

While we are
getting
started...

Please introduce yourself in the chat!

- Where are you logging in from?
- What hazard(s) brought you here today?
- What are you working on that you hope can benefit from lessons learned during this series?

Natural Hazards 101 Series

SESSION #1:
INTRODUCTION TO
NATURAL HAZARDS
AND LAND USE
PLANNING

AUGUST 14, 2024



Agenda:

1. Introductions
2. Hazards and Land Use Presentations
 - I. Forestry, Fire, Air Quality, and Extreme Heat
 - II. Coastal and Inland Flooding, Storm Surge, and Sea Level Rise
 - III. Erosion, Landslides, and Water Quality
3. Questions
4. Closing and Next Sessions

Forestry, Fire, Air Quality, and Extreme Heat: Information for Land Use Planners



Presented by:

David Ludwig, Senior Climate Planner, Maine DACF



Wildfires in Maine

- Wildfire danger typically highest in spring
 - After snow melt but before new growth
 - High wildfire danger doesn't require long-term drought – and fires can happen in any season
- Fires driven by dead vegetation, dry conditions, low humidity, high winds
- Check conditions daily during fire season at MaineFireWeather.org

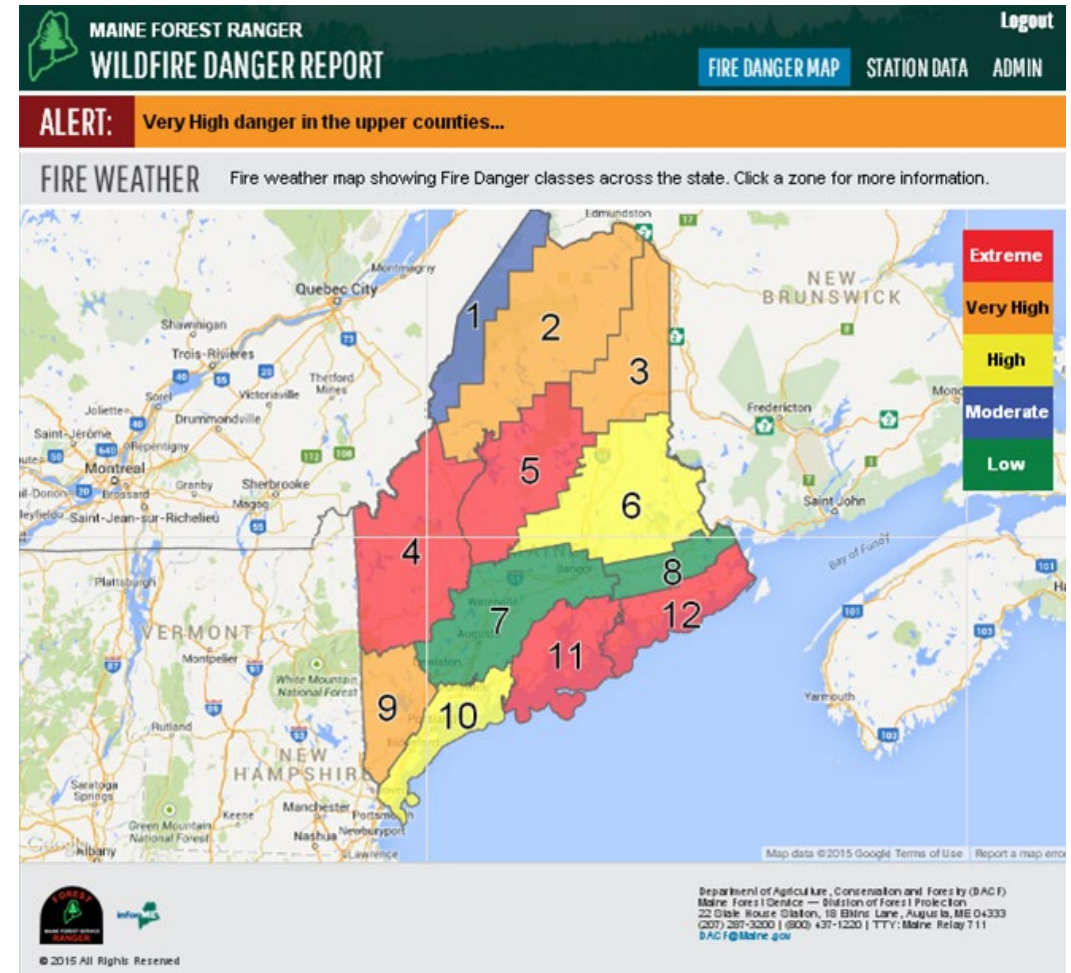


Image: Maine Forest Service and National Weather Service

Historic Wildfires in Maine

- Major wildfires impacted Maine in the fall of 1947, burning over 220,000 acres, including:
 - Shapleigh: 109,110 acres
 - Biddeford: 21,910 acres
 - Brownfield: 21,120 acres
 - Centerville-Jonesboro: 19,970 acres
 - Bar Harbor/MDI: 17,188 acres

16 Largest Wildfires
in Maine
October 1947*

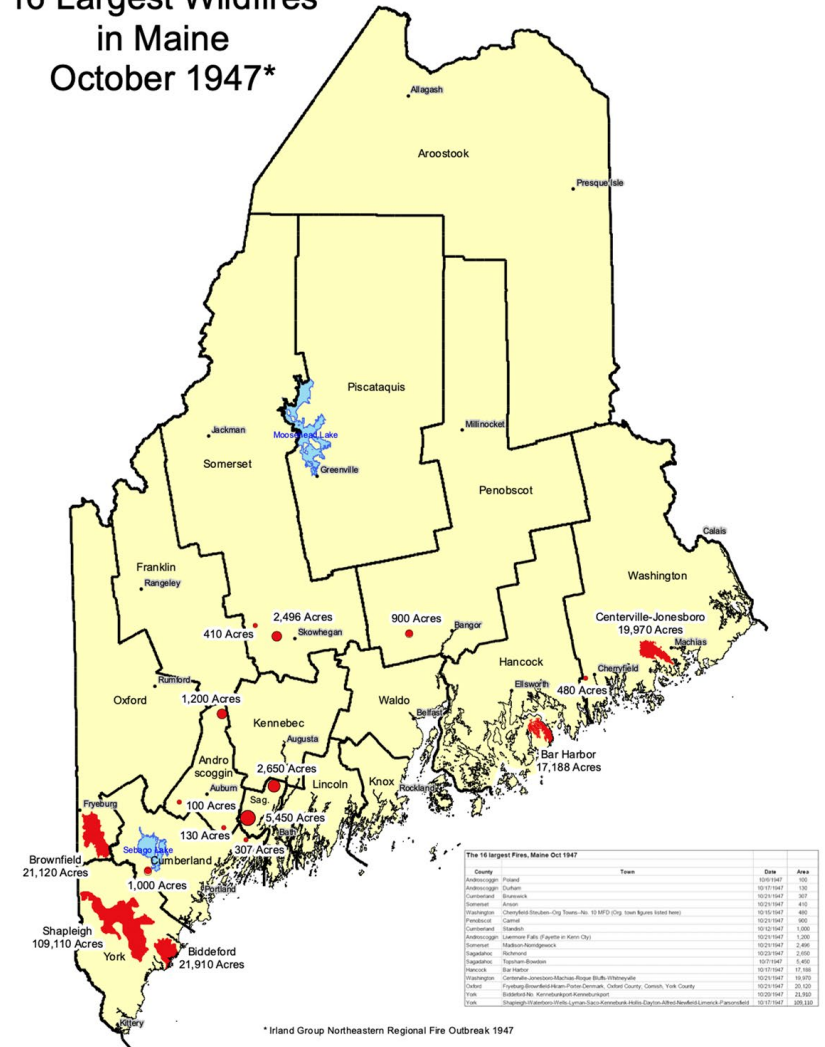


Image: Maine Forest Service

https://www.maine.gov/DACF/mfs/forest_protection/1947_fire.html#fire_map

Historic and Recent Wildfires in Maine

- 1968 – T12 R12 WELS: 4,111 acres
- 1969 – Cutler: 1,105 acres
- 1977 – Baxter State Park fire: 3,500 acres
- 1984 – Jonesport: 1,076 acres
- 1992 – Allagash: 1,092 acres
- 1994 – Addison: 657 acres
- 2006 – Centerville: 735 acres
- 2018 – Kennebunk/Wells: 314 acres
- 2020 – Island Falls: 236 acres



Image: Maine Forest Service

2023 Nova Scotia Wildfires



Important Considerations: Wildland-Urban Interface (WUI)

- Places where vegetated landscapes and human development meet
 - Interface: clear boundary between human community and vegetation
 - Intermix: structures are interspersed within vegetated areas
- Maine has greater percentage of structures in the WUI than almost any other state

