Module 2: Understanding Climate Change Exposure



Climate Resilience Action Plan Steps



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Asset Inventory

List the assets that can contribute to your financial well-being or the success of your business.

1

Understand Exposure

Evaluate business assets and their exposure to climate-related hazards.

2

Assess Vulnerability and Risk

Identify the business assets most vulnerable and at-risk to climate-related hazards.

3

Investigate Options

List strategies to reduce the greatest climate-related risks to vulnerable assets.

4

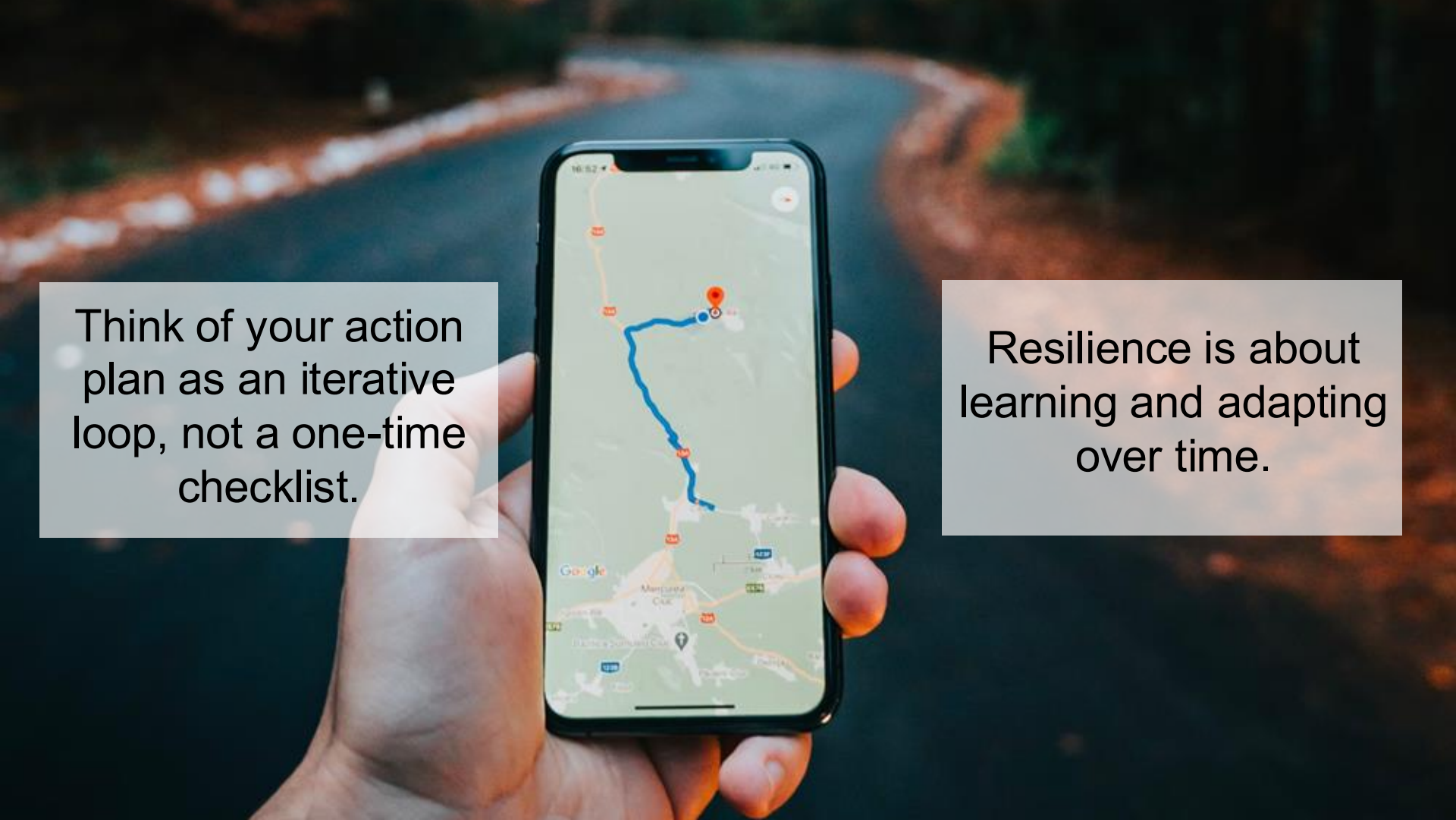
Prioritize and Plan

Design an implementation plan for the strategies that are most likely to reduce vulnerability and risk.

