

Climate Ready Great Lakes



Developing a Climate Adaptation Plan

An Overview of Planning Processes and Strategies for Climate Change Adaptation

Adaptation Planning

Part 1: How to Develop an Adaptation Plan

- Step-by-step overview of a planning process, which is adaptable to different communities

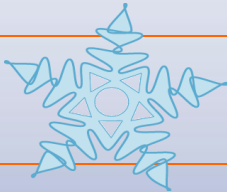
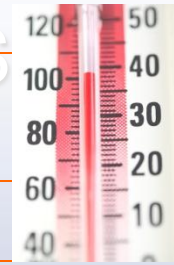
Part 2: Strategies for Adaptation

- Methods to address impacts to stormwater, floods, drought, infrastructure, ecosystems, and urban heat
- Incentives and Resources

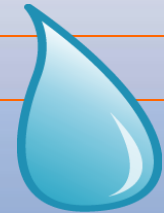
Climate Change Impacts in the Great Lakes Region



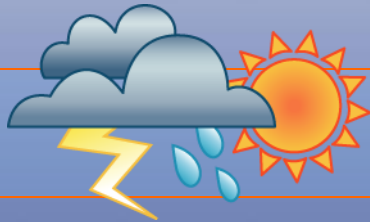
Temperature Changes



Melting ice

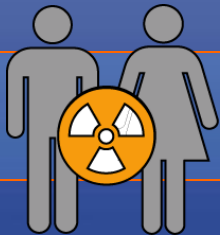
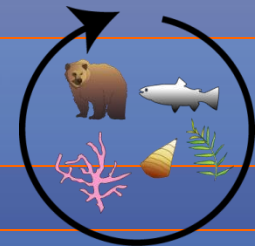


Lake Levels Distribution



Severe Weather

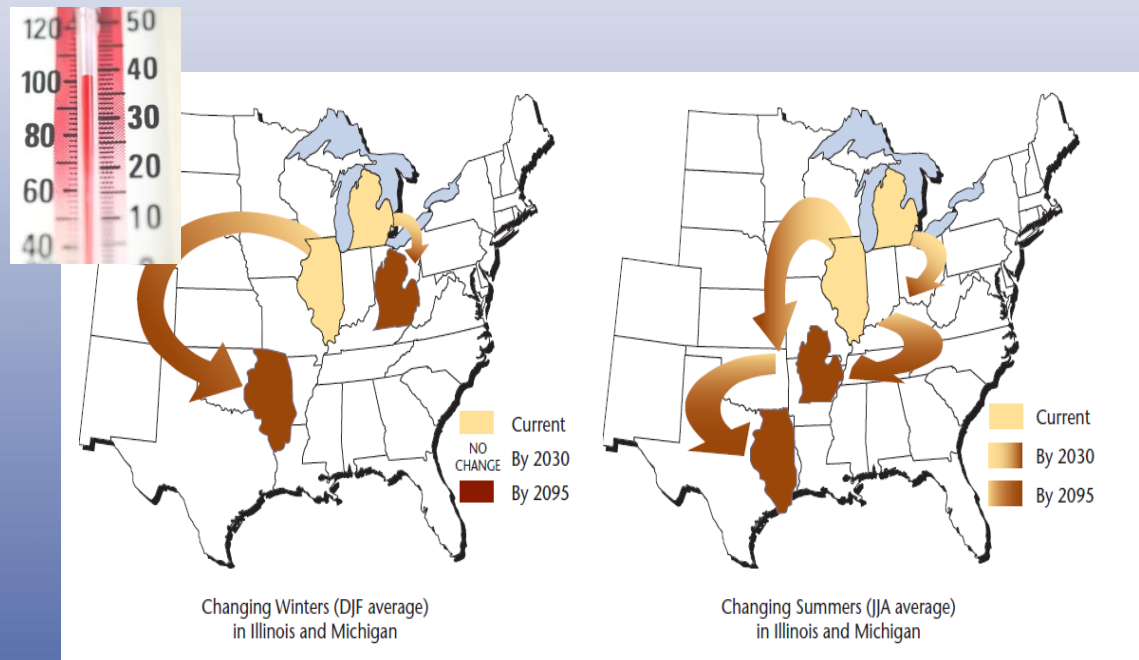
Ecosystem Changes



Human Health Concerns

Predicted Climate Change Impacts: Temperature Changes

- Increasing surface temperatures
- Less days with sub-zero lows
- More days with highs above 90°F
- More frequent heavy/extreme rainstorms



Great Lakes states (e.g., Illinois and Michigan) are likely to experience winter and summer seasons indicative of the Ohio Valley and Southern Plains by 2095.

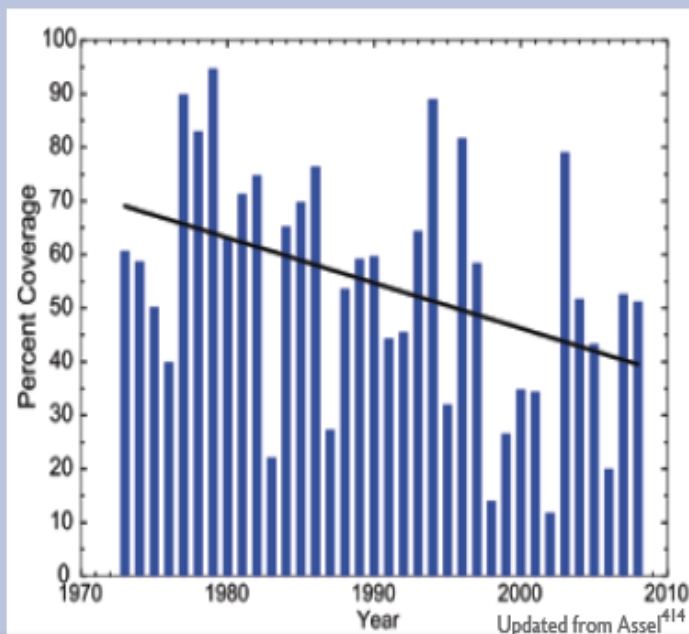
Predicted Climate Change Impacts: Melting Ice and Lower Lake Levels

Melting Ice



- Less ice cover

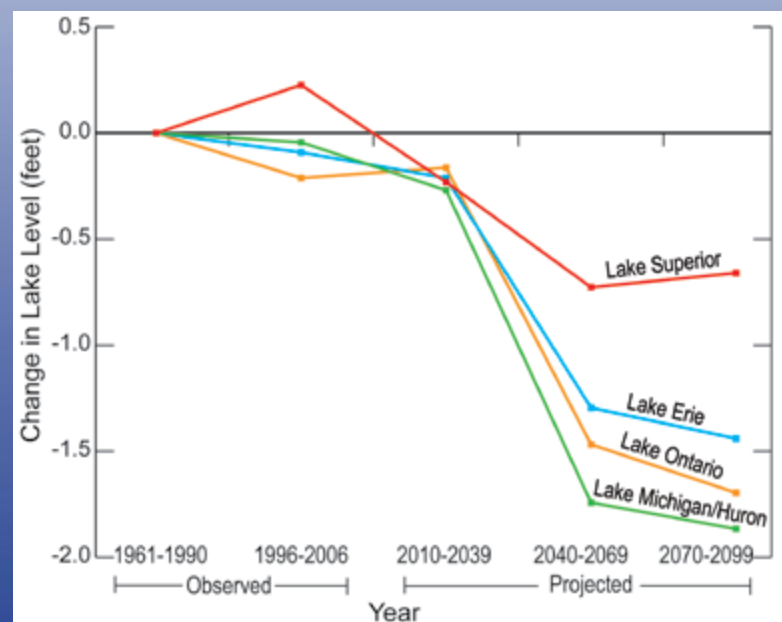
Observed Changes in Great Lakes Ice Cover
Seasonal Maximum Coverage, 1973 to 2008



Lake Levels



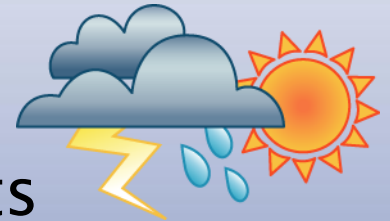
- Continued variability, but generally lower levels



Predicted Climate Change Impacts: Severe Weather, Ecosystems, and Health

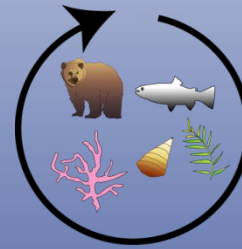
Severe Weather

- More frequent and severe flooding
- Threat of drought between rain events



Ecosystem Changes

- Shifts in the ranges of habitats and species



Human Health Concerns

- More frequent extreme heat waves
- Decreased water quality



What is an Adaptation Plan?

A climate change adaptation plan:

- Identifies and assesses impacts that are likely to affect the planning area.
- Develops goals and actions to minimize the impacts.
- Establishes a process to implement those actions.



Perennial Raingarden

Five Themes of Successful Planning

1. Build adaptive capacity
 - Change human systems
 - Change infrastructure

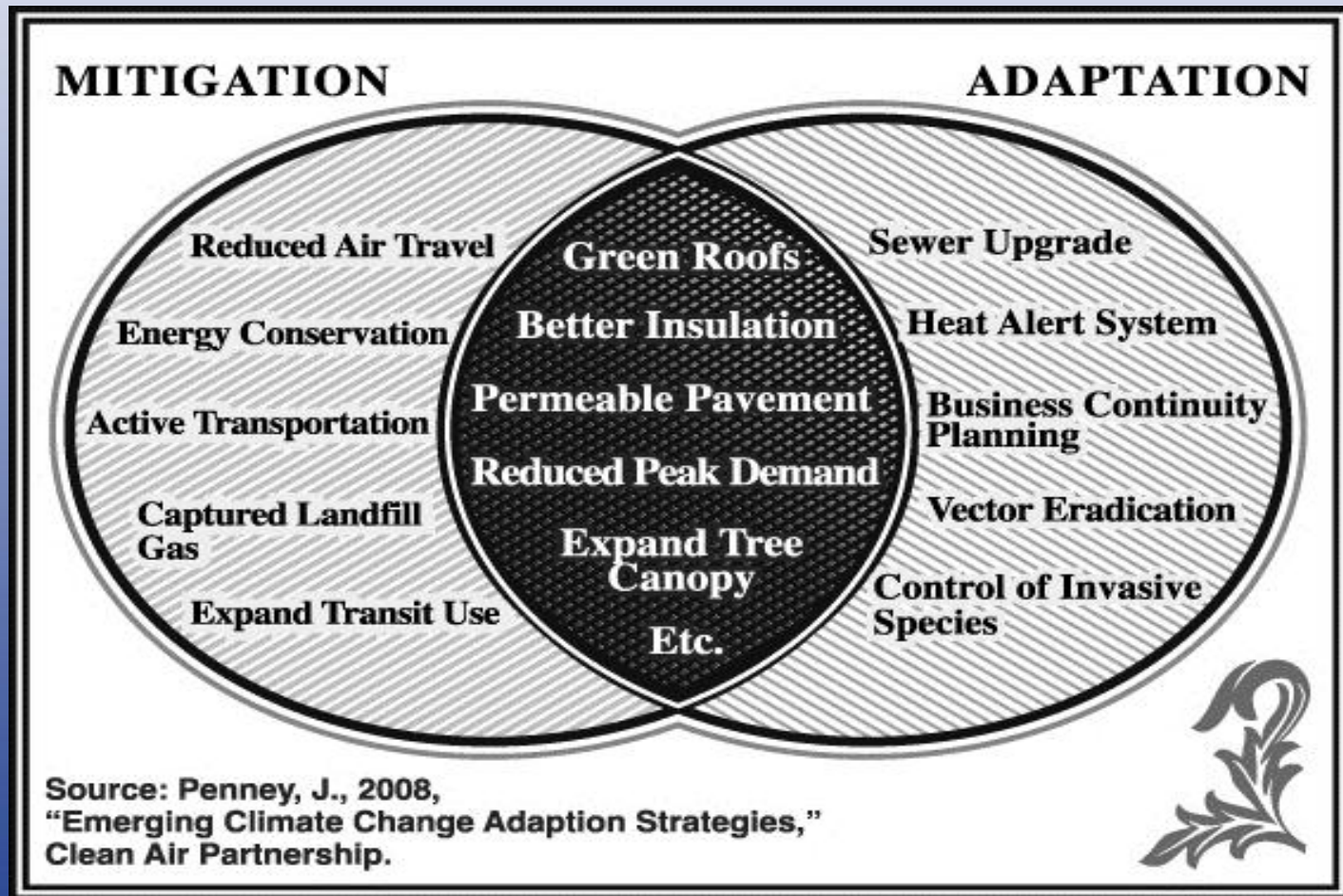


2. Embed climate-readiness in routine planning processes



Five Themes of Successful Planning

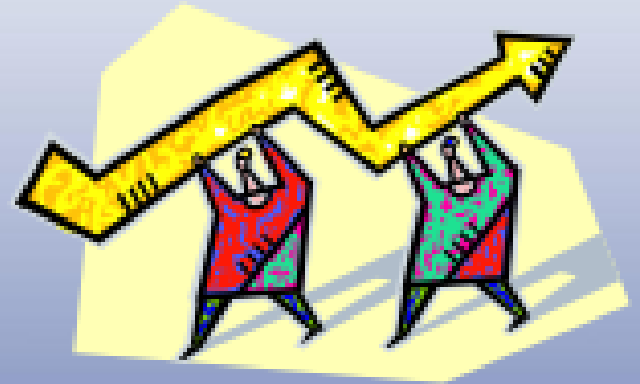
3. Look for win-win actions



Five Themes of Successful Planning

4. Take incremental steps

- Set up phased projects



5. Be aware and flexible

- Continually incorporate new data

Steps in a Planning Process

1. Establish the planning process

2. Assess vulnerability and opportunities

3. Create an adaptation strategy

4. Design a process for plan implementation and maintenance

Obtaining Community Participation

Convene stakeholders and present issue of climate change

- Discuss probable impacts
- Discuss potential challenges and opportunities

Key Theme: Anticipating instead of reacting (that is, readiness for greater fluctuations in environmental conditions)

Planning with Imperfect Information



Many decisions and city plans are based on uncertainty:

- Population growth
- Natural disasters
- Flood insurance
- Disease control

Managing Uncertainty



- Prepare for a range of extremes
- Prioritize ‘win-win’ and ‘no-regrets’ programs
- Use modeling to identify a range of future conditions
- Downscale

Developing a Community Vision Statement

- Develop a shared vision for the community
 - What should it be like in 20 years? In 50 years?
- Act instead of react (i.e., anticipating and preparing)



Will the Tulip-time Festival in Holland, MI, be earlier in the spring?