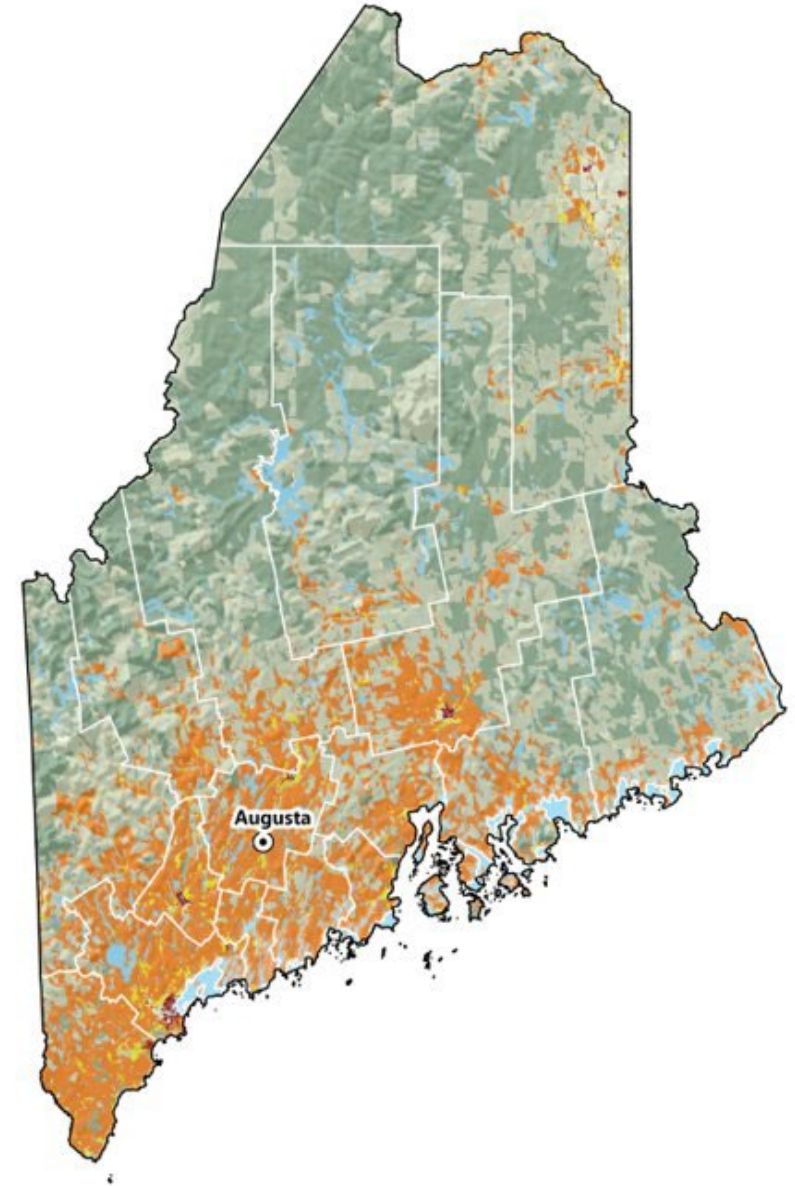
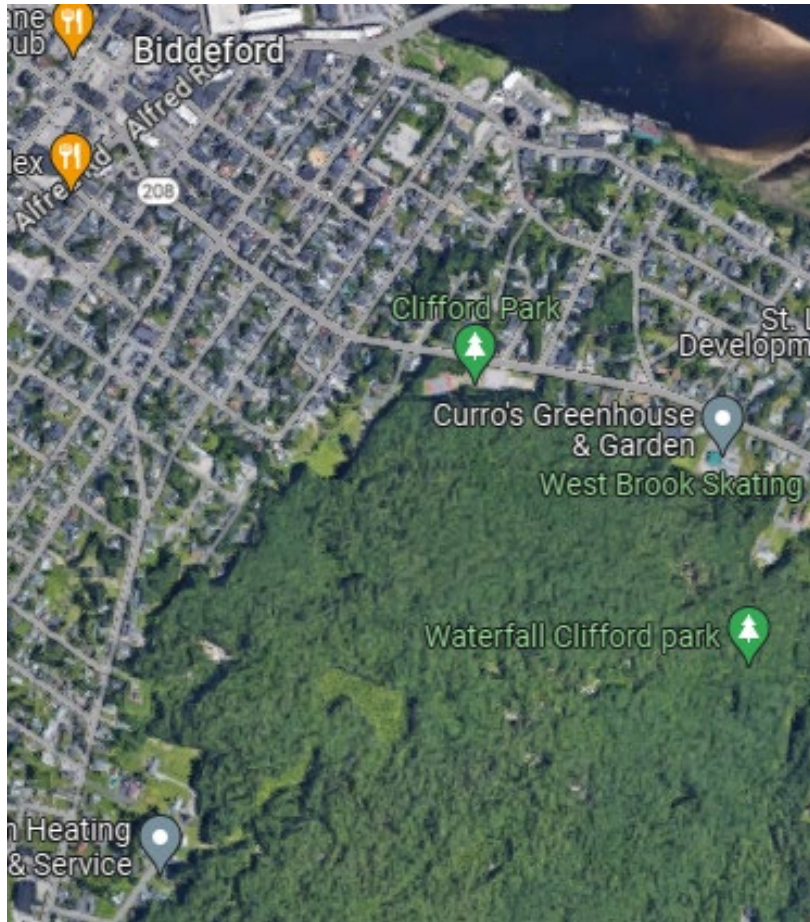


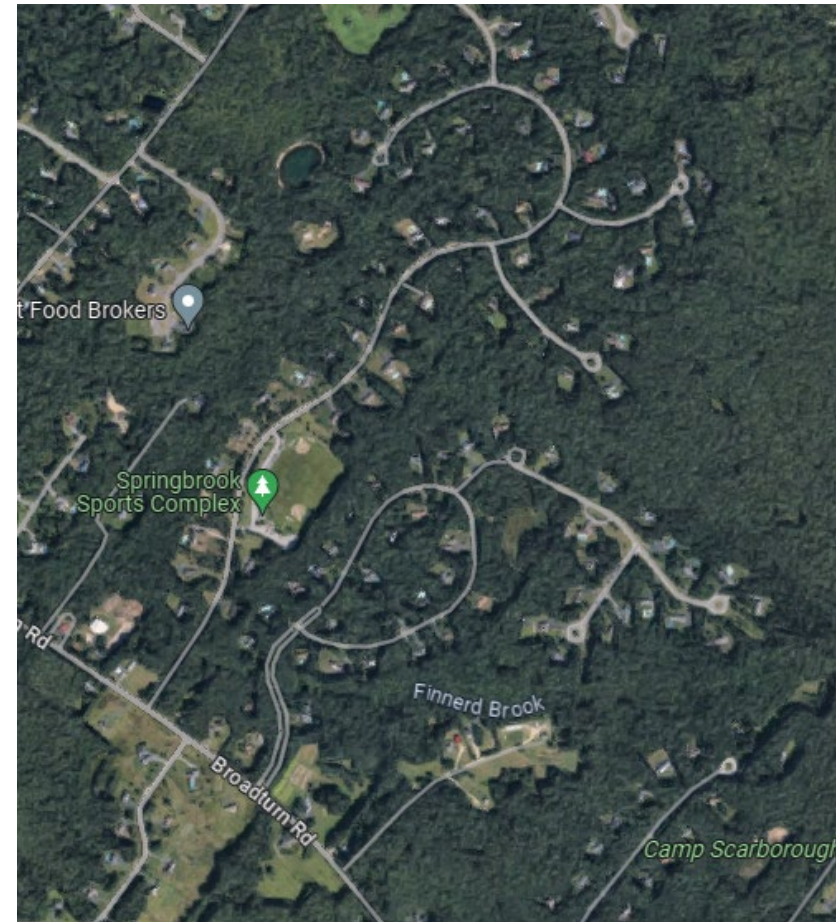
Image: Wildland-Urban Interface and Intermix (WUI) Areas in Maine

Wildland-Urban Interface versus Intermix

Interface Example: Biddeford



Intermix Example: Scarborough



Important Considerations: Defensible Space

- Can include vegetation management and home hardening
- Have homeowners prepared?
 - Key for major incidents or when capacity is limited
 - Homeowners should not assume a fire engine will be parked outside their house if a major fire occurs
- Must abide by any applicable shoreland zoning requirements, etc.

Does the vegetation near your home or camp look like this?
If so, it may be at higher risk for damage from a wildfire.



In order to keep a wildfire from threatening your home, Maine's Forest Rangers recommend at least 30' of defensible space between your home and the forest.

Please check all local and state laws before removing any vegetation from within the shoreland zone.



For more information, please contact your local forest ranger at 1-800-750-9777 or visit:

www.maineforestservice.gov



Maine Department of Agriculture, Conservation and Forestry

Important Considerations: Capacity

- Local, state, federal, and NGO resources available
- Training, experience, and certifications
- Equipment (personal protective equipment, hand tools, hoses, engines, tankers, etc.)
 - Differs from equipment for structure fires



Image: David Ludwig

Other Important Considerations

- Communications
 - Consider both plans and infrastructure
- Access
 - Ingress/egress
- Water Supply
- Ongoing Needs
 - Shelter, medical care, mental health, damage assessment, recovery

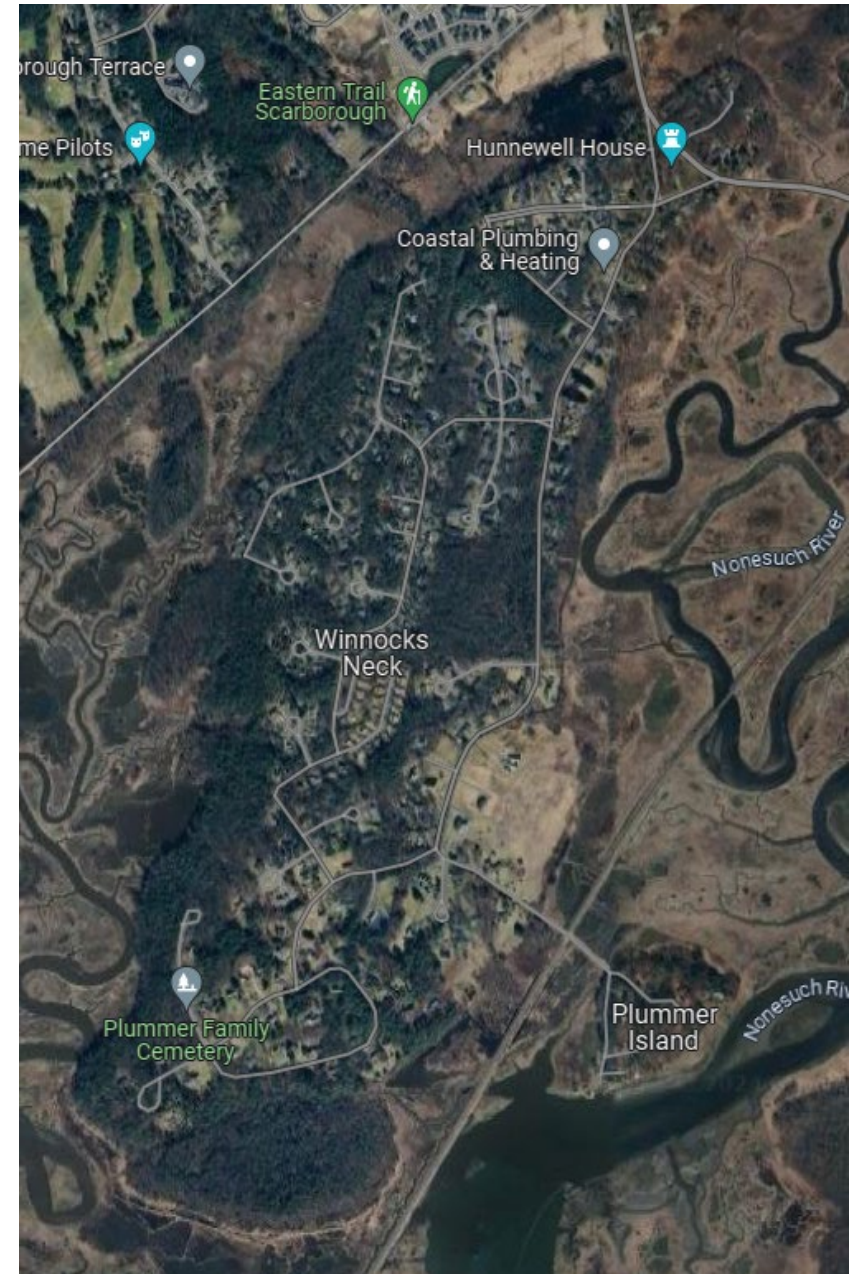


Image: Google Maps

Large-scale Community Wildfire Protection Plans

- Blue Hill Peninsula (Hancock County)
- Massabesic Region (York County)
- Millinocket Area (Penobscot County)
- Southeast Washington County
- Fish River Chain of Lakes (Aroostook County)