5

Take Action

Implement and communicate the plan with employees (if applicable).
Monitor.
Iterate.


Think of your action plan as an iterative loop, not a one-time checklist.
Resilience is about learning and adapting over time.

Climate Resilience Action Plan Steps



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Asset Inventory



What is an asset?

*An **asset** is something that can contribute to your financial well-being or the success of your business*

What are types of assets?

- **Tangible** - physical (can be touched)
- **Intangible** - often a special quality or advantage with value (reputation, employee expertise, community relationships)
- **Supportive** - infrastructure that you do not own or control but provides critical support to your business (ie. roads, utilities, laws)

Example - Asset Inventory

Physical Assets (Property, Plant, & Equipment (PPE))	Intangible Assets	Supportive (Infrastructure) Assets
Buildings/Space	Employees - Expertise & Retention	Supply chains
Machinery	Customers	Customer Access
Inventory	Suppliers	Utilities
Computers and computer software	Network	Telecommunications
Vehicles	Intellectual property	
Furniture	Contracts	
Land	Reputation	

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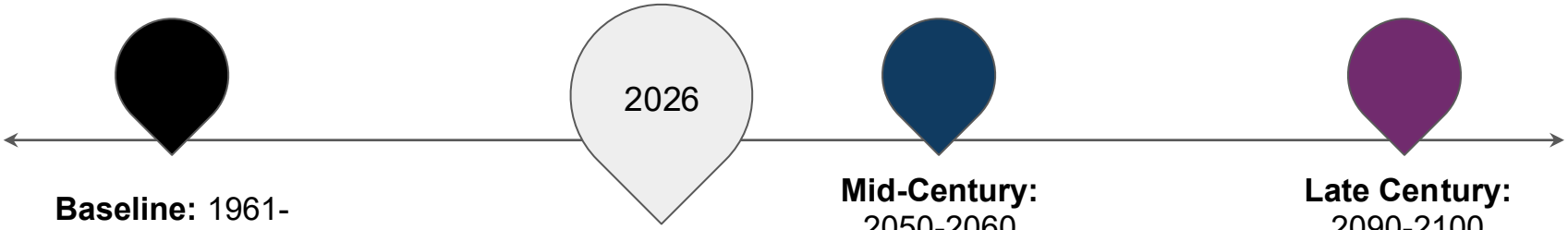
Climate Projections for Vermont

Next, we'll move from what you have
to what threatens it.

