INTRODUCTION TO CLIMATE VULNERABILITY ASSESSMENT

April Taylor
Tribal Liaison
South Central Climate Adaptation Science Center

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

What do you think of as vulnerable to climate change?

What do you feel is already threatened/disrupted by climate change?

Vulnerability

At this point we've covered climate science, and some projected changes

That is, we've been thinking and talking about the science and some impacts

Vulnerability takes us from the thinking about science to thinking about key items we're concerned about.

- What affects those items? (Hazards or Stressors)
- What are the impacts and consequences?
- What are the related actions and choices?

Vulnerability is about the *key items of concern*

Cultural

Ecosystems

Infrastructure

Species

Definitions of Vulnerability

1. ”an aggregate measure of human welfare that integrates environmental, social, economic and political exposure to a range of harmful perturbations” (Bohle et al. 1994)

2. “…the exposure to contingencies and stress, and difficulty in coping with them. (Chambers 1989)

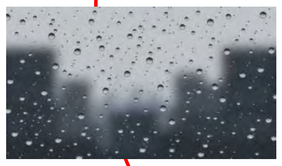
3. ” *Vulnerability:* the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. (IPCC 2001)

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

Vulnerability Assessments examine many factors

Climate Stressors (Hazards): Current and Future

Temperature



Precipitation

Extreme Events

Vulnerability Assessment

Sensitivity + Adaptive Capacity

Socioeconomic Factors

Enhanced Environmental Exposure

Ability to Respond

Exposure

- **The degree of climate stress upon a particular unit of analysis**

- **Climate stress:**
  - **long-term climate conditions**
  - **climate variability**
  - **magnitude and frequency of extreme events**

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

Sensitivity

Sensitivity
How big is the impact of the hazards?

What climate related hazards you are exposed to depends on where you are.

For example, with precipitation variability and semi-arid areas, Oklahoma is exposed to drought.

Sensitivity: the degree to which a given community or ecosystem is affected by climate stresses.

In Oklahoma increased heat during already hot summers might have significant impacts. That could include

- Crop damage
- Stress on water resources
- Dangers to public health (increases in heat stress / heat stroke)

Adaptive Capacity

Adaptive Capacity
Is it possible to cope or adapt?

Adaptive capacity or resilience coping is the ability to withstand negative impacts from a hazard and adapt to a given climate impact.

Coping actions are things people do to protect themselves from harm, like getting help from friends or neighbors.

Examples:
- mutual aid agreements
- conservation
- reliable water resources
- insurance
- knowledge of developing risks (like drought or severe weather monitoring)