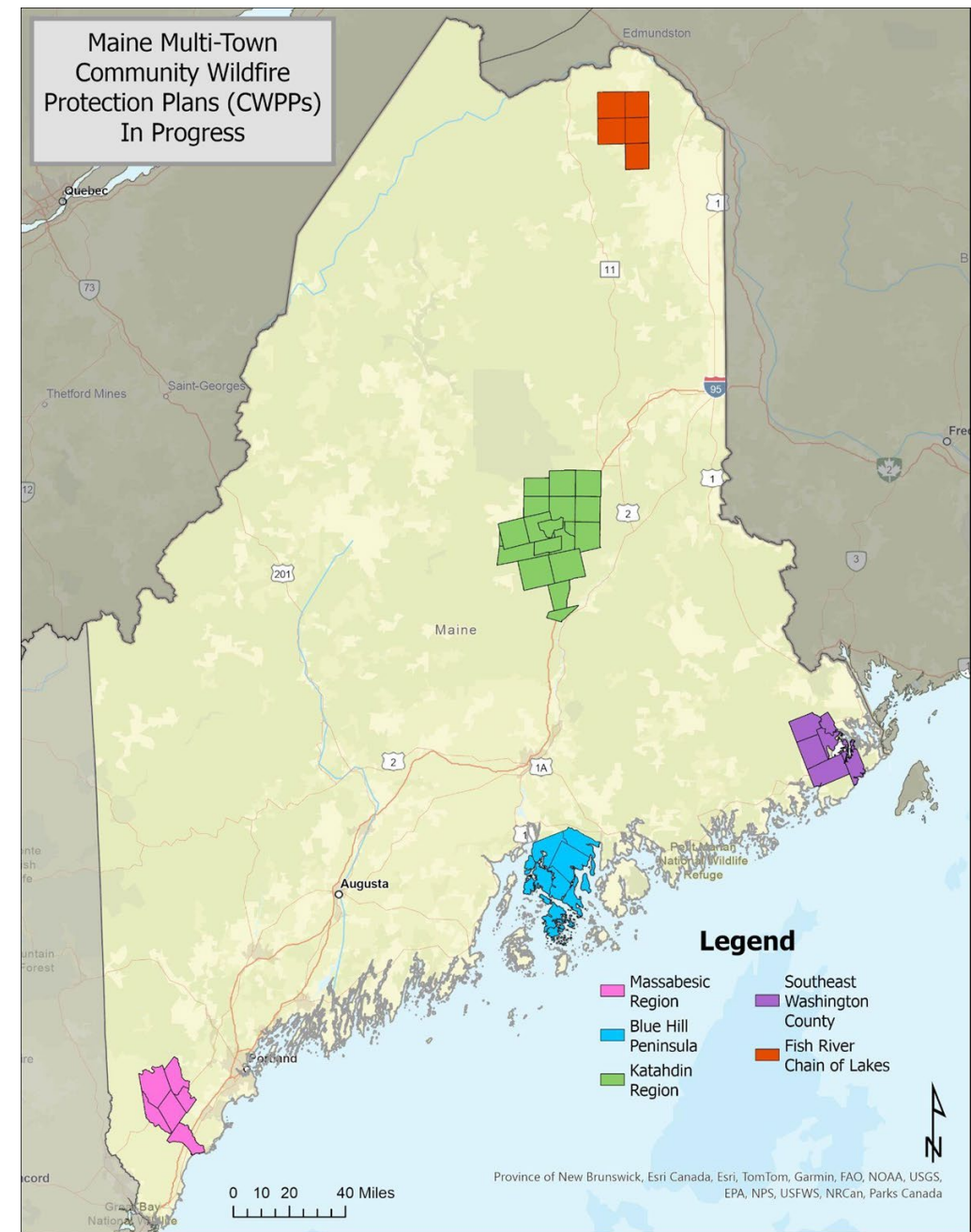


Image: Maine Land Use Planning Commission

Wildfire Smoke and Air Quality

- Felt locally and globally
- Hazardous to human and animal health, especially those with pre-existing conditions
- Several resources exist
 - AirNow [Fire and Smoke Map](#)
- **Do:** monitoring, public education, and outreach
- Clean air centers (like warming or cooling centers) may be needed in severe scenarios



Left image: Maine Forest Service. Right image: David Ludwig

Extreme Heat

- Multiple record-breaking heat events in Maine
- Deadliest natural hazard nationally
- Low rates of air conditioning + past rarity of extreme heat = greater vulnerability now
 - Men, middle aged adults, and those working outdoors experience more heat-related emergencies
- **Community needs for the future include:**
 - Additional air conditioning
 - Community cooling centers
 - Increased urban tree cover
 - Public health monitoring and education

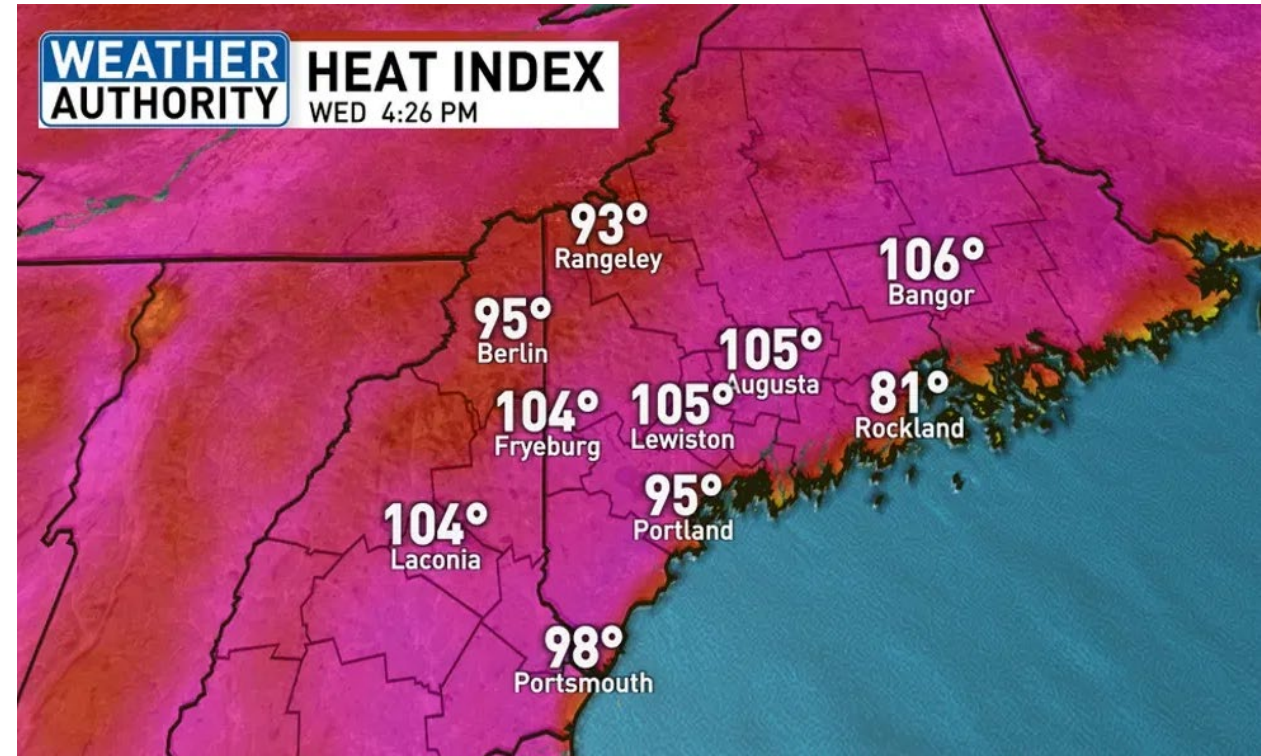


Image: WGME, June 19, 2024

Benefits of Urban Trees

- Reduce urban heat island effect
- Improve health, mood, and social networks
- Reduce air pollution
- Store carbon
- Intercept stormwater and reduce runoff
- Provide wildlife habitat
- Reduce traffic speeds and improve safety
- Provide a sense of place and community identity
- Can be historically or culturally significant



Image: Texas A&M Forest Service

Urban Forests

- Need active management to provide maximum benefits
- **Where do I start?**
 - Inventory: prioritize maintenance, removal (if needed), planting
- Watch for threats
 - Pests, diseases, extreme weather, vandalism, improper care
- Plan for future climate conditions
- Caring for trees is building community!



Image: Orono Tree Board



Murray Carpenter / Maine Public

on Woodman Hill Road in Jay, Maine.