Assessing Needs and Responsibilities

In relation to the Community Vision:

- What needs to happen to achieve it?
- What community resources will be involved?
- What programs already exist?
- What new data is needed?
- Who will be responsible for implementation?

This information helps determine the resources for the planning process.

Designating a Planning Coordinator

1. Provides centralized communication
2. Organizes meetings
3. Collects and disseminates reports
4. Keeps track of participants



Selecting a Planning Team

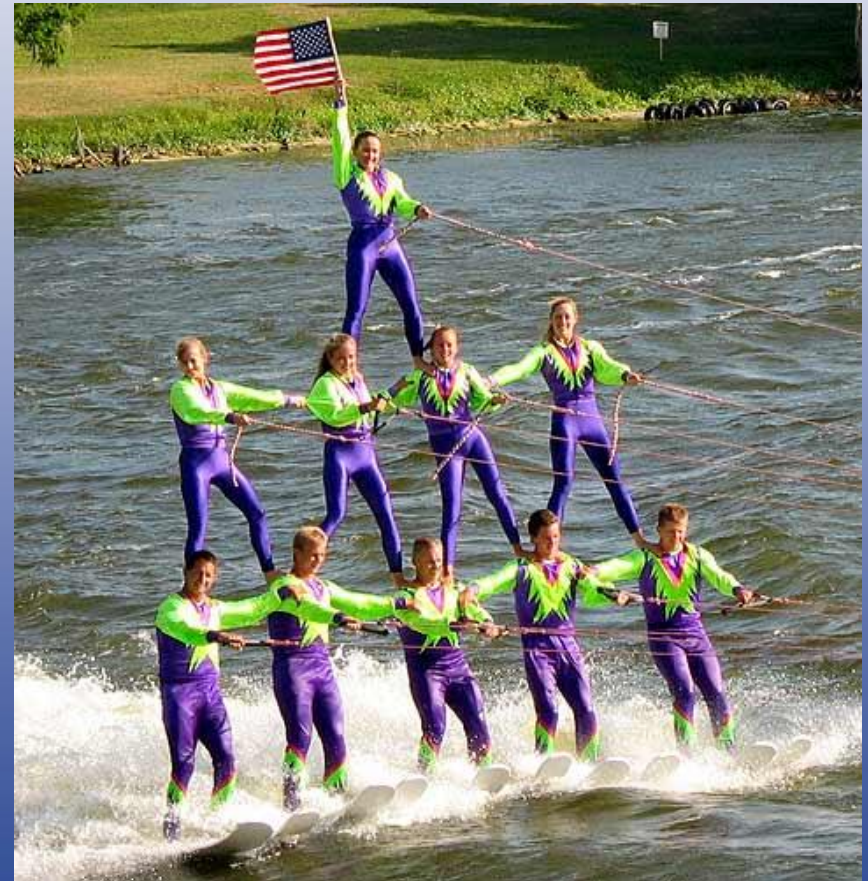
Create a planning team that can help with development and implementation.

Make sure to include stakeholders. For example, consider:

- Who will be affected by the plan?
- Who has technical data?

Adaptation Planning Benefits from Collaboration

- Linked agency efforts
- Effective solutions as a result of a range of actions by multiple groups
- Shared resources
- Resolving differing perspectives by participating in shared research



Questions to Guide Team Selection

- What entities are involved in activities that (1) might impact or stress coastal systems and/or (2) are managed by the coastal program?
- Who is engaged in climate change adaptation planning? In climate change mitigation?
- What other groups have investments or management responsibilities in the coastal zone?
- Who might be able to provide additional human or technical resources?

Educating the Planning Team

Provide information about predicted climate change impacts

- Foundation for assessing areas of vulnerability

Determine where research is needed

- Which departments need data and resources?
- What sources of information are available?

Deciding on the Planning Process

The team needs to decide:

- When, where, and how often will meetings be held?
- What topics will be researched and by whom?
- How will data be presented and who will have access to it?
- What communication methods will be used within the planning team, within working groups, across groups, and with the public?

Steps in a Planning Process

1. Establish the planning process

2. Assess vulnerability and opportunity

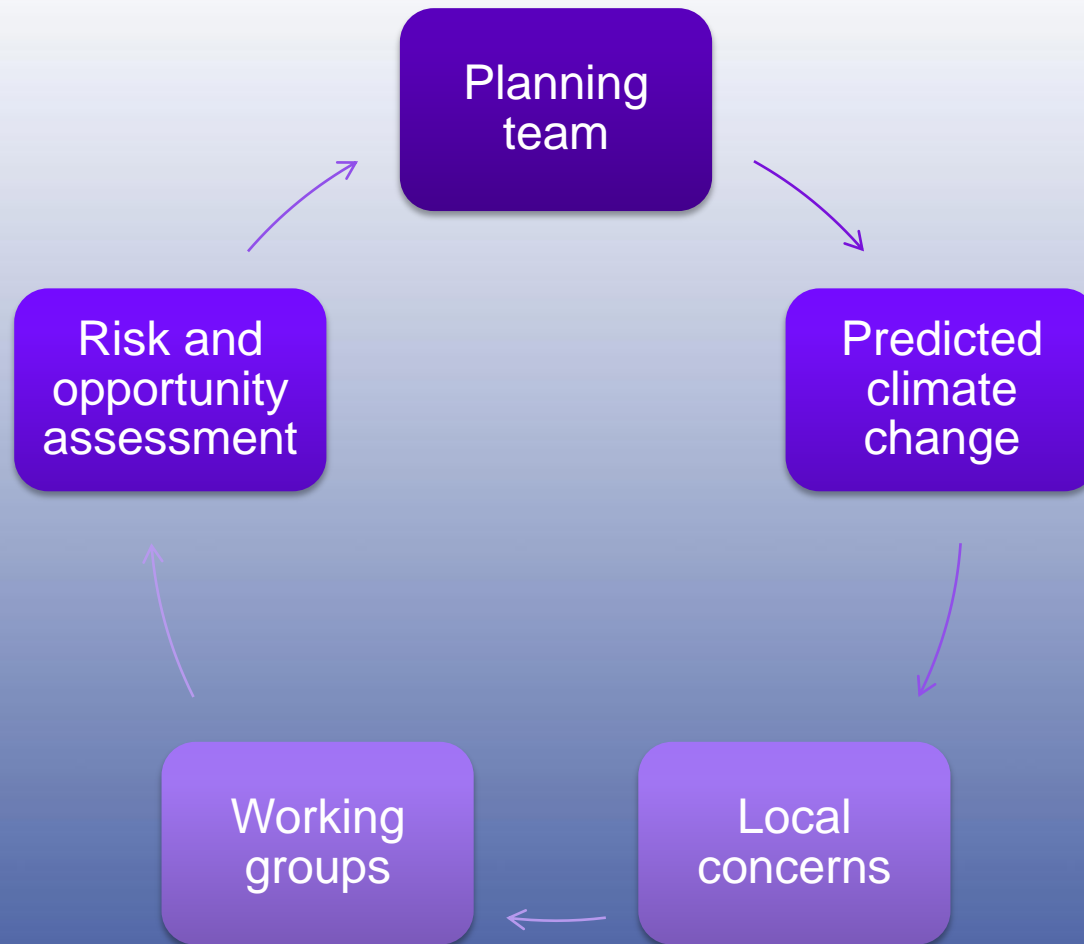
3. Create an adaptation strategy

4. Design a process for plan implementation and maintenance

Assess Vulnerabilities and Opportunities

- Consider areas of likely climate change impact
- Create working groups to assess local risks
- Organize working groups around topics linked with institutional resources (such as Water Management, Health, and Natural Areas)

This allows assessment of (1) risks to existing systems and (2) agency resources for adapting to climate impacts.



Working Groups Assess Local Situation

1. Identify climate change impacts and consequences
2. Assess physical characteristics and exposure
3. Consider adaptive capacities
4. Develop scenarios and simulate change
5. Summarize vulnerability and identify focus areas

Data Collection and Risk Assessment

Research the likely impacts of climate change on the community, then use that data to create a risk assessment.

Risk is a combination of:

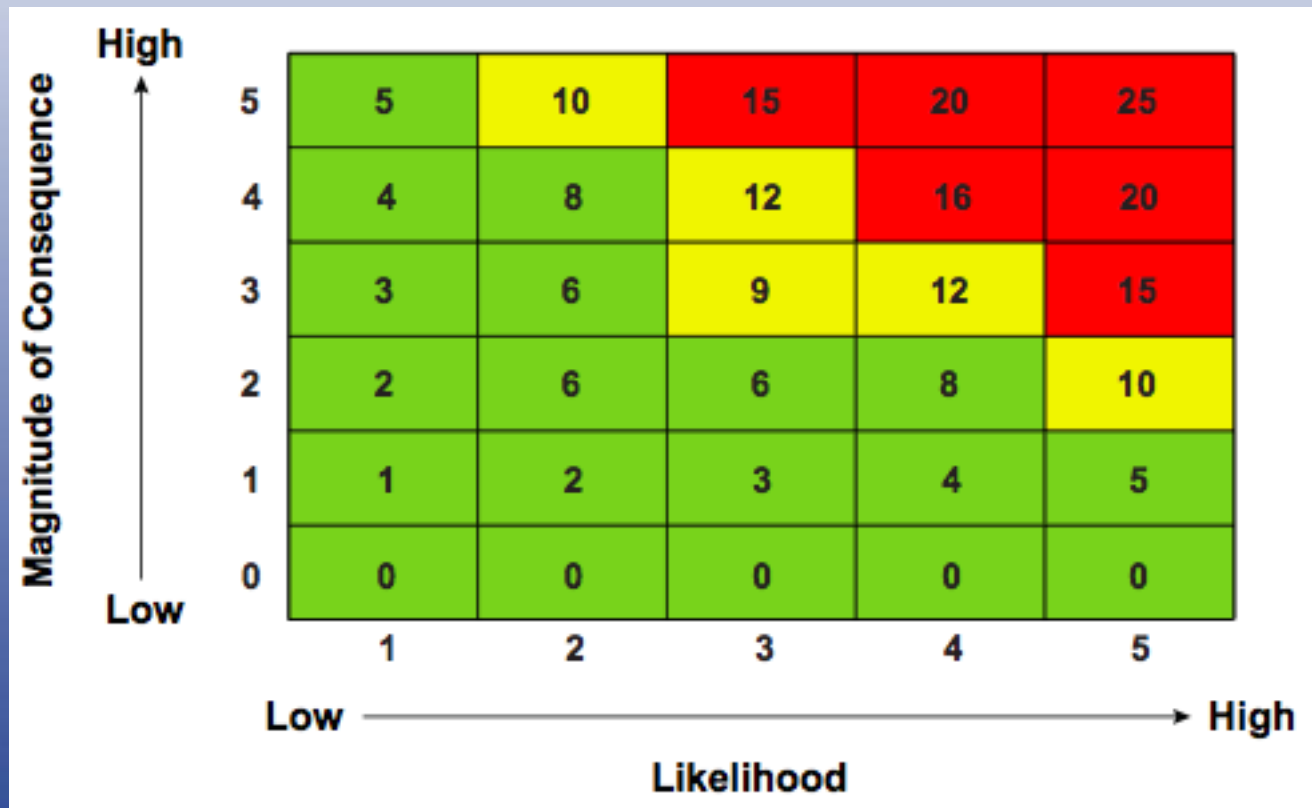
1. Likelihood of an event occurring
2. Level of consequence (or magnitude of impact) if the event occurs

Assess Exposure

- Risk assessment requires data about the level of exposure to climate impacts for community
 - People
 - Infrastructure
 - Natural resources
 - Cultural resources
 - Economic resources
- Calculating the levels requires expertise

Likelihood and Magnitude of Consequence

Rated on a numerical scale (1-5); 5 is the highest likelihood.