Interpretations

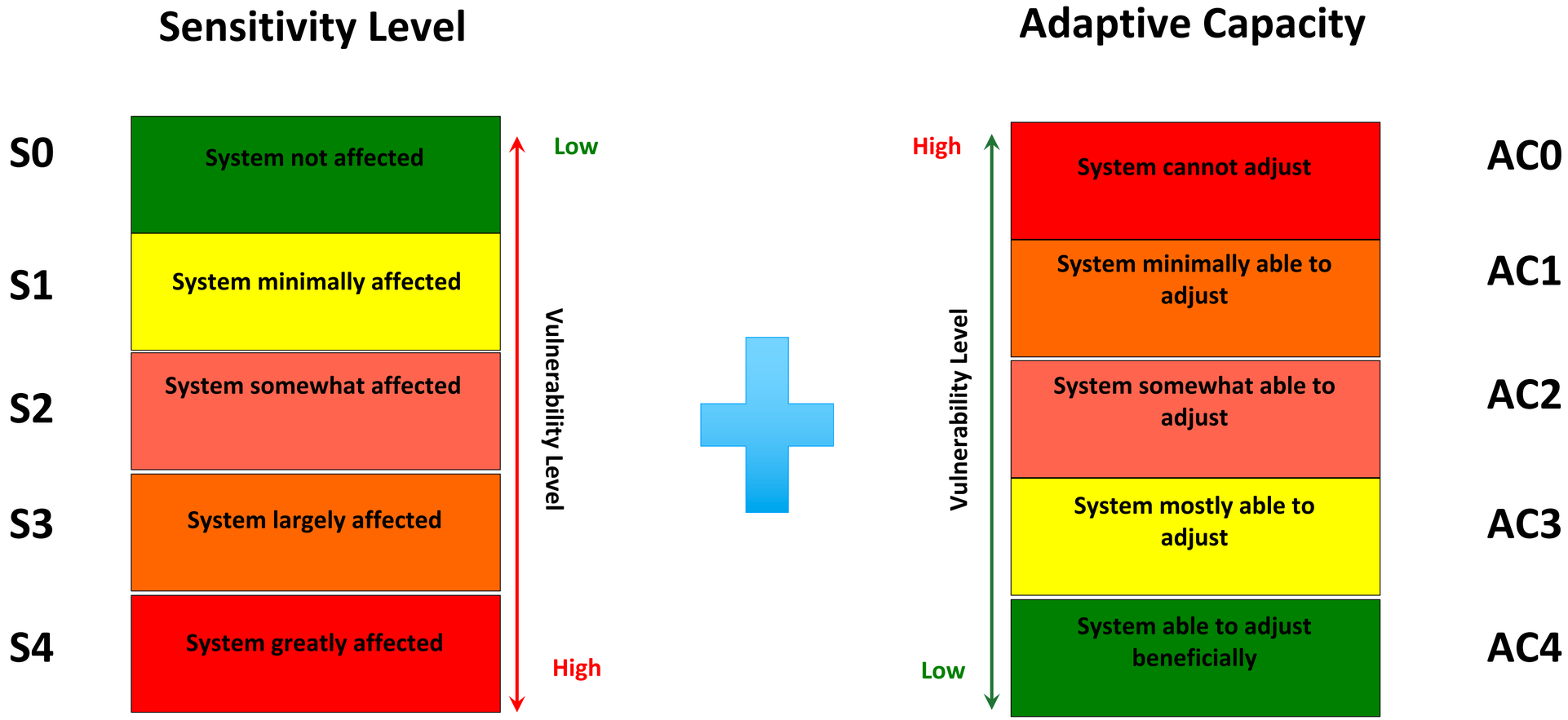
Interpretation I

- Vulnerability analysis as a means of defining the extent of the climate problem
- Vulnerability = Impacts – Adaptations
- Adaptability defines vulnerability

Interpretation 2

- Vulnerability analysis as a means of identifying what to do about climate change.
- Vulnerability is shaped by adaptive capacity.
- Vulnerability determines adaptability
- Vulnerability is the starting point of the analysis.

Some things are less vulnerable than others



Navajo Vulnerability Assessment Report

More Vulnerable

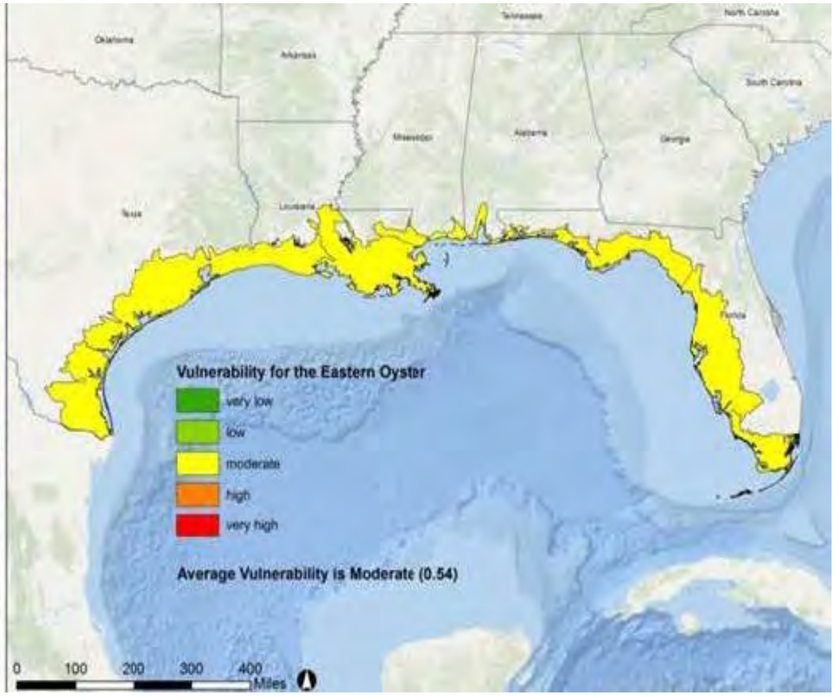
	Golden Eagle
Man-made barriers	
Dispersal Ability	
Temperature	
Precipitation	
Habitat requirements	
Interspecies interactions	
Diet	
Population/Genetics	
Human interactions	