Coastal and Inland Flooding, Storm Surge, and Sea Level Rise

PRESENTED BY:

DEVIN DOMEYER

COASTAL RESILIENCE SPECIALIST

MAINE COASTAL PROGRAM



Significance of the 2023-24 Winter Storms

- ~5,779 lakes and ponds
- ~5,299 miles of coastline
- ~8,600 miles of floodplains



The third 100-year storm in three months

By Stephen Betts Mar 10, 2024 - Updated - Mar 12, 2024

NEWS

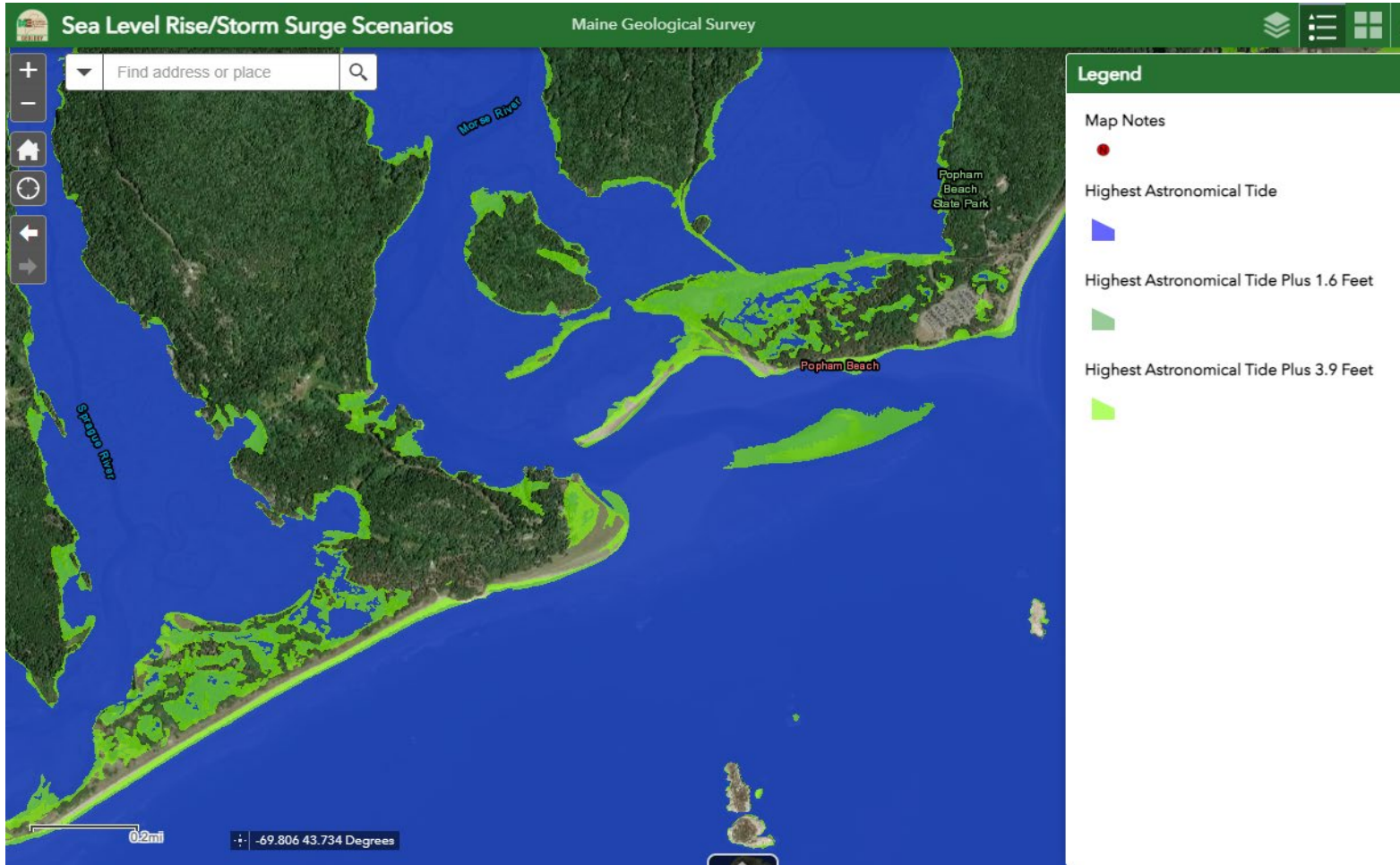


Water from Rockland Harbor surged over Harbor Park and around the harbor master's office.

Photo by Stephen Betts

100-Year Storms

- What is 100-year flooding or “Special Flood Hazard Area”?
- 1% chance/year = 26% chance over a 30-year mortgage.
- **FOUR in the last 4 months**
(Dec 17, Jan 10, Jan 13, Mar 10)
- 1-ft inundation difference between 100-year and 10-year event.

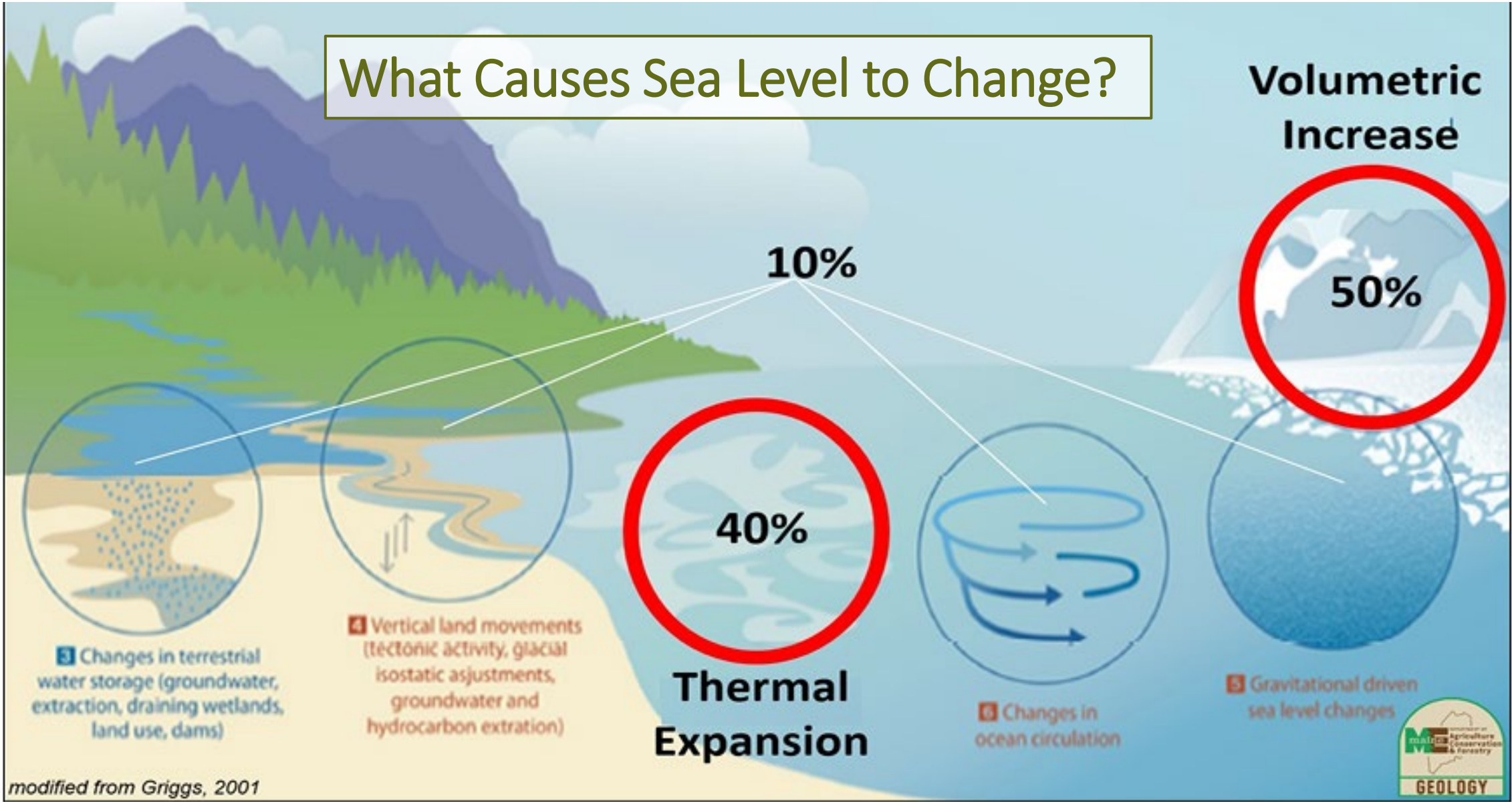


Popham Beach State Park, Maine

Sea Level Rise in Maine

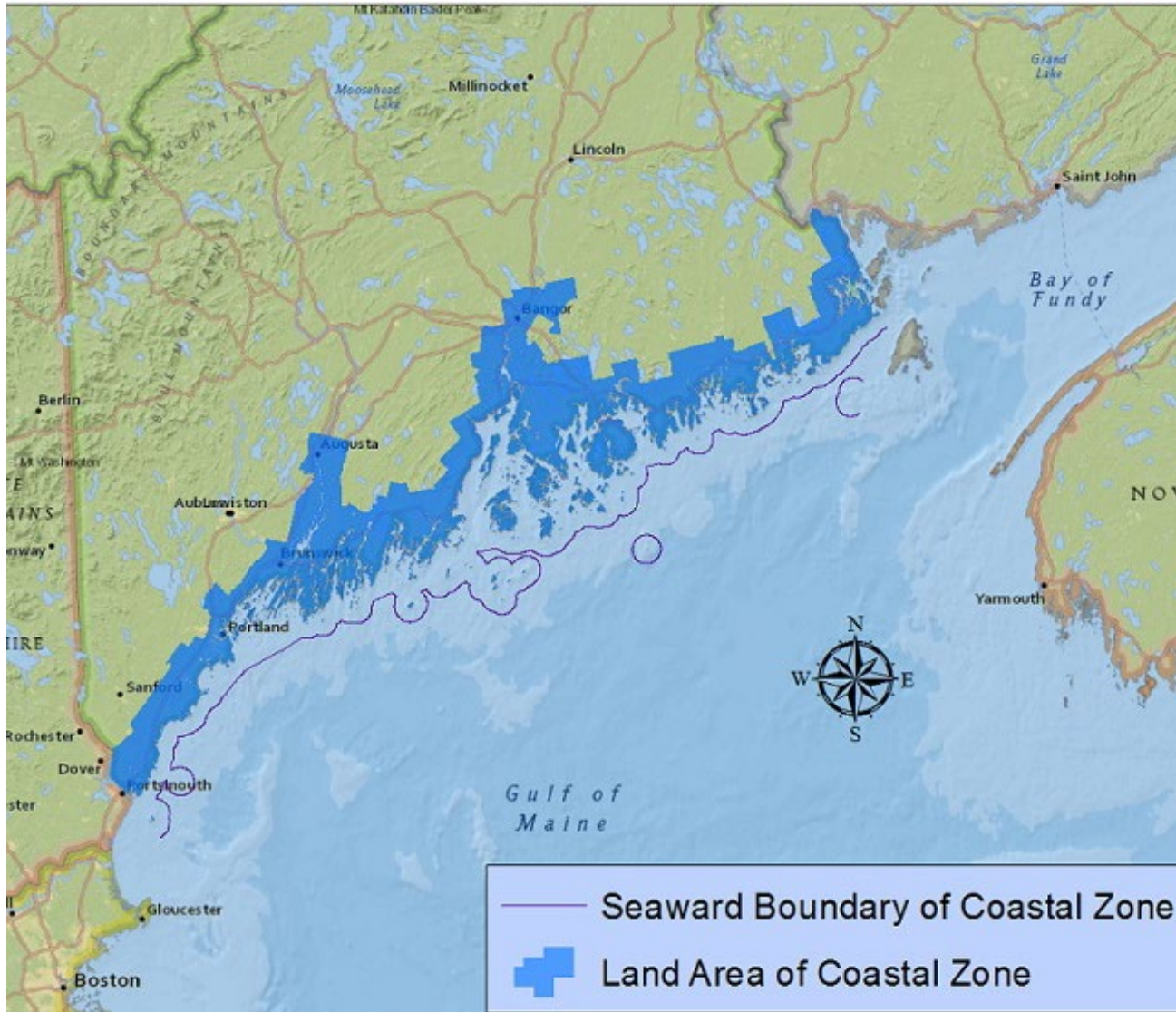
- Current sea level rise: ~1ft per 100 years
- But the rate of sea level rise is increasing
- Maine Climate Council recommends committing to manage 1.5 ft of sea level rise by 2050
- 1.6 ft of sea level rise:
 - Could submerge 2/3 of Maine's sand dunes
 - Could reduce beach area by 43%