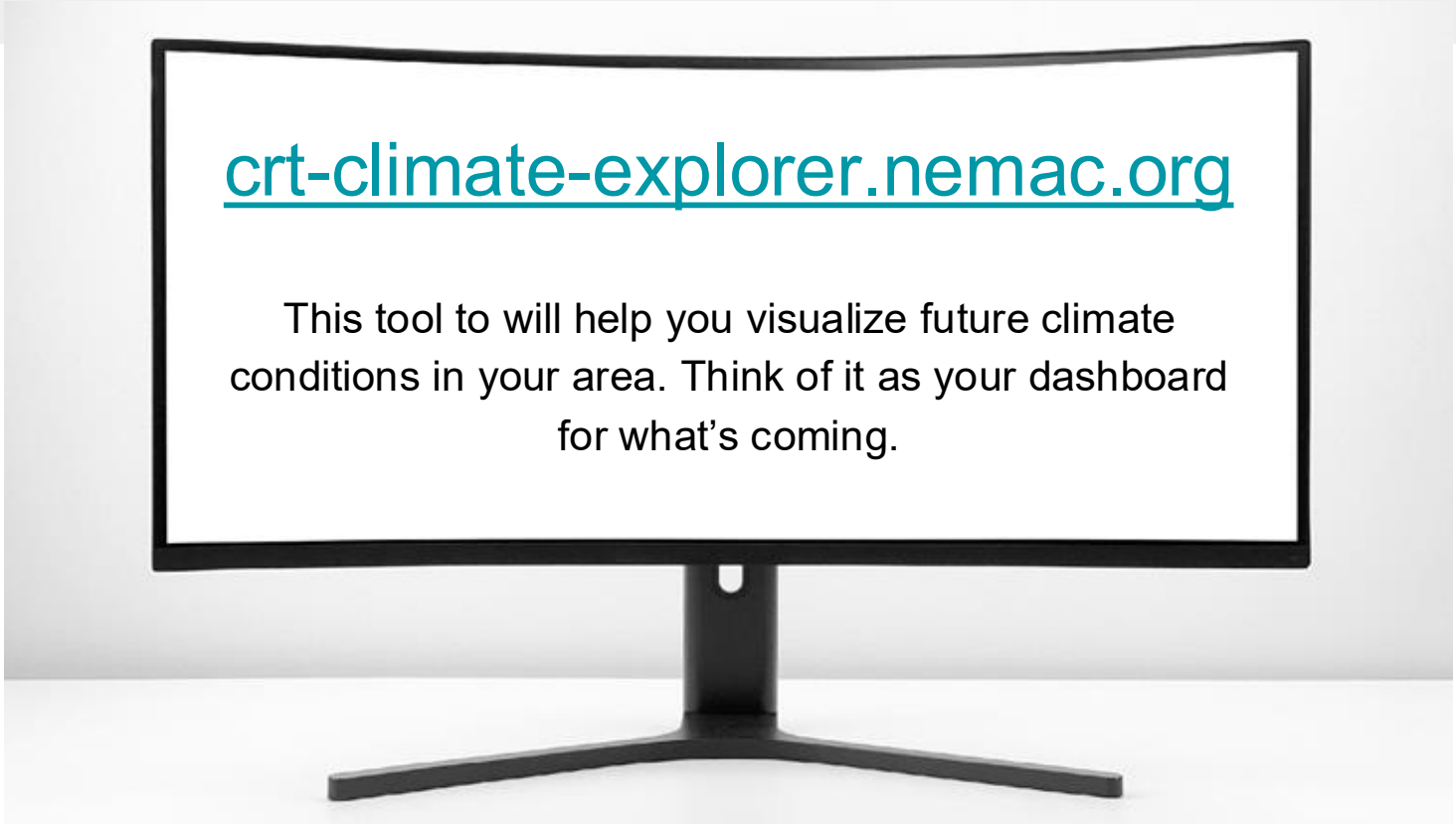
What's the outlook?

When interpreting climate projections, focus on:

- Trend direction
- Magnitude of change
- Timing
- Variations in models
- Scientific uncertainty



Climate Explorer Website



Climate Explorer Website



This website integrates data from NOAA, NASA, USGS, EPA, academic & research institutions to produce on-demand visual and numeric projections of localized climate changes out to year 2100

https://crt-climate-explorer.nemac.org/

Example of Climate Explorer Output

Average Daily Max Temperature 1950-2100 Windham County, VT (Observed & Projected)



Air Temperature

Higher Average Temperatures



	Annual	Summer (July)	Winter (January)
2050s	▲ +4.9° to 6.4°F	▲▲ +4.8° to 6.8°F	▲ +6.5° to 8.0°F
2090s	+6.3° to 11.1°F	+6.3° to 12.0°F	+7.9° to 12.6°F

▲

Insect pests reduce hemlock shade, thus **warming trout streams**

Increase in **tick population** and risk for tick-borne diseases

Air Temperature

Higher Average Temperatures



Since 1900, Windham county's average temperature has risen +3.75°F

- More extreme heat and fewer icing days mean changes in everything from tourism to public health.
- Growing season has increased about 6 days per decade since 1950, roughly 45 more days than in the 1950s
- More "backward" or "false" springs, with warming in late winter and early spring followed by snow and freezing rain in April–June, cold temperatures, and northwest winds
- We'll see increased risks like algae blooms, tick-borne diseases, and energy stress on cooling systems
- **Losing hemlocks will warm trout streams.** Hemlock woolly adelgid is held back by cold snaps, and with our warming winters, we are getting fewer of these cold snaps, especially in southern Vermont, so these insects are expanding their range. Hemlocks cast heavy shade over streams, which is essential for brown and brook trout. Like algae, this is a delayed tipping-point problem. The trees die, the shade goes, water temperatures rise, and native brook trout drop out of headwater streams.