Prioritization

To calculate priorities consider:

1. How many municipal activities would be affected by each risk?
2. How soon are the impacts likely to be realized?

Sample of Chicago's Prioritization

Table 3.1 (cont)

Impact	Risk	Timing **	Construction, Buildings & Property	Tourism	Environment	Fire	Fleet Management	Housing	Human Services	Emergency Management	Police	Public Health	Streets and Sanitation	Transportation	Water Management	Parks and Open Space	Storm Water Management
Increase in heat related deaths	High	Now	x	x		x		x	x	x	x	x		x		x	
Increase in heat related hospitalization	High	Now				x			x	x	x	x					
Increase in health impacts due to "water-in-basement" incidents	High	Near	x			x				x		x	x		x		

Summarize Vulnerability and Identify Focus Areas

The vulnerability summary guides the adaptation plan by:

- Telling where to focus efforts
- Identifying what goals to set
- Determining which actions to select

Public Feedback on Risk Assessment

Public discussion of the assessment is important because:

- Issues may have been overlooked
- People may disagree about the priorities or want to help determine the priorities
- Private sector programs may offer opportunities for partnership in implementing adaptation plans

Steps in a Planning Process

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Create an Adaptation Strategy

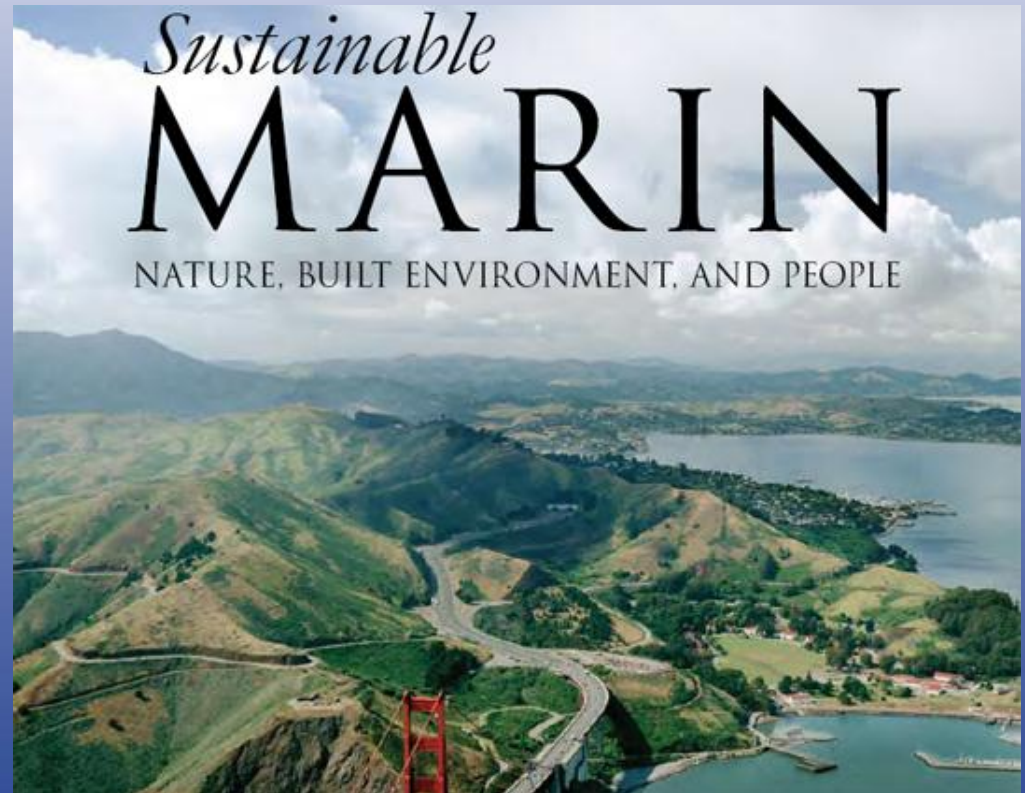
1. Set goals
2. Identify actions
3. Evaluate, select, and prioritize actions
4. Write action plans



Countywide Sustainability Plan

Creative Solution: Incorporating sustainability into the existing county planning cycle

- Planning budget
- Staff resources
- Grants from:
 - utilities
 - FEMA
 - state
- Permitting fees



Incorporate Existing Research

- Chicago Climate Action Plan
- Wisconsin's WICCI research
- NOAA's *Adapting to Climate Change: A Planning Guide for State Coastal Managers*



- The Nature Conservancy

Cost Benefit Analysis Example

Green Bay Municipal Sewer District

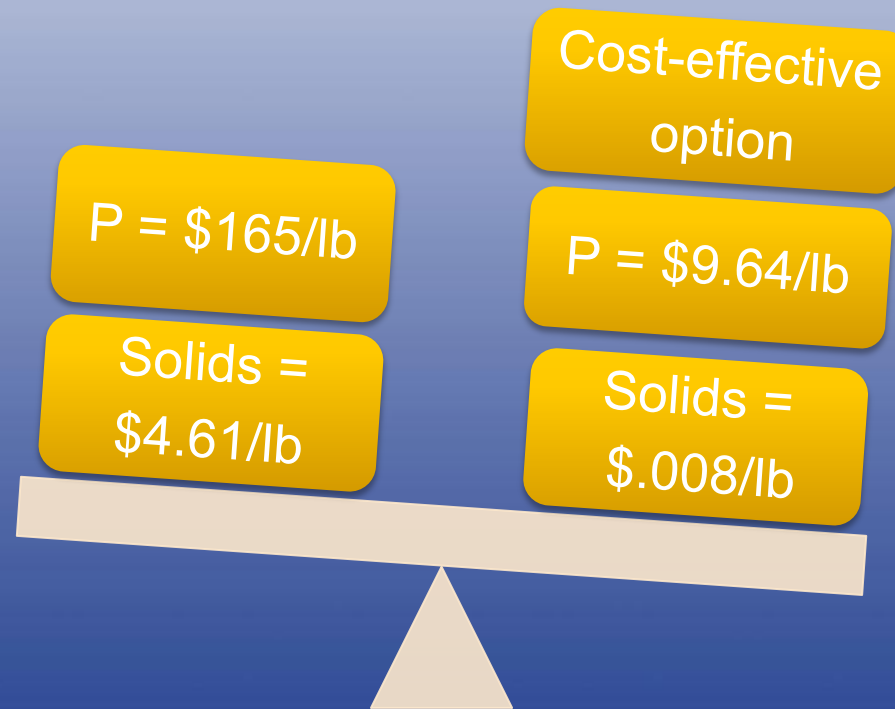
- **Goal:** reduce water pollution
- **Issue:** phosphorus and suspended solids



Green Bay Municipal Sewer District

Treat at plant

Control
upstream



Steps in a Planning Process

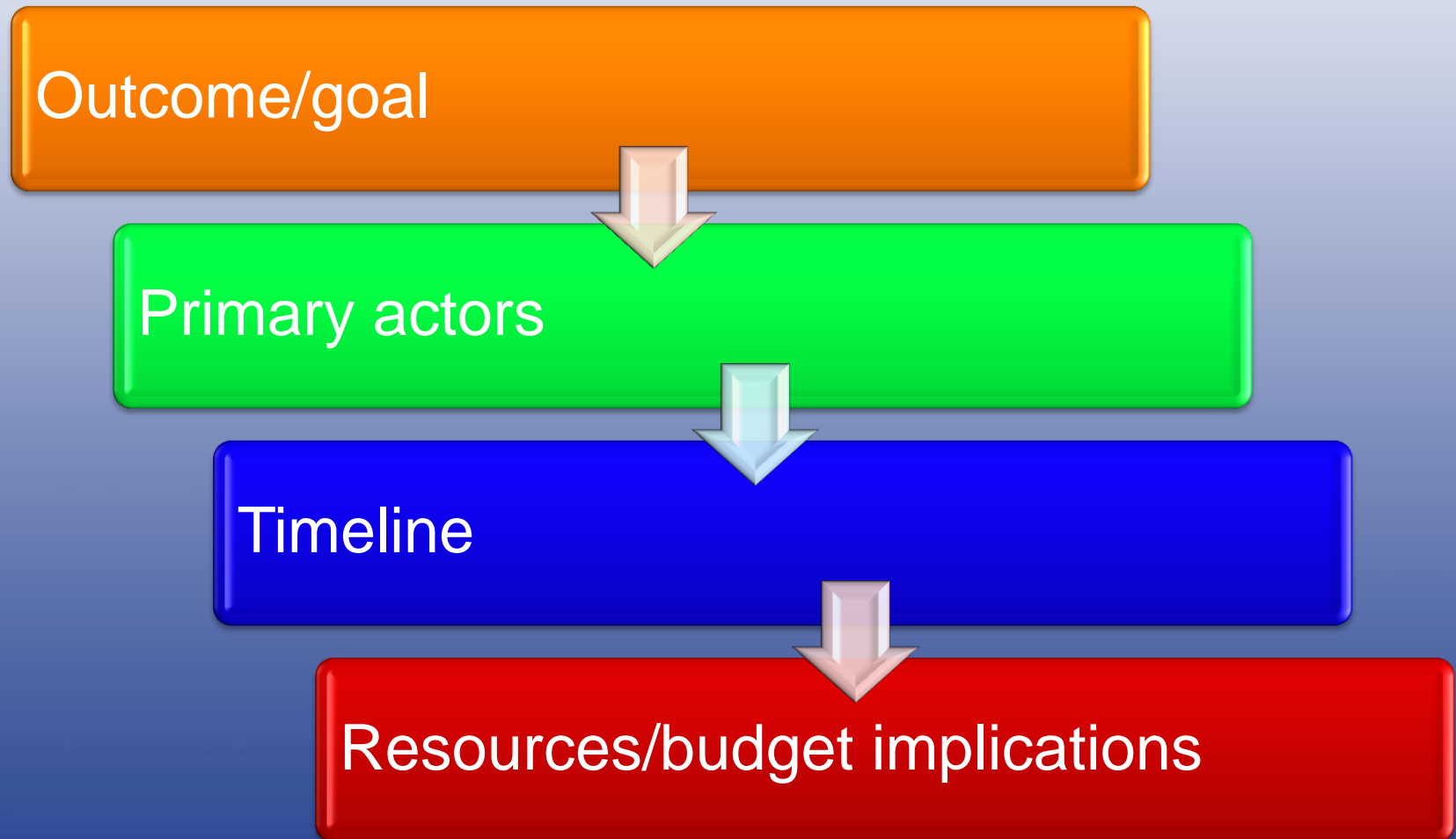
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Implementation in Brief



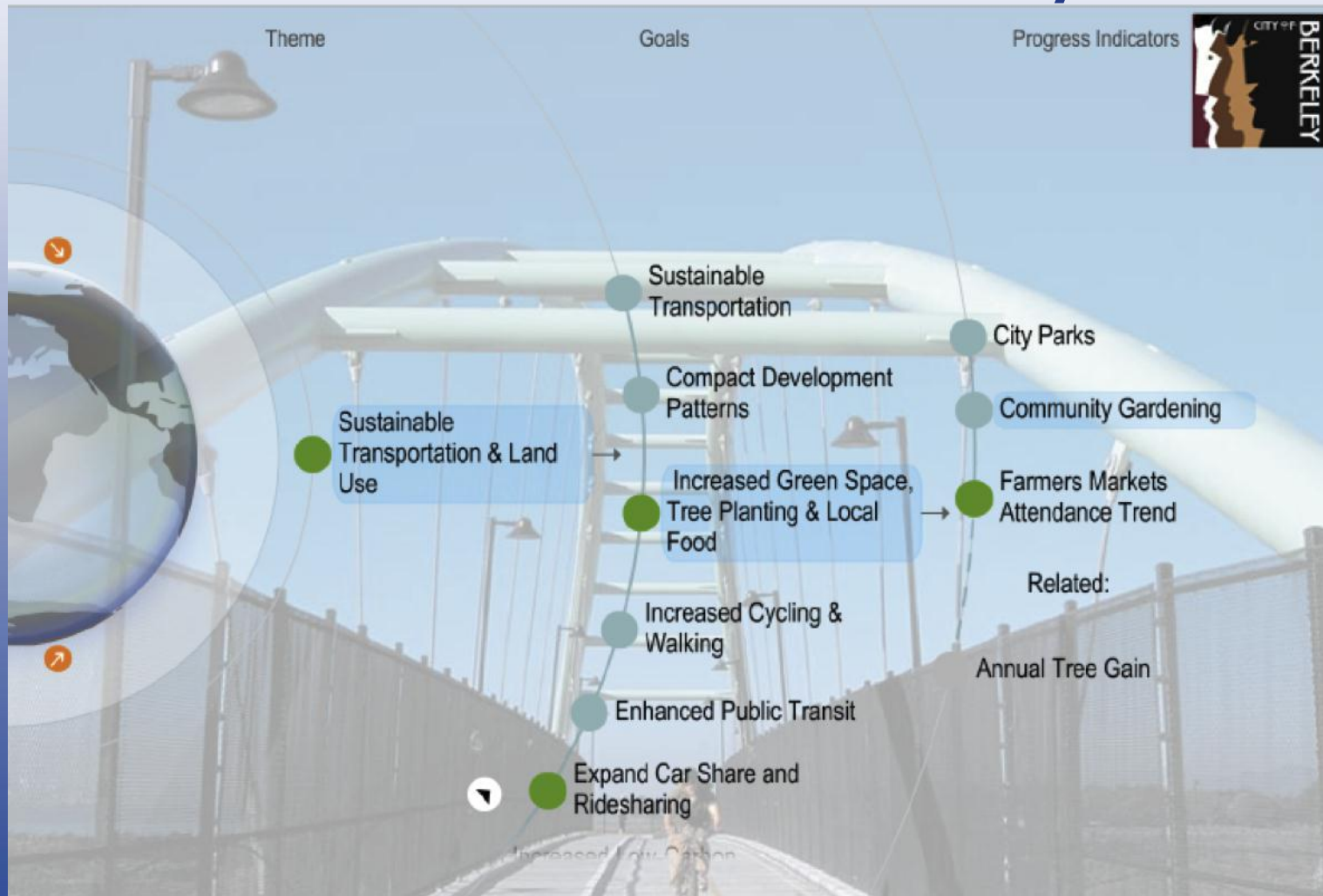
Benchmarking

Setting benchmarks helps determine if a project is on track and it allows for:

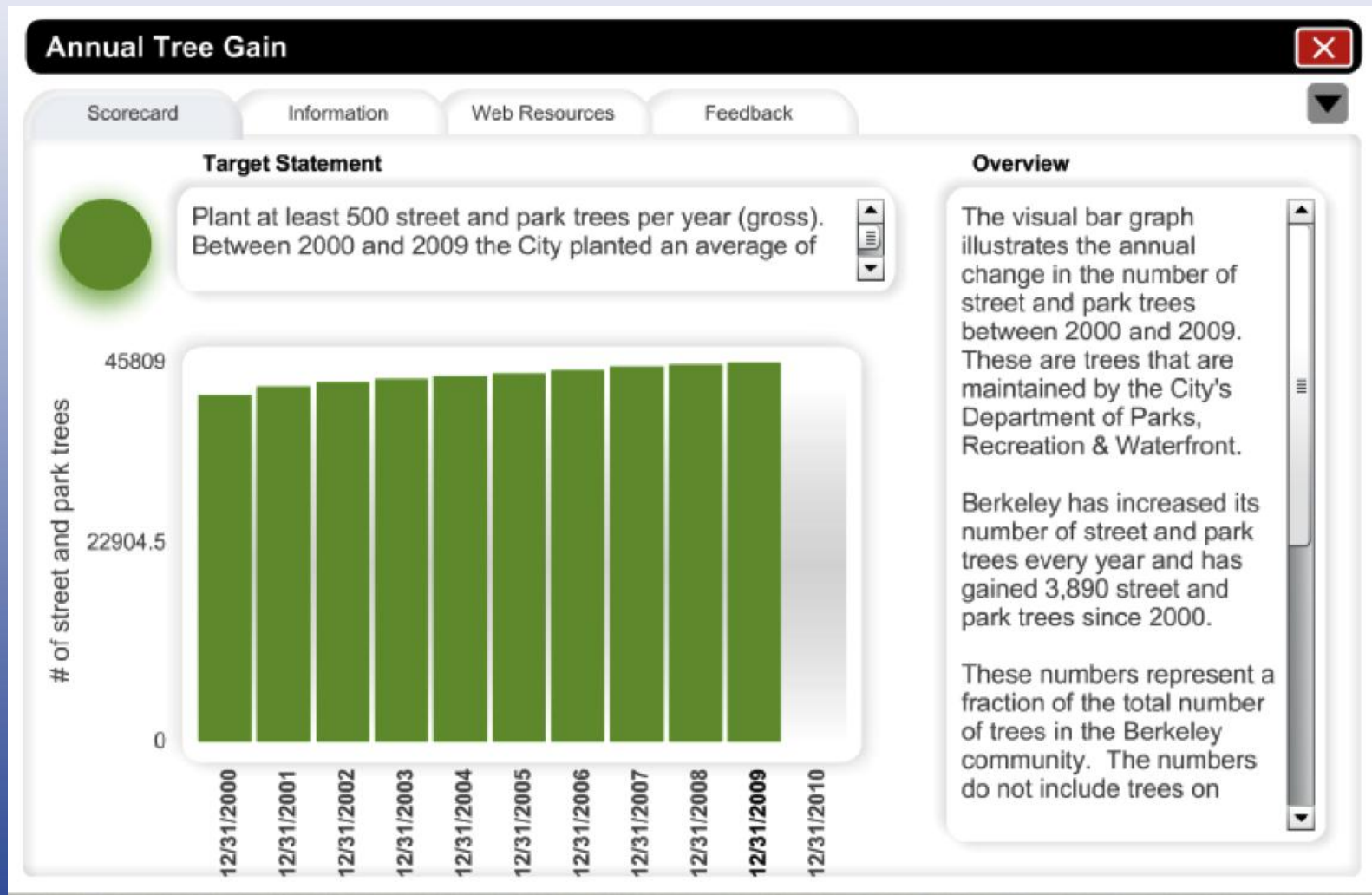
- Detection of problems early in the process
- Recognition of successes
- Analysis of practices for future applications



See-it Website (Berkeley, CA)



Charting Progress of Tree Planting



Update the Adaptation Plan

Plans need continuous updating to incorporate:

- Uncertainty in predictions
- New science
- Reaction to successes/problems with current efforts
- New government policies and priorities
- Changes in funding resources

Summary of Planning Process

Stages:

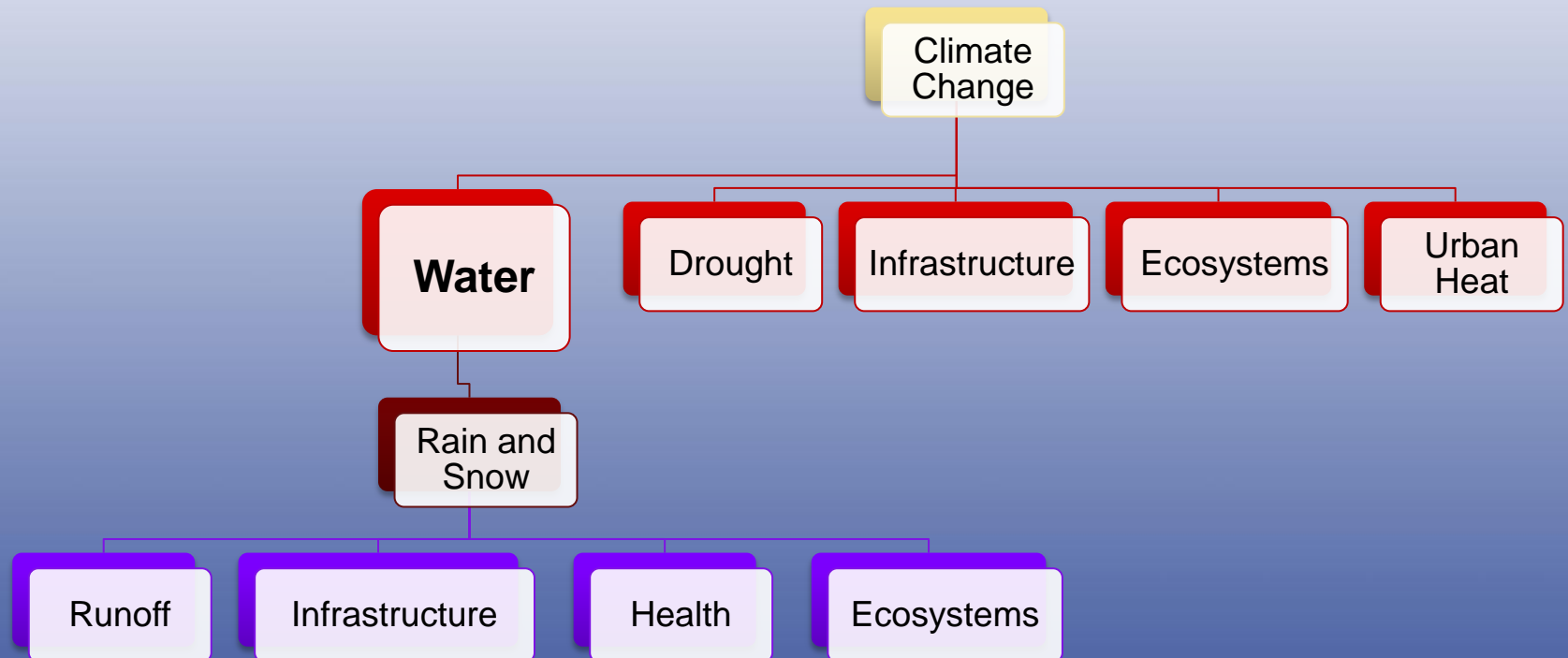
1. Establish process
2. Assess vulnerability
3. Select strategies
4. Implementation

Themes: Anticipation, flexibility, and connecting to existing programs

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Part 2: Strategies for Adaptation

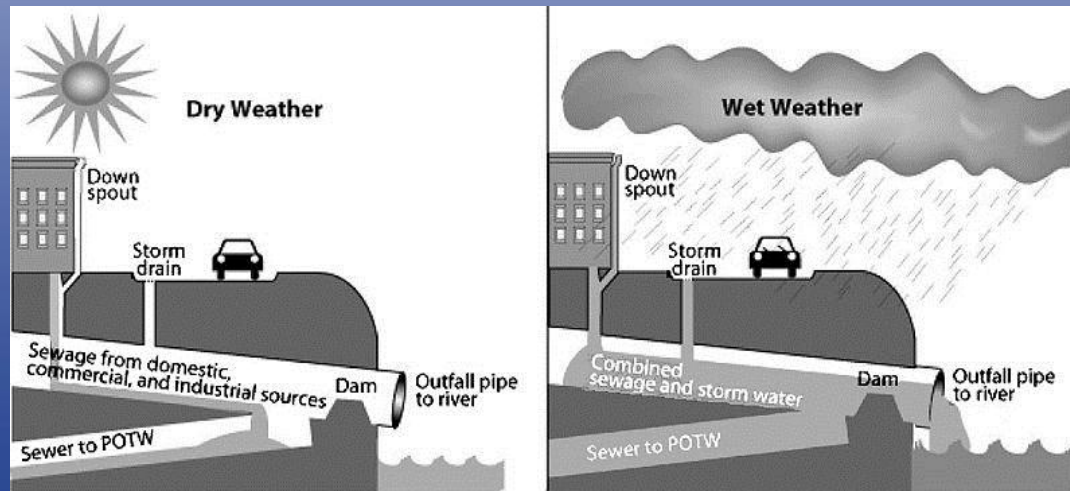
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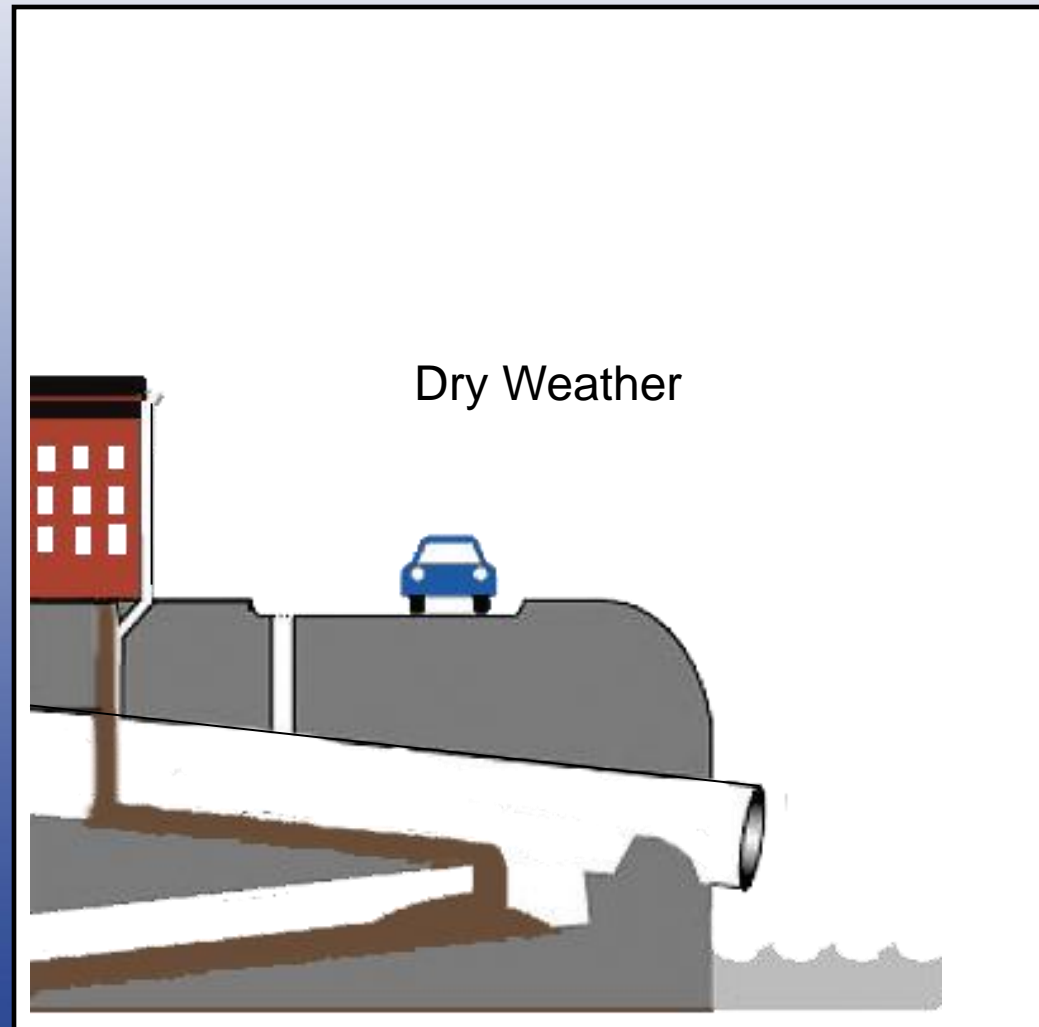
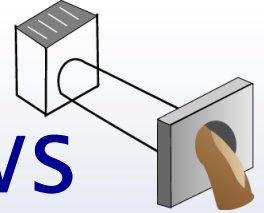
Climate Impacts on Drainage Systems

Increased frequency and intensity of precipitation events, may

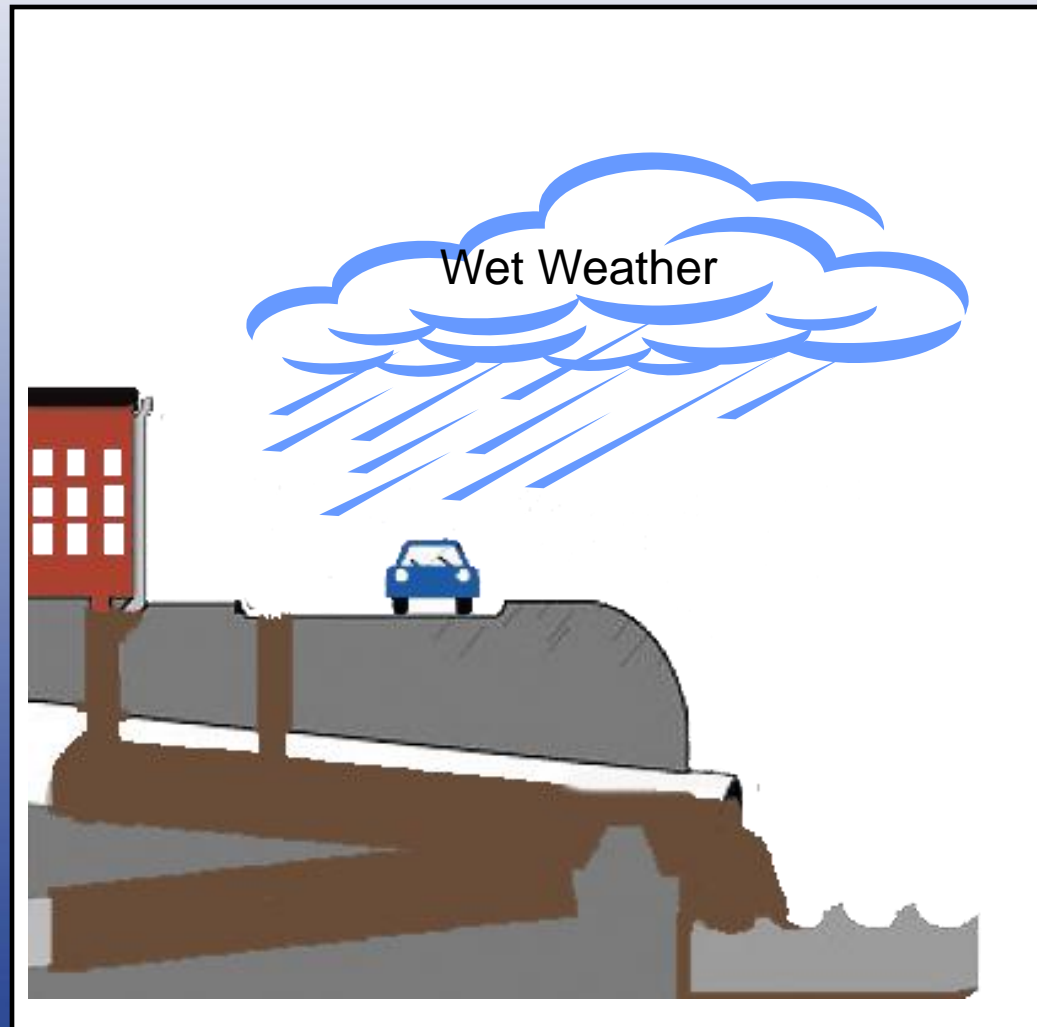
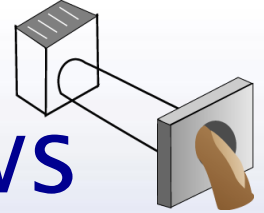
- Overload drainage systems and water treatment facilities
- Exacerbate existing problems with combined sewer overflows (CSOs)



Combined Sewer Overflows

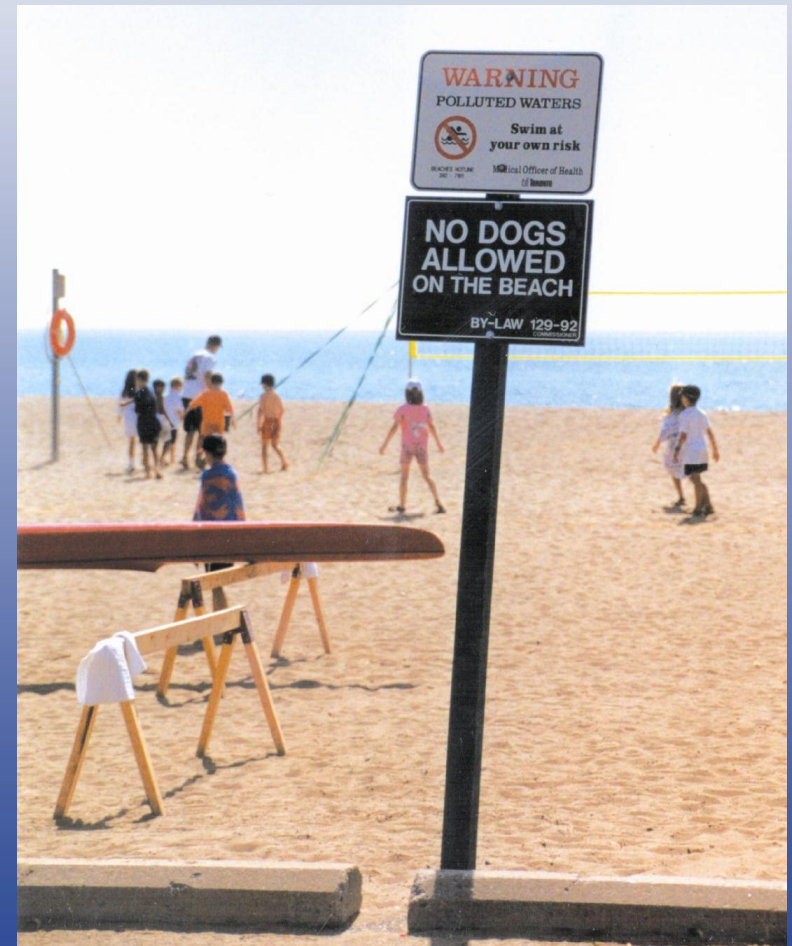


Combined Sewer Overflows



Effects of CSOs

- Poor water quality
- Beach closures
- Risks to human health



Strategies to Manage CSOs

- Separate stormwater conveyance system from wastewater conveyance system \$\$\$
- Build a CSO storage facility \$\$
- Install retention treatment basins \$\$
- Build a screening and disinfection facility \$\$
- Reduce amount of stormwater runoff through stormwater control measures \$

Stormwater Control Measures (SCMs)/ Green Infrastructure

SCMs can

- Reduce runoff volume and peak flows
- Remove pollutants
- Be either structural or non-structural



Structural SCMs

Measures to reduce runoff volume through structural SCMs include:

- Bioswales
- Wet/dry ponds (also called detention basins)
- Stormwater wetlands
- Erosion and sediment control
- Green roofs
- Pervious pavement



Non-structural SCMs

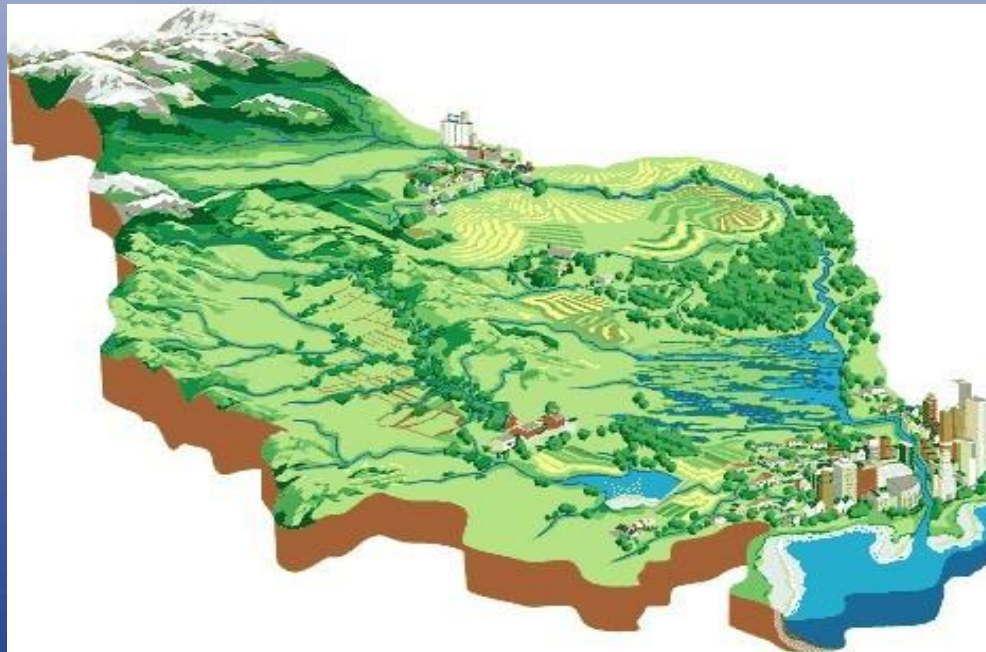
Measures to reduce runoff volume through non-structural SCMs include:

- Earthwork minimization
- Watershed and land-use planning
- Conservation of natural areas
- Reforestation and soil conservation
- Impervious cover minimization



SCM Implementation

- Best managed on a regional or watershed scale
- Designed as an integrated system of structural and non-structural SCMs and incorporating watershed goals



Flood Prevention: Floodplain Management and Erosion Control

- Re-evaluate existing regulations governing floodplain and stormwater management and erosion control
- Evaluate risks to infrastructure
- Evaluate risks to community well-being



Fair weather condition



Water quality capture volume



100-year storm event

Floodplain in Menomonee Valley, Wisconsin

140-acres: old rail yards are now park areas

Structural Flood Prevention

Traditional approach to flood prevention:

- Levees
- Drainage channels
- Combined sewer and storm drain



Non-Structural Flood Prevention



Non-Structural Flood Prevention

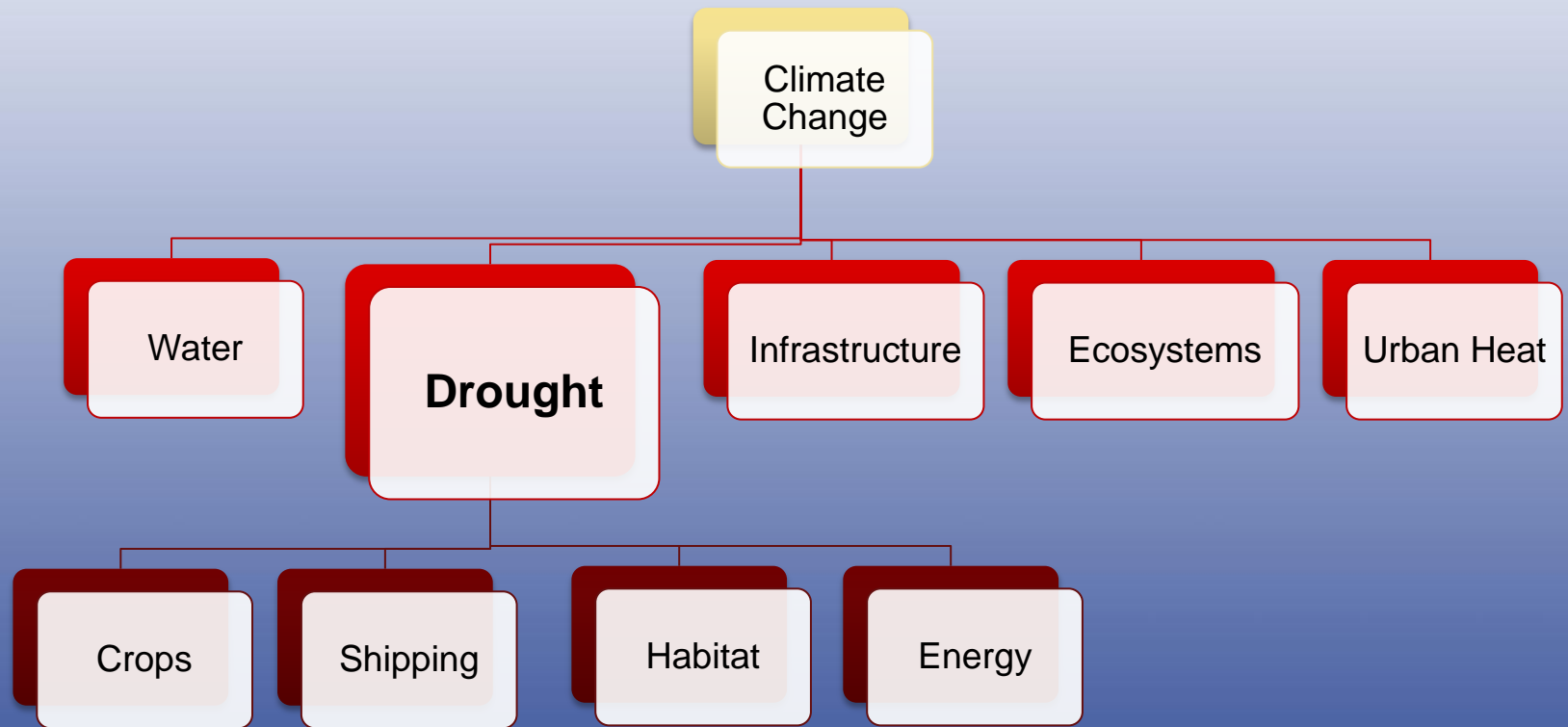
- Relocating vulnerable populations and structures
- Using natural systems to direct or divert floodwaters
- Planning measures to direct growth to less vulnerable areas
- Conservation easements



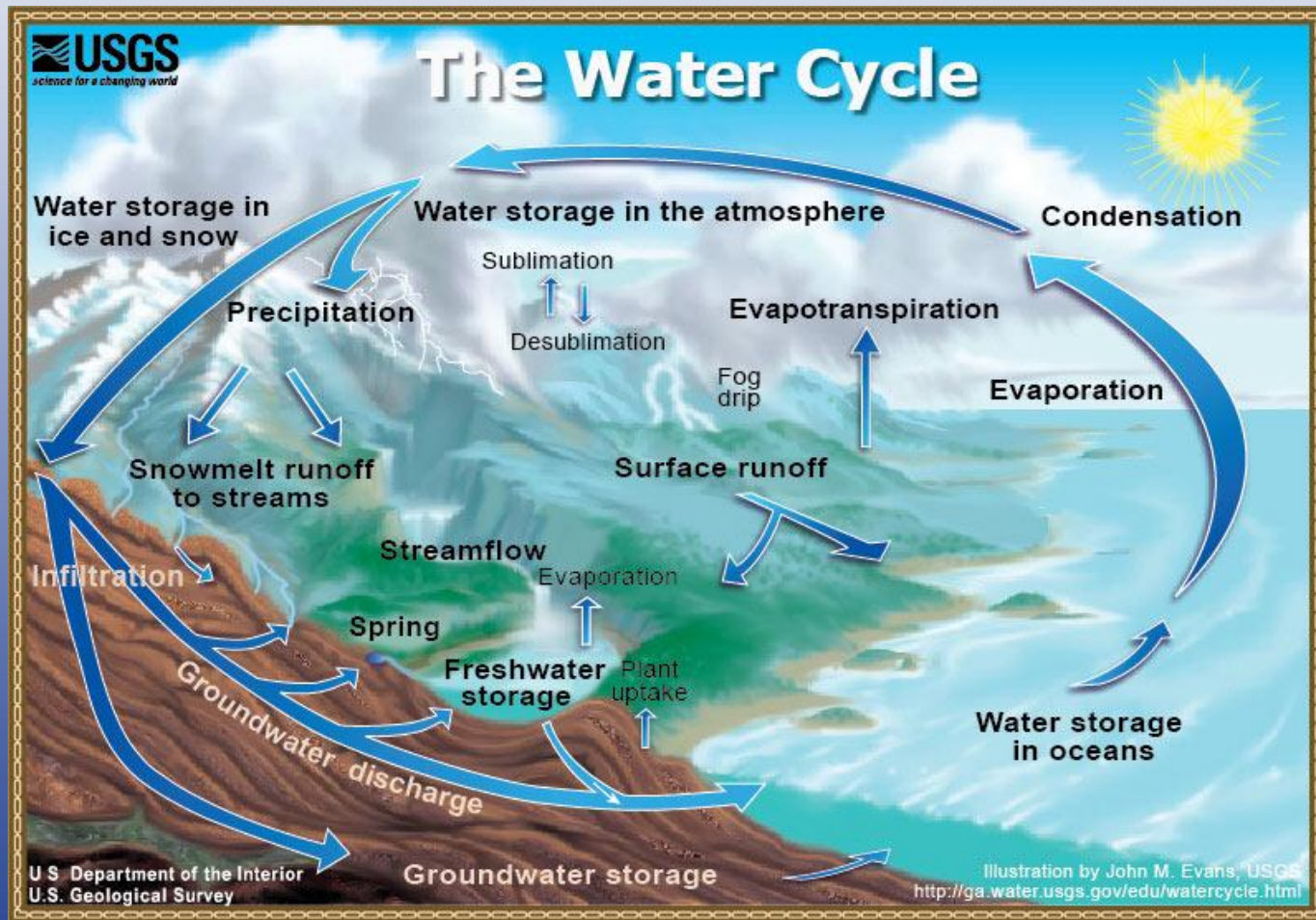
Water Management Summary

- Climate change → Increase in heavy precipitation events
- Green infrastructure (structural SCMs)
 - Manage water flow
 - Improve water quality
 - Reduce flood hazard
- Regulations and development

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Drought: Lack of Precipitation Disrupts Hydrological Cycles



1988: Great Lakes Region Drought

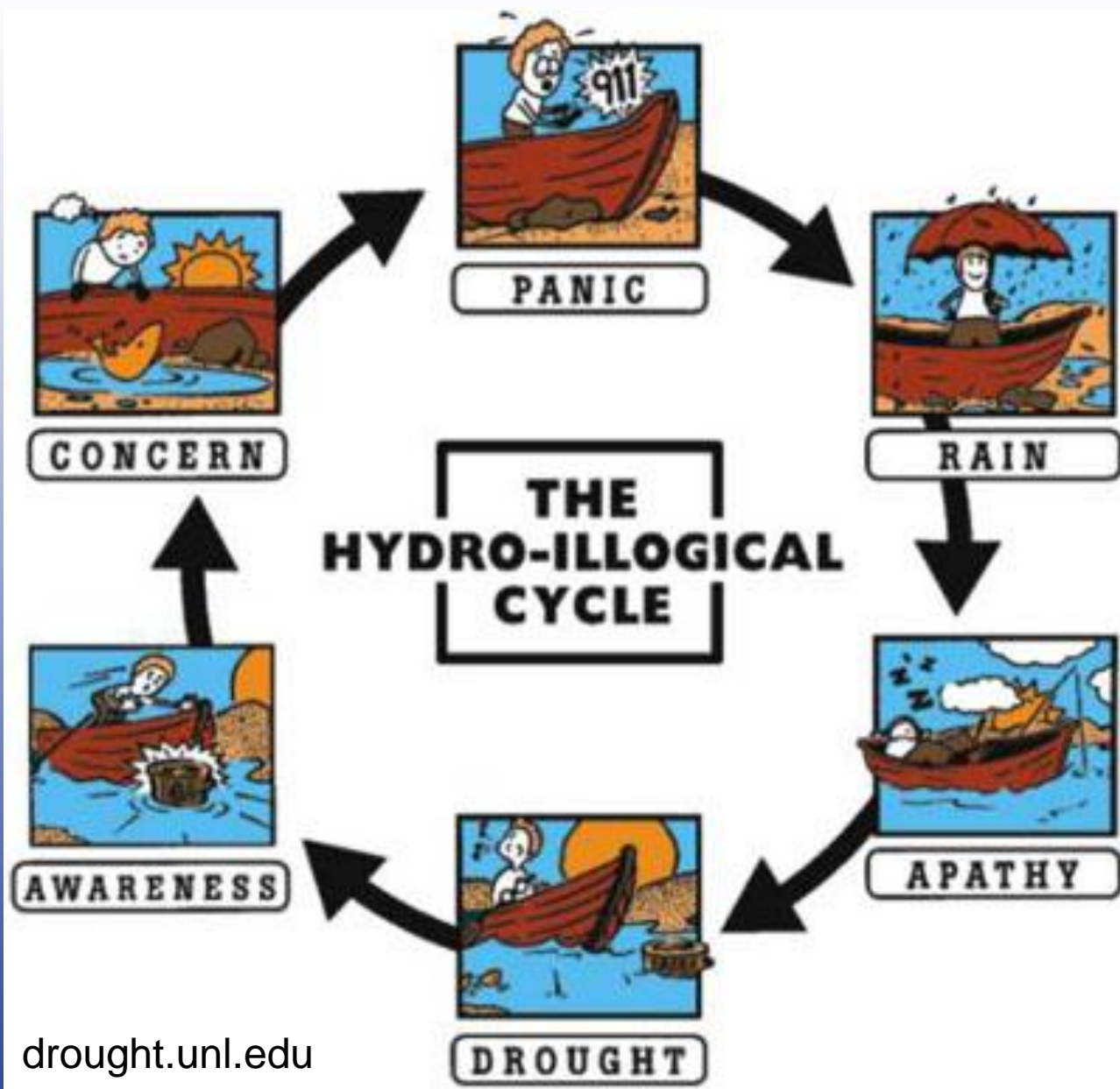
Timing of precipitation led to drought

- Below-average snowfall (winter 1987–88)
 - Light spring runoff
 - Reduced groundwater recharge
- Below-average precipitation for first part of the year (driest period in March–July)
- Unusually hot May–June

Effects of 1988 Drought

- Crop production dropped 29–49%
 - Corn, soy, sorghum, wheat, oats, and barley
- Shipping bottlenecks and load reductions
- Groundwater pumping restrictions
- Water conflicts spiked
- Energy production reduced





drought.unl.edu

Areas of Impact

- Crops and irrigation withdrawal
- Energy (cooling of plants)
- Shipping: harbors and channels
- Concentration of pollutants
- Water-use conflicts



Drought Plans = Contingency Plans

- Criteria trigger phase in/out of actions
- Structures for information flow
- Mechanism to assess impact on economy and environment
- Mechanism for equitable water allocation
- Plan to increase conservation

Set Up Contingencies

- Establish levels of drought and related response
- Monitor conditions: NOAA provides regular data on weather and water levels in the Great Lakes basin



Indiana State Drought Plan

Stages determine actions:

1. Watch: Voluntary conservation
 - watering, car washing
2. Warning: Voluntary reductions
 - irrigation of yards, golf courses
 - industry use of recycled water
3. Emergency: Eliminate non-essential water use

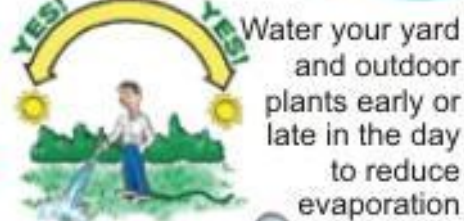
Conservation Measures

- Efficiency
 - plumbing fixtures
 - leak detection: UFF (unaccounted-for flow)
- Pricing systems
 - Charge more for higher water use

These reduce demand quickly and impose low costs on government.

Play your part, be water smart!

Wise Water Use



Get an Energy Star labeled washing machine. Wash only full loads.



Put faucet aerators on sink faucets.



Install new toilets that use less than 1.6 gallons per flush.



Use plants that require less water.



Turn off the water while soaping hands and brushing teeth.



Turn off sink faucet while scrubbing dishes and pots.



Use low flow showerhead.

Use a shut-off nozzle on your hose.



Mulch around plants to hold water in the soil.



Use a broom, not a hose, to clean driveways and walkways.

Save it, or do without it!

Side Benefits of Conservation

Realize benefits even without drought:

- Reduced water and sewer bills
- Postpone/eliminate need for new supplies
- Higher streamflow for fish and wildlife habitat
- Improved water quality
- More water for agriculture, power generation, transportation, and recreation

Case Study: Quakertown, PA

Problem with wells in 1980

- Passed conservation ordinance in 1981
- Requires efficient fixtures in all new construction and remodels



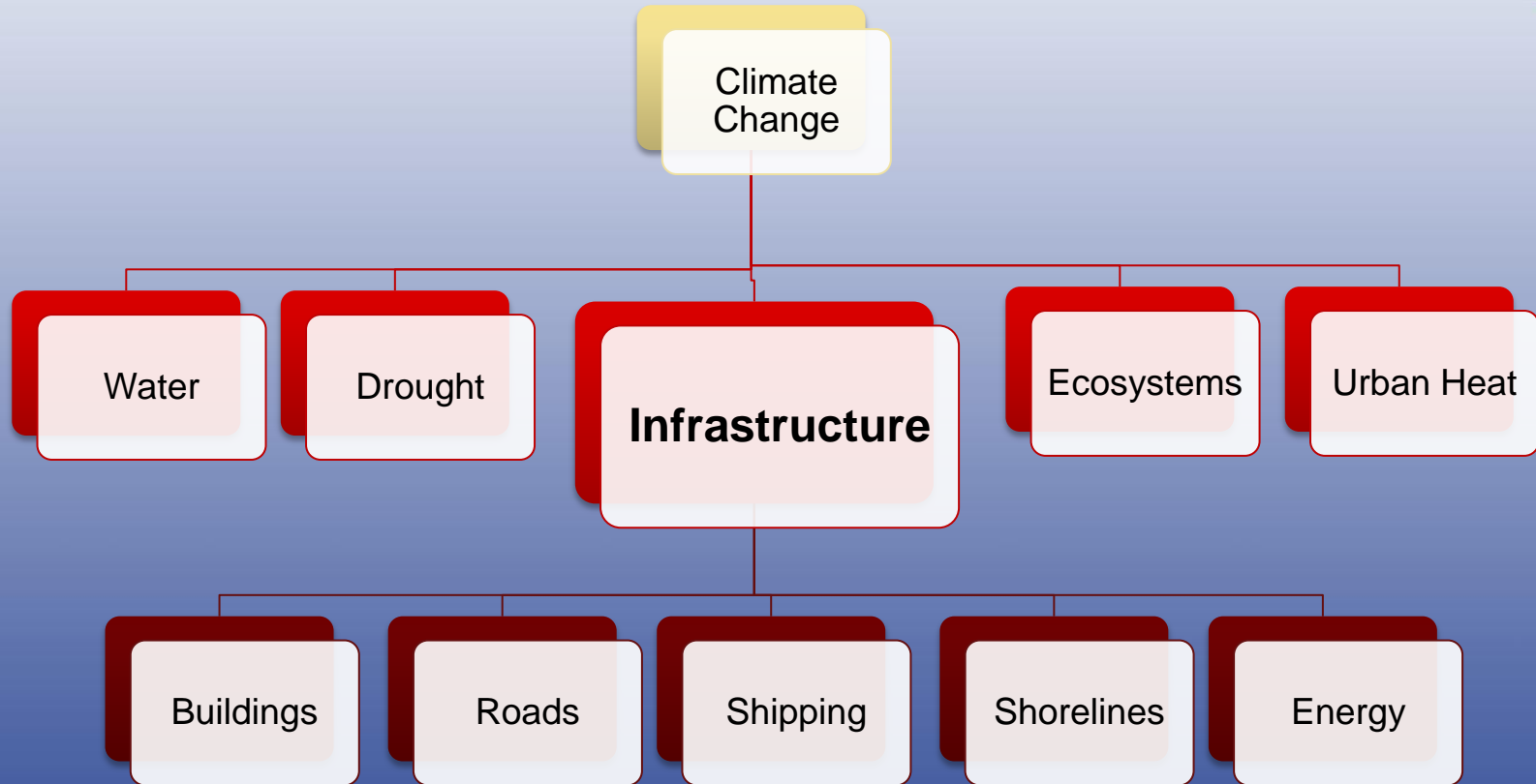
Photo from Quakertown Water Dept webpage

Drought Planning Summary

- Climate change → increased variability
- Contingency plans
- Conservation



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Infrastructure

Buildings, roads, shipping channels, shoreline conditions, energy supplies and usage may all be affected by climate change:

- Stress on power grid during hotter summers
- Damage to infrastructure from extreme weather events
- Increased potential for erosion



General Infrastructure Strategies

- Manage power vulnerability
Better ventilation, reduced energy use, switch to renewable energy sources, distribute current energy sources to improve resiliency of existing system
- Manage fleet vulnerability with different purchases and maintenance schedules
- Include climate change in new development and renovation planning
- Set appropriate codes and standards

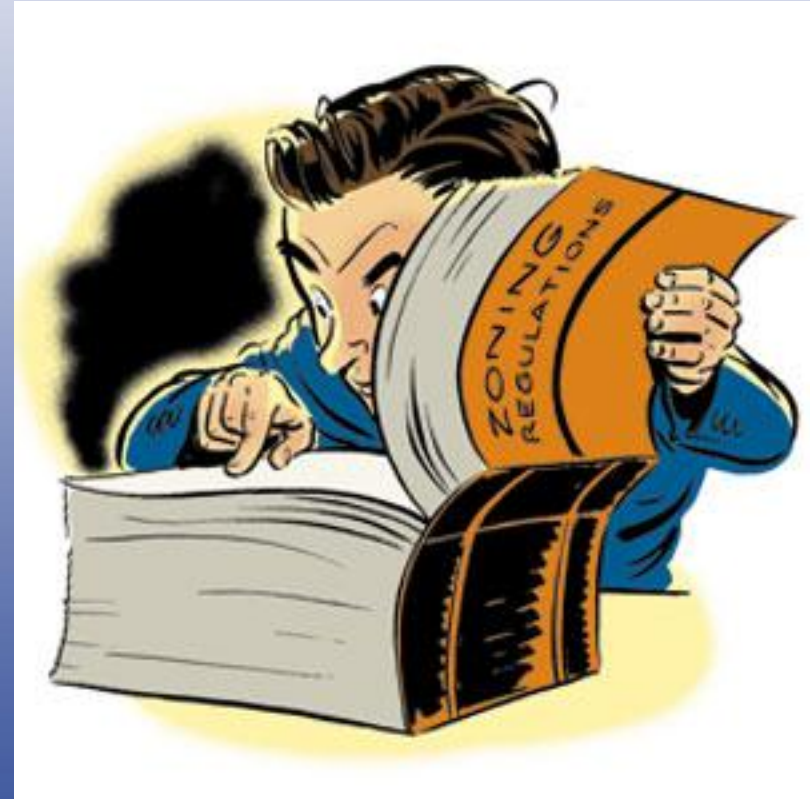
Building Codes Shape Development

Zoning is an important regulatory tool which can:

- Minimize impervious surfaces
- Increase mixed land use to shorten vehicle trips
- Require landscaping, mature tree preservation, and open spaces

Shoreline Infrastructure: Zoning

- Prevent development in expanded shore areas
- Regulate parcel use
- Determine setbacks
- Specify type of construction (e.g., easily movable)
- Require shore protection structures



Wisconsin's Coastal Zoning

Wisconsin's Shoreland Management Program sets minimum standards for all counties to:

- Further safe and healthy conditions
- Prevent and control water pollution
- Protect spawning grounds, fish, and aquatic life
- Control building sites, placement of structures, and land uses
- Preserve shore cover and natural beauty

Ports

- Revise loading/unloading policies for fluctuations in lake levels
- Monitor draft depths
- Determine dredging needs



Marinas

- Floating docks: adapt to lake-level flux
- Clean marinas: protect ecosystems



Promoting Environmentally Sound Marina and Boating Best Practices

Shoreline Management

Living shorelines use stabilization techniques:



- Vegetative plantings
- Sand fill
- Hybrid approach of vegetative planting with low rock sills
- Shore protection structures

Shoreline Management

- Beach nourishment (placing sand on an eroding beach)
- Dune management



Sediment Management

Sediment helps protect shoreline ecosystem and infrastructure.

Manage by:

- Dredging and placing sediment
- Building protective structures that trap or divert sediment
- Mining



Transportation: Roads



- Review flood hazards related to roads
 - Install warning signs and barriers
- Review evacuation routes
 - Revise plowing guidelines
 - Add emergency routes
- Revise weight limits for winter road use

Energy

- Revise supply schedules
- Extend water intake pipes
- Shift power usage to off-peak hours

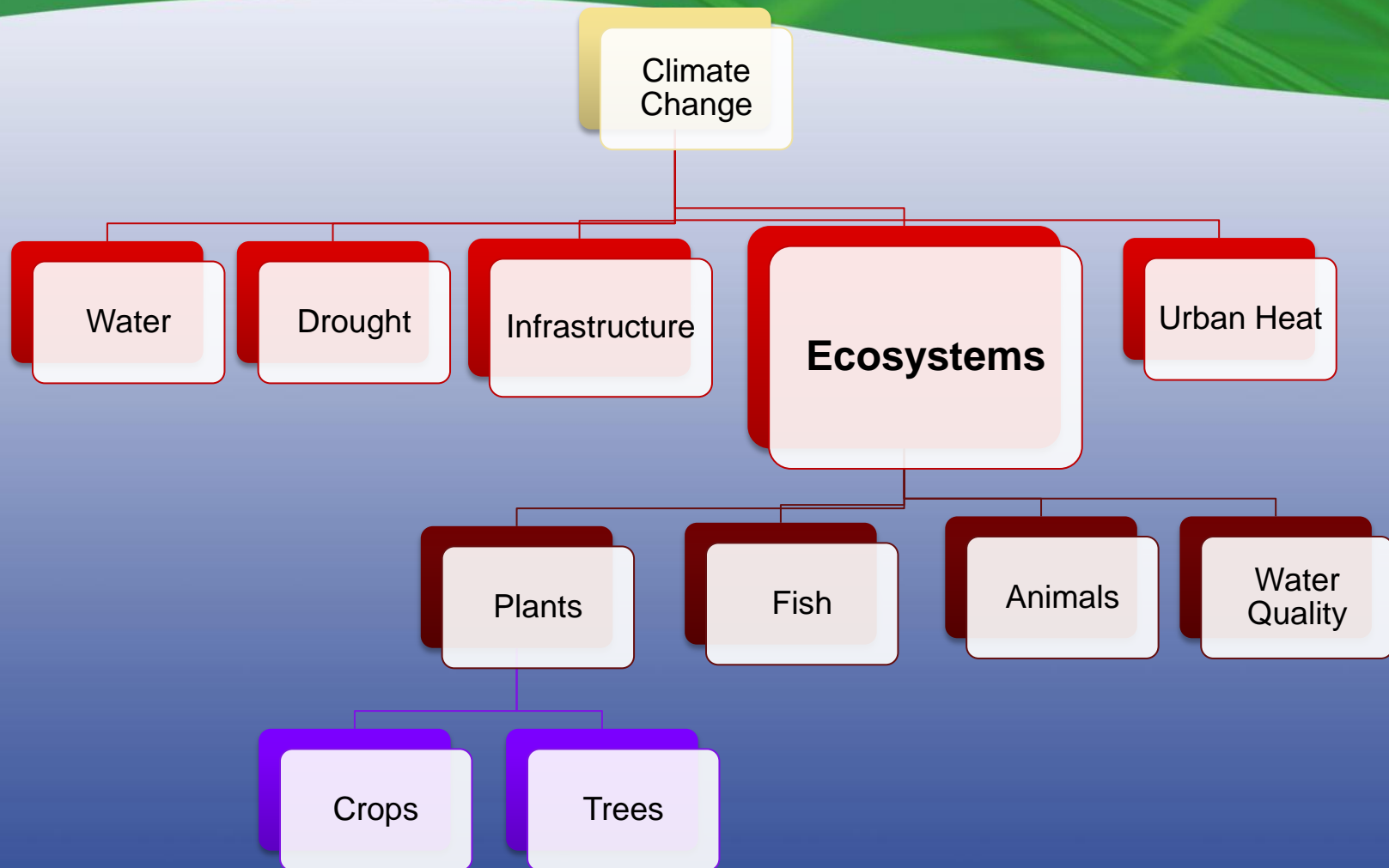


Chiller plant at University of Chicago

Infrastructure Summary

- Zoning
 - Buildings and shorelines
- Regulations
 - Shipping and roads
- Updated Infrastructure
 - Energy

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Ecosystem Resilience and Adaptive Capacity

Ecosystem Resiliency:

The ability of an ecosystem to cope with disturbances without shifting to become a different system.

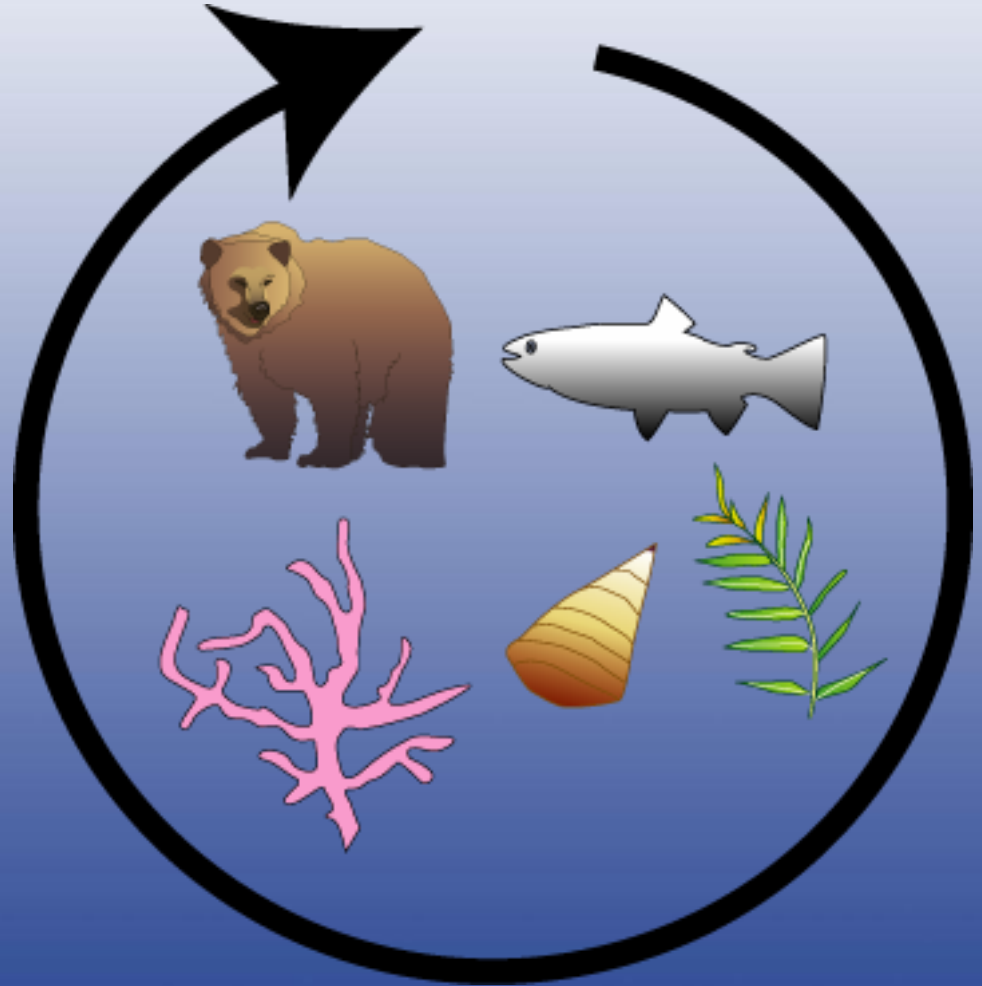


Adaptive Capacity:

The ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Climate Effects on Ecosystems

- Birds
- Plants
- Insects
- Animals
- Fish
- Interactions among species



Good News: Win-Win Strategies

Improving ecosystem resilience helps:

- Mitigate carbon emissions
- Reduce urban heat effect
- Improve air and water quality
- Improve stormwater management
- Increase flood resiliency

Decrease Stresses on Ecosystems

- Assess strategies for invasive species
- Revise restoration guidelines/BMPs
- Prevent stormwater pollution
- Reduce pollutants in air, water, and soil
- Determine minimum stream flow levels to maintain aquatic ecosystems

Increase Ecosystem Resilience

- Establish larger landscapes and waterscapes for biodiversity with internal redundancy and connectivity
- Assess resiliency of current conservation/preserve designs
- Evaluate effectiveness of current wetlands restoration programs
- Map the region to control development
 - Prioritize smart growth in low-risk areas
 - Zone to discourage expansion into high-risk areas

Protection Techniques and Mechanisms

- Restoration
- Acquisition
- Conservation easements
- Greenway connection
- Non-structural stormwater management
 - Use native plants
 - Add/increase buffers to protect river systems



Ecosystem-based
adaptation:

Best management
practices for
agriculture



Adaptive Plant Selections



- Crops
- Orchards
- Forestry
- Stream buffers
- Urban trees

Partnerships

Government and land trusts can partner to preserve valuable areas.



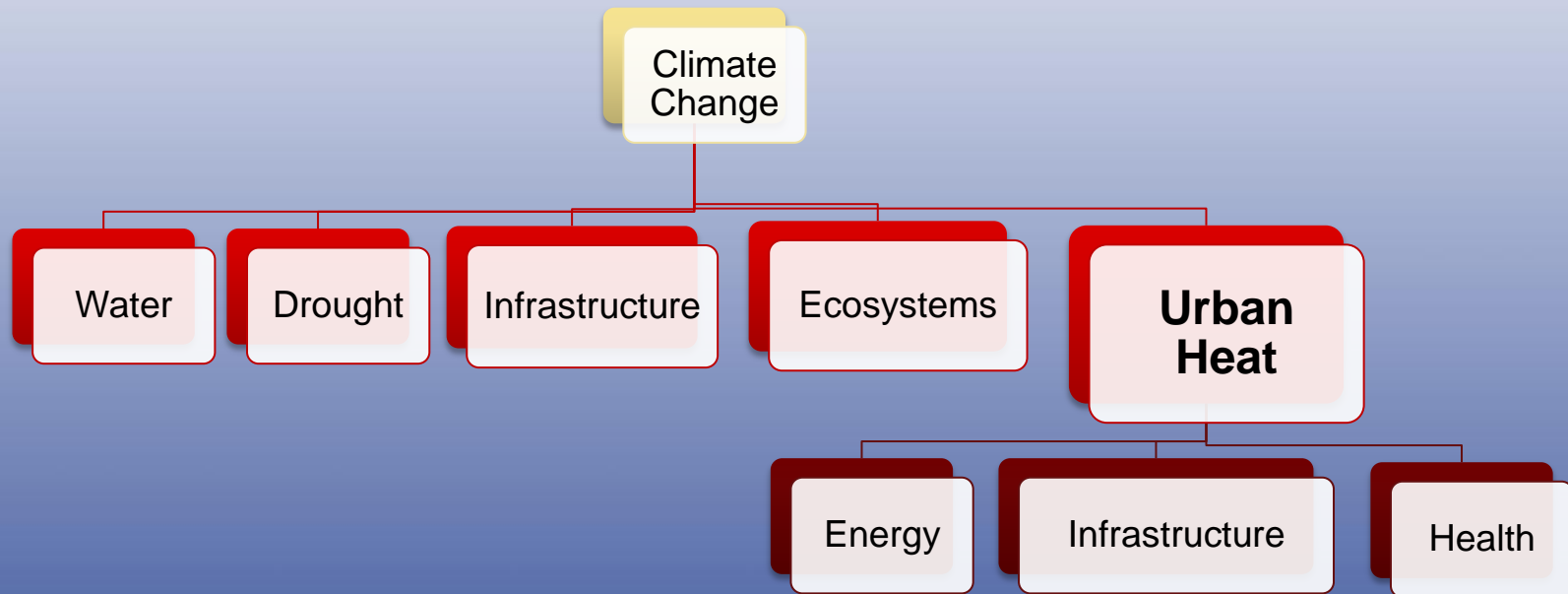
For example, the Milwaukee Metropolitan Sewerage District partnered with the Conservation Fund to protect and restore floodplains through the Milwaukee Watershed Conservation Plan.

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Urban Heat Islands



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Urban Heat Islands (UHI)

- Thermal energy from impermeable surfaces causes higher temperatures in dense urban areas.
- Hot days can raise city temperatures 4–10°F.
- UHI could increase energy demands, roadwear, fires, power outages, city services, respiratory problems, and heat stroke.



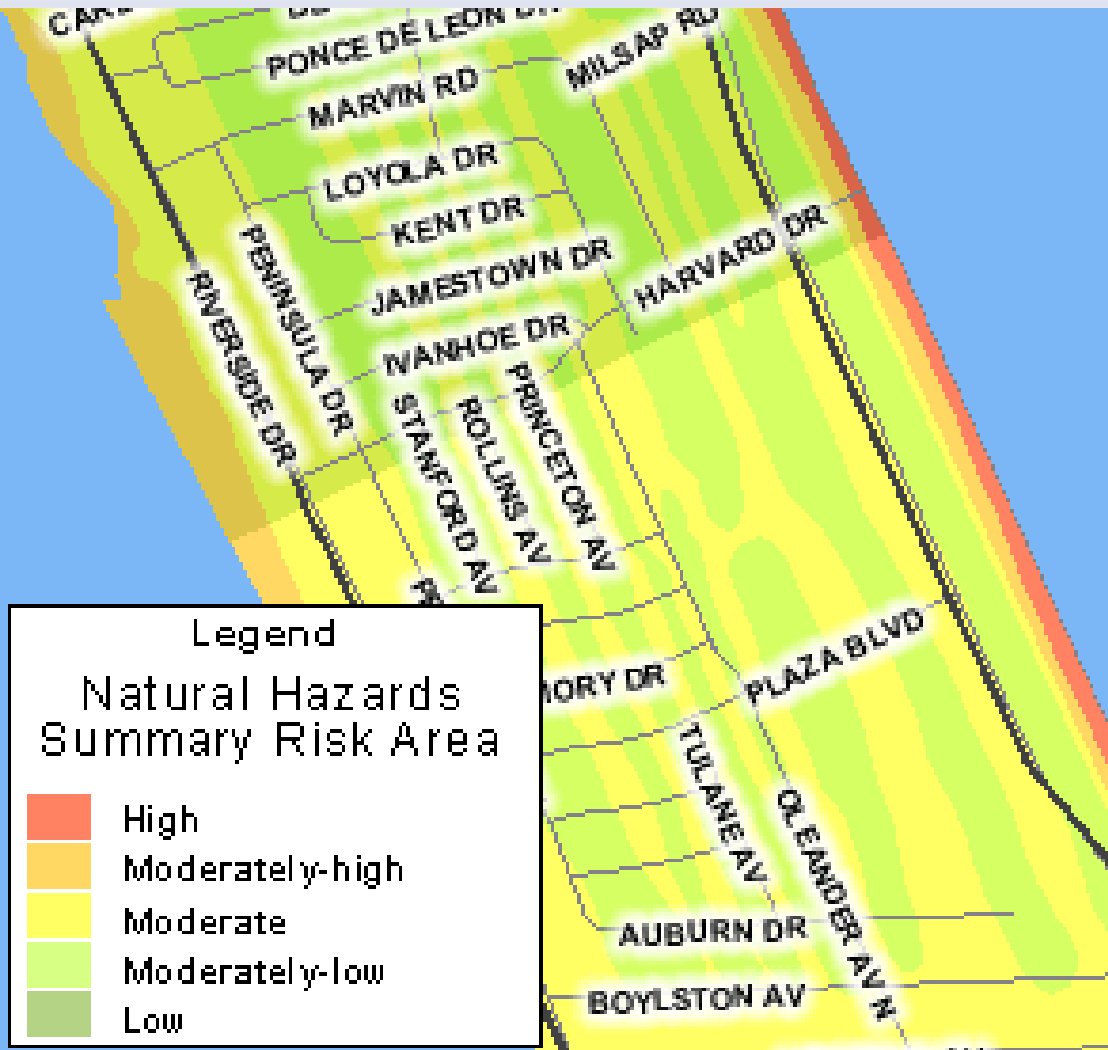
Vulnerability Planning

Extreme heat events are the #1 cause of weather-related deaths in United States.

Communities can reduce vulnerability:

- React to heat: emergency plans
- Mitigate heat: reduce dark surfaces

Vulnerability Assessment



- Create a heat vulnerability map
- Use thermal remote sensing data to understand variation in cities

Extreme Heat Mitigation and Planning

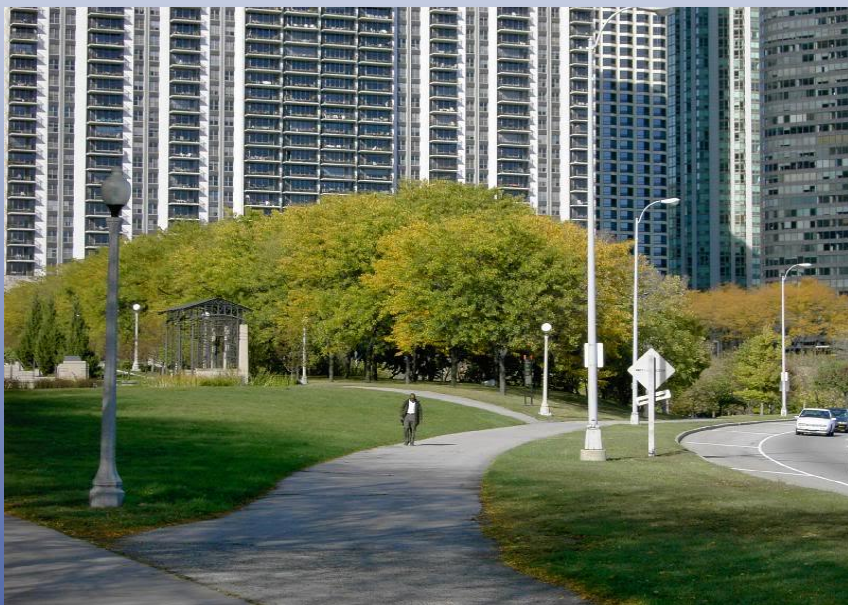
Greenery:

- Reduces heat
- Provides shade
- Improves air quality
- Is economically efficient



Green Alleyways

- Effective way to mitigate heat
 - Perpendicular to shore
 - Low greenery/short trees
- Lets the wind through



Chicago's Lake Shore Drive

Locally Appropriate Solutions

Green Roof

- Improves air quality
- Adds green space
- Adds humidity

BUT...

- Requires specialized construction
- Expensive
- Requires maintenance
- Heat can stress plants

OR

Increased Roof Albedo

(Paint, shingles, etc.)

- Less expensive
- Does not add humidity

SO...

This option is more cost-effective, despite stormwater and runoff benefits of green roofs.

Summary of Urban Heat

Emergency planning:

- Cooling centers
- Transit to pools

Reduce dark surfaces:

- Lighten roofs
- Increase green space

Financial and Regulatory Incentives

Use of Policies and Regulations
to Promote Adaptation

Financing Approaches

- Most existing financing approaches for adaptation are reactive.
- A more effective approach would be having an adaptation financing structure built-in to local policies.



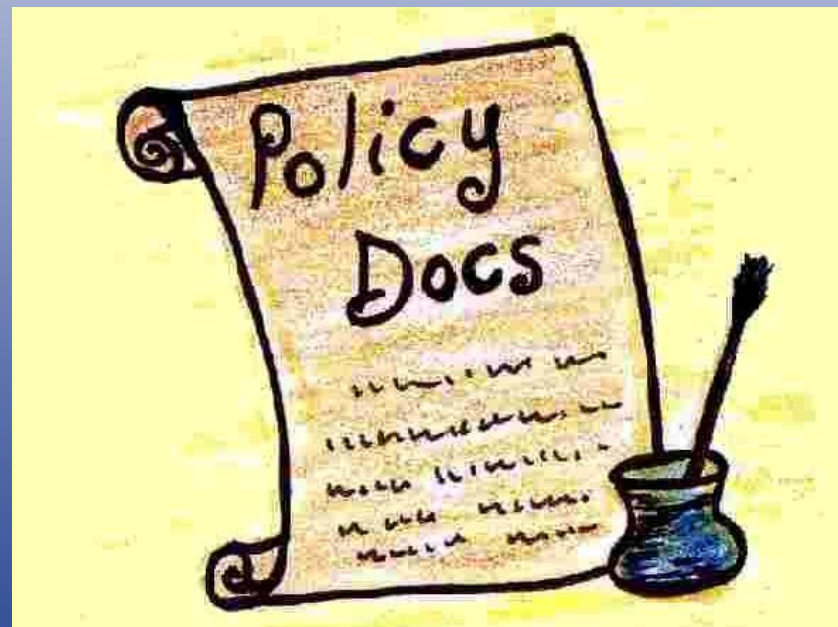


Fiscal Incentives

- Use finances to discourage damage to ecological resiliency and encourage increased adaptive capacity
- Adjust existing financing mechanisms to support activities that increase adaptive capacity

Policy Incentives

- Enforce and strengthen policies that are already in motion to restore and protect ecosystem resiliency
- Shift away from policies that reduce adaptive capacity
- Integrate climate change explicitly into policies



Local Governments Can Create Their Own Incentives

- Expedite plan review for projects that meet or exceed climate objectives
- Waive permit fees
- Give rebate and trade-in incentives for home and business upgrades
- Provide technical assistance to help developers meet new goals and standards
- Offer community financing mechanisms to offset start-up costs

Funding and Policy Resources

See handouts for more information on:

- Potential funding sources
- Federal laws and executive orders relevant to climate change on the coast

From NOAA's *Adapting to Climate Change: A Planning Guide for State Coastal Managers*