What Causes Sea Level to Change?



modified from Griggs, 2001





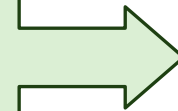
Seawater Flooding

Heavily affected by:

- Storm surge
- Wave action
- Tidal stage
- Topography

Coastal flooding affects tidal rivers.

King Tide (HAT)
Storm Surge
Wave Action



Storm Tide
Flooding

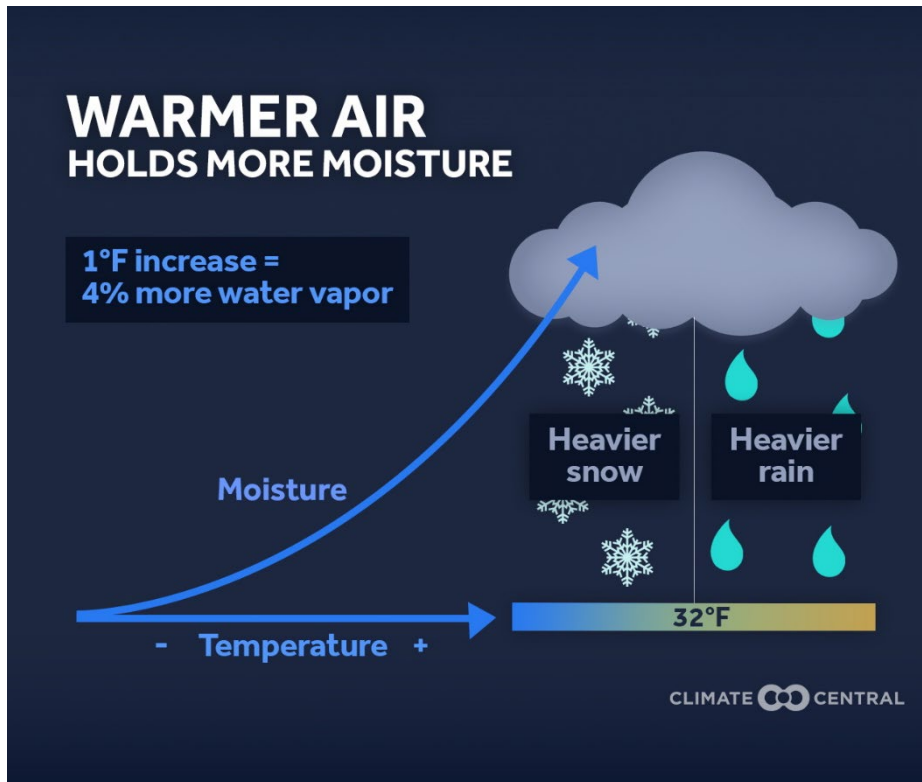
It has been a record-setting wet month of March in Maine

The first half of the month is the wettest in more than 150 years of record-keeping

Share



Updated: 9:30 AM EDT Mar 18, 2024

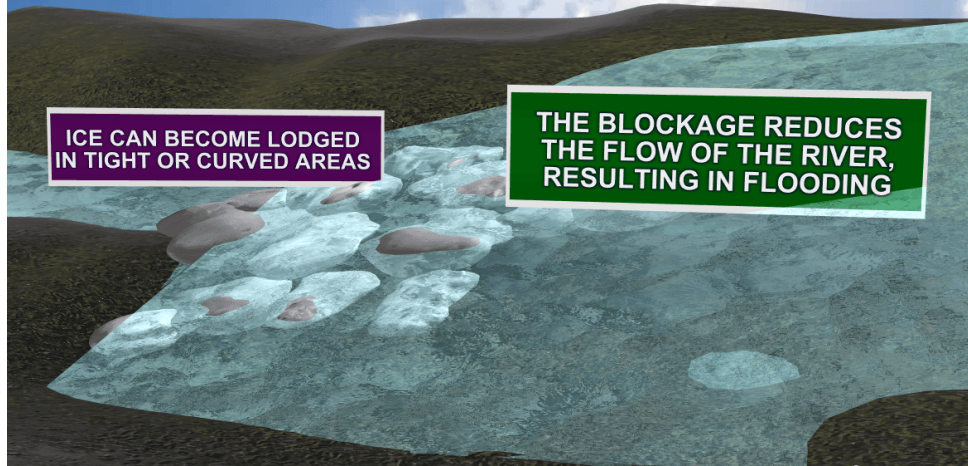


Rainfall Flooding

- Statewide annual precipitation: 6 in. increase since 1895
- Heavy storms of 2-4 inches more frequent
- More frequent, high-intensity storms:
 - Less likely to replenish groundwater
 - More likely to cause flooding and erosion
 - Multiple in a row can oversaturate ground -> rapid runoff
- More than 50% of Mainers rely on private wells

> WHAT IS AN ICE JAM?