Air Temperature

Less Ice, More Extreme Heat





Icing days are days when the air temperature doesn't rise above freezing. This is important in places like Vermont because they influence **snowpack persistence and ice formation.**

	▼ ▼ **Icing days** (<32° F)	▲ ▲ **Days over 90°F**
2050s	**-37% to -46%**	**+11 to +18 days**
2090s	**-46% to -70%**	**+16 to +47 days**

Precipitation

Rain & Snow





- We’re seeing significant changes in precipitation — more total rainfall, but concentrated in shorter, more intense events.
- Annual average precipitation has increased nearly 6 inches since the 1960s. This means greater flood risk and less predictable snowfall.
- For businesses, that affects access, supply chains, and building integrity.

Precipitation

Rain & Snow





Shifts In Amount/Timing of Rainfall

▲

Annual precipitation

+9% to +12%
by the 2050s

+12% to +18%
by the 2090s

(baseline: 48.3 in)

Projected to increase mostly during winter and spring.

***Rain** projected to **increase more** than **snow** due to rising temperatures.*

Reduced Snowfall

▼

Declines in snowfall frequency and shorter season length

?

Uncertain changes in intensity of snow events and frequency/intensity of ice and freezing rain

▲

Likelihood of increased frequency and intensity of floods due to more rain and melting

Drought

Potential increase in frequency & intensity of drought conditions



- **Changing precipitation patterns:** Warmer winters bring more rain than snow and earlier snowmelt, reducing spring snowpack and increasing drought risk
- **Intensifying water cycle impacts:** Higher temperatures and heavier rain events drive more evaporation and runoff, lowering groundwater recharge and worsening drought conditions
- **Rising wildfire risks:** Hotter, drier conditions heighten the likelihood of drought, wildfires, and smoke exposure
- **Business risks:** Drought can disrupt water supply, agriculture, and even manufacturing operations

Key Takeaways

Increased unpredictability makes planning challenging but critical.



Warmer Year-round



More Total Precipitation



Less Snowy Winters



More Drought & Smoke Conditions



More Extreme Events with Less Predictability



Impacts on Built & Natural Environments

Climate Hazard Exposure

Identify your “Best Bet” resilience investments to protect your critical assets.

Climate Hazard Exposure: Overview

This is not about being perfectly precise. It's about building a shared, practical understanding of risk.



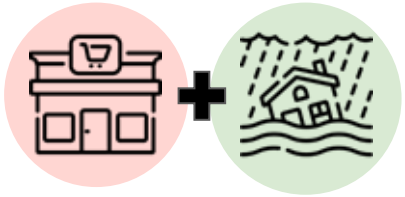
Asset Prioritization

Select **top priority assets** (~3-5) for your business



Potential Climate Hazards

Use **online tools** to identify **highest probability hazards** for your location(s)



Asset-Hazard Pairing

Pair each of your priority assets with **climate-related hazard(s)** that are likely to affect it

Let’s use a fictional business as an example.

We’ll use this same example throughout the course.

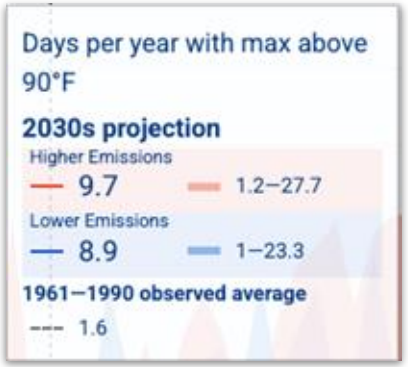


Pete’s Pick & Pack is a fictional meal delivery business.
The HQ is located at 2136 Main Street, Londonderry, VT.