Less Vulnerable

	Mountain Lion
Man-made barriers	
Dispersal Ability	
Temperature	
Precipitation	
Habitat requirements	
Interspecies interactions	
Diet	
Population/Genetics	?
Human interactions	

http://conbio.org/images/content_publications/Final_Navajo_Vulnerability_Assessment_Report_2.pdf

Vulnerability Assessments Include Planning

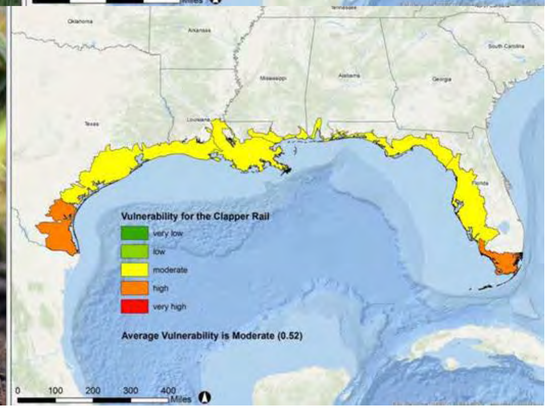


"…oyster reefs with marginal water quality could be targeted for habitat restoration to promote future population growth or recruitment in extreme years when isohalines have moved up or down estuary." – Gulf Coast Vulnerability Assessment 2015, p.80, Adapted from Stein et al. 2014, emphasis added

Blue Crab

Tidal Emergent Marsh

Clapper Rail



Gulf Coast Vulnerability Assessment 2015

(NOTE: BE SURE TO COMPARE/CONTRAST TO VLN)
Hazard Management

Hazards (threats to people and what they value) emerge from causally linked series of events, choices, and consequences – a causal chain.

Whatever the hazard, its impacts and consequences are dependent on societal and individual choices and actions.

Many hazards are not weather or climate related such as earthquakes and terrorism.

Example: Development along the wildland urban interface

- Might increase risk, wildfire danger
- Direct effect: losses and damages from wildfire
- Indirect effect: runoff/erosion or poor water quality after a fire

What other considerations are involved in this example?

Types of losses

	Human - social	Physical	Economic	Cultural Environmental
Direct losses	• Fatalities • Injuries • Loss of income or employment • Homelessness	• Structural damage or collapse to buildings • Non-structural damage and damage to contents • Structural damage infrastructure	• Interruption of business due to damage to buildings and infrastructure • Loss of productive workforce through fatalities, injuries and relief efforts • Capital costs of response and relief	• Sedimentation • Pollution • Endangered species • Destruction of ecological zones • Destruction of cultural heritage
Indirect losses	• Diseases • Permanent disability • Psychological impact • Loss of social cohesion due to disruption of community • Political unrest	• Progressive deterioration of damaged buildings and infrastructure which are not repaired	• Economic losses due to short term disruption of activities • Long term economic losses • insurance losses weaken-ing the insurance market • Less investments • Capital costs of repair • Reduction in tourism	• Loss of biodiversity • Loss of cultural diversity

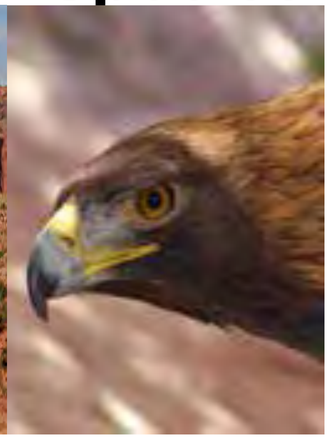
Vulnerability is about the *key items of concern*

Cultural

Ecosystems

Infrastructure

Species



1ST STEP- IDENTIFY KEY ITEMS OF CONCERN

What are the aspects/ assets/ resources of your tribe that may be vulnerable to climate related exposures?