WEATHER
AUTHORITY

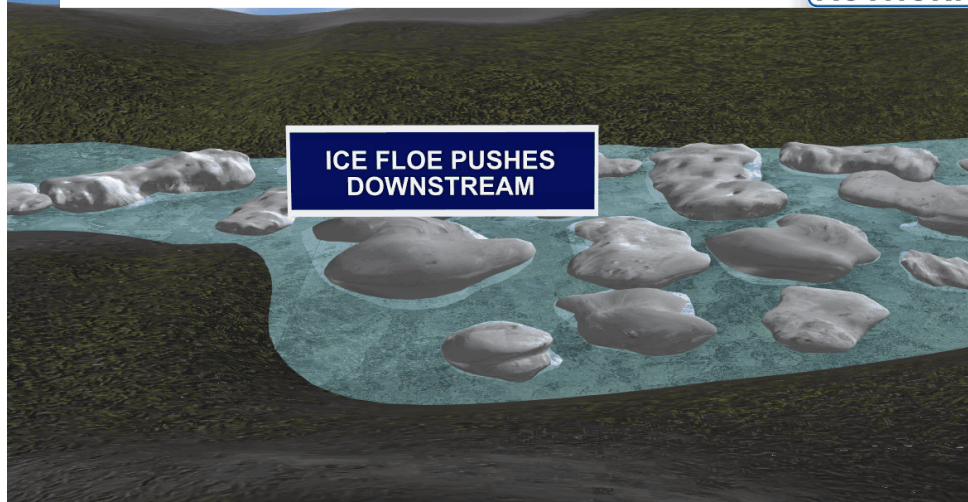


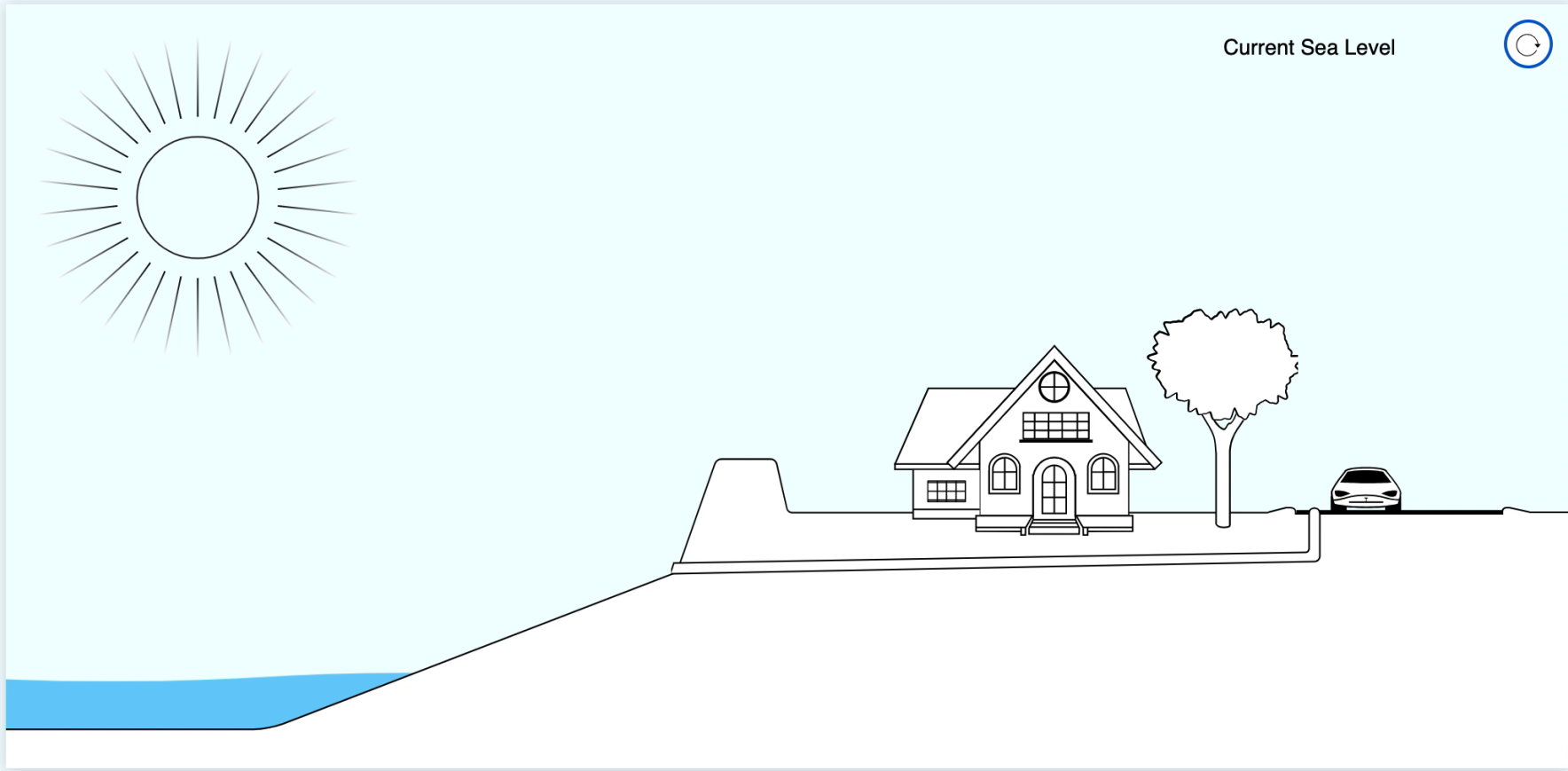
Snow Melt and Ice Jams

- Common during winter along rivers, streams, and creeks
- Ice Jam Formation = Upstream flooding
- Ice Jam Break = Downstream flash flooding
- Mid winter ice break ups more destructive than Spring thaw

> WHAT IS AN ICE JAM?

WEATHER
AUTHORITY





Regional Oceanographic

VIEW

Highest Tide / King Tide

VIEW

King Tide with Rainfall

VIEW

Wind Waves

VIEW

Storm Surge

VIEW

Sea Level Rise

Add Sea Level Rise to view impacts.



Mold issues pile up in Maine after rainy winter storms

Maine Public | By Irwin Gratz
Published March 18, 2024 at 7:15 AM EDT



Flooding Events Cause:

- Infrastructure damage
- Delay in emergency response
- Electrical and fire hazards
- Prolonged power outage
- Oil spills
- Drinking water contamination (bacteria, chemicals, CSO, etc.)
- Landslides
- Saltwater intrusion
- Erosion and land loss
- Marsh migration
- “Coastal squeeze”

Opportunities for Increasing Flood Resilience

Emergency Response Plans

Shoreland Zoning Ordinance Updates

- Increase setbacks
- Expanded resource protection land use districts (SLR, marsh migration, etc.)

Ordinance Changes: subdivision and site plan review

National Flood Insurance Program

New Mandatory Real Estate Disclosures

Low Impact Development

- Minimize impervious areas
- Limit areas of clearing and grading
- Minimize directly connected impervious areas
- Manage stormwater at the source and break up drainage
- Open space planning

CoastWise and StreamSmart

An aerial photograph of a coastline. The water is a light blue-grey color. The shoreline is irregular, with several large logs and branches protruding from the water. The land is covered in trees with autumn foliage in shades of yellow, orange, and brown. A paved path runs along the top left, and a grassy area is visible on the right.

Erosion, Landslides, and Water Quality

Nicholas Whiteman, Marine Geologist

Maine Geological Survey



Why Does Erosion Happen?

- Maine's surface is mostly covered by loose sediment, left behind by glaciers.
- With nothing holding sediment together, it is easily moved.

Coastal Bluff – A steep sided, unconsolidated, eroding body of sediment.



Image: N. Whiteman (February 2017)

Why Does Erosion Happen?

- Maine's surface mostly loose sediment, left behind by glaciers.
- With nothing holding sediment together, it is easily moved.

**Unconsolidated sediments flow under gravity.
(Maine's sediments are usually not this clean.)**



Image: giphy.com (2024)

Why Does Erosion Happen?

- Water, wind, and people move sediment.
- Seasons degrade sediment.
- Weathering is a major impact.
- Erosion can be chronic, whereas a stream meanders over time.

A meandering river easily changes its course.

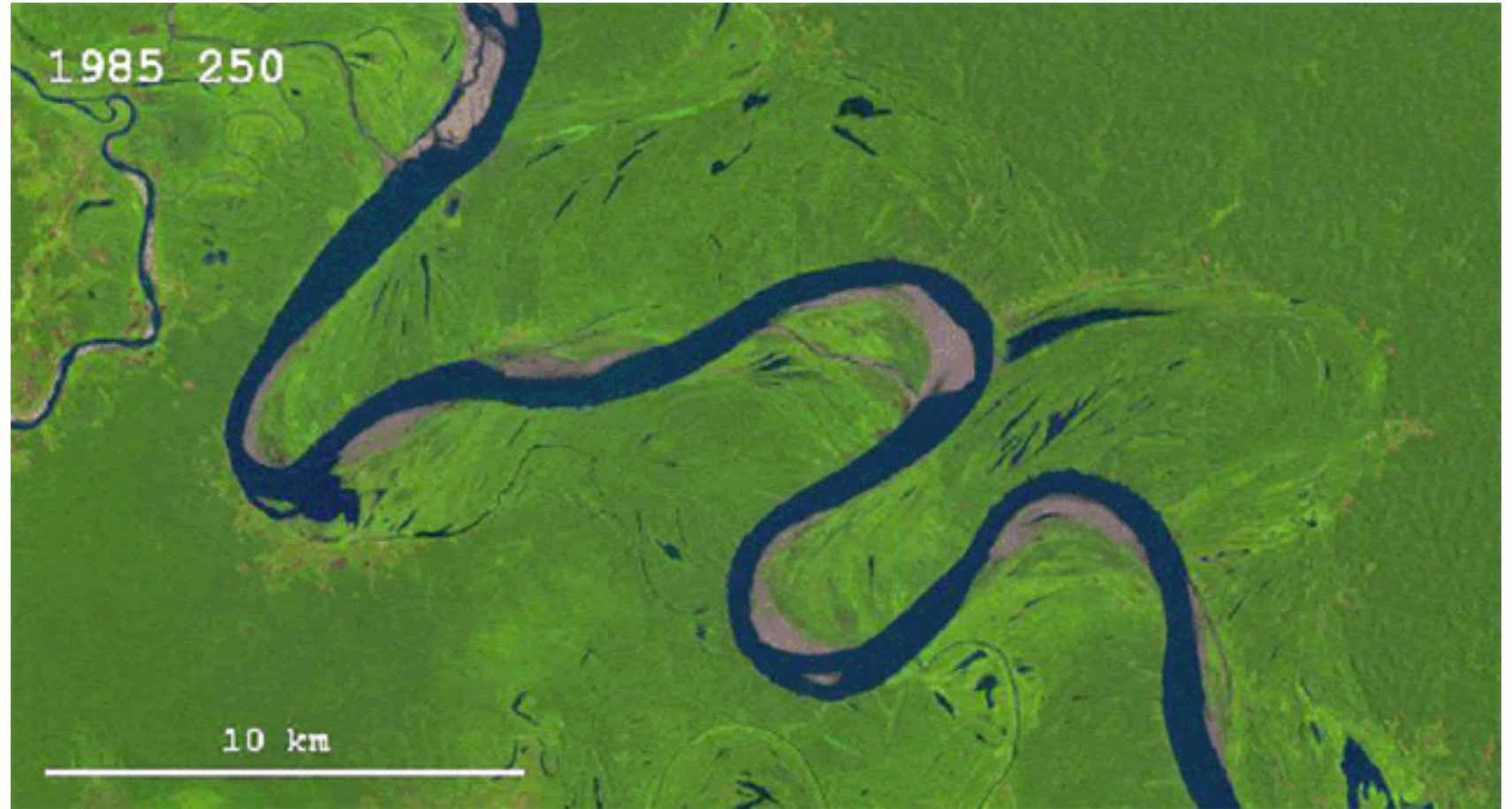


Image: Historiaelpalo: Meandros (2016)

Erosion

- Or episodic, following storm events, intense rainfall, or freeze-thaw days.
- Erosion events often happen quicker than the time between storm events.

Fire Island New York, 1989-2022, Barrier island breach.