Identifying Potential Climate Hazard Exposure

- One helpful way to begin thinking about exposure is to look at **simple future projections**.
- Tools like Climate Explorer allow us to see how conditions such as temperature or precipitation are expected to change over time.
- What's important here is not the exact number or prediction — it's the **direction of change**.
- Notice how we translate that data into what it means for business operations at our fictional business (Peter's Pick and Pack) - employee safety, storage conditions, or equipment reliability
- We use this kind of information as a **conversation starter**, not as a precise forecast

Temp Changes in My Business Location

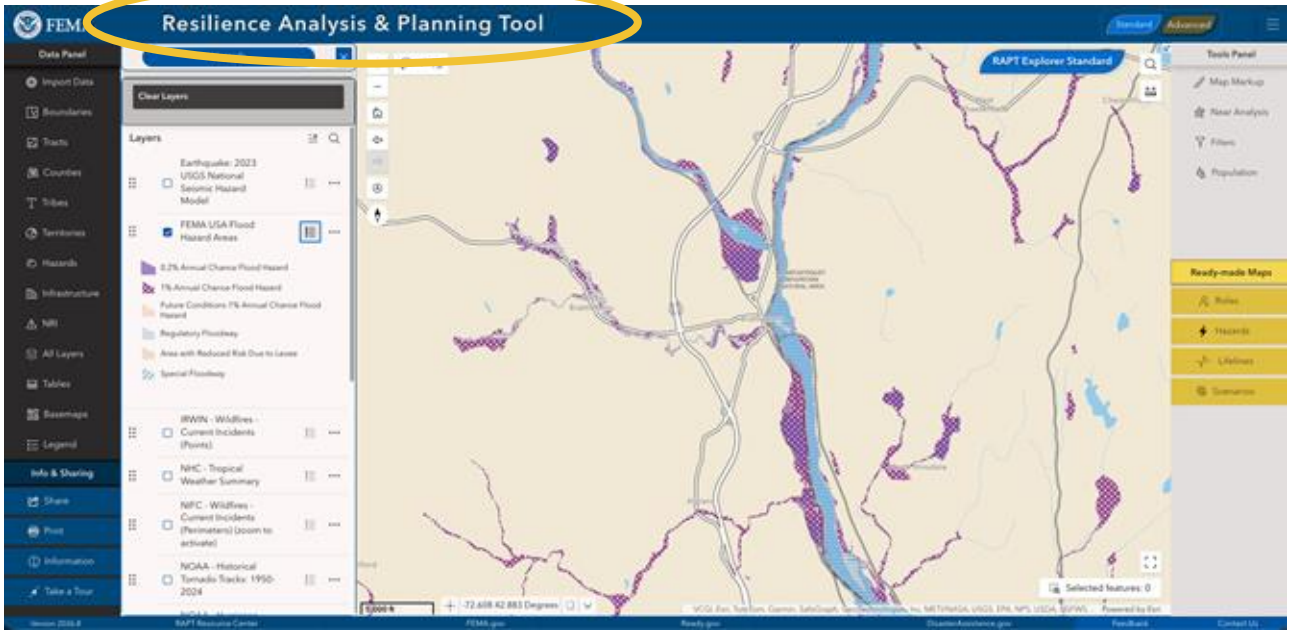


From Climate Explorer website

Potential Hazard Exposure

Extreme Heat

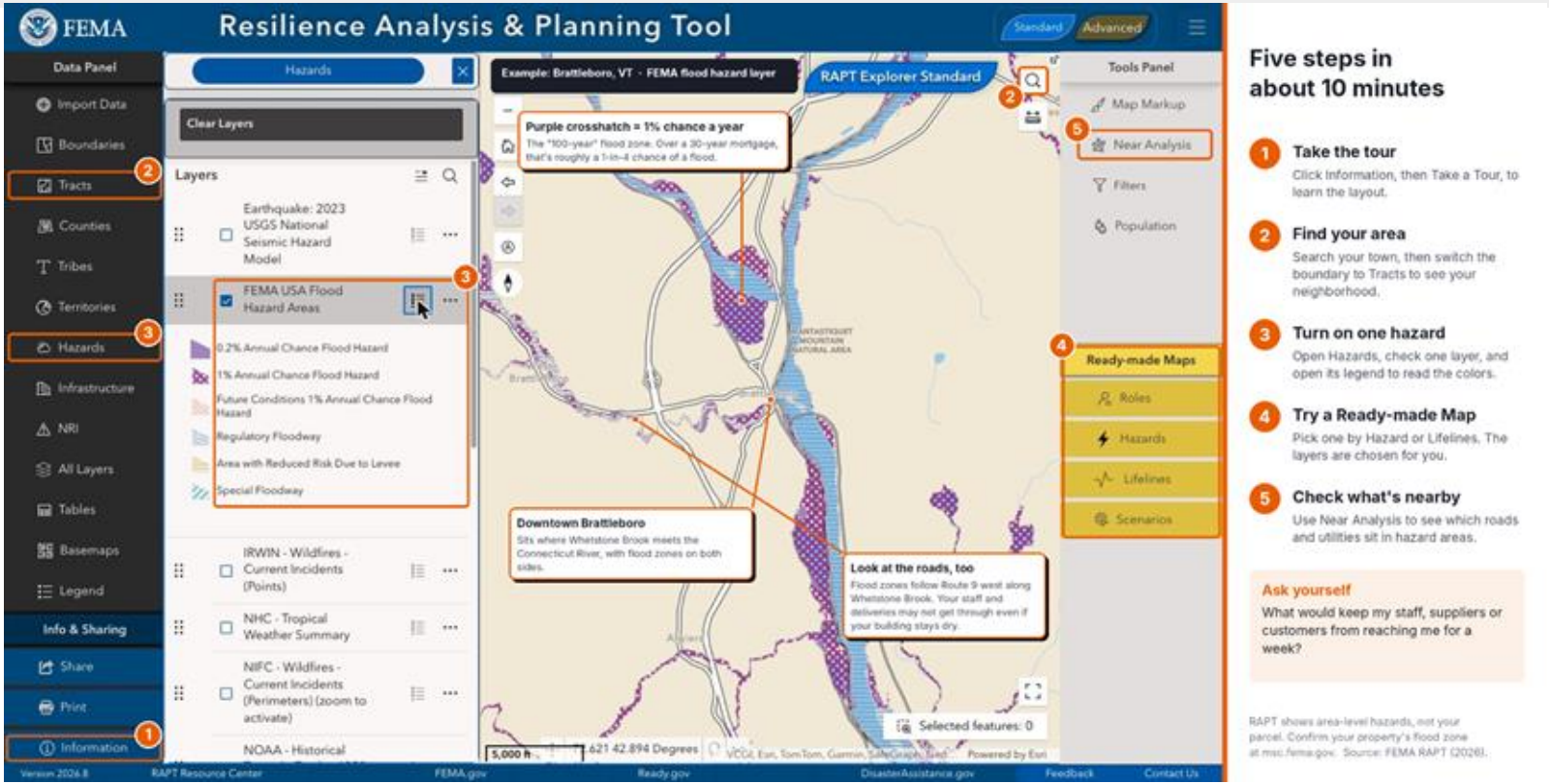
Another free tool for seeing which climate hazards could affect your area is FEMA's Resilience Analysis and Planning Tool, or "RAPT" for short.



https://arcg.is/0WrqK41

- You can zoom in on your town or neighborhood and turn on different map layers, such as flood zones, areas prone to extreme heat, communities that may have a harder time recovering from a disaster, and roads, utilities, and other services that could be disrupted.
- One caution: some of this information is a few years old, and much of it covers broad areas. It won't tell you exactly what will happen at your building.

FEMA's Resilience Analysis and Planning Tool



FEMA's Resilience Analysis and Planning Tool

The five steps (~30 sec)

- ***Point to the right panel:***
- Five steps, about ten minutes.
- Take the tour, find your town, turn on one hazard layer at a time, try a ready-made map, and check what's nearby.
- The orange numbers on the screen show you where to click.

What Brattleboro shows (~60 sec)

- This is Brattleboro with FEMA's flood layer turned on.
- Purple crosshatch is the "100-year" flood zone. That sounds rare, but over a 30-year mortgage it's about a one-in-four chance.
- Downtown sits right where Whetstone Brook meets the Connecticut River.
- Now look at the roads. The flood zone follows Route 9 west along the brook.
- Your building can stay dry and you can still be closed for a week if your staff, your deliveries or customers can't get to you.

Limits and the takeaway (~15 sec)

- One caution: RAPT shows the risk in your area, not for your specific property. To check your own address, you can go to the online FEMA Flood Map Service Center at msc.fema.gov. But keep in mind that the data is potentially up to 20 years old.

After using the tool, answer this question:

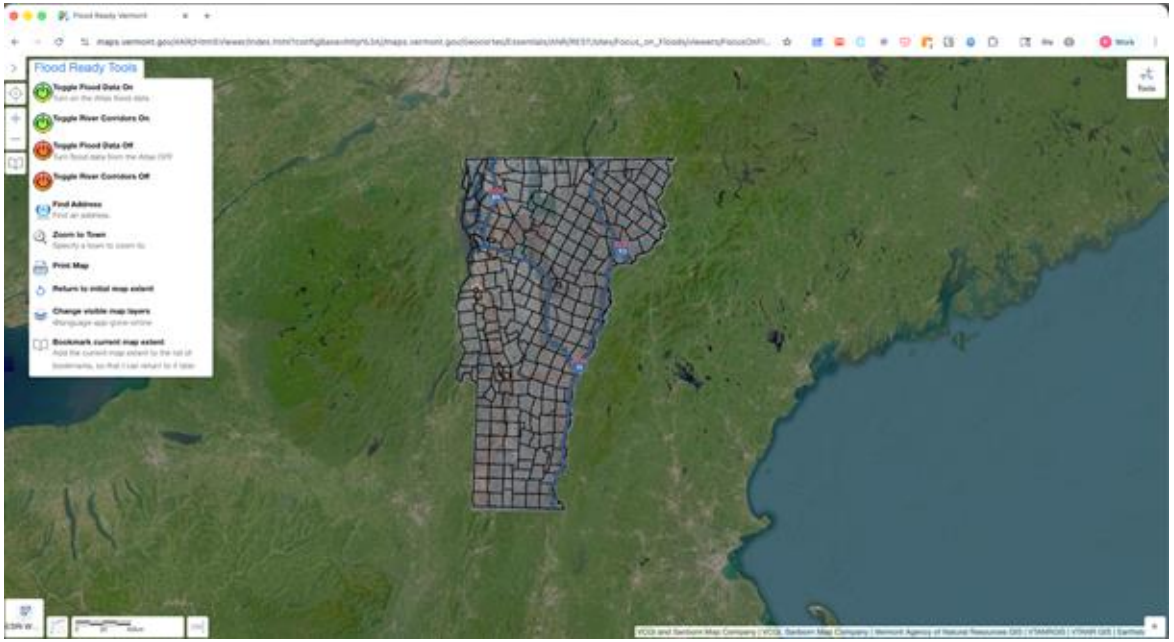
- "what would keep my staff, suppliers or customers from reaching me for a week?"

The Vermont Flood Atlas

Website:
https://floodready.vermont.gov/

Click on “Vermont Flood Atlas”

- This tool has a lot of layers, technical terms, and navigation steps that can feel a bit overwhelming at first.
- Still, for those who want to really **deep-dive into flood risk and hazard exposure**, especially at the local level, it is still a very valuable resource.



The Vermont Flood Atlas

From Flood Ready VT website



Potential Hazard Exposure

River Flooding?

The Vermont Flood Atlas

- When you zoom in using the Flood Atlas, you can start to see much more detailed information about potential flood pathways, inundation areas, and terrain relationships.
- This level of detail can be especially helpful when thinking about:
  - specific building locations
  - access routes and evacuation constraints
  - storage areas or utilities
  - nearby streams, culverts, or drainage patterns
- Again, this is not about getting perfect answers.
- It's about gaining a **stronger sense of how water might move through your area** and where exposure could concentrate.
- For many businesses, just seeing this visual detail can lead to very practical insights — like relocating inventory, adjusting parking or loading practices, or thinking differently about emergency planning

Now we combine everything - assets and hazards.

Step 1: Identify Hazards for Each Asset

- List the climate and weather-related events that could damage each priority asset

Step 2: Create Asset-Hazard Pairs

- Pair each asset with every hazard that could affect it

Example

Asset-Hazard Pairs
Inventory Storage Room - Flooding
Inventory Storage Room - Extreme Storms
Staff - Extreme Heat
Staff - Extreme Storms
Electric, etc. Utilities - Extreme Storms
Electric, etc. Utilities - Flooding

Here's what a completed Asset-Hazard Pairing looks like:

Asset-Hazard Pairs
Inventory Storage Room - **Flooding**
Inventory Storage Room - **Extreme Storms**
Staff - **Extreme Heat**
Staff - **Extreme Storms**
Electric, etc. Utilities - **Extreme Storms**
Electric, etc. Utilities - **Flooding**



"Best Bet" opportunities for my climate resilience investments — the ones most likely to yield impact and return.