material is available on-line and gives extensive direction and guidance on replacing aging or failed stream crossing structures or placing new correctly-sized and sited structures (please the References section of this document). Maine's Stream-Smart Program recommends the following rules for stream crossing structures (known as the Four S's):

There are partnership opportunities for funding and technical assistance when using Stream Smart design for a crossing. For more information contact the Maine Coastal Program or the Habitat Restoration coordinator at The Nature Conservancy.

- Span the stream
- Set the elevation correctly
- Slope should match the natural stream
- Substrate in the crossing

While mapping, assessing existing culverts and prioritizing culvert replacement methodology can vary, depending on a community's needs, following the Stream Smart principles helps to insure the overall health of Maine's stream systems along with creating more resilience in the transportation infrastructure to changing climate conditions.

The Stream Smart principles are intended to help communities and land owners avoid common problems with stream crossing structures such as:

- Pinching the stream (inadequate structure span) which can cause the structure to become perched and lead to scour or to fail completely during high-volume precipitation events
- Incorrect elevation which can impede the flow downstream
- Slope that doesn't follow the stream's natural slope which can cause sedimentation problems
- Structure bottom too high which impedes adequate flow and functionality as a natural stream

In addition, inadequate or improperly sited stream crossing structures can pose the following problems to fish and wildlife:

- Flows too fast or too steeply (fish or wildlife cannot pass through to go upstream)
- Flow can be too shallow (impediment to passage)

- Poses a physical barrier to wildlife (perched outlet, inlet blocked by debris, blockages can cause water to warm too much for coldwater fish species like trout)

Using Stream Smart principles not only helps to support conditions for Maine's abundant wildlife and fish through improved fish and wildlife passage it also adds resilience to stream crossing structures through capacity to handle increased flows.

Best Management Practice (BMP)

No discussion of stormwater management would be complete without inclusion of BMPs – built infrastructure to control runoff. However, rather than focus on BMP designs, this section will discuss methods for communities to get the most out of BMP systems.

BMPs are often a large detention (meant to detain water temporarily before it is gradually drained into a storm sewer or waterway) or retention feature (meant to hold water indefinitely) constructed to control the rate of stormwater discharge from a site. These BMPs differ from the approach that LID takes since BMP considers runoff a waste product to be contained or disposed of whereas smaller LID systems mimic pre-development hydrological conditions and infiltrate water on-site. Other types of BMPs like sand traps and infiltration trenches or basins do perform infiltration on-site so in practice the line between BMPs and LID is blurred in functionality if not in aesthetics.

In Maine, all sites prior to new development should be assumed to have good condition groundcover, whether wooded or meadow and all sites post-development should be assumed to have poor since there is no guarantee that property owners will maintain the site in its best possible condition and because construction equipment compacts the soils on any developed site to some extent. Any site that was wooded within the last 5 years should be considered undisturbed forest for pre-construction run-off conditions and calculations regardless of any cutting that may have occurred prior to the development permit issuance.

Pretreatment devices installed on BMPs will remove unwanted materials from stormwater runoff prior to its entrance into the BMP and thus prevent failures due to sedimentation and blockage. Pretreatment solutions include upfront settling basins, a deep sump catch basin not in the series, or a maintainable filter. The pretreatment device should be set up so that when it requires maintenance, it will begin to fail. For best results, failure means the pretreatment device should not only stop collecting sediment but also will stop passing water through. The failure must be obvious so that the pretreatment device will be serviced.

The cold weather climate of Maine should be a factor when considering BMPs, for example, the design of infiltration systems should assume storage only and no exfiltration during winter months, where possible, the use of traditional overflows to a municipal system as backup in case of freezing, separation of infiltration BMPS from the road by more than 10 feet and use of small volume BMPs only

where infiltration might seep under the roadway. When infiltration units are used with vegetation, fencing to protect the vegetation from salt and plowing is important.

All stormwater controls should be sized assuming annual maintenance only, as it rarely happens more frequently. Sizing should also take into account higher rainfall events such as the 50 and 100-year storm. Failure of BMPs is often due to lack of maintenance or poor design of the BMP such that the unit must essentially be replaced each time it requires cleaning. Another frequent contributor to BMP failure is lack of access to the BMP because it is on private land.

Maine communities can apply this checklist when considering a BMP:

- Is the BMP difficult to access by equipment?
- Is the BMP difficult to clean without complete renovation?
- Is there a maintenance easement to access the BMP?
- Is there an ability to see when the unit is full or clogged with sediment?
- Does the owner of the BMP understand the maintenance needs?
- Is there the ability to back charge the owner if the municipality must do the maintenance work?
- Is maintenance required too frequently due to under-sizing of BMP?
- Is the proposed maintenance burden on the owner too great (set up for failure)?

Important Considerations for Stormwater BMP Design

- Sized to treat all stormwater on-site, preferably for a 100-year storm event
- Formal equipment access
- Ease and minimal cost of cleaning
- Permanent maintenance easement
- Method and easy access for evaluation of maintenance
- Pretreatment devices strongly recommended to prevent clogging or sedimentation problems
- Provisions for groundwater monitoring and assessment of quantities of water removed along with estimates in the design of expected sediment quantities
- A detailed and reasonable Operations & Maintenance (O & M) plan should be developed

FUNDING

An excellent way for a community to plan for funding stormwater management solutions is through Capital Improvement Planning (CIP). CIP is a budgeting process that any community regardless of its size can undertake on a yearly basis. While CIP is done on a yearly basis, it also provides a community with a budgetary vision for a 5–10 year horizon range and gives the community a big picture product.

Other Options

There are other ways that a community can work to protect itself from the adverse effects of higher precipitation generating events. Working at the local level, communities can examine their ordinances and strengthen them with an eye towards stormwater protection that is balanced by natural infrastructure and LID. Starting with planning boards and municipal officials, educate the community about LID, natural infrastructure, BMPs and Stream-Smart crossings.

Using existing ordinances:

- Revise existing development controls through subdivision and site plan review ordinance changes to require retaining total runoff on each site. Please see the Model Site Plan Ordinance Addressing Stormwater Runoff included in this toolkit.
- If site plan review has not been adopted by the community, add it to the local ordinances. Please see the Model Site Plan Ordinance Addressing Stormwater Runoff included in this toolkit.
- Minimize site disturbance through ordinances that require clustering or conservation subdivisions and retention of open spaces
- Revise shoreland zoning ordinances to protect more than the minimum riparian buffer required by Maine State regulations
- Require that clearing limits and stockpiles be staked out on individual sites and ensure enforcement
- Review engineering calculations on site plans for overly optimistic pre and post runoff assumptions and/or require the developer to pay for engineering peer review of drainage calculations and site design.

Additional opportunities:

- Adopt guidance and design criteria using natural infrastructure for commercial and residential development
- Adopt LID requirements for development
- Set a good example on municipally owned properties
- Create a public education program and demonstration project using LID
- Hold a workshop for code enforcement officers, planning board members and the board of appeals members on Stream-Smart stream crossings and invite the general public
- Partner with land trusts and other land preservation organizations to permanently protect significant lands that have value for multiple reasons: wildlife habitat, water quality and stormwater control.

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Open Space Protection and Flood Mitigation: A National Study (Brody, S. Highfield, W. 2013 as published in Land Use Policy, Volume 32, pages 89-95)

Conservation Design for Stormwater Management (Delaware Department of Natural Resources and Environmental Control, 1997)
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A Financial Impact Assessment of LD 1725: Stream Crossings (The New England Environmental Finance Center)
http://efc.muskie.usm.maine.edu/docs/ld1725_finanancial_impact_assessment.pdf

Maine Stormwater Best Practices Manual:
http://www.maine.gov/dep/land/stormwater/stormwaterbmps/

U.S. Department of Environmental Protection, Low Impact Development
http://water.epa.gov/polwaste/green/

EPA's national stormwater calculator:
http://www2.epa.gov/water-research/national-stormwater-calculator

National Climate Assessment – Regional Projections 2012:
http://nca2014.globalchange.gov/highlights#section-5682

Assessing Vulnerability of Water Conveyance Infrastructure from a Changing Climate in the Context of a Changing Landscape Webinar:
Download the slides.

Maine's Sustainability Solutions Initiative at the University of Maine:
Climate news: http://umaine.edu/maineclimatenews/

Maine Stream Crossings:
http://www.fws.gov/northeast/ecologicalservices/pdf/MaineStreamCrossings.pdf

Maine Stream-Smart Program:
https://sites.google.com/a/maineaudubon.org/stream-smart-road-crossing-workshops/
http://maineaudubon.org/wp-content/uploads/2012/04/StreamSmart-How-To-TechnicalGuidance.pdf

Cornell University Extreme Precipitation in New York and New England:
http://precip.eas.cornell.edu/

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2017

Municipal Climate Adaptation Guidance Series: Stream Smart Crossings

JOEL GREENWOOD, KENNEBEC VALLEY COUNCIL OF GOVERNMENTS

This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

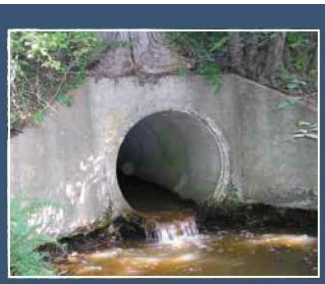
Introduction

Stream-Smart road crossings maintain fish and wildlife habitat while protecting roads and public safety. And, they prepare us for the large and frequent storm events that have been washing out roads around the state and the northeast.

Many hundreds of miles of streams flow through Maine. These streams are habitat for a variety of fish, birds, insects, reptiles, mammals, and amphibians, and they provide recreational opportunities and economic benefits to Maine residents. Maine also has an extensive network of roads that is vital to the social and economic health of our communities. Wherever a road crosses a stream, a bridge or culvert made that crossing possible. Most bridges allow streams and the wildlife that they support to pass freely under them but incorrectly sized, poorly placed or damaged bridges and culverts can prevent fish and wildlife from accessing food, breeding areas and other important habitat, particularly on smaller streams. Fortunately, efforts are underway to improve road-stream crossings. With proper stream crossing sizing and installation, streams can function naturally, fish and wildlife can freely migrate, and roads can be improved.

Principals for Stream-Smart Road Crossings

- If using a culvert, set the bottom of the structure at the natural, pre-disturbance stream bed elevation
- Size the span of the crossing to avoid pinching the stream channel and preferably, exceed the natural channel width
- Maintain natural slope and alignment of the stream channel
- Ensure that the crossing maintains natural substrate within the structure.
- Designed with appropriate bed forms and streambed characteristics so that water depths and velocities are comparable to those found in the natural channel at a variety of flows
- “Openness” of the structure should be greater than 0.82 feet (0.25 meters) in order to make the structure more likely to pass small, riverine wildlife such as turtles, mink, muskrat and otter that may tend to avoid structures that appear too constricted
- Banks should be present on each side of the stream matching the horizontal profile of the existing stream and banks



UNDERSIZED CROSSINGS
restrict natural stream flow, causing several problems including scouring and erosion, high flow velocity, clogging, and ponding.

SHALLOW CROSSINGS
have water depths too low for many organisms to move through them and may lack appropriate bed material.

PERCHED CROSSINGS
are above the level of the stream bottom at the downstream end. Perching erodes streambeds and can prevent wildlife from migrating upstream. They can result from either improper installation or from years of downstream bed erosion.

scouring and erosion

high flow velocity

clogging

ponding

low flow areas

damaged culvert

Common Problems with Road Stream Crossings

Road-stream crossings that do not allow fish and wildlife to freely migrate are most often undersized structures that would not meet today's design criteria for fish passage. This is primarily because designs were historically based on standards only intended to protect roads.

In many cases, crossings that were once wildlife-friendly are now barriers to migration because of:

- Clogging at inlets,
- Scouring and erosion around outlets,
- Deteriorating construction materials, or
- Stream channels shifting out of alignment with the structure.

These problems result in further long- lasting effects on natural systems by:

- Degrading stream water quality, and
- Isolating large portions of habitat, which in turn alters natural dispersal patterns for fish and wildlife.

Incorrectly sized, poorly placed, or damaged bridges and culverts tend to have a shorter service life. They usually require frequent maintenance and extensive repairs that place a significant demand on the limited resources of towns, forestry companies, and other private landowners.

Safe, stable, and fish and wildlife friendly stream crossings, on the other hand, can accommodate wildlife and protect stream health while reducing expensive erosion and structural damage.

Key features of good road-stream crossings

Good road-stream crossings simulate the upstream and downstream characteristics of the natural stream channel. Well-designed crossings:

- Use *natural substrate* within the crossing;
- Match the natural *water depths* and *velocities*; and
- Are *wide and high* relative to their length. Structures should be at least 1.2 times the natural stream bank width so they can retain natural substrates and allow fish, wildlife, floods, and debris to pass.

Bridges and open-arch designs are the preferred structure types because they allow characteristics of the natural stream channel to be simulated. Replicating the slope, dimensions and streambed material creates water depths and velocities similar to the natural channel. These structures are also capable of handling a range of flows and will allow most organisms to freely pass through them.

Why upgrade road-stream crossings?

Stream crossing designs have improved. Structures based on today's designs:

- **Require less frequent repairs.** Upgrading Maine's road-stream crossings will reduce long-term maintenance costs and periodic losses of use. Newer designs also last longer. For example, open-arch culverts can last in excess of 75 years.
- **Help wildlife access stream natural areas.** Upgrading will in turn improve fishing, hunting, and wildlife observation opportunities for Maine's residents and visitors.
- **Handle a wider range of flows.** Climate change is increasing the amount and intensity of precipitation. A study in Keene, New Hampshire revealed that 30 to 80 percent of the city's culverts were likely to fail under projected flow conditions. Upgrading will prevent or minimize the potential negative impacts of increased flow conditions on Maine's infrastructure.

For more information on Stream-Smart road crossings go to:
http://maineaudubon.org/streamsmart/

2017

Municipal Climate Adaptation Guidance Series: Comprehensive Planning

STEPHANIE CARVER, GREATER PORTLAND COUNCIL OF GOVERNMENTS

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MAINE COMPREHENSIVE PLANNING

CLIMATE CHANGE CONSIDERATIONS

CONTENTS OF BLUE BOXES ARE OFFERED TO FACILITATE CONSIDERATION OF CLIMATE CHANGE-RELATED ISSUES FOR ANY MUNICIPALITY THAT CHOOSES, AT ITS OPTION, TO ADDRESS SUCH ISSUES IN ITS COMPREHENSIVE PLAN.

THE SUGGESTIONS FOUND IN THE BLUE BOXES ARE NOT PART OF THE COMPREHENSIVE PLAN REVIEW CRITERIA RULE.

EXCERPTS OF THE COMPREHENSIVE PLAN REVIEW CRITERIA RULE APPEAR OUTSIDE THE BLUE BOXES, AND ARE SHOWN SOLELY TO PROVIDE CONTEXT FOR THE SUGGESTED CLIMATE CHANGE CONSIDERATIONS.

SECTION 2. REQUIRED ELEMENTS

1. Vision Statement

The plan must include a vision statement that summarizes the community's desired future community character in terms of economic development, natural and cultural resource conservation, transportation systems, land use patterns and its role in the region.

Vision Statement:

Communities may also wish to use this section to express how they will address the challenges of climate change. For coastal areas this may mean sea level rise, and increased scale and frequency of storm events.

Example Language to add to Vision:

- The community will attempt to operate in a secure, effective and efficient manner in a changing climate.
- The community will attempt to reasonably assess its vulnerability to climate change, implement appropriate adaptation strategies, and collaborate with surrounding communities to strengthen regional adaptation efforts.

SECTION 3. REQUIRED TOPIC AREAS

1. Historic and Archaeological Resources

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.1(C) to answer the following questions.

(1) Are historic patterns of settlement still evident in the community?

(2) What protective measures currently exist for historic and archaeological resources and are they effective?

(3) Do local site plan and/or subdivision regulations require applicants proposing development in areas that may contain historic or archaeological resources to conduct a survey for such resources?

(4) Have significant historic resources fallen into disrepair, and are there ways the community can provide incentives to preserve their value as an historical resource?

C. **Condition and Trends**

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Historic Preservation Data Set prepared and provided to the community by the Historic Preservation Commission, and the Office, or their designees.

(2) An outline of the community's history, including a brief description of historic settlement patterns and events contributing to the development and character of the community and its surroundings.

(3) An inventory of the location, condition, and use of any historical or archaeological resource that is of local importance.

(4) A brief description of threats to local historic resource and to those of state and national significance as identified by the Maine Historic Preservation Commission.

Historic and Archaeological Resources

Analysis:

- Has the community developed any strategies to deal with the issue of historic architecture in the floodplain, and shoreland zones?
- Has the community attempted to apply for competitive grants to retrofit flood-damaged properties and elevate structures?
- The evaluation criteria used by the National Register conflicts with the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). How will the community deal with this conflict? Has it been an issue for any rehabilitation projects to date?
- Do historic or archeological resource plans include discussion of climate adaptation strategies, or incorporate a preference for sustainable building standards that are sensitive to historic materials and techniques? Does the community require new planning efforts to include discussion of strategies to deal with such impacts?

Conditions and Trends:

- A description of past natural disasters and their effects on historic neighborhoods, structures, or culturally significant areas. If possible, perhaps include maps of the structures or areas affected.

Policies:

- Reduce impacts of climate change on the community's historic and archeological resources.
- Work with preservation professionals and local stakeholders to incorporate more sustainable construction methods and materials

Strategies:

- Develop and promote education programs.
- Incentivize methods to increase adaptation of historic resources to climate change that is consistent with NPS standards and protects the long term stability of these structures.

D. **Policies**

Minimum policy required to address state goals:

Protect to the greatest extent practicable the significant historic and archaeological resources in the community.

E. **Strategies**

Minimum strategies required to address state goals:

(1) For known historic archeological sites and areas sensitive to prehistoric archeology, through local land use ordinances require subdivision or non-residential developers to take appropriate measures to protect those resources, including but not limited to, modification of the proposed site design, construction timing, and/or extent of excavation.

(2) Adopt or amend land use ordinances to require the planning board (or other designated review authority) to incorporate maps and information provided by the Maine Historic Preservation Commission into their review process.

(3) Work with the local or county historical society and/or the Maine Historic Preservation Commission to assess the need for, and if necessary plan for, a comprehensive community survey of the community's historic and archaeological resources.

2. Water Resources

A. **State Goal**

To protect the quality and manage the quantity of the State's water resources, including lakes, aquifers, great ponds, estuaries, rivers, and coastal areas.

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.2(C) to answer the following questions.

(1) Are there point sources (direct discharges) of pollution in the community? If so, is the community taking steps to eliminate them?

(2) Are there non-point sources of pollution? If so, is the community taking steps to eliminate them?

(3) How are groundwater and surface water supplies and their recharge areas protected?

(4) Do public works crews and contractors use best management practices to protect water resources in their daily operations (e.g. salt/sand pile maintenance, culvert replacement street sweeping, public works garage operations)?

(5) Are there opportunities to partner with local or regional advocacy groups that promote water resource protection?

C. **Conditions and Trends**

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Water Resources Data Set prepared and provided to the community by the Department of Inland Fisheries and Wildlife, the Department of Environmental Protection and the Office, or their designees.

(2) A description of each great pond, river, surface drinking water supply, and other water bodies of local interest including:

a. ecological value;

b. threats to water quality or quantity;

c. documented water quality and/or invasive species problems.

Water Resources

Analysis:

- Does the community consider the impact of climate change when prioritizing or protecting the resources that are more likely to be vulnerable?
- Is the municipal stormwater system a combined system? What steps has the community taken so far to reach that goal?
- Does the system overflow directly into a waterbody? If this is a pollution concerns, has the community taken steps to mitigate this issue?

Policies:

- Minimize climate change impacts to water resources and infrastructure, and increase planning activities to establish strategies for long term adaptation responses.

Strategies:

- Enhance climate adaptation planning efforts and prioritize and protect the water resources that are more likely to be vulnerable to climate change impacts.
- Encourage conservation, and reuse of water resources where there is opportunity.
- Collaborate with stakeholders to mutually support efforts sharing data, education efforts, and assessment tools.
- Consider land use policy that promotes the reduction of impervious surfaces, increase vegetated infiltration basins for new development, and retrofit existing developments to reduce storm flow runoff and increase infiltration of rainfall whenever possible.
- Upgrade stormwater and combined stormwater and sewage systems to prepare for more frequent and heavier rainfall events and investigate opportunities for the beneficial reuse of stormwater and wastewater.

(3) A summary of past and present activities to monitor, assess, and/or improve water quality, mitigate sources of pollution, and control or prevent the spread of invasive species.

(4) A description of the location and nature of significant threats to aquifer drinking water supplies.

(5) A summary of existing lake, pond, river, stream, and drinking water protection and preservation measures, including local ordinances.

D. **Policies**

Minimum policies required to address state goals:

(1) To protect current and potential drinking water sources.

(2) To protect significant surface water resources from pollution and improve water quality where needed.

(3) To protect water resources in growth areas while promoting more intensive development in those areas.

(4) To minimize pollution discharges through the upgrade of existing public sewer systems and wastewater treatment facilities.

(5) To cooperate with neighboring communities and regional/local advocacy groups to protect water resources.

E. **Strategies**

Minimum strategies to meet state goals:

(1) Adopt or amend local land use ordinances as applicable to incorporate stormwater runoff performance standards consistent with:

a. Maine Stormwater Management Law and Maine Stormwater regulations (Title 38 M.R.S.A. §420-D and 06-096 CMR 500 and 502).

b. Maine Department of Environmental Protection's allocations for allowable levels of phosphorus in lake/pond watersheds.

c. Maine Pollution Discharge Elimination System Stormwater Program

(2) Consider amending local land use ordinances, as applicable, to incorporate low impact development standards.

(3) Where applicable, develop an urban impaired stream watershed management or mitigation plan that will promote continued development or redevelopment without further stream degradation.

(4) Maintain, enact or amend public wellhead and aquifer recharge area protection mechanisms, as necessary.

(5) Encourage landowners to protect water quality. Provide local contact information at the municipal office for water quality best management practices from resources such as the Natural Resource Conservation Service, University of Maine Cooperative Extension, Soil and Water Conservation District, Maine Forest Service, and/or Small Woodlot Association of Maine.

(6) Adopt water quality protection practices and standards for construction and maintenance of public and private roads and public properties and require their implementation by contractors, owners, and community officials and employees.

(7) Participate in local and regional efforts to monitor, protect and, where warranted, improve water quality.

(8) Provide educational materials at appropriate locations regarding aquatic invasive species.

3. Natural Resources

A. State Goal

To protect the State's other critical natural resources, including without limitation, wetlands, wildlife and fisheries habitat, sand dunes, shorelands, scenic vistas, and unique natural areas.

B. Analyses

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.3(C) to answer the following questions.

(1) Are any of the community's critical natural resources threatened by development, overuse, or other activities?

(2) Are local shoreland zone standards consistent with state guidelines and with the standards placed on adjacent shorelands in neighboring communities?

(3) What regulatory and non-regulatory measures has the community taken or can the community take to protect critical natural resources and important natural resources?

(4) Is there current regional cooperation or planning underway to protect shared critical natural resources? Are there opportunities to partner with local or regional groups?

C. Conditions and Trends

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Natural Resources Data Set prepared and provided to the community by the Department of Inland Fisheries and Wildlife, Department of Environmental Protection and the Office, or their designees.

(2) A map or description of scenic areas and scenic views of local importance, and regional or statewide importance, if available.

D. Policies

Minimum policies required to address state goals:

(1) To conserve critical natural resources in the community.

Natural Resources:

Analysis:
- Does the community measure the direct or indirect impacts of climate change on existing species in need of conservation or protection?
- The scope, scale and uncertainty of climate change impacts will require a high level of expertise support and collaboration. Has the community considered coordinating with state, regional or nonprofit partners to measure these impacts?
- Does the community engage in coordination efforts across municipal boundaries to address adaptation issues as they relate to natural resources?
- Has the community engaged in efforts to maintain or restore landscape and habitat connectivity?

Policies:
- Improve and expand the ability of the community's natural resources to adapt to the impacts of climate change.

Strategies:
- Promote conservation of low-lying, undeveloped uplands where coastal marshes, beaches, and other intertidal natural communities can migrate inland with sea level rise.
- Engage in efforts to protect and restore natural protective features, such as floodplains, wetlands, marshes, and dunes

(2) To coordinate with neighboring communities and regional and state resource agencies to protect shared critical natural resources.

E. **Strategies**

Minimum strategies required to address state goals:

(1) Ensure that land use ordinances are consistent with applicable state law regarding critical natural resources.

(2) Designate critical natural resources as Critical Resource Areas in the Future Land Use Plan.

(3) Through local land use ordinances, require subdivision or non-residential property developers to look for and identify critical natural resources that may be on site and to take appropriate measures to protect those resources, including but not limited to, modification of the proposed site design, construction timing, and/or extent of excavation.

(4) Through local land use ordinances, require the planning board (or other designated review authority) to include as part of the review process, consideration of pertinent BwH maps and information regarding critical natural resources.

(5) Initiate and/or participate in interlocal and/or regional planning, management, and/or regulatory efforts around shared critical and important natural resources.

(6) Pursue public/private partnerships to protect critical and important natural resources such as through purchase of land or easements from willing sellers.

(7) Distribute or make available information to those living in or near critical or important natural resources about current use tax programs and applicable local, state, or federal regulations.

4. Agricultural and Forest Resources

A. State Goal

To safeguard the State's agricultural and forest resources from development which threatens those resources.

B. Analyses

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.4(C) to answer the following questions.

(1) How important is agriculture and/or forestry and are these activities growing, stable, or declining?

(2) Is the community currently taking regulatory and/or non-regulatory steps to protect productive farming and forestry lands? Are there local or regional land trusts actively working to protect farms or forest lands in the community?

(3) Are farm and forest land owners taking advantage of the state's current use tax laws?

(4) Has proximity of new homes or other incompatible uses affected the normal farming and logging operations?

(5) Are there large tracts of agricultural or industrial forest land that have been or may be sold for development in the foreseeable future? If so, what impact would this have on the community?

(6) Does the community support community forestry or agriculture (i.e. small woodlots, community forests, tree farms, community gardens, farmers' markets, or community-supported agriculture)? If so, how?

(7) Does the community have town or public woodlands under management, or that would benefit from forest management?

C. Conditions and Trends

Minimum data required to address Analyses:

Agricultural and Forest Resources:

Analysis:
- Has the community developed effective strategies to deal with future/long term impacts of climate on agriculture and forest resources?
- Has the community experienced any climate impacts on agriculture and forest resources to date (examples include insect infestations, crop selection changes, reoccurring storms and flooding issues impacting these areas)?
- Has the community assessed its vulnerability to climate change related to such factors as local water demand and availability, the length of growing seasons, excessive precipitation or drought, adequate soils, pests or disease-causing pathogens?
- In agricultural sectors, does the community have sufficient irrigation and /or drainage/stormwater infrastructure capacity to meet water needs of their entire acreage during extended periods of summer drought, or excessive precipitation?

Policies:
- To reduce the impacts of climate change on the community's forestry and agricultural resources.
- Increase infrastructure capacity to better protect forestry and agricultural resources.

Strategies:
- Support and promote sustainable Forestry and agricultural practices such as improving adaptive capacity and to respond to changes in water demands.

(1) The community's Comprehensive Planning Agriculture and Forestry Data Set prepared and provided to the community by the Department of Agriculture, the Maine Forest Service, and the Office, or their designees.

(2) A map and/or description of the community's farms, farmland, and managed forest lands and a brief description of any that are under threat.

(3) Information on the number of parcels and acres of farmland, tree growth, and open space enrolled in the state's farm, tree growth, and open space law taxation programs, including changes in enrollment over the past 10 years.

(4) A description of any community farming and forestry activities (e.g. community garden, farmer's market, or community forest).

D. **Policies**

Minimum policies required to address state goals:

(1) To safeguard lands identified as prime farmland or capable of supporting commercial forestry.

(2) To support farming and forestry and encourage their economic viability.

E. **Strategies**

(1) Minimum strategies required to address state goals: Consult with the Maine Forest Service district forester when developing any land use regulations pertaining to forest management practices as required by 12 M.R.S.A. §8869.

(2) Consult with Soil and Water Conservation District staff when developing any land use regulations pertaining to agricultural management practices.

(3) Amend land use ordinances to require commercial or subdivision developments in critical rural areas, if applicable, maintain areas with prime farmland soils as open space to the greatest extent practicable.

(4) Limit non-residential development in critical rural areas (if the town designates critical rural areas) to natural resource-based businesses and services, nature tourism/outdoor recreation businesses, farmers' markets, and home occupations.

(5) Encourage owners of productive farm and forest land to enroll in the current use taxation programs.

(6) Permit land use activities that support productive agriculture and forestry operations, such as roadside stands, greenhouses, firewood operations, sawmills, log buying yards, and pick-your-own operations.

(7) Include agriculture, commercial forestry operations, and land conservation that supports them in local or regional economic development plans.

5. Marine Resources (if applicable)

A. **State Goal and State Coastal Policies**

(1) To protect the State's marine resources industry, ports and harbors from incompatible development and to promote access to the shore for commercial fishermen and the public.

(2) For coastal communities, the *Growth Management Act* requires that a local comprehensive plan address the state coastal management policies (38 M.R.S.A. §1801). These are:

a. To promote the maintenance, development, and revitalization of the State's ports and harbors for fishing, transportation and recreation;

b. To manage the marine environment and its related resources to preserve and improve the ecological integrity and diversity of marine communities and habitats, to expand our understanding of the productivity of the Gulf of Maine and coastal waters and to enhance the economic value of the State's renewable marine resources;

Marine Resources:

Analysis:

- Has the community completed a climate change vulnerability assessment to determine the impact of climate related issues on the marine environment and economy? Have specific adaptation strategies been developed and/or implemented through this effort?
- Does the community pursue opportunities to improve marine habitat, expand or create wetland areas, improve water quality, or purchase property to increase open space and access opportunities?
- Has the community drafted an emergency management plan that offers strategies to adapt to sea level rise or increased severity of storm events?

Policies:

- To reduce the impacts resulting from climate change on marine resources and the marine economy.

Strategies:

- Incentivize or promote design and landscape practices that are sensitive to environmental effects and impacts of climate change on marine resources and/or offer opportunities to adapt to these changes.

c. To support shoreline management that gives preference to water-dependent uses over other uses, that promotes public access to the shoreline and that considers the cumulative effects of development on coastal resources;

d. To discourage growth and new development in coastal areas where, because of coastal storms, flooding, landslides or sea-level rise, it is hazardous to human health and safety;

e. To encourage and support cooperative state and municipal management of coastal resources;

f. To protect and manage critical habitat and natural areas of state and national significance and maintain the scenic beauty and character of the coast even in areas where development occurs;

g. To expand the opportunities for outdoor recreation and to encourage appropriate coastal tourist activities and development;

h. To restore and maintain the quality of our fresh, marine and estuarine waters to allow for the broadest possible diversity of public and private uses; and,

i. To restore and maintain coastal air quality to protect the health of citizens and visitors and to protect enjoyment of the natural beauty and maritime characteristics of the Maine coast.

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.5(C) to answer the following questions.

(1) Is coastal water quality being monitored on a regular basis?

(2) Is there a local or regional plan in place to identify and eliminate pollution sources?

(3) Has closing of clam or worm flats threatened the shellfishing industry, and are sources of contamination known? If so, are sources point (direct discharge) or nonpoint sources?

(4) Are traditional water-dependent uses thriving or in decline? What are the factors affecting these uses? If current trends continue, what will the waterfront look like in 10 years?

(5) Is there reasonable balance between water-dependent and other uses, and between commercial and recreational uses? If there have been recent conversions of uses, have they improved or worsened the balance?

(6) How does local zoning treat land around working harbors?

(7) Is there a local or regional harbor or bay management plan? If not, is one needed?

(8) Are there local dredging needs? If so, how will they be addressed?

(9) Is there adequate access, including parking, for commercial fishermen and members of the public? Are there opportunities for improved access?

(10) Are important points of visual access identified and protected?

C. **Conditions and Trends**

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Marine Resources Data Set prepared and provided to the community by the Department of Marine Resources, and the Office, or their designees.

(2) A map and / or description of water-dependent uses.

(3) A brief summary of current regulations influencing land use patterns on or near the shoreline.

(4) A description of any local or regional harbor or bay management plans or planning efforts.

(5) The location of facilities (wharves, boat ramps, pump-out stations, etc.), with a brief description of any regional or local plans to improve facilities.

(6) A description or map showing public access points to the shore. Include a brief description of their use, capacity, physical condition, and plans to improve, expand, or acquire facilities such as parking or toilets.

(7) A list of scenic resources along the shoreline, including current ownership (public or private) and any protections.

D. **Policies**

Minimum policies required to address state goals:

(1) To protect, maintain and, where warranted, improve marine habitat and water quality.

(2) To foster water-dependent land uses and balance them with other complementary land uses.

(3) To maintain and, where warranted, improve harbor management and facilities.

(4) To protect, maintain and, where warranted, improve physical and visual public access to the community's marine resources for all appropriate uses including fishing, recreation, and tourism.

E. **Strategies**

Minimum strategies required to address state goals:

(1) Identify needs for additional recreational and commercial access (which includes parking, boat launches, docking space, fish piers, and swimming access).

(2) Encourage owners of marine businesses and industries to participate in clean marina/boatyard programs.

(3) Provide information about the Working Waterfront Access Pilot Program and current use taxation program to owners of waterfront land used to provide access to or support the conduct of commercial fishing activities.

(4) Support implement of local and regional harbor and bay management plans.

(5) If applicable, provide sufficient funding for and staffing of the harbormaster and/or harbor commission.

(6) Work with local property owners, land trusts, and others to protect major points of physical and visual access to coastal waters, especially along public ways and in public parks.

6. Population and Demographics

A. State Goal

None required.

B. Analyses

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.6(C) to answer the following questions.

(1) Is the rate of population change expected to continue as in the past, or to slow down or speed up? What are the implications of this change?

(2) What will be the likely demand for housing and municipal and school services to accommodate the change in population and demographics, both as a result of overall change and as a result of change among different age groups?

(3) Does your community have a significant seasonal population, is the nature of that population changing? What is the community's dependence on seasonal visitors?

(4) If your community is a service center or has a major employer, are additional efforts required to serve a daytime population that is larger than its resident population?

C. Conditions and Trends

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Population and Demographic Data Set (including relevant local, regional, and statewide data) prepared and provided to the community by the Office or its designee.

D. Policies

None required.

E. Strategies

None required.

Population and Demographics:

Analyses:
- Are populations increasing or decreasing along sensitive coastal areas?
- Is there greater exposure to climate impacts for certain vulnerable populations (new immigrants or elderly) such as less ability to afford migration and adaptation actions?

Strategies:
- Identify populations and groups particularly vulnerable to each of the projected climate change impacts and establish a communication strategy to increase awareness, mitigation, and adaptation efforts, and to coordinate emergency response.
- Continue to support and expand regional cooperation for emergency response, water supply and sewer systems, adaptation measures, and climate related hazard prevention and preparedness.

7. **Economy**

A. **State Goal**

Promote an economic climate that increases job opportunities and overall economic well-being.

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.7(C) to answer the following questions.

(1) Is the economy experiencing significant change, and how does this, or might this, affect the local population, employment, and municipal tax base?

(2) Does the community have defined priorities for economic development? Are these priorities reflected in regional economic development plans?

(3) If there is a traditional downtown or village center(s) in the community? If so, are they deteriorating or thriving?

(4) Is tourism an important part of the local economy? If so, what steps has the community taken to support this industry?

(5) Do/should home occupations play a role in the community?

(6) Are there appropriate areas within the community for industrial or commercial development? If so, are performance standards necessary to assure that industrial and commercial development is compatible with the surrounding land uses and landscape?

(7) Are public facilities, including sewer, water, broadband access or three-phase power, needed to support the projected location, type, and amount of economic activity, and what are the issues involved in providing them?

(8) If there are local of regional economic development incentives such as TIF districting, do they encourage development in growth areas?

(9) How can/does the community use its unique assets such as recreational opportunities, historic architecture, civic events, etc. for economic growth?

C. **Conditions and Trends**

Minimum data required to address Analysis:

(1) The community's Comprehensive Planning Economic Data Set prepared and provided to the community by the Office or its designee.

(2) A brief historical perspective on how and why the current economy of the community and region developed.

Economy

Analysis

- Does the community provide technical assistance to support natural hazard assistance and mitigation strategies for vulnerable small businesses?

(3) A list of local and regional economic development plans developed over the past five years, which include the community.

(4) Where does the community's population work and where do employees in your community reside? A description of the major employers in the community and labor market area and their outlook for the future.

(5) A description of any economic development incentive districts, such as tax increment financing districts, in the community.

D. **Policies**

Minimum policies required to address state goals:

(1) To support the type of economic development activity the community desires, reflecting the community's role in the region.

(2) To make a financial commitment, if necessary, to support desired economic development, including needed public improvements.

(3) To coordinate with regional development corporations and surrounding towns as necessary to support desired economic development.

E. **Strategies**

Minimum strategies required to address state goals:

(1) If appropriate, assign responsibility and provide financial support for economic development activities to the proper entity (e.g., a local economic development committee, a local representative to a regional economic development organization, the community's economic development director, a regional economic development initiative, or other).

(2) Enact or amend local ordinances to reflect the desired scale, design, intensity, and location of future economic development.

(3) If public investments are foreseen to support economic development, identify the mechanisms to be considered to finance them (local tax dollars, creating a tax increment financing district, a Community Development Block Grant or other grants, bonding, impact fees, etc.)

(4) Participate in any regional economic development planning efforts.

8. Housing

A. State Goal / Minimum Policy

To encourage and promote affordable, decent housing opportunities for all Maine citizens.

B. Analyses

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.8(C) to answer the following questions.

(1) How many additional housing units (if any), including rental units, will be necessary to accommodate projected population and demographic changes during the planning period?

(2) Is housing, including rental housing, affordable to those earning the median income in the region? Is housing affordable to those earning 80% of the median income? If not, review local and regional efforts to address issue.

(3) Are seasonal homes being converted to year-round use or vice-versa? What impact does this have on the community?

(4) Will additional low and moderate income family, senior, or assisted living housing be necessary to meet projected needs for the community? Will these needs be met locally or regionally?

(5) Are there other major housing issues in the community, such as substandard housing?

(6) How do existing local regulations encourage or discourage the development of affordable/workforce housing?

Housing

Analysis:

- Has the community considered increasing the Base Floor Elevation (BFE) standards in areas vulnerable to flooding?
- Has the community incorporated any other building design specifications that increase resistance to impacts from sea level rise or more intense storm events?

Policies:

- Reduce the impacts of climate change on quality, amount and affordability of housing in the community.

Strategies:

- Review current zoning codes, regulations, and policies to incorporate more sustainable building practices, such as LID design standards.
- Consider climate impacts when identifying future growth areas.

C. Conditions and Trends

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Housing Data Set prepared and provided to the community by the Maine State Housing Authority, and the Office, or their designees.

(2) Information on existing local and regional affordable/workforce housing coalitions or similar efforts.

(3) A summary of local regulations that affect the development of affordable/workforce housing.

D. Policies

Minimum policies required to address state goals:

(1) To encourage and promote adequate workforce housing to support the community's and region's economic development.

(2) To ensure that land use controls encourage the development of quality affordable housing, including rental housing.

(3) To encourage and support the efforts of the regional housing coalitions in addressing affordable and workforce housing needs.

E. **Strategies**

Minimum strategies required to address state goals:

(1) Maintain, enact or amend growth area land use regulations to increase density, decrease lot size, setbacks and road widths, or provide incentives such as density bonuses, to encourage the development of affordable/workforce housing.

(2) Maintain, enact or amend ordinances to allow the addition of at least one accessory apartment per dwelling unit in growth areas, subject to site suitability.

(3) Create or continue to support a community affordable/workforce housing committee and/or regional affordable housing coalition.

(4) Designate a location(s) in growth areas where mobile home parks are allowed pursuant to 30-A M.R.S.A. §4358(3)(M) and where manufactured housing is allowed pursuant to 30-A M.R.S.A. §4358(2).

(5) Support the efforts of local and regional housing coalitions in addressing affordable and workforce housing needs.

(6) Seek to achieve a level of at least 10% of new residential development built or placed during the next decade be affordable.

9. Recreation

A. State Goal

To promote and protect the availability of outdoor recreation opportunities for all Maine citizens, including access to surface waters.

B. Analyses

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.9(C) to answer the following questions.

(1) Will existing recreational facilities and programs in the community and region accommodate projected growth or changes in age groups in your community?

(2) Is there a need for certain types of services or facilities or to upgrade or enlarge present facilities to either add capacity or make them more usable?

(3) Are important tracts of open space commonly used for recreation publicly-owned or otherwise permanently conserved?

(4) Does the community have a mechanism, such as an open space fund or partnership with a land trust, to acquire important open spaces and access sites, either outright or through conservation easements?

(5) Does the public have access to each of the community's significant water bodies?

(6) Are recreational trails in the community adequately maintained? Are there use conflicts on these trails?

(7) Is traditional access to private lands being restricted?

C. Condition and Trends

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Recreation Data Set prepared and provided to the community by the Department of Conservation, and the Office, or their designees.

(2) A description of important public and private active recreation programs, land and water recreation areas (including hunting and fishing areas), and facilities in the community and region, including regional recreational opportunities as appropriate, and identification of unmet needs.

Recreation

Analysis:

- Is there an inventory of publicly-owned and maintained recreation facilities in vulnerable areas?

Policies:

- Discourage the location of new active recreation facilities in areas vulnerable to climate change impacts.

Strategies:

- Use tools such as TIF and impact fees to fund capital improvements, including recreation facilities, to attract development to growth areas and away from vulnerable ones.
- Limit public funding for recreation facilities in vulnerable areas.

(3) An inventory of any fresh or salt water bodies in the community determined locally to have inadequate public access.

(4) A description of local and regional trail systems, trail management organizations, and conservation organizations that provide trails for all-terrain vehicles, snowmobiling, skiing, mountain biking, or hiking.

(5) A map or list of important publicly-used open spaces and their associated facilities, such as parking and toilet facilities.

D. **Policies**

Minimum policies required to address state goals:

(1) To maintain/upgrade existing recreational facilities as necessary to meet current and future needs.

(2) To preserve open space for recreational use as appropriate.

(3) To seek to achieve or continue to maintain at least one major point of public access to major water bodies for boating, fishing, and swimming, and work with nearby property owners to address concerns.

E. **Strategies**

Minimum strategies required to address state goals:

(1) Create a list of recreation needs or develop a recreation plan to meet current and future needs. Assign a committee or community official to explore ways of addressing the identified needs and/or implementing the policies and strategies outlined in the plan.

(2) Work with public and private partners to extend and maintain a network of trails for motorized and non-motorized uses. Connect with regional trail systems where possible.

(3) Work with an existing local land trust or other conservation organizations to pursue opportunities to protect important open space or recreational land.

(4) Provide educational materials regarding the benefits and protections for landowners allowing public recreational access on their property. At a minimum this will include information on Maine's landowner liability law regarding recreational or harvesting use, Title 14, M.R.S.A. §159-A.

10. Transportation

Sensible Transportation Policy Act

If a community has adopted a local or applicable regional long-range transportation plan that has been approved by the Maine Department of Transportation as consistent with the *Sensible Transportation Policy Act* (23 M.R.S.A. §73), then the transportation section is deemed complete for the purposes of review under this Chapter. The transportation section of the comprehensive plan need only include a letter from the Maine Department of Transportation stating that the community's long-range transportation plan is consistent with 17-229 CMR Chapter 103 subchapter 3 and is current in accordance with 17-229 CMR Chapter 103 subchapter 3.2(F).

Absent such approval, the following information, analyses, policies and strategies are required. Regional transportation plans must be consulted in preparing this section.

A. **State Goal**

To plan for, finance and develop an efficient system of public facilities and services to accommodate anticipated growth and economic development.

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.10(C) to answer the following questions.

(1) What are the transportation system concerns in the community and region? What, if any, plans exist to address these concerns?

(2) Are conflicts caused by multiple road uses, such as a major state or U.S. route that passes through the community or its downtown and serves as a local service road as well?

(3) To what extent do sidewalks connect residential areas with schools, neighborhood shopping areas, and other daily destinations?

(4) How are walking and bicycling integrated into the community's transportation network (including access to schools, parks, and other community destinations)?

(5) How do state and regional transportation plans relate to your community?

Transportation

Analysis:

- Has the community evaluated the vulnerability of its transportation infrastructure to the effects of climate change such as flooding, storm surge, or excessive precipitation?
- How does the transportation infrastructure relate to vulnerable areas where impacts are expected?
- Does the community track maintenance costs associated with flooding damage to its transportation infrastructure?

Policies:

- To consider the impacts of climate change on future construction and maintenance priorities related to transportation infrastructure.

Strategies:

- If not already done, evaluate current transportation infrastructures vulnerability to climate change and flooding impacts.
- Use transportation policies to guide growth to safe locations and limit access to natural hazard areas.
- Newly constructed infrastructure should be designed and built in recognition of the best current understanding of future environmental risks. Incorporated future costs needed to increase infrastructure resiliency into CIP.
- Minimalize the risk to key transportation assets from floods, storms, landslides, and power outages through land use and development decisions, or retrofitting/replacement of utilities and infrastructure.
- Develop an inventory of all municipal Transportation infrastructure, and track maintenance related to flooding and other climate impacts.
- Review emergency access and evacuation And their vulnerability to extreme weather events.

(6) What is the community's current and approximate future budget for road maintenance and improvement?

(7) Are there parking issues in the community? If so what are they?

(8) If there are parking standards, do they discourage development in village or downtown areas?

(9) Do available transit services meet the current and foreseeable needs of community residents? If transit services are not adequate, how will the community address the needs?

(10) If the community hosts a transportation terminal, such as an airport, passenger rail station, or ferry terminal, how does it connect to other transportation modes (e.g. automobile, pedestrian, bicycle, transit)?

(11) If the community hosts or abuts any public airports, what coordination has been undertaken to ensure that required airspace is protected now and in the future? How does the community coordinate with the owner(s) of private airports?

(12) If you are a coastal community are land-side or water-side transportation facilities needed? How will the community address these needs?

(13) Does the community have local access management or traffic permitting measures in place?

(14) Do the local road design standards support the community's desired land use pattern?

(15) Do the local road design standards support bicycle and pedestrian transportation?

(16) Do planned or recently built subdivision roads (residential or commercial) simply dead-end or do they allow for expansion to adjacent land and encourage the creation of a network of local streets? Where dead-ends are unavoidable, are mechanisms in place to encourage shorter dead-ends resulting in compact and efficient subdivision designs?

C. **Conditions and Trends**

Minimum data required to address Analyses:

(1) The community's Comprehensive Planning Transportation Data Set prepared and provided to the community by the Department of Transportation, and the Office, or their designees.

(2) Location and overall condition of roads, bridges, sidewalks, and bicycle facilities, including any identified deficiencies or concerns.

(3) Identify potential on and off-road connections that would provide bicycle and pedestrian connections to neighborhoods, schools, waterfronts and other activity centers.

(4) Identify major traffic (including pedestrian) generators, such as schools, large businesses, public gathering areas/activities, etc. and related hours of their operations.

(5) Identify policies and standards for the design, construction and maintenance of public and private roads.

(6) List and locate municipal parking areas including capacity, and usage.

(7) Identify airports within or adjacent to the community and describe applicable airport zoning and airspace protection ordinances your community has in place.

(8) Identify bus or van services.

(9) Identify existing and proposed marine and rail terminals within your community including potential expansions.

(10) If coastal communities identify public ferry service and private boat transportation support facilities (may be covered under Marine Resources with cross reference) including related water-side (docks/piers/wharves) and land-side (parking) facilities.

D. **Policies**

Minimum policies required to address state goals:

(1) To prioritize community and regional needs associated with safe, efficient, and optimal use of transportation systems.

(2) To safely and efficiently preserve or improve the transportation system.

(3) To promote public health, protect natural and cultural resources, and enhance livability by managing land use in ways that maximize the efficiency of the transportation system and minimize increases in vehicle miles traveled.

(4) To meet the diverse transportation needs of residents (including children, the elderly and disabled) and through travelers by providing a safe, efficient, and adequate transportation network for all types of users (motor vehicles, pedestrians, bicyclists).

(5) To promote fiscal prudence by maximizing the efficiency of the state or state-aid highway network.

E. **Strategies**

Minimum strategies required to address state goals:

(1) Develop or continue to update a prioritized improvement, maintenance, and repair plan for the community's transportation network.

(2) Initiate or actively participate in regional and state transportation efforts.

(3) Maintain, enact or amend local ordinances as appropriate to address or avoid conflicts with:

a. Policy objectives of the *Sensible Transportation Policy Act* (23 M.R.S.A. §73);

b. State access management regulations pursuant to 23 M.R.S.A. §704; and

c. State traffic permitting regulations for large developments pursuant to 23 M.R.S.A. §704-A.

(4) Maintain, enact or amend ordinance standards for subdivisions and for public and private roads as appropriate to foster transportation-efficient growth patterns and provide for future street and transit connections.

11. Public Facilities and Services

A. **State Goal**

To plan for, finance and develop an efficient system of public facilities and services to accommodate anticipated growth and economic development.

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.11(C) to answer the following questions.

(1) Are municipal services adequate to meeting changes in population and demographics?

(2) Has the community partnered with neighboring communities to share services, reduce costs and/or improve services? In what ways?

(3) If the community has a public sewer system, what issues or concerns are there currently and/or anticipated in the future? Is the sanitary district extension policy consistent with the Future Land Use Plan as required by (38 M.R.S.A. §1163), or will it be?

(4) If the community has a public water system are any public water supply expansions anticipated? If so, have suitable sources been identified and protected? Is the water district extension policy consistent with the Future Land Use Plan?

Public Facilities

Analysis:

- Is there an inventory of publicly-owned and maintained facilities in vulnerable areas?

Policies:

- Discourage the location of new facilities in areas vulnerable to climate change impacts.

Strategies:

- Build an interconnected network of infrastructure such as roads, pipelines, and cables. The network structure will allow impacted equipment to be isolated as necessary so as not to shut down the entire area.
- Locate police, fire stations or emergency response in safe locations that are not likely to be affected by flooding.
- Use tools such as TIF and impact fees to fund capital improvements to attract development to growth areas and away from vulnerable ones.
- Limit public funding for infrastructure and facilities in vulnerable areas.

(5) If the town does not have a public sewer or water system, is this preventing the community from accommodating current and projected growth?

(6) Are existing stormwater management facilities adequately maintained? What improvements are needed? How might future development affect the existing system?

(7) How do residents dispose of septic tank waste? Are there issues or concerns regarding septic tank waste?

(8) Is school construction or expansion anticipated during the planning period? Are there opportunities to promote new residential development around existing and proposed schools?

(9) Is the community's emergency response system adequate? Are improvements needed?

(10) Is the solid waste management system meeting current needs? Is the community reducing the reliance on waste disposal and increasing recycling opportunities? Are improvements needed to meet future demand?

(11) Are improvements needed in the telecommunications and energy infrastructure?

(12) Are local and regional health care facilities and public health and social service programs adequate to meet the needs of the community?

(13) Will other public facilities, such as town offices, libraries, and cemeteries accommodate projected growth?

(14) To what extent are investments in facility improvements directed to growth areas?

(15) Does the community have a street tree program?

C. **Conditions and Trends**

Minimum data required to address Analyses includes the identification of the following as applicable for the public facilities and services in 3.11 C (5) (a through i):

(1) location of facilities and service areas (mapped as appropriate);

(2) general physical condition of facilities and equipment;

(3) capacity and anticipated demand during the planning period;

(4) identification of who owns/manages the systems;

(5) estimated costs of needed capital improvements to public facilities; and

(6) the following information related to each of these public facilities and services:

a. **Sewerage and/or Water Supply** – Identify number and types of users, and percent of households served

b. **Septage** – Identify any community policies or regulations regarding septage collection and disposal.

c. **Solid Waste** – Describe the community's solid waste management system. Identify types and amounts of municipal solid waste and recycled materials for the past five (5) years.

d. **Stormwater Management** – Identify combined sewer overflows. For Municipal Separate Stormwater System (MS4) communities, describe plan and status of the major goals of the MS4 requirements.

e. **Power and Communications** – Availability of 3-phase power, Internet (including broadband), and cable within the community.

f. **Emergency Response System** –Average call response times for fire, police, and emergency/rescue.

g. **Education** – Identify school administrative unit. Include primary/secondary school system enrollment for the most recent year information is available and for the ten (10) years after the anticipated adoption of plan.

h. **Health Care** - Describe major health care facilities (hospitals, clinics) and other providers serving the community. Identify public health and social services supported by the community through municipal subsidy.

i. **Municipal Government Facilities and Services** – Describe facilities and staffing for municipal administrative, enforcement, and public works operations.

j. **Street Tree Program** - Describe the community's street tree program.

D. **Policies**

Minimum policies required to address state goals:

(1) To efficiently meet identified public facility and service needs.

(2) To provide public facilities and services in a manner that promotes and supports growth and development in identified growth areas.

E. **Strategies**

Minimum strategies to meet state goals:

(1) Identify any capital improvements needed to maintain or upgrade public services to accommodate the community’s anticipated growth and changing demographics.

(2) Locate new public facilities comprising at least 75% of new municipal growth-related capital investments in designated growth areas.

(3) Encourage local sewer and water districts to coordinate planned service extensions with the Future Land Use Plan.

(4) If public water supply expansion is anticipated, identify and protect suitable sources?

(5) Explore options for regional delivery of local services.

12. Fiscal Capacity and Capital Investment Plan

A. **State Goal**

To plan for, finance and develop an efficient system of public facilities and services to accommodate anticipated growth and economic development.

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.12(C) to answer the following questions.

(1) How will future capital investments identified in the plan be funded?

(2) If the community plans to borrow to pay for capital investments, does the community have sufficient borrowing capacity to obtain the necessary funds?

(3) Have efforts been made by the community to participate in or explore sharing capital investments with neighboring communities? If so, what efforts have been made?

C. **Conditions and Trends**

Minimum data required to address Analyses:

(1) Identify community revenues and expenditures by category for the last five (5) years and explain trends.

(2) Describe means of funding capital items (reserve funds, bonding, etc.) and identify any outside funding sources.

(3) Identify local and state valuations and local mil rates for the last five (5) years.

(4) How does total municipal debt (including shares of county, school and utility) compare with the statutory and Maine Bond Bank recommended limits on such debt?

D. **Policies**

Minimum policies required to address state goals:

(1) To finance existing and future facilities and services in a cost effective manner.

(2) To explore grants available to assist in the funding of capital investments within the community.

Fiscal Capacity and Capitol Investment Plan

Analysis:

- Is there an inventory of publicly-owned and maintained facilities in vulnerable areas?

Policies:

- Discourage the location of new facilities in areas vulnerable to climate change impacts.

Strategies:

- Build an interconnected network of infrastructure such as roads, pipelines, and cables. The network structure will allow impacted equipment to be isolated as necessary so as not to shut down the entire area.
- Locate police, fire stations or emergency response in safe locations that are not likely to be affected by flooding.
- Use tools such as TIF and impact fees to fund capital improvements to attract development to growth areas and away from vulnerable ones.
- Limit public funding for infrastructure and facilities in vulnerable areas.

(3) To reduce Maine's tax burden by staying within LD 1 spending limitations.

E. **Strategies**

Minimum strategies required to address state goals:

(1) Explore opportunities to work with neighboring communities to plan for and finance shared or adjacent capital investments to increase cost savings and efficiencies.

F. **Capital Investment Plan**

The comprehensive plan must include a capital investment plan that:

(1) Identifies and summarizes anticipated capital investment needs within the planning period in order to implement the comprehensive plan, including estimated costs and timing, and identifies which are municipal growth-related capital investments;

(2) Establishes general funding priorities among the community capital investments; and

(3) Identifies potential funding sources and funding mechanisms.

13. Existing Land Use

A. **State Goal**

None required.

B. **Analyses**

To generate minimum analyses to address state goals, use Conditions and Trends data in Section 3.13(C) and the community's vision statement to answer the following questions.

(1) Is most of the recent development occurring: lot by lot; in subdivisions; or in planned developments? Is recent development consistent with the community's vision?

(2) What regulatory and non-regulatory measures would help promote development of a character, and in locations that are consistent with the community's vision?

(3) Is the community's administrative capacity adequate to manage its land use regulation program, including planning board and code enforcement officer?

(4) Are floodplains adequately identified and protected? Does the community participate in the National Flood Insurance Program? If not, should it? If so, is the floodplain management ordinance up to date and consistently enforced? Is the floodplain management ordinance consistent with state and federal standards?

Existing Land Use

Analysis:
- Has the community analyzed hazard exposure and vulnerability?

Policies:
- Discourage growth and new development in areas where, because of coastal storms, flooding, changes in precipitation, landslides or sea level rise, it is hazardous to human health and safety.

Strategies:
- Establish regular schedule for updating flood maps and risk assessment, with provisions for extra mapping when new information becomes available that will substantially change high risk areas.
- Update development guidelines to include adaptation to future climate conditions.
- Take advantage of redevelopment to obtain or restore public and natural amenities that increase resilience through density bonuses, variances, or purchase.

C. **Conditions and Trends**

Minimum data required to address Analyses:

(1) An existing land use map, by land use classification (such as mixed-use, residential, commercial, institutional, industrial, agricultural, commercial forests, marine, park/recreational, conserved, and undeveloped land).

(2) A summary of current lot dimensional standards.

(3) A description or map identifying the location of lots and primary structures created within the last ten years. Include residential, institutional, commercial, and industrial development.

(4) Provide a brief description of existing land use regulations and other tools utilized to manage land use, including shoreland zoning, floodplain management, subdivision, site plan review, and zoning ordinances.

(5) Estimate the minimum amount of land needed to accommodate projected residential, institutional, commercial, or industrial development at least ten (10) years into the future.

D & E. **Policies & Strategies** None Required

SECTION 4. FUTURE LAND USE PLAN

1. State Goal

To encourage orderly growth and development in appropriate areas of each community, while protecting the state's rural character, making efficient use of public services, and preventing development sprawl.

2. Future Land Use Plan Overview

The plan must include a Future Land Use Plan that is consistent with the community's vision and other policies in the plan. The Future Land Use Plan brings together plan elements that affect land use. It is intended to synthesize these elements into a cohesive guide to realizing the community's vision, including the development of land use regulations/ordinances. Use the analysis of conditions and trends data in Section 4, in conjunction with the vision statement, to develop the community's Future Land Use Plan.

The Future Land Use Plan divides the community into geographical areas identified as either most suitable for growth or most suitable for rural uses unless exempted under 30-A M.R.S.A. §4326(3-A), more fully described below. The Future Land Use Plan also incorporates a map of critical natural resources and any designated critical rural and critical waterfront areas within the community. The Future Land Use Plan will be the focus of the Office review for consistency with the Act.

3. Review Criteria for Future Land Use Plan Designations

A. **Growth Areas**

A community's Future Land Use Plan must identify a growth area or areas. The designation of growth areas is intended to ensure that planned growth and development and related infrastructure are directed to areas most suitable for such growth and development. Land areas designated as growth area must be consistent with the following provisions.

Future Land Use:

Note: The Future Land Use Plan should avoid, if possible, designating as growth areas those lands that are vulnerable to flooding or impacts from increased storm events. If such areas are designated as growth areas, the community should carefully outline adaptation measures it will pursue to mitigate this the negative impacts.

(1) The Future Land Use Plan must designate as growth area those lands into which the community intends to direct a minimum of 75% of dollars for municipal growth-related capital investments made during the planning period.

(2) Built-out or developed areas that may not have capacity for further growth but require maintenance, replacement, or additional capital investment to support existing or infill development must also be designated as growth areas.

(3) Growth areas must generally be limited to land areas that are physically suitable for development or redevelopment. Growth areas may include incidental land areas that are physically unsuitable for development or redevelopment, including critical natural resource, however, the plan must addresses how these areas will be protected from negative impacts of incompatible development to the greatest extent practicable or, at a minimum, as prescribed by law.

(4) To the greatest extent practicable growth areas should be located adjacent to existing densely-populated area.

(5) Growth areas, to the greatest extent practicable, should be limited to an amount of land area and a configuration to encourage compact, efficient development patterns (including mixed uses) and discourage development sprawl and strip development.

(6) Growth areas along roads should be configured to avoid strip development and promote nodes or clusters of development.

B. **Growth Area Exemptions**

In some communities, conditions may make the identification of specific areas for residential, institutional, commercial, and/or industrial growth inappropriate. These conditions, as described in 30-A M.R.S.A. §4326(3-A) and Section 4.5 of this Chapter, include:

(1) Severe physical limitations;

(2) Minimal or no growth; or

(3) The lack of a village or densely populated area.

Communities with one or more of these conditions may develop a Future Land Use Plan that does not identify growth areas for residential, institutional, commercial, or industrial growth pursuant to the criteria identified in Section 4.5. If a growth area exemption is proposed, the plan's description of existing trends and conditions must support the exemption request. Communities with growth caps or rate-of-growth ordinances are not eligible for a growth area exemption.

C. **Shared Growth Areas**

Pursuant to and in accordance with 30-A M.R.S.A. §4325, communities may enter into an interlocal agreement with one or more neighboring communities to designate regional growth areas for anticipated residential, institutional, commercial, or industrial growth and/or related services or infrastructure.

D. **Transitional Areas**

The Future Land Use Plan may designate as transitional area those land areas which the community identifies as suitable for a share of projected residential, institutional, commercial or industrial development but that is neither intended to accept the amount or density of development appropriate for a growth area nor intended to provide the level of protection for rural resources afforded in a rural area or critical rural area. Designated transitional areas are intended to provide for limited suburban or rural residential development opportunities. Land areas designated as transitional area must be consistent with the following provisions:

(1) Transitional areas cannot be defined as growth areas for the purposes of state growth related capital investment pursuant to 30-A M.R.S.A. §4301(5-B).

(2) Development standards in transitional areas must limit strip development along roads through access management, minimum frontage requirements, and other techniques.

(3) Transitional areas cannot include significant contiguous areas of working farms, wood lots, properties in state tree growth and farm and open space tax programs, prime agricultural and forestry soils, unfragmented habitat, or marine resources identified in the conditions and trends in Sections 3.3, 3.4, and 3.5.

(4) Transitional areas must be compatible with designations in adjacent communities or provide buffers or transitions to avoid land use conflicts with neighboring communities.

E. **Rural Areas**

The community's Future Land Use Plan must identify a rural area or areas. The designation of rural areas is intended to identify areas deserving of some level of regulatory protection from unrestricted development for purposes that may include, but are not limited to, supporting agriculture, forestry, mining, open space, wildlife habitat, fisheries habitat and scenic lands, and away from which most development projected over ten (10) years is diverted.

A community's Future Land Use Plan must designate as rural area or areas any portion of the community consistent with the following provisions:

(1) To the greatest extent practicable, rural areas must include working farms, wood lots, properties enrolled in current-use tax programs related to forestry, farming or open space, areas of prime agricultural soils, critical natural resources, and important natural resources.

(2) The Future Land Use Plan must identify proposed mechanisms, both regulatory and non-regulatory, to ensure that the level and type of development in rural areas is compatible with the defined rural character and does not encourage strip development along roads.

(3) Rural areas shall not include land areas where the community actively encourages new residential, institutional, or commercial development.

(4) Rural areas must be compatible with designations in adjacent communities or provide buffers or transitions to avoid land use conflicts with neighboring communities.

F. **Critical Natural Resources**

For the purpose of protecting Critical Natural Resources from the impacts of incompatible development, the Future Land Use Plan must distinguish between areas where those resources are present and where they are absent.

Future Land Use:

Note: Incompatible development may also include development that does not consider vulnerability to sea level rise, or impacts from increased storm frequency and intensity.

The Future Land Use Plan must include a map or maps depicting Critical Natural Resources and a description of proposed regulations (including ongoing local, state and federal regulations) and non-regulatory measures designed to ensure that these resources are, to the greatest practicable extent, protected from the impacts of incompatible development. (Typically, some of the information contained in a plan's Natural Resources section will be repeated or summarized in the Future Land Use section.)

G. **Critical Rural Areas and Critical Waterfront Areas**

As an option, the community may identify and designate one or more critical rural areas or critical waterfront areas as defined in this Chapter on the Future Land Use Plan. If the community chooses to make such designations, land areas so designated must be consistent with the following provisions:

(1) Critical rural areas and critical waterfront areas are those rural and waterfront areas in a community most vulnerable to impacts from incompatible development.

(2) The Future Land Use Plan must identify current and proposed mechanisms, both regulatory and non-regulatory, to ensure that critical rural areas and critical waterfront areas are, to the greatest extent practicable, protected from the impacts of incompatible development.

(3) Critical rural areas and critical waterfront areas must be compatible with designations in adjacent communities or provide buffers or transitions to avoid land use conflicts with neighboring communities.

4. Required Elements for the Future Land Use Plan

A. Analyses

(1) Does the Future Land Use Plan align and/or conflict with the community's vision statement?

(2) Is the configuration of the growth area(s) shaped by natural opportunities and/or constraints (i.e. the physical suitability or unsuitability of land for development)? The location of public facilities? The transportation network?

Future Land Use

Analysis:

- Does the Future Land Use Plan consider the future impacts of climate change?

(3) How does the Future Land Use Plan relate to recent development trends?

(4) Given current regulations, development trends, and population projections, estimate how many new residential units and how much commercial, institutional, and/or industrial development will likely occur in the planning period? Where is this development likely to go?

(5) How can critical natural resources and important natural resources be effectively protected from future development impacts?

B. Components

The Future Land Use Plan must include:

(1) A map or maps showing:

a. Growth area(s) (unless exempted) and Rural area(s) and any land use districts within each;

Future Land Use

Components:

- A map of areas vulnerable to sea level rise or increased flooding resulting from sea level rise or storm events, including such resources as historic or culturally significant areas, schools, hospitals, utilities, and critical infrastructure.

b. Critical Natural Resources in accordance with 4.3.F, above

c. Any of the following optional land use areas, if proposed, along with any land use districts within each: Transitional, Critical Rural, Critical Waterfront.

(2) A map depicting the constraints to development identified in the plan (may be a combination of maps from other sections).

(3) A narrative description of each land use district including:

a. The district's relationship to the community's vision;

b. The district's natural opportunities and/or constraints;

c. The types and intensity of proposed land uses, including residential density;

d. The compatibility or incompatibility of proposed uses to current uses, critical natural resources and important natural resources within and around the district along with any special development considerations (e.g. need for additional buffers, conservation subdivision provisions, architectural design standards, etc.); and

e. Any anticipated major municipal capital investments needed to support the proposed land uses.

C. **Policies**

Minimum policies to address state goals:

(1) To coordinate the community's land use strategies with other local and regional land use planning efforts.

(2) To support the locations, types, scales, and intensities of land uses the community desires as stated in its vision.

(3) To support the level of financial commitment necessary to provide needed infrastructure in growth areas.

(4) To establish efficient permitting procedures, especially in growth areas.

(5) To protect critical rural and critical waterfront areas from the impacts of development.

D. **Strategies**

In addition to the strategies required below, include any strategies as necessary to support the establishment of any rate of growth or impact fee ordinances proposed. These may include strategies found in other sections of the plan.

Minimum strategies required to address state goals:

(1) Assign responsibility for implementing the Future Land Use Plan to the appropriate committee, board or municipal official.

(2) Using the descriptions provided in the Future Land Use Plan narrative, maintain, enact or amend local ordinances as appropriate to:

a. Clearly define the desired scale, intensity, and location of future development;

b. Establish or maintain fair and efficient permitting procedures, and explore streamlining permitting procedures in growth areas; and

c. Clearly define protective measures for critical natural resources and, where applicable, important natural resources.

d. Clearly define protective measures for any proposed critical rural areas and/or critical waterfront areas, if proposed.

(3) Include in the Capital Investment Plan anticipated municipal capital investments needed to support proposed land uses.

(4) Meet with neighboring communities to coordinate land use designations and regulatory and non-regulatory strategies.

(5) Provide the code enforcement officer with the tools, training, and support necessary to enforce land use regulations, and ensure that the Code Enforcement Officer is certified in accordance with 30-A M.R.S.A. §4451.

(6) Track new development in the community by type and location.

(7) Direct a minimum of 75% of new municipal growth-related capital investments into designated growth areas identified in the Future Land Use Plan.

(8) Periodically (at least every five years) evaluate implementation of the plan in accordance with Section 2.7.

5. Criteria for Growth Area Exemptions

A. Severe Physical Limitations

The Future Land Use Plan need not identify growth areas if the plan demonstrates that it is not possible to accommodate future residential, institutional, commercial, or industrial growth because of severe physical limitations, including, without limitation, the lack of adequate water supply and sewage disposal services, very shallow soils, or limitations imposed by critical natural resources.

To be considered for a growth area exemption because of severe physical limitations, the Future Land Use Plan must clearly indicate the physical limitation and the rationale for the exemption, based on one or more of the following three criteria:

(1) **Water delivery and sewage disposal limitations**. To qualify under this criterion, the Future Land Use Plan shall include descriptions of existing water delivery system(s) and sewage disposal system(s), including an analysis of the current capacity of the system(s) and potential for service expansion or introduction of such services. This discussion must also include descriptions and maps of aquifers in the planning area, and a description of how these aquifers relate to future capacity to serve as water supply.

(2) **Soils**. Description of soils types and conditions (available from the Natural Resources Conservation Service and the Maine Geological Survey), including the presence of ledge or steep slopes. This discussion must also describe the limitations of these soils related to wastewater disposal [pursuant to Maine Subsurface Wastewater Disposal regulations (10-144 CMR 241)], and describe how these soil limitations make designation of any growth areas in the community with densities in the range of 20,000 to 80,000 square feet impractical.

(3) **Critical natural resources**. Description of critical natural resources, with accompanying map(s) detailing the location of those resources. Based on this information, this discussion must also include a description of the constraints placed on future development by critical natural resources, alone or in conjunction with other physical limitations.

B. **Minimal or No Growth**

The Future Land Use Plan is not required to identify growth areas for residential, institutional, commercial or industrial growth if it demonstrates that the community or region has experienced minimal or no residential, institutional, commercial, or industrial development over the past decade and this condition is expected to continue over the planning period. Communities that have adopted growth caps or rate-of-growth ordinances are not eligible for a growth area exemption.

For consideration of a growth area exemption because of minimal residential, institutional, commercial, or industrial development, the Future Land Use Plan must clearly indicate the rationale for the exemption according to the type of exemption, as described below:

(1) **Residential growth area exemption**. For both the preceding 10-year period and the projected planning period, the Future Land Use Plan must include: the community's population; the number of households; and the average household size. Based on this information, the Future Land Use Plan must demonstrate that the community has experienced minimal or no residential development as defined in Section 1.2(CC) and expects such a trend to continue.

(2) **Commercial/Institutional growth area exemption**. The Future Land Use Plan must include: information on the type and amount (square footage) of institutional or commercial development that occurred in the community during the preceding 10-year period, and a discussion of the type and amount of institutional or commercial development that is likely during the projected planning period. Based on this information, the Future Land Use Plan must demonstrate that the community has experienced minimal or no commercial/ institutional growth, as defined in Section 1.2(AA), and expects such trends to continue.

(3) **Industrial growth area exemption**. The Future Land Use Plan must include: information on the type and amount (square footage) of industrial development that occurred in the community during the preceding 10-year period, and a discussion of what type and amount of industrial development is likely during the projected planning period. Based on this information, the Future Land Use Plan must demonstrate that the community has experienced minimal or no industrial development, as defined in Section 1.2(BB), and expects such a trend to continue.

C. **Lack of a Village or Densely Populated Area**

The Future Land Use Plan is not required to identify growth areas for residential, institutional, commercial, or industrial growth anywhere in the community if it demonstrates that the community or region growth patterns do not include a village center or other densely populated area, and that no such areas are expected over the planning period.

For consideration of a growth area exemption because of the absence of a village or densely populated area, the Future Land Use Plan must discuss the manner in which the community intends to remain a rural community. As part of this discussion, the Future Land Use Plan must describe the rationale for the exemption, and must meet the following three criteria:

(1) Except for shoreland zones, the community has no land areas with residential dwelling densities greater than one unit per two acres within an area encompassed by any 500-foot radius; and

(2) The community has no land areas with village characteristics, such as a compact mix of commercial, civic, and residential development or a mix of housing types; and

(3) The community has no municipal or quasi-public water or wastewater systems.

MAINE COMPREHENSIVE PLANNING
CLIMATE CHANGE CONSIDERATIONS:

Climate Adaptation Resources for Communities

General References:

- Georgetown Climate Center
- FEMA Climate Change Tools

Historic Preservation:

- National Park Service's Climate Change Response Strategy
- Coastal Archaeological Resources Risk Assessment
- Cultural Heritage at Risk in the Twenty-First Century: A Vulnerability Assessment of Coastal Archaeological Sites in the United States
- National Park Service Policy Memorandum 14-02, section 2. Cultural Resources Decision-making in an Era of Climate Change
- Department of the Interior Climate Action Plan, section II: The Department of the Interior's Climate Adaptation Policy, Guiding Principles, Cultural and Heritage Resources
- National Park Service's Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings

Water Resources:

- Climate Change Handbook for Regional Water planning.
- Climate Ready Water Utilities Website
- Climate Resilience Evaluation and Awareness Tool (CREAT)
- Climate Ready Estuaries
- Climate Change and Water Resource Management: Adaptation Strategies for Protecting People and the Environment

Natural Resources:

- National Park Service-Climate Change Website

- U.S. Climate Resilience Toolkit: Adaptation Workbook for Natural Resources

Marine Resources:

- New York City Comprehensive Waterfront Plan: Vision 2020

Agricultural and Forest Resources:

- Climate Change and Agriculture in the United States: Effects and Adaptation, USDA Bulletin 1935, February 2013

Housing:

- The U.S. Department of Housing and Urban Development Policy Statement for Climate Change Adaptation

Land Use:

- USGS Website

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2017

Municipal Climate Adaptation Guidance Series: Shoreland Zoning

ROBERT FAUNCE, LINCOLN COUNTY REGIONAL PLANNING COMMISSION

This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

This guidance document is comprised of suggested revisions that can be made to a local Shoreland Zoning Ordinance which reflect the need for, and promote, greater climate resiliency among Maine municipalities. As a convenience to the user, the suggested revisions are presented within the context of the Maine Department of Environmental Protection's Rules Chapter 1000: Guidelines for Municipal Shoreland Zoning , however, the suggested revisions are NOT part of Chapter 1000 and, prior to incorporating any of them into a local ordinance, municipal officials should first consult with the MDEP Shoreland Zoning Program

Suggested new language is blue and underlined, while suggested deletions are noted in the right magin.

Proposed Guidance for Changes to Local Ordinances Adopted Pursuant to
Chapter 1000: GUIDELINES FOR MUNICIPAL SHORELAND ZONING ORDINANCES
To Adapt to Sea Level Rise

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15. Land Use Standards

A. Minimum Lot Standards

(2) Land within the 100-year floodplain , land below the normal high-water line of a water body or upland edge of a wetland and land beneath roads serving more than two (2) lots shall not be included toward calculating minimum lot area.

B. Principal and Accessory Structures

(1) All new principal and accessory structures shall be set back at least one hundred (100) feet, horizontal distance, from the normal high-water line of great ponds classified GPA and rivers that flow to great ponds classified GPA, and seventy-five (75) feet, horizontal distance, from the elevation of the 100-year floodplain in tidal areas, and the normal high-water line of other water bodies, tributary streams, or the upland edge of a wetland, except that in the General Development I District the setback from the normal high-water line shall be at least twenty five (25) feet, horizontal distance, and in the Commercial Fisheries/Maritime Activities District there shall be no minimum setback. In the Resource Protection District the setback requirement shall be 250 feet, horizontal distance, except for structures, roads, parking spaces or other regulated objects specifically allowed in that district in which case the setback requirements specified above shall apply. In no event shall any new principal structure in the Resource Protection District be located within the limits of moderate wave action (LiMWA) landward of Coastal A or V zones.~~, as defined in Federal Emergency Management Agency *Procedure Memorandum #50*, (Buckley 2008).~~

In addition:

(c) For principal structures, water and wetland setback measurements shall be taken from the top of a coastal bluff that has been identified on Coastal Bluff maps as being "highly unstable" or "unstable" by the Maine Geological Survey pursuant to its "Classification of Coastal Bluffs" and published on the most recent Coastal Bluff map. If the applicant and the permitting official(s) are in disagreement as to the specific location of a "highly unstable" or "unstable" bluff, or where the top of the bluff is located, the applicant may at his or her expense, employ a Maine Registered Professional Engineer, a Maine Certified Soil Scientist, a Maine State Geologist, or other qualified individual to make a determination. If agreement is still not reached, the applicant may appeal the matter to the board of appeals. In the Limited Residential District, in areas subject to shoreline erosion for which an annual erosion rate has been established by the Maine Geological Survey, the set back shall be either seventy-five (75) feet, horizontal distance, or seventy (70) times the measured annual erosion rate, whichever is greater. Such areas shall be shown on the Official Shoreland Zoning Map

NOTE: A municipality may choose not to adopt subparagraph B(1)(ed) below. However, if a municipality elects to adopt a provision similar to that subparagraph, it must be no less restrictive.

(d) For principal structures located adjacent to tidal waters, water and wetland setback measurements shall be taken from the contour line at the elevation of the 100 year floodplain.

(ed)On a non-conforming lot of record on which only a residential structure exists, and it is not possible to place an accessory structure meeting the required water body, tributary stream or wetland setbacks, the code enforcement officer may issue a permit to place a single accessory structure, with no utilities, for the storage of yard tools and similar equipment. Such accessory structure shall not exceed eighty (80) square feet in area nor eight (8) feet in height, and shall be located as far from the shoreline or tributary stream as practical and shall meet all other applicable standards, including lot coverage and vegetation clearing limitations. In no case shall the structure be located closer to the shoreline or tributary stream than the principal structure.

NOTE: All tidal land which is subject to tidal action during the highest annual tide is coastal wetland. In tidal areas, the shoreline position, defined as the upland edge of the coastal wetland, may be established on the official shoreland zoning map by utilizing LiDAR data available from the Maine Office of GIS (MEGIS) to locate the contour line at the height of the maximum spring tide. Municipalities who wish to depict a more accurate shoreline in this manner should consult with their Regional Planning Commission or other mapping professionals.

(3) The lowest floor elevation or openings of all buildings and structures, including basements, shall be elevated at least ~~one~~ three feet~~foot~~ above the elevation of the 100 year flood in a shoreland zone of a coastal wetland, and at least one foot above the elevation of the 100 year flood in shoreland zone of a water body or freshwater wetland, the flood of record, or in the absence of these, the flood as defined by soil types identified as recent flood-plain soils. In those municipalities that participate in the National Flood Insurance Program and have adopted the April 2005 version, or later version, of the Floodplain Management Ordinance, accessory structures may be placed in accordance with the standards of that ordinance and need not meet the elevation requirements of this paragraph.

(4) Within any frontal or back dune areas in the Resource Protection District, as designated by the Department of Environmental Protection Sand Dune Rules, the total footprint of all structures as defined by this ordinance, and parking lots and other non-vegetated surfaces shall not exceed fifteen (15) percent of the lot or portion thereof, located in said areas. With the exception of General Development Districts located adjacent to coastal wetlands and rivers that do not flow to great ponds, and Commercial Fisheries/Maritime Activities Districts, non-vegetated surfaces shall not exceed a total of twenty (20) percent of the portion of the lot located within the shoreland zone. This limitation does not apply to public boat launching facilities regardless of the district in which the facility is located.

In a General Development District located adjacent to coastal wetlands, or rivers that do not flow to great ponds, or in a Commercial Fisheries/Maritime Activities District, non-vegetated surfaces shall not exceed a total of seventy (70) percent of the portion of the lot located within the shoreland zone.

For the purposes of calculating lot coverage, non-vegetated surfaces include, but are not limited to the following: structures, driveways, parking areas, and other areas from which vegetation has been removed. Naturally occurring ledge and rock outcroppings are not counted as nonvegetated surfaces when calculating lot coverage for lots of record on March 24, 1990 and in continuous existence since that date. Land within the 100-year floodplain and land below the normal high-water line of a water body or upland edge of a wetland shall not be included toward calculating the maximum allowable footprint of non-vegetated surfaces.

H. Roads and Driveways. The following standards shall apply to the construction of roads and/or driveways and drainage systems, culverts and other related features.

(5) In no event shall a new road or driveway be located within a 100 year floodplain, except for crossings where no reasonable alternative exists as determined by the Planning Board. A road over a 100 year floodplain shall be elevated three feet above the height of the 100 year flood as determined by the latest FEMA flood insurance rate map, or by a professional engineer, where no flood height has been determined.

(6~~5~~) Road and driveway banks shall be no steeper than a slope of two (2) horizontal to one (1) vertical, and shall be graded and stabilized in accordance with the provisions for erosion and sedimentation control contained in Section 15(T).

(7~~6~~) Road and driveway grades shall be no greater than ten (10) percent except for segments of less than two hundred (200) feet.

(8~~7~~) In order to prevent road and driveway surface drainage from directly entering water bodies, tributary streams or wetlands, roads and driveways shall be designed, constructed, and maintained to empty onto an unscarified buffer strip at least (50) feet plus two times the average slope, in width between the outflow point of the ditch or culvert and the normal high-water line of a water body, tributary stream, or upland edge of a wetland. Surface drainage which is directed to an unscarified buffer strip shall be diffused or spread out to promote infiltration of the runoff and to minimize channelized flow of the drainage through the buffer strip.

(9~~8~~) Ditch relief (cross drainage) culverts, drainage dips and water turnouts shall be installed in a manner effective in directing drainage onto unscarified buffer strips before the flow gains sufficient volume or head to erode the road, driveway, or ditch. To accomplish this, the following shall apply:

(a) Ditch relief culverts, drainage dips and associated water turnouts shall be spaced along the road, or driveway at intervals no greater than indicated in the following table:

Grade (Percent)	Spacing (Feet)
0-2	250
3-5	200-135
6-10	100-80
11-15	80-60
16-20	60-45
21 +	40

(b) Drainage dips may be used in place of ditch relief culverts only where the grade is ten (10) percent or less.

(c) On sections having slopes greater than ten (10) percent, ditch relief culverts shall be placed at approximately a thirty (30) degree angle downslope from a line perpendicular to the centerline of the road or driveway.

(d) Ditch relief culverts shall be sufficiently sized and properly installed in order to allow for effective functioning, and their inlet and outlet ends shall be stabilized with appropriate materials.

(10~~9~~) Ditches, culverts, bridges, dips, water turnouts and other storm water runoff control installations associated with roads and driveways shall be maintained on a regular basis to assure effective functioning.

16. Administration

E. Special Exceptions.

(3) All proposed buildings, sewage disposal systems and other improvements are:

(a) Located on natural ground slopes of less than 20%; and

(b) Located outside the floodway of the 100-year flood-plain along rivers and artificially formed great ponds along rivers and outside the velocity zone in areas subject to tides, based on detailed flood insurance studies and as delineated on the Federal Emergency Management Agency's Flood Boundary and Floodway Maps and Flood Insurance Rate Maps; all buildings, including basements, comply with the structure elevation requirements of Section 15.B(3)~~are elevated at least one foot above the 100-year flood-plain elevation~~; and the development is otherwise in compliance with any applicable municipal flood-plain ordinance.

If the floodway is not shown on the Federal Emergency Management Agency Maps, it is deemed to be 1/2 the width of the 100-year flood-plain.

H. Appeals

(2) **Variance Appeals**. Variances may be granted only under the following conditions:

(e) Notwithstanding the requirements of Section 16(H)(2)(c)ii, above, the Board of Appeals may grant a variance to exceed the maximum height requirement of Section 15.B.2 to the owner of a residential dwelling provided that:
(i) the residential dwelling was in existence prior to January 1, 2017;
(ii) the dwelling is subject to the structure elevation requirements of Section 15.B.3; and
(ii) the increase in height is no more than the distance that the lowest floor elevation (including basement) is raised above its original elevation to comply with but not exceed the minimum structure elevation requirements of section 15.B.3.

(fe) The Board of Appeals shall limit any variances granted as strictly as possible in order to ensure conformance with the purposes and provisions of this Ordinance to the greatest extent possible, and in doing so may impose such conditions to a variance as it deems necessary. The party receiving the variance shall comply with any conditions imposed.

(gf) A copy of each variance request, including the application and all supporting information supplied by the applicant, shall be forwarded by the municipal officials to the Commissioner of the Department of Environmental Protection at least twenty (20) days prior to action by the Board of Appeals. Any comments received from the Commissioner prior to the action by the Board of Appeals shall be made part of the record and shall be taken into consideration by the Board of Appeals.

17. Definitions

Limits of Moderate Wave Action (LiMWA) – As defined in FEMA Memorandum #50 (Buckley, 2008), the landward limit of the 1.5-foot breaking wave during a 100 year flood event.

Lot area - The area of land enclosed within the boundary lines of a lot, minus:

(1) land below the normal high-water line of a water body or upland edge of a wetland; ~~and~~
(2) land within the 100 year floodplain; and
(3) areas beneath roads serving more than two lots.

2017

Municipal Climate Adaptation Guidance Series: Site Plan Review Ordinances

TOM MARTIN, HANCOCK COUNTY PLANNING COMMISSION
STEPHANIE CARVER, GREATER PORTLAND COUNCIL OF GOVERNMENTS

This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

SITE PLAN REVIEW HANDBOOK

AND

CLIMATE RESILIENCE

This guidance document is comprised of revisions to the Site Plan Review Handbook: A Guide to Developing a Site Plan Review System, published in October 1997 by the Maine State Planning Office. These revisions are designed to update the Handbook to reflect the need for, and to promote, greater climate resiliency among Maine municipalities.

PART A. OVERVIEW OF SITE PLAN REVIEW

Part A of the Handbook is designed to familiarize municipal officials, staff, and the general public with the concept of site plan review. Among other things, it helps the reader understand key issues and make informed decisions about the kinds of things that should be considered as part of the Site Plan Review process. It does not include model ordinance provisions, but provides background on various aspects of development.

The passages from Part A which appear below, have been edited to reflect a new focus on issues relating to climate resiliency (new language for Part A is underlined):

WHAT ISSUES DOES SITE PLAN REVIEW ADDRESS?

Site plan review deals with how a particular development is designed. Site plan regulations typically address issues related to public health, public safety, and the environment such as water supply, sewage disposal, traffic, emergency access, and stormwater management. In addition, many communities choose to address the protection of neighboring properties through standards for buffering, noise, lighting, and other external impacts. Some communities also choose to deal with how new projects fit into the community and review site design and landscaping provisions. In a time when climate variability has become a fact of life, communities are striving to increase their resiliency by assuring that new development projects are designed to minimize the impacts of more frequent severe storm events.

EXPANSION OF THE AMOUNT OF IMPERVIOUS OR PAVED SURFACES

While the construction of buildings or structures is the focus of most **site plan review** regulations, communities should also be mindful of the environmental impacts resulting from the construction of

parking lots and other paved or impervious surface areas (including roofs). Impervious surfaces can significantly increase both the rate and volume of surface runoff, cause contamination of ground and surface waters, and when used for vehicle circulation and parking, give rise to noise and traffic safety concerns. For these reasons, many communities require that the creation of impervious surface areas greater than certain size (e.g. 1,000 square feet) go through **site plan review**.

PUBLIC SAFETY, HEALTH, AND ENVIRONMENTAL FACTORS

Most communities choose to address basic issues dealing with public safety, public health, and the environment in their site plan review process. In these cases, factors considered in the review process may include:

- *Adequacy of access to the site*
- *Provisions for access into and out of the site*
- *Pedestrian and vehicular circulation within the site*
- *Layout of parking*
- *Provisions for emergency vehicle access*
- *Stormwater management (including LID techniques)*
- *Erosion and sedimentation control*
- *The protection of the water quality in water bodies*
- *Groundwater quality protection*
- *Provisions for groundwater recharge*
- *Solid and hazardous wastes management*
- *Provisions for water supply and sewage disposal*
- *Handicapped accessibility*
- *Provisions for fire protection*
- *The management of important natural resources (floodplains, unique natural areas, wildlife habitat, etc.*
- *The protection of historic and archaeological resources*
- *Provisions to manage potential impacts of more frequent flooding and rising storm surge levels*

PART B. DEVELOPING A SITE PLAN REVIEW SYSTEM

Part B of the Handbook is designed to help craft a site plan review ordinance and, in Sections 9 through 11, it provides an array of provisions which can be included in a site plan review ordinance.

The editing instructions (written in italics) and revised language for Sections 9 through 11, which appear below, are designed to amend these provisions so they better reflect issues relating to climate adaptation and resilience.

SECTION 9. THE BASIC SITE PLAN REVIEW SYSTEM

A. Purpose and Applicability Provisions

APPLICABILITY OF SITE PLAN REVIEW

(9) *Replace existing provision with:*

The creation of more than 2,000 square feet of Impervious Area within any three (3) year period.

D. Submission Requirements

2. Existing Conditions

(3) *Replace existing provision with:*

location and size of any existing sewer and water mains, culverts and drains, on-site sewage disposal systems, wells, underground tanks and installations, and utility lines and poles on the subject property, abutting streets, and land that may serve the development or that may be affected by post-development stormwater runoff. Appropriate site grade elevations and culvert, pipe and utility structure invert elevations must be provided as necessary to demonstrate the direction of flow.

(9) Delete paragraph and renumber subsequent paragraphs accordingly.

3. Proposed Development Activity

(2) Replace existing provision with:

A stormwater management plan, prepared by a Maine-licensed professional engineer in accordance with the *Maine Stormwater Best Management Practices Manual*, Maine Department of Environmental Protection, which includes:

a) A plan depicting the locations, elevations and construction or planting details of all existing and proposed LID and conventional stormwater management features.
b) Calculations utilizing NOAA Atlas-14 precipitation data that estimate pre- and post-development stormwater runoff quantity and quality, including:
    1) Levels of phosphorus, total suspended solids and hydrocarbons; and
    2) Discharge peak flows resulting from a two, ten and twenty-five-year, 24-hour storm.
c) A program for the ongoing operation and maintenance of the stormwater management system, which includes:
    1) An operation and maintenance manual with descriptions, schedules and assignments of responsibility for all necessary tasks; and
    2) An executable contract between the applicant and a party with demonstrated technical expertise for all maintenance, repair and monitoring activities associated with all features of the stormwater management plan. The contract must require immediate notification of the CEO of any contract termination of expiration.

(12) Replace existing provision with:

A sediment and erosion control plan, prepared by a Maine-licensed professional engineer in accordance with *Maine Erosion and Sediment Control BMPs*, Maine Department of Environmental Protection, March 2003, that describes and shows the locations, elevations, installation schedule and construction or planting details of all proposed pre- and post-construction erosion and sediment control measures.

(13) Add the following provision:

In coastal areas prone to flooding, the board may request a risk assessment prepared by a qualified engineer estimating base flood elevations and projected shoreland location of the highest astronomical tide (HAT) line given projected erosion rates and considering 2 feet of sea level rise.

E. Standards and Criteria

2. Traffic Access and Parking

Parking Layout and Design

(7) Add the following provision

Parking areas and roadways should be designed to reduce the percentage of impervious cover on the site, and encourage the use of LID techniques to the maximum extent practicable and in accordance with the *Maine Stormwater Best Management Practices Manual*, Maine Department of Environmental Protection.

4. Stormwater Management

Second alternative standard

(1) Replace existing provision with:

To the extent practicable, the plan must manage stormwater using the site's natural features, modified as necessary through the use of LID stormwater management techniques. To the extent that the use of LID techniques interferes with the essential functions or character of the proposed development, conventional stormwater management techniques may be used.

(2) Replace existing provision with:

Unless the discharge is directly into the ocean, major river segment of great pond, the proposed stormwater management system must detain, retain, or induce the infiltration of stormwater from the two-year, ten-year, and twenty-five-year, 24-hour storms so that post-development peak flows do not exceed pre-development peak flows. In calculating pre-development peak flows, any portion of a site that was wooded within five years prior to submission of the application must be treated as undisturbed woods.

(3) Replace existing provision with:

The capacity of on- and off-site systems and channels must be sufficient to carry post-development flows without adverse effects such as flooding, soil erosion and damage to vegetation, on adjacent and downstream properties, streets and shoreland areas. Any improvements necessary to increase carrying capacities or mitigate adverse effects are the responsibility of the applicant.

(5) Delete paragraph and renumber subsequent paragraphs accordingly.

5. Erosion Control

Replace existing provision with:

Erosion Control - All building, site, and roadway designs and layouts must harmonize with existing topography and conserve desirable natural surroundings to <u>the greatest</u>

practicable extent, such that filling, excavation and earth moving activity are minimized. Parking lots on sloped sites must be terraced to avoid undue cut and fill and the need for retaining walls. Natural vegetation must be preserved and protected wherever practicable.

Soil erosion and sedimentation of watercourses and water bodies must be minimized by an active control program designed and implemented in accordance with *Maine Erosion and Sediment Control BMPs*, Maine Department of Environmental Protection, March 2003.

H. Administrative Provisions

DEFINITIONS

Add New and Replace Existing Definitions with the following:

IMPERVIOUS AREA: An area that is covered by Impervious Surface. Impervious Area is measured horizontally in two dimensions (i.e. plan view).

IMPERVIOUS SURFACE: A material or structure on or above the ground that prevents or greatly impedes the infiltration of stormwater through the underlying soil. Impervious surfaces are typically used to shed water from buildings, storage areas, driveways, streets, parking lots, sidewalks, patios, etc., and include, but are not limited to, metal, stone, concrete, asphalt, and compacted gravel, crushed stone and dirt.

INFILTRATION: The process of stormwater percolating into the ground (subsurface materials). Also, a stormwater management technique that allows captured stormwater to infiltrate into the ground over a period of time.

INVERT ELEVATION: The lowest point at a given location on the inside of a pipe, tunnel, trench or drainage structure, such as a manhole.

LEVEL-LIP SPREADER: An erosion control device designed to prevent the concentrated flow of stormwater runoff by releasing collected water evenly over a broad, level outlet edge onto gently sloping ground.

LID: See “Low Impact Development”.

LOW IMPACT DEVELOPMENT (LID): The use of structural or non-structural features and practices that are designed to reduce storm water runoff, pollutant loads, discharge

volumes, and/or peak flow discharge rates of stormwater runoff by preserving or mimicking the natural hydrology of a development site.

PEAK FLOW: The greatest rate of flow in a drainage way, measured as volume per unit of time, resulting from a storm of specified frequency and duration.

PRACTICABLE: Available and feasible considering cost, existing technology and logistics based on the overall purpose of the project.

STORMWATER: The part of precipitation, including runoff from rain or melting ice and snow, that flows across the surface as sheet flow, shallow concentrated flow, or in drainage ways.

TWO (TEN, TWENTY-FIVE)-YEAR, 24-HOUR STORM: A precipitation event with a 50% (for two-year), 10% (for ten-year), or 4% (for 25-year) probability of being equaled or exceeded during any twenty-four-hour period during any given year.

SECTION 10. ALTERNATIVES FOR STRUCTURING THE SITE PLAN REVIEW SYSTEM

Options 2, 3, 4 and 5

CLASSIFICATION OF PROJECTS

Replace existing provision with:

The Planning Board shall classify each project as a major or minor development. Minor developments are smaller scale, less complex projects for which a less complex review process is adequate to protect the [City=s] [Town=s] interest. Major developments are larger, more complex projects for which a more detailed review process and additional information are necessary.

Minor developments shall include projects that involve: 1) creation or addition of fewer than [five thousand (5,000)] square feet of gross nonresidential floor area; 2) creation of addition of fewer than [five thousand (5,000)] square feet of impervious area; 3) creation of fewer than [five (5)] dwelling units in a five (5) year period; or, 4) the conversion of existing buildings or structures from one use to another without enlargement of the gross floor area.

Major developments shall include projects that involve: 1) creation or addition of [five thousand (5,000)] or more square feet of gross nonresidential floor area; 2) creation or addition of [five thousand (5,000)] or more square feet of impervious area; 3) creation

of [five (5)] or more dwelling units in a five (5) year period; or, 4) other proposals requiring review which are not classified as minor developments.

C. Submission Requirements

2. Site Plan Application Submission Requirements

2.1.b Existing Conditions

(3) *Replace existing provision with:*

location and size of any existing sewer and water mains, culverts and drains, on-site sewage disposal systems, wells, underground tanks and installations, and utility lines and poles on the subject property, abutting streets, and land that may serve the development or that may be affected by post-development stormwater runoff. Appropriate site grade elevations and culvert, pipe and utility structure invert elevations must be provided as necessary to demonstrate the direction of flow.

(9) Delete paragraph and renumber subsequent paragraphs accordingly.

2.1.c Proposed Development Activity

(2) Replace existing provision with:

A stormwater management plan, prepared by a Maine-licensed professional engineer in accordance with the *Maine Stormwater Best Management Practices Manual*, Maine Department of Environmental Protection, which includes:

a) A plan depicting the locations, elevations and construction or planting details of all existing and proposed LID and conventional stormwater management features.
b) Calculations utilizing NOAA Atlas-14 precipitation data that estimate pre- and post-development stormwater runoff quantity and quality, including:
    1) Levels of phosphorus, total suspended solids and hydrocarbons; and
    2) Discharge peak flows resulting from a two, ten and twenty-five-year, 24-hour storm.
c) A program for the ongoing operation and maintenance of the stormwater management system, which includes:
    1) An operation and maintenance manual with descriptions, schedules and assignments of responsibility for all necessary tasks; and
    2) An executable contract between the applicant and a party with demonstrated technical expertise for all maintenance, repair and monitoring activities associated with all features of the stormwater management plan. The contract must require immediate notification of the CEO of any contract termination of expiration.

(12) Replace existing provision with:

A sediment and erosion control plan, prepared by a Maine-licensed professional engineer in accordance with *Maine Erosion and Sediment Control BMPs*, Maine Department of Environmental Protection, March 2003, that describes and shows the locations, elevations, installation schedule and construction or planting details of all proposed pre- and post-construction erosion and sediment control measures.

(13) Add the following provision:

In coastal areas prone to flooding, the board may request a risk assessment prepared by a qualified engineer estimating base flood elevations and projected shoreland location of the highest astronomical tide (HAT) line given projected erosion rates and considering 2 feet of sea level rise.

2.2 Major Developments

(3) Delete paragraph and renumber subsequent paragraphs accordingly.

SECTION 11. ADDITIONAL STANDARDS OF APPROVAL

Design Standards

1. Landscaping

Replace existing provision with:

Landscaping -Landscaping must be provided as part of site design. The landscape plan for the entire site must use landscape materials to integrate the various elements on site, preserve and enhance the particular identity of the site, and create a pleasing site character. The landscaping should define street edges, break up parking areas, soften the appearance of the development, screen it from abutting properties and, when incorporated into and LID design, help to control, cleanse and infiltrate stormwater runoff.

Landscaping may include plant materials such as trees, shrubs, groundcovers, perennials, and annuals, and other materials such as rocks, water, sculpture, art, walls, fences, paving materials, and street furniture.

10. Landscaping of Parking Lots

Replace existing provision with:

Landscaping of Parking Lots - Landscaping around and within parking lots shades their hot surfaces and visually softens their harsh appearance. Landscaping, when incorporated into a Low Impact Development (LID) stormwater management system filters pollutants, reduces runoff and encourages infiltration and groundwater replenishment. Landscaping should be installed to screen parking lots from adjacent residential uses and streets. A ten-car parking lot should contain at least one landscaped island, with an additional island for every 20 cars of parking capacity.

APPENDIX A BASIC MODEL

Appendix A of the Handbook presents a complete basic model site plan review ordinance.

The editing instructions (written in italics) and revised language for Appendix A, which appear below, are designed to transform the Basic Model Site Plan Review Ordinance into one that better reflects issues relating to climate adaptation and resilience.

SEC. 3. DEFINITIONS

3.2 *Add New and Replace Existing Definitions with the following:*

IMPERVIOUS SURFACE: A material or structure on or above the ground that prevents or greatly impedes the infiltration of stormwater through the underlying soil. Impervious surfaces are typically used to shed water from buildings, storage areas, driveways, streets, parking lots, sidewalks, patios, etc., and include, but are not limited to, metal, stone, concrete, asphalt, and compacted gravel, and dirt.

INFILTRATION: The process of stormwater percolating into the ground (subsurface materials). Also, a stormwater management technique that allows captured stormwater to infiltrate into the ground over a period of time.

INVERT ELEVATIONS: The elevation of an invert (lowest inside point) of pipe, utility infrastructure or sewer at a given location in reference to a bench mark.

LID: See “Low Impact Development”.

LOW IMPACT DEVELOPMENT (LID): The use of structural or non-structural features and practices that are designed to reduce storm water runoff, pollutant loads, discharge volumes, and/or peak flow discharge rates of stormwater runoff by preserving or mimicking the natural hydrology of a development site.

PEAK FLOW: The greatest rate of flow in a drainage way, measured as volume per unit of time, resulting from a storm of specified frequency and duration.

PRACTICABLE: Available and feasible considering cost, existing technology and logistics based on the overall purpose of the project.

STORMWATER: The part of precipitation, including runoff from rain or melting ice and snow, that flows across the surface as sheet flow, shallow concentrated flow, or in drainage ways.

TWO (TEN, TWENTY-FIVE)-YEAR, 24-HOUR STORM: A precipitation event with a 50% (for two-year), 10% (for ten-year), or 4% (for 25-year) probability of being equaled or exceeded during any twenty-four-hour period during any given year.

SEC. 8. SUBMISSION REQUIREMENTS

8.2. Existing Conditions

8.2 (3) *Replace existing provision with:*

location and size of any existing sewer and water mains, culverts and drains, on-site sewage disposal systems, wells, underground tanks and installations, and utility lines and poles on the subject property, abutting streets, and land that may serve the development or may be affected by post-development stormwater runoff. Appropriate site grade elevations and culvert, pipe and utility structure invert elevations must be provided as necessary to demonstrate the direction of flow.

8.2 (9) Delete paragraph and renumber subsequent paragraphs accordingly

8.3 Proposed Development Activity

8.3 (2) *Replace existing provision with:*

A stormwater management plan, prepared by a Maine-licensed professional engineer in accordance with the *Maine Stormwater Best Management Practices Manual*, Maine Department of Environmental Protection, which includes:

a. a plan depicting the locations, elevations and construction or planting details of all existing and proposed LID and conventional stormwater management features;
b. calculations utilizing NOAA Atlas-14 precipitation data that estimate pre- and post-development stormwater runoff quantity and quality, including:
    1. levels of phosphorus, total suspended solids and hydrocarbons; and
    2. discharge peak flows resulting from a two, ten and twenty-five-year, 24-hour storm.
c. A program for the ongoing operation and maintenance of the stormwater management system, which includes:
    1. an operation and maintenance manual with descriptions, schedules and assignments of responsibility for all necessary tasks; and
    2. an executable contract between the applicant and a party with demonstrated technical expertise for all maintenance, repair and monitoring activities associated with all features of the stormwater management plan. The contract must require immediate notification of the CEO of any contract termination of expiration.

8.3 (12) *Replace existing provision with:*

A sediment and erosion control plan, prepared by a Maine-licensed professional engineer in accordance with *Maine Erosion and Sediment Control BMPs*, Maine Department of Environmental Protection, March 2003, that describes and shows the locations, elevations, installation schedule and construction or planting details of all proposed pre- and post-construction erosion and sediment control measures.

8.3 (13) *Add the following provision*

In coastal areas that are prone to flooding, the board may request a risk assessment prepared by a qualified engineer estimating base flood elevations and projected shoreland location of the highest astronomical tide (HAT) line given projected erosion rates and considering 2 feet of sea level rise.

SEC. 9. APPROVAL STANDARDS AND CRITERIA

9.8. Stormwater Management

9.8. (1) *Replace existing provision with:*

To the extent practicable, the plan must manage stormwater using the site's natural features, modified as necessary through the use of LID stormwater management techniques. To the extent that the use of LID techniques interferes with the essential functions or character of the proposed development, conventional stormwater management techniques may be used.

9.8. (2) *Replace existing provision with:*
Unless the discharge is directly into the ocean, major river segment of great pond, the proposed stormwater management system must detain, retain, or induce the infiltration of stormwater from the two-year, ten-year, and twenty-five-year, 24-hour storms so that post-development peak flows do not exceed pre-development peak flows. In calculating pre-development peak flows, any portion of a site that was wooded within five years prior to submission of the application must be treated as undisturbed woods.

9.8. (3) *Replace existing provision with:*
The capacity of on- and off-site systems and channels must be sufficient to carry post-development flows without adverse effects such as flooding, soil erosion and damage to vegetation, on adjacent and downstream properties, streets and shoreland areas. Any improvements necessary to increase carrying capacities or mitigate adverse effects are the responsibility of the applicant.

9.8. (5) *Delete paragraph and renumber subsequent paragraphs accordingly.*

2017

Municipal Climate Adaptation Guidance Series: Subdivision Ordinances

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This guidance document was funded under awards CZM NA14NOS4190066, NA16NOS4190018 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

This guidance document consists of model language that can make local subdivision ordinances and regulations more responsive to the growing need for climate resiliency. As a convenience to the user, the model language is presented as revisions to the Model Subdivision Regulations for Use by Maine Planning Boards***. The revisions focus on stormwater management, and include a general standard (10.12.C) which allows a choice between a conventional and an alternative approach to the management of stormwater for smaller project. The specific standards for the alternative approach, known as "Low-Impact Development" (LID), are provided as an appendix (Appendix U).***

It is expected that the LID standards will provide water quality treatment, erosion control, and flood mitigation sufficient to protect downstream properties and receiving waters from development impacts, however, a municipality may wish to tailor these standards to better address known concerns in the community.

Revise Section ***10.12 Stormwater Management****, paragraphs A and B to read as follows:*

A. Subdivisions that require a state permit under the Site Location of Development Act or the Stormwater Management Law shall comply with the standards of Department of Environmental Protection Rule Chapter 500 (Stormwater Management Regulations).

B. Applications for subdivisions that are not subject to paragraph A, above, shall comply with one of the following:

1. The standards of Department of Environmental Protection Rule 500 (Stormwater Management Regulations); or

2. The Low Impact Development Standards of *Appendix U*.

Add ***Appendix U*** *as follows:*

Appendix U: Low-Impact Development (LID) Standards

1. Applicability.

Applications for subdivisions subject to Section 10.12.B of this ordinance that do not satisfy the standards of Department of Environmental Protection Rule Chapter 500 (Stormwater Management Regulations) must satisfy the following General Standards (Section 2) and either the Basic Lot Standards (Section 3) or the Alternative Lot Standards (Section 4). Refer to Definitions (Section 5) for the specific meaning of terms found in this Appendix.

2. General Standards

A. All LID Practices used to meet these Low Impact Development Standards shall be:

1. Designed by a Maine-licensed professional engineer in accordance with the Maine LID Guidance Manual;
2. Maintained in perpetuity in accordance with an approved Operation and Maintenance Plan; and
3. Modified or replaced only if the standards continue to be met, as determined by Codes Enforcement Officer. (The CEO may require the owner to provide documentation from a Maine-licensed professional engineer demonstrating that the standards will continue to be met after the proposed changes.)

B. Roads The following standards apply to roads within a subdivision:

1. Maximum paved width: 22 feet
2. Must be drained by roadside swales

C. Inside Great Pond Watersheds Applications for subdivisions located wholly or partly within the watershed of a Great Pond and which, within that watershed, propose, a) the creation of five or more lots or dwelling units within a five-year period; or, b) 800 or more linear feet of new or upgraded driveways or streets; shall also include a stormwater management plan, prepared by a Maine licensed professional engineer, demonstrating that development within the watershed is in compliance with the standards of the Department of Environmental Protection Phosphorus Design Manual (Maine Stormwater Best Management Practices, vol. II).

D. The capacity of on- and off-site systems and channels must be sufficient to carry post-development flows without adverse effects such as flooding, soil erosion and damage to vegetation, on adjacent and downstream properties, streets and shoreland areas. Design, permitting and installation of any on- and off-site improvements necessary to increase carrying capacities or mitigate adverse effects shall be the responsibility of the applicant.

3. Basic Lot Standards

A. Outside Sensitive Watersheds The following standards apply to lots and portions of lots located outside a Sensitive Watershed Area:

1. Single and Two-Family Residential Lots:
   a. Maximum Disturbed Area: 15,000 square feet or 75% of lot area, whichever is less
   b. Maximum Impervious Surface: 7,500 square feet
   c. Minimum width of Vegetated Buffer:
      1. Forest vegetation: 35 feet
      2. Meadow vegetation: 50 feet

2. Residential Lots with Multi-Family (3 or more) Dwellings:
   a. Maximum Disturbed Area: 43,560 square feet.

b. Maximum Impervious Area: 15,000 square feet
c. Minimum Undisturbed Natural Area: 15 % of lot area
d. Natural Vegetated Buffer
1. Minimum width: 60 feet.
2. Level spreader required if length of runoff flow path to buffer from:
a. Impervious Area exceeds 60 feet.
b. Pervious Area exceeds 100 feet.

B. Inside Sensitive Watersheds The following standards apply to lots and portions of lots located inside a Sensitive Watershed Area:

1. Single and Two-Family Residential Lot standards
a. Maximum Disturbed Area: 15,000 square feet or 60% of lot area, whichever is less
b. Maximum Impervious Surface: 7,500 square feet
c. Minimum Vegetated Buffer
1. Forest vegetation: 50 feet
2. Meadow vegetation: 75 feet

2. Multi-Family Residential Lot standards:
a. Maximum Disturbed Area: 43,560 square feet.
b. Maximum Impervious Surface: 15,000 square feet
c. Minimum Undisturbed Natural Area: 25 % of lot area
d. Natural Vegetated Buffer
1. Minimum width: 100 feet.
2. Level spreader required if length of runoff flow path across:
a. Impervious Area exceeds 60 feet.
b. Pervious Area exceeds 100 feet.

4. Alternative Lot standards

A. Outside Sensitive Watersheds The following standards apply to lots and portions of lots located outside a Sensitive Watershed Area:

1. Each Single or Two-Family Residential Lot shall include LID practices sufficient to treat a minimum of:
a. 0.5 inches of runoff from Impervious Area; and
b. 0.2 inches of runoff from Disturbed Pervious Areas.

2. Each Multi-Family Residential Lot shall include LID practices sufficient to treat a minimum of:
a. 0.5 inches of runoff from all Impervious Areas; and
b. 0.2 inches of runoff from all Disturbed Pervious Areas

B. Inside Sensitive Watersheds The following standards apply to lots or portions of lots located inside a Sensitive Watershed Area:

1. Each Single or Two-Family Residential Lot shall include LID practices sufficient to treat a minimum of:
   a. 1.0 inches of runoff from Impervious Areas; and
   b. 0.4 inches of runoff from Disturbed Pervious Areas.

2. Each Multi-Family Residential Lot shall include LID practices sufficient to treat a minimum of:
   a. 1.0 inches of runoff from all Impervious Area; and
   b. 0.4 inches of runoff from all Disturbed Pervious Areas

5. Definitions

Disturbed Area An area of land that has been subject to stripping, grading, grubbing, filling, excavating, vegetation removal and any other human action that causes a change in the position, location, or arrangement of soil, sand, rock, gravel or similar earth material.

Disturbed Pervious Area A Disturbed Area that remains pervious after the completion of a development project. Disturbed Pervious Area is defined to include lawns and other landscaped areas.

Impervious Area An area of land that is covered by a material or structure on or above the ground that prevents water from infiltrating through the underlying soil. Impervious Area is defined to include rooftops, paved sidewalks and patios, and paved, gravel and compacted dirt driveways, roads and parking areas.

LID Practices Built or naturally-occurring landscape features and systems that serve to store and remove pollutants from stormwater runoff flowing from a development project. LID Practices are described in the Maine LID Guidance Manual, and include: Buffer/filter strips, Underdrain soil filters, Dry wells, Permeable pavers, Rain barrels/cisterns, Stormwater planters, and Green roofs.

Landscaped area An area of land that has been disturbed and re-planted or covered with one or more of the following: lawn or other herbaceous plants, shrubs, trees, or mulch; but not including area that has reverted to a natural, vegetated condition. A field or meadow is considered landscaped if it is mowed more than twice per twelve month period.

Level Spreader A stormwater management and erosion control device designed to prevent the concentrated flow of stormwater runoff by releasing collected water evenly over a broad, level outlet edge onto gently sloping ground.

Natural Vegetated Buffer An LID Practice consisting of a strip of Undisturbed Natural Area located and configured so as to intercept the stormwater runoff from a development project.

Operation and Maintenance Plan A plan that defines the functional, financial and organizational mechanisms for the ongoing operation and maintenance of approved LID practices to ensure that they continue to function as designed.

Pervious Area An area of land that is not an Impervious Area.

Sensitive Watershed The watershed of a "Lake Most at Risk from New Development" or an "Urban Impaired Stream", as identified by the Maine Department of Environmental Protection in accordance with Chapter 502 of its rules.

Undisturbed Area Any area of land that is not a Disturbed Area.

Undisturbed Natural Area An Undisturbed Area with naturally-occurring vegetation. A Disturbed Area may be converted to an Undisturbed Natural Area through the implementation of an approved restoration and re-vegetation plan.

Vegetated Buffer An LID Practice consisting of a strip of non-lawn, vegetated Landscaped Area located and configured so as to intercept the stormwater runoff from a development project.