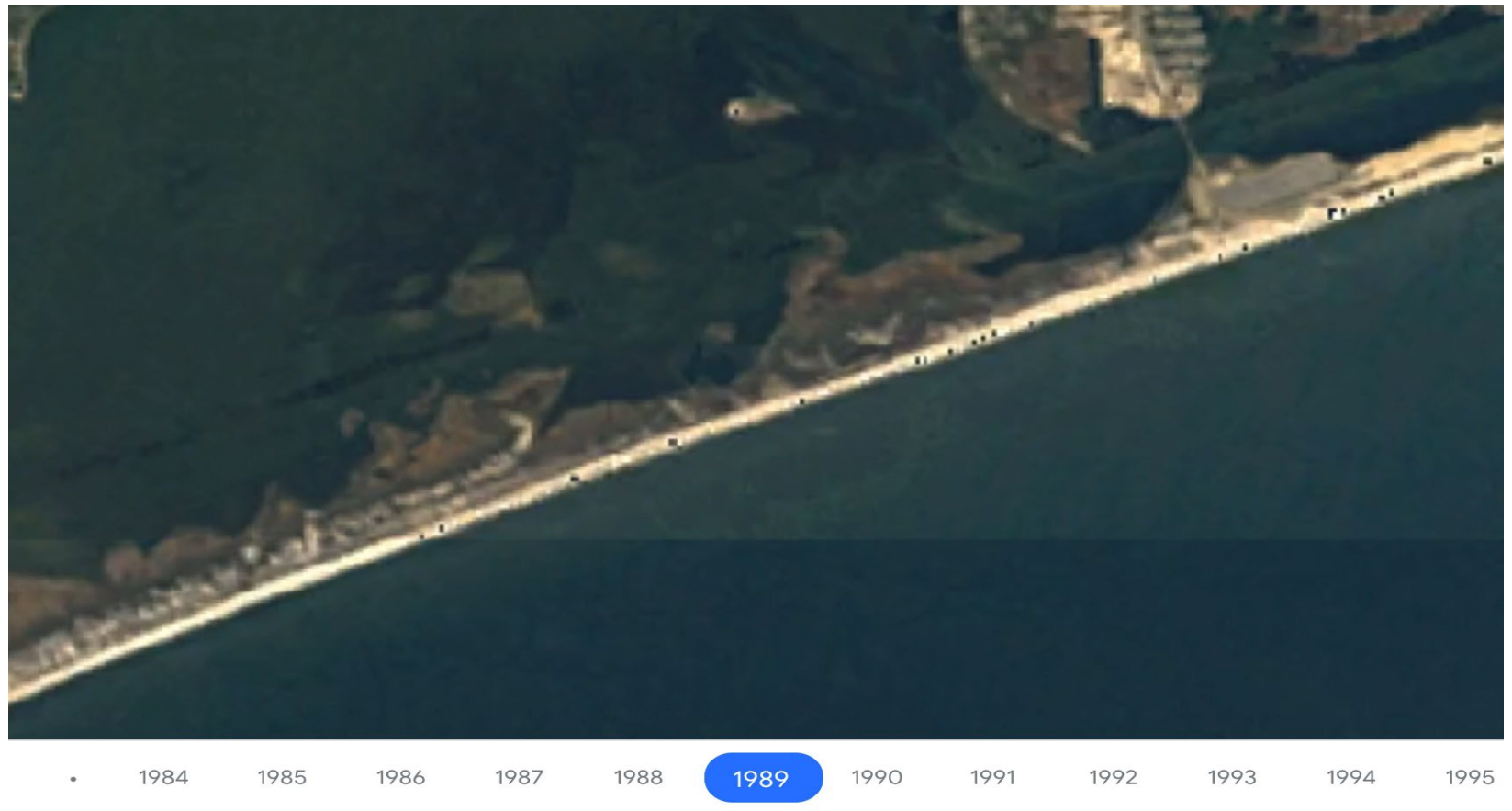


Image: Google Earth Timelapse (2024)

Erosion

Erosion happens at all scales: from raindrops, to roadsides, to entire neighborhoods perched on loose sand dunes.

Erosion is not just a coastal concern.

Raindrops do a lot of work when you add them all up.

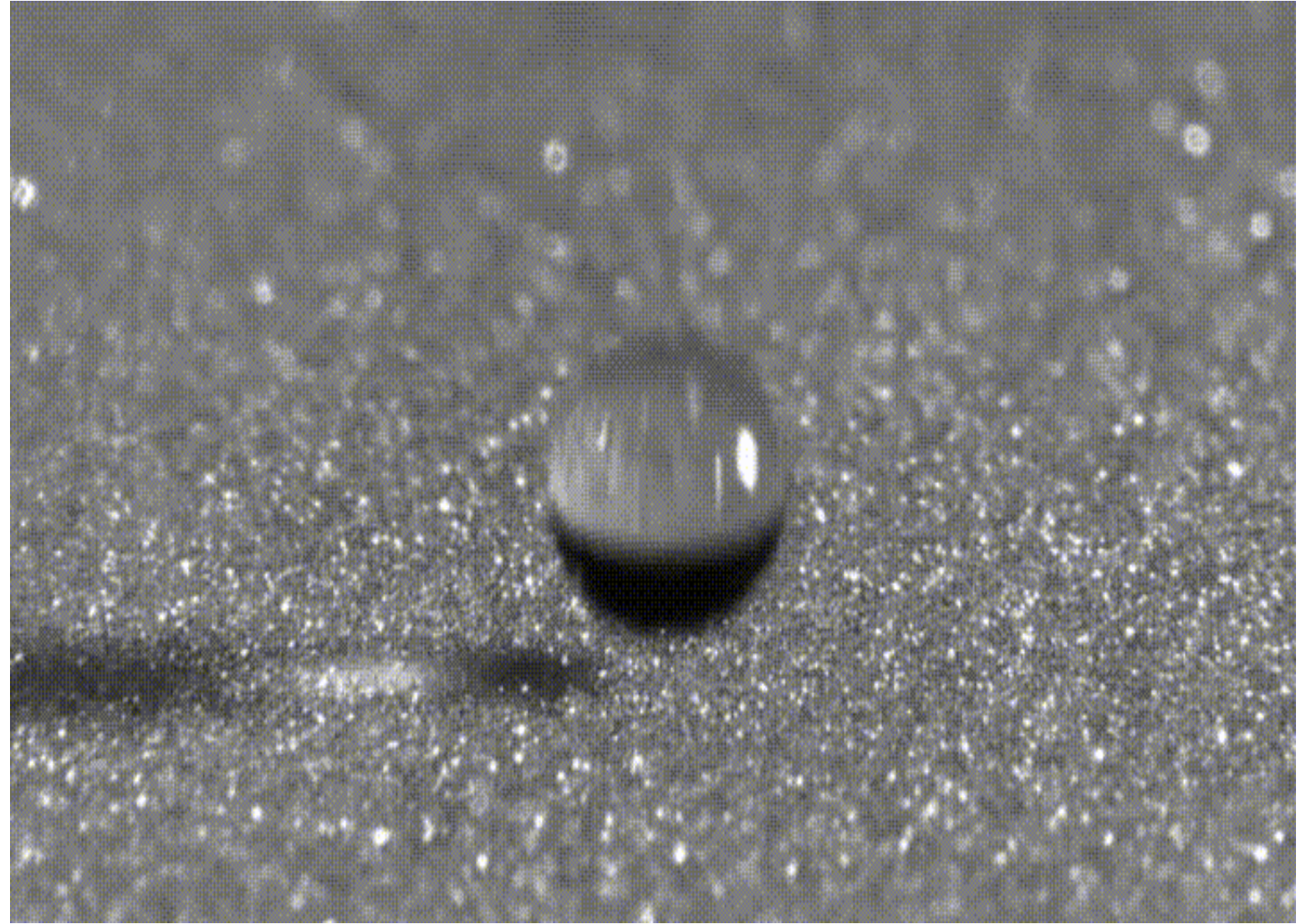


Image: tumblr.com (2024)

Erosion

Erosion can cut through roads, undermine structures, impact water quality, and/or condition a slope for a more serious landslide hazard.



Woodman Hill Road, Jay, Maine.

Murray Carpenter / Maine Public

on Woodman Hill Road in Jay, Maine.

Erosion

Recent development and poor land use management can both exacerbate an erosion problem.

Gullying after land clearing, Freeport, Maine.



N. Whiteman (2022)

Erosion – a resource?

While erosion can worsen landslide hazards and water quality conditions, some erosion is **essential** for sustaining some of Maine's most valuable habitats.

A landslide has provided sediments to sustain a local fringing salt marsh.



Image: N.Whiteman, Oct. 2017

Mudflats, sandflats, sand beaches and dunes, coastal wetlands, and shellfish flats are among the habitats sustained by erosion.

Erosion

Contiguous and congruent projects fare better than individual efforts.

Building or engineering in erosion-prone areas is often subject to NRPA, MSZA, MDEP, Town Codes Offices.

Awareness of Harm's Way should be considered in all planning efforts.



Image: N.Whiteman, May 2024

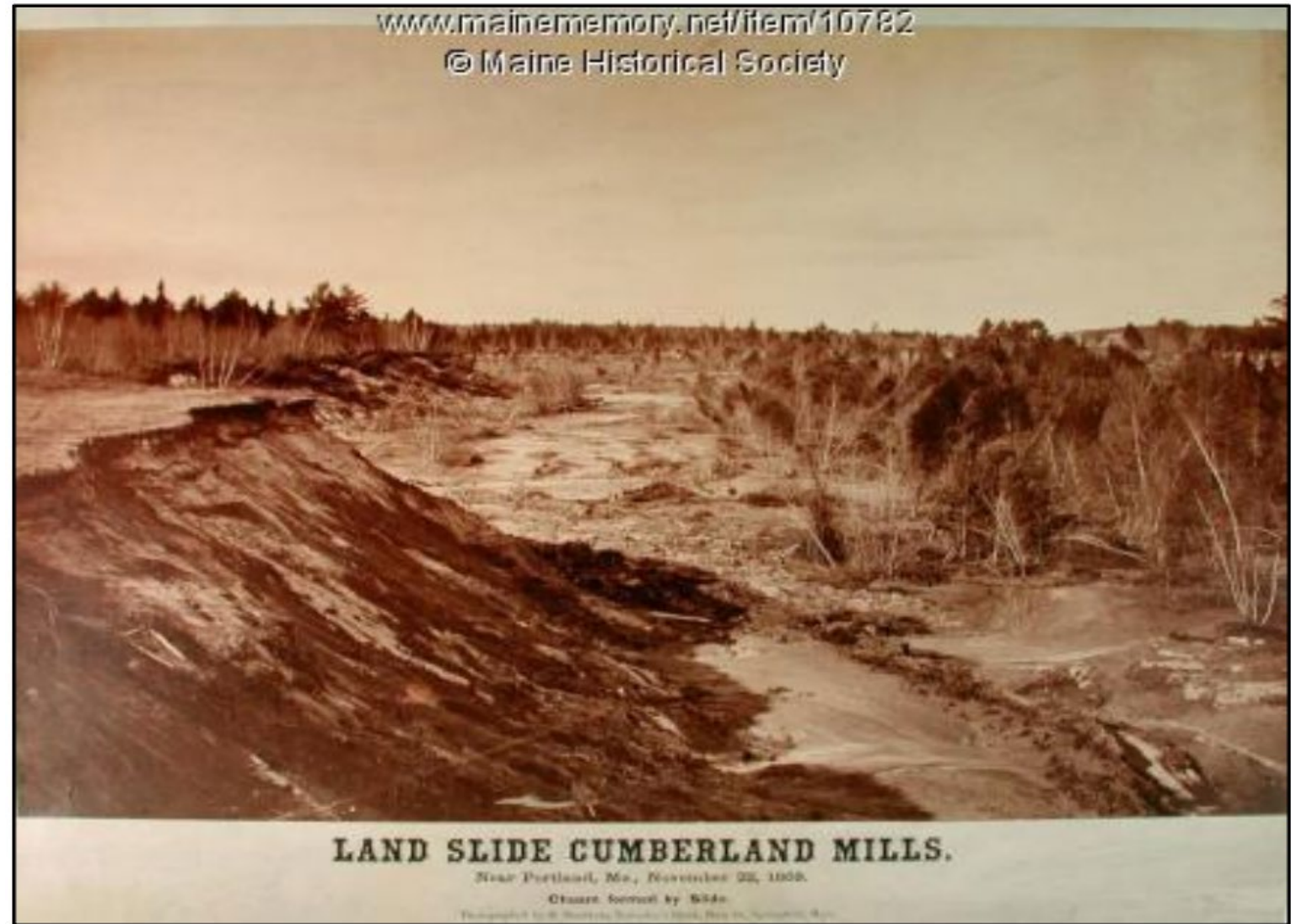


April 1996 Rockland Landslide and MGS on the case. (MGS)

Landslides

- Statewide problem
- Individual events are unpredictable but hazardous areas, susceptibility, and symptoms are well known.
- Natural and human influences and triggers
- Different landslide types may require different mitigation strategies.

The Great Landslide of 1868, Westbrook, Maine.



Landslides in Maine are often associated with “Maine’s Blue Clay,” the Presumpscot Formation.

Landslides

- Most significant factors include:
- sediment type: finer clays, silts, sands flow most readily.
- Terrain steepness and relief. Anything over 6ft is considered hazardous. Overburden stress increases with relief.
- Water saturation is a leading trigger. Intense rainfall from storms, snow melt, and human sources like septic or irrigation, poor roof or driveway drainage design.



Image: N.Whiteman, Mar. 2024

Landslides

- Alteration of a slope, whether by natural or human drivers, can provoke landslides in vulnerable areas
- Landslides are most likely to occur..
- **When:** wet periods, such as spring and early summer, on warm winter thaw days, or following intense soaking rainfall from hurricanes and nor'easters.
- **Where:** steep sided slopes, banks of shorelines and rivers, and recently cleared lots.

Warm winter days above freezing can lead to bluff instability.



Image: N.Whiteman, Mar. 2018

Landslides

- Important to realize that the land surface in Maine is continually eroding.
- Frequent monitoring of an area for signals of ground movement is critical.
- Consult MGS and/or geotechnical professionals if you suspect ground motion or a landslide hazard risk.

The New York Times

The Hills Are Alive With the Flows of Physics

Landscapes around you may appear static, but research using lasers suggests even the most steady terrain is creeping along.

Image: New York Times *Science*, Adam Mann, June 2021

Landslides

- If high landslide risk is confirmed, it may be prudent to avoid building new roads or structures.
- Risk reduction recommendations include:
- Changing the slope of the land surface, diverting water flow, supporting the bottom of an eroding slope, planting erosion-resistant vegetation.
- In some cases, relocation of roads or structures may be recommended.

Tension cracks developing in a road prior to slope failure.



Image: from MGS Landslide Susceptibility Mapping (MGS)

MGS Geologists are available to help explain these maps and resources.

Landslides – MGS Resources

[MGS Hazards WebPage](#)

[Maine Landslide Guide,
FAQs, and Fact Sheets](#)

[MGS Landslide
Susceptibility Mapping](#)

[MGS Maine Landslides
StoryMap](#)

[Contribute to the MGS
Landslide Inventory](#)

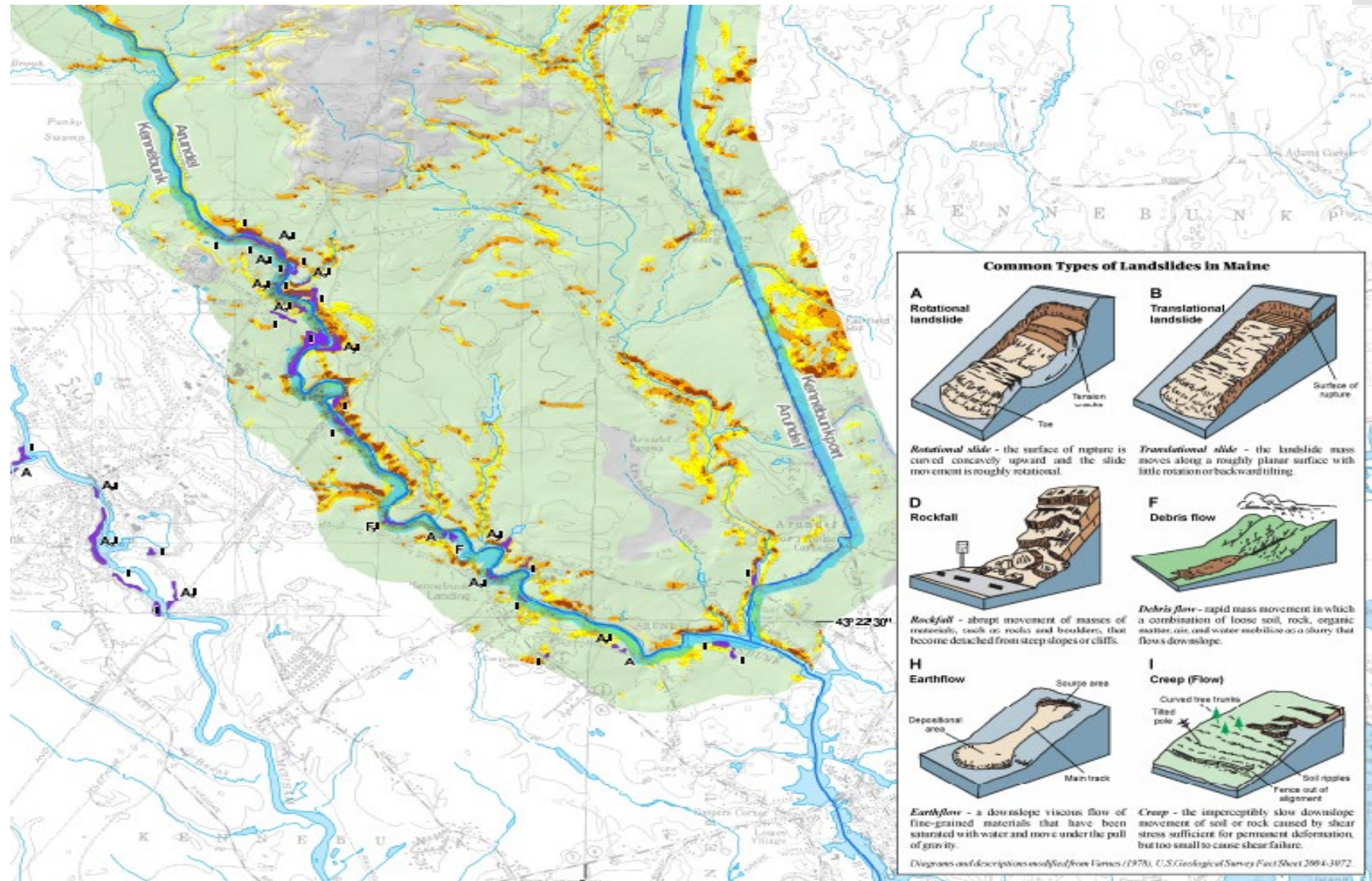


Image: from MGS Landslide Susceptibility Mapping (MGS)

Water Quality



Water Quality

- Landslide and Erosion control both require considerations for 'downstream' effects.
- Water quality hazards are not exclusively an erosion issue.
- Water quality has many natural and human influences.
- The following slide(s) are common considerations and not a complete list.

Suspended sediments carried away by snow melt.



N.Whiteman, Mar. 2018

Water Quality

- Stormwater disturbance and turbidity
- Waterborne debris battering
- Flood damage and pollution spills
- Saltwater/groundwater intrusion
- Bio/algal blooms, inland coastal
- Tidal current impasse



Water Quality

- Consider all downstream consequences of any project or plan.
- Consult MEDEP and partner agencies for best management practices and guidance.
- Inventory existing hazardous sources.
- Incentivize adaptation for resilient infrastructure.



Presenter Contact Information



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Maine Geological Survey

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Series Next Steps

1. Assessing Risk from Natural Hazards
 - September 17, 2024, from 5:30-7:30pm – Hybrid and in Damariscotta
 - 1-hour hybrid lecture followed by 1-hour in-person applications
2. Comprehensive Planning and Hazard Mitigation Plans
 - October 24, 2024, from 5:30-7:30pm – Hybrid and in Rockland
 - 1-hour hybrid lecture followed by 1-hour in-person applications
3. Zoning and Model Ordinances for Risk Reduction
 - November 19, 2024, from 5:30-7:30pm - Zoom
4. Financing Hazard Resilience
 - December 11, 2024, from 4-5:00pm - Zoom

BONUS: Infrastructure and Nature-Based Solutions (TBD)

Additional Resources:

Wildfire:

[Maine Forest Service Forest Protection Division](#)

Wildfire Smoke and Air Quality:

[Maine Governor's Office](#)

[AirNow Fire and Smoke Map](#)

Extreme Heat:

[Maine Emergency Management Agency](#)

Urban and Community Forestry:

[Project Canopy](#)

CONCERNED ABOUT WILDFIRE OCCURRING IN YOUR COMMUNITY?

The Maine Forest Service has a community-based wildfire prevention program.

If your community or homeowner association is interested in developing a wildfire protection plan, please contact us.

There is also a new federal grant program that can help with fire plans and forest fuel mitigation.

FMI: Maine.forestrangers@maine.gov • 207-287-4989





[Maine Floodplain Management Program's Map Modernization Program](#)



[Maine's Stormwater Best Management Practices Manual](#)



[Regional Stormwater Working Groups](#)



[County Soil & Water Conservation District](#)



[Municipal Climate Adaptation Guidance Series](#)

Flooding Resources:

Erosion and Landslide Resources:

- [MGS Hazards WebPage](#)
 - [MGS Coastal Property Owner's Guide to Hazards](#)
 - [MGS Maine Landslides StoryMap](#)
 - [MGS Landslide Guide, FAQs, and Fact Sheets](#)
 - [MGS Landslide Susceptibility Mapping](#)
 - [MEDEP Erosion Control Best Management Practices](#)
 - [MEDEP Erosion & Sedimentation Control](#)
 - [EPA National Menu of Best Management Practices](#)
 - [NOAA Ocean and Coastal Hazards](#)
- [Contribute to the MGS Landslide Inventory](#)