- Land Resources
- Economic Development
- Transportation
- Air Quality
- Energy Systems
- Water Supply or water quality
- Traditional Foods
- Culturally Significant Species
- Public Health
- Social Services
- Agriculture/ Native Farmers
- Tourism
- Youth
- Elders
- ETC.

ACTIVITY: DISCUSS KEY ITEMS OF CONCERN IN YOUR COMMUNITY (15 MIN)

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

GATHERING VULNERABILITY INFORMATION

- Who to contact in your community that has the relevant information?
- What types of information would be useful to determine vulnerability or adaptive capacity?
- Why is it vulnerable/ root causes? (i.e. Band aid the problem vs. solving the problem)
- Example:
  - Do you know who has the health data or access for heat related illnesses and heat strokes or deaths?
  - How hot or how many hot days does the heat health become a concern?
  - Why are people with diabetes more stressed by health? Are there other health conditions that would make them more vulnerable?
  - Does your community respond and are they able to respond?

GATHERING VULNERABILITY INFORMATION

- Example:
  - Who has the data for native farmers in our jurisdiction? What do they grow or raise?
  - Are native farmers able to adapt to more intense and reoccurring droughts?
  - Why are they not able to adapt? Economic?
  - How bad is the economic impact of a drought?
  - What would be needed to adapt over time? Irrigation equipment; new equipment and knowledge to grow a different crop?
  - Does your tribe assist native farmers respond currently? Are there things they could assist with?
  - Would the tribe go after Farm bill funding or other programs?

GATHERING VULNERABILITY INFORMATION

- How to approach gathering the information?
- Meetings?
- Literature?
- Surveys or film interviews?
- Process to gather the information?

ACTIVITY: DISCUSS GATHERING VULNERABILITY INFORMATION

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

GAP ASSESSMENT:

WHAT IS MISSING? OR WE DON'T KNOW? COULD WE START MONITORING AND ACQUIRING THIS INFORMATION?

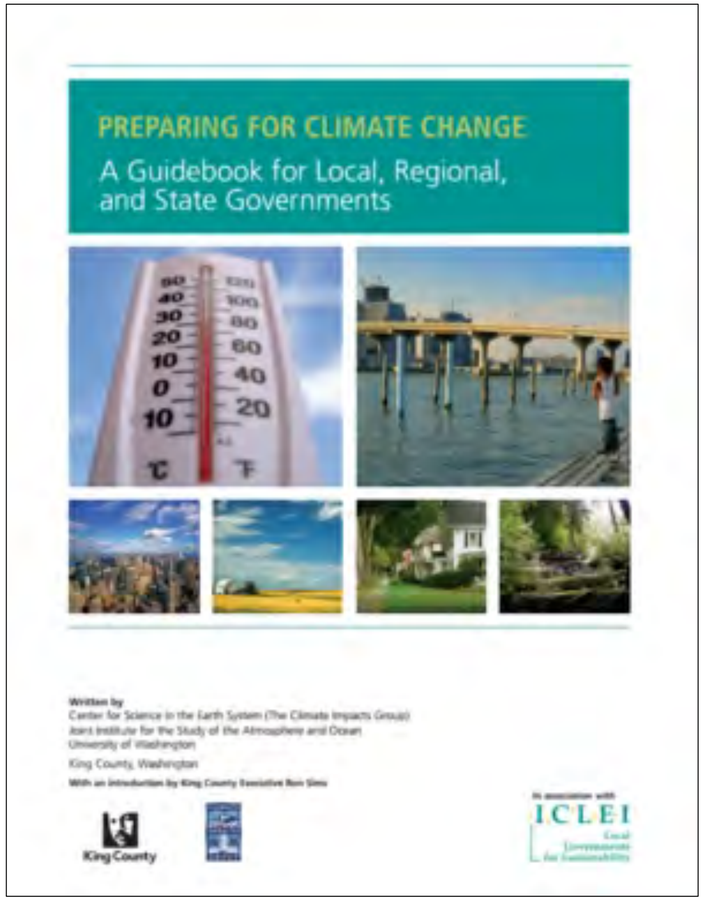
SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

VULNERABILITY ASSESSMENTS GUIDEBOOKS AND FRAMEWORKS

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

ITEP- Toolkit and the Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments

- The purpose of the guide is to help decision-makers in a local, regional, or state government prepare for climate change by recommending a detailed process for climate change preparedness based on familiar resources and tools.
- **ITEP Toolkit: http://www7.nau.edu/itep/main/tcc/Resources/adaptation**
- **(Note-ITEP program is now developing sector based curriculum. Tribes now join a facilitated cohort for a minimum of 1.5 years.)**

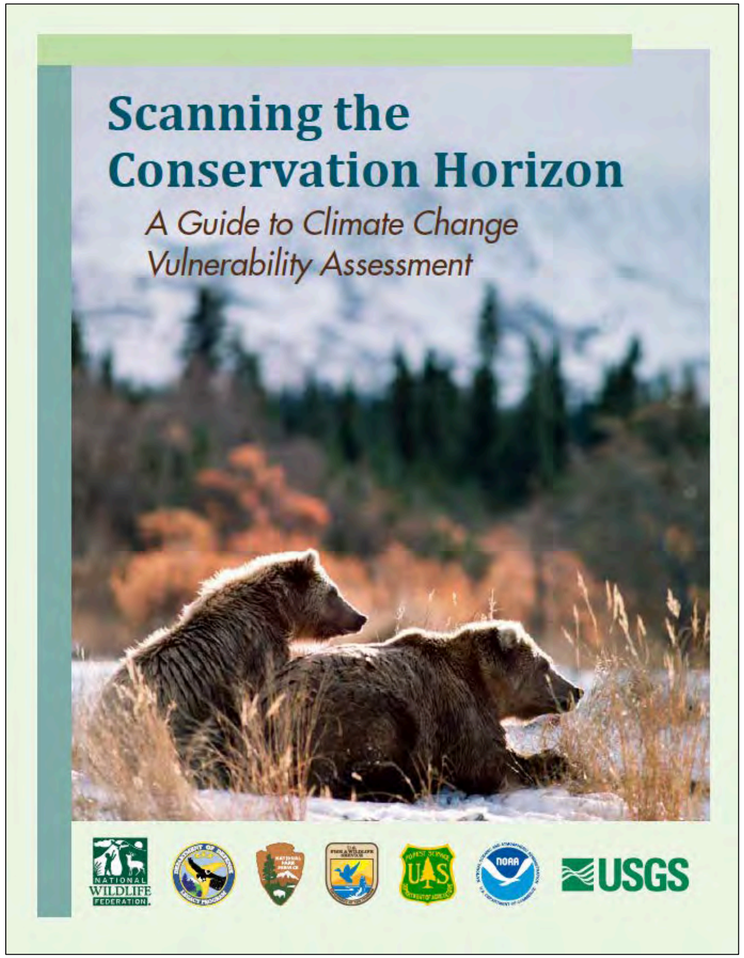


Species Guidebook

Scanning the Conservation Horizon is a vulnerability assessment guide focusing on ecological impacts and resource management.

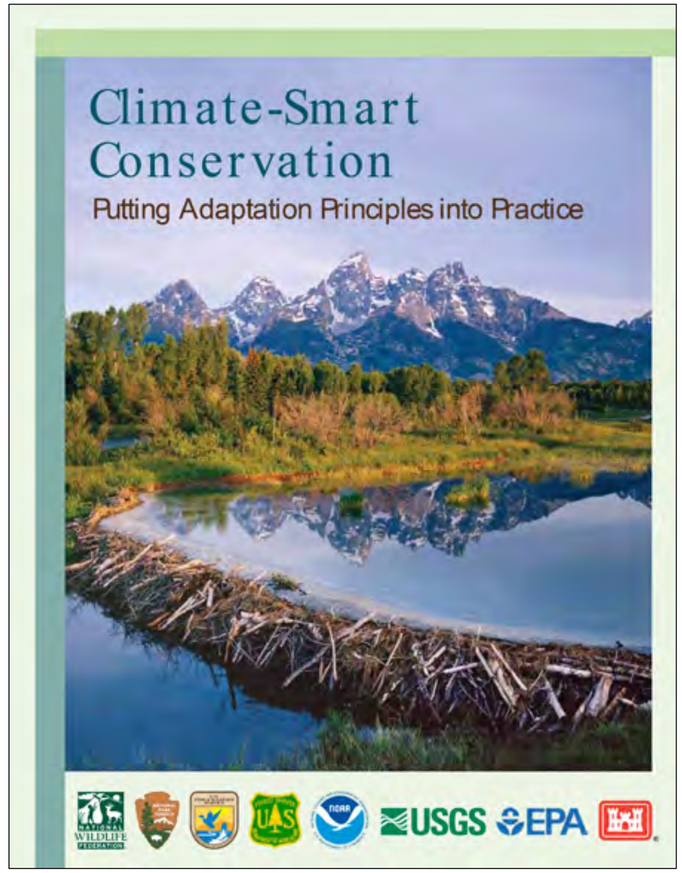
The document covers vulnerability basics and features case study examples from around the US.

Online pdf:
www.nwf.org/vulnerabilityguide



CLIMATE SMART FRAMEWORK

- Integrate climate change adaptation into other plans or types of projects
- Not look at the past or previous conditions but to ensure they persist for decades to come. Thus manage for change.
- Minimize loss
- Avoid maladaptation
- Consider GHGs of the adaptation strategies/ minimize the carbon footprints of our actions
- Climate smart monitoring plans

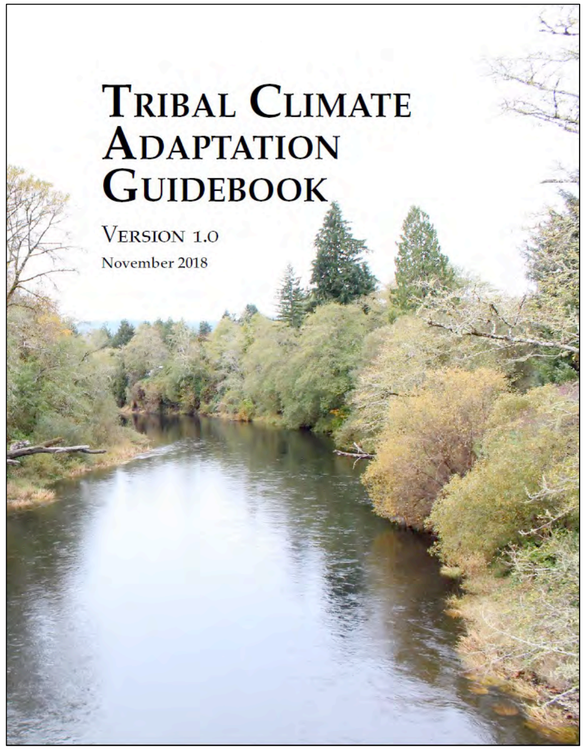


TRIBAL ADAPTATION GUIDEBOOK

- Useful for tribes at any stage of adaptation planning, from initiation to implementation, and with varying degrees of funding and staff capacity. (i.e. skip parts)

- Considers the unique issues facing Indigenous communities, and identifies opportunities and guidance for incorporating Traditional Knowledges

- Download at http://www.occri.net/projects/tribal-climate-adaptation-guidebook/



EXAMPLES OF TRIBAL VULNERABILITY ASSESSMENTS

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER

OU-BIA VULNERABILITY ASSESSMENTS

- Kaw Nation
- Otoe Missouria Nation
- Wichita and Affiliated Tribes
- Fort Sill Apache
- Citizen Potawatomi Nation

- Approach for each determined by the tribe.
- Each tribe has a steering committee to guide the individual project.
- Topics
  - Water (drought, flooding, water quality)
  - GIS
  - Visioning and collaboration

CITIZEN POTAWATOMI NATION VULNERABILITY ASSESSMENT

- Cultural Resources
- Emergency Management
- Flood Management
- Wildfire Management
- Economic Development
- Tribal Services
- Water Resources
- Food Security

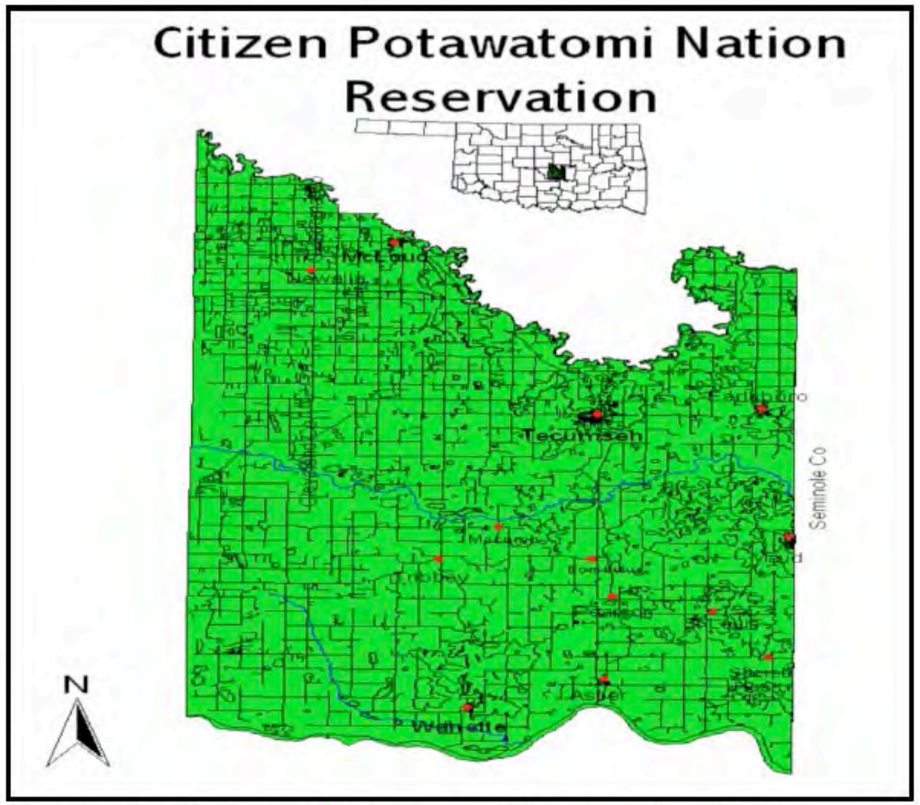


Figure 2: Citizen Potawatomi Nation territory.

Table 3

Cultural Resources - Sensitivity Analysis

1.) Planning Area	2.) Current and Expected Stresses to Systems in this Planning Area	3.) Known Climate Conditions Relevant to Systems in this Planning Area	4.) How Known Climate Conditions currently Affect Systems in this Planning Area	5.) How Known Climate Conditions are Projected to Change	6.) Projected Impact of Changes to Systems in This Planning Area (without mitigation efforts)
Cultural Practices	Resource Scarcity	Conditions that will impact Oklahoma are drought, wildfire, and severe weather events. In the Great Lakes, warmer winters pose a threat to cultural practices.	Climate variability has always dictated the availability of resources for cultural practices.	Climate change projections including increasing temperatures, impact the timing and availability of culturally-relevant plants and animals.	Without mitigation efforts, climate change will worsen existing resource stresses both in Oklahoma and in the Great Lakes.
	Ceremonial Use of Fire		Daily weather conditions dictate the ability of Citizen Potawatomi Nation citizens to utilize fire in their ceremonies.	Climate change projections suggest that the number of days where average summer temperatures reach over 100 degrees Fahrenheit will quadruple. Warmer temperatures coupled with drought-like conditions increase the likelihood of wildfires.	Without mitigation efforts, the ceremonial use of fire by Potawatomi members will become increasingly limited because of wildfire threats.
	Extreme Heat	Extreme heat and severe weather events dictate	Extreme heat events present safety concerns for cultural event attendees. Extreme heat events also hinder the	Increasing average temperatures will mean more frequent extreme heat events	Extreme heat events will continue to create additional challenges to Nation-sponsored cultural events that require resources and manpower from the Nation's

Emergency Management - Sensitivity Analysis

1.) Planning area	2.) Current and expected stresses to systems in this planning area	3.) Known climate conditions relevant to systems in this planning area	4.) How known climate conditions currently affect systems in this planning area	5.) How known climate conditions are projected to change	6.) Projected impact of changes to systems in this planning area (without mitigation efforts)
Emergency Management	**Financial** *Immediate costs of EM event response *Long term costs of economic disruption *Long term costs of increased preparedness and response **Regional Governance** *No formal agreements	Drought, Wildfire, Severe Storms, Tornadoes, Flooding, Severe Winter Storms, Earthquake, and Dam Failure.	The unpredictability and increased severity of these severe weather events increases the possibility of associated costs including: (1) immediate costs of event response, (2) long term economic disruption, and (3) long term costs of increased preparedness.	Climate change projections indicate that much of Oklahoma (including Pottawatomie County) will likely experience increased severity of torrential rainfall and flash flooding.	Financial stresses will likely continue to increase for preparedness activities and personnel.
			Climate conditions significantly impact both the Citizen Potawatomi Nation and its neighbors. CPN has frequently responded to the needs of its neighbors, however formal agreements have not been utilized by CPN. Due to the long term nature of changing climate conditions, this could place the Nation at risk if formal agreements are not implemented.		Regional governance stresses will likely increase, with increasing costs, assuming that CPN continues to provide the same level of services to surrounding communities.

Flood Management - Sensitivity Analysis

1.) Planning area	2.) Current and expected stresses to systems in this planning area	3.) Known climate conditions relevant to systems in this planning area	4.) How known climate conditions currently affect systems in this planning area	5.) How known climate conditions are projected to change	6.) Projected impact of changes to systems in this planning area (without mitigation efforts)
Flood Management	**Financial** *Flood Damages to physical assets *Degradation to agricultural land *Overall costs for mitigation efforts *Structural Upgrades *Losses to agricultural production *Losses in industrial park production *Loss of Access (Temporary) to Iron Horse & other CPN Facilities for Tribal Members *Limited access to tribal facilities during/after flooding *Losses to cultural and historically significant sites	Flooding and flash flooding.	Some assets currently experience flood damage during extended periods of heavy rainfall which leads to high costs of mitigation efforts and flood studies. CPN will also experience economic losses due to replacement/reconstruction costs, reduced agricultural production, and limitations on industrial park production due to limited access. CPN also is in danger of potential damages to culturally and historically significant sites.	Climate change projections indicate that much of Oklahoma (including Pottawatomi County) will likely experience increased severity of torrential rainfall and flash flooding.	Changes in climate conditions may require increased mitigation efforts, thus requiring more funding for adaptation and mitigation. CPN assets may receive increased damage and further decreased industrial and crop production resulting in greater economic losses. Without addressing the need for mitigation, CPN will potentially increase the risk to culturally and historically significant assets.
	Regional Governance *No formal agreements		Climate conditions significantly impact both the Citizen Potawatomi Nation and its neighbors. CPN has frequently responded to the needs of its neighbors, however formal agreements have not been utilized by CPN.		Regional governance stresses will likely increase as a result of increased disaster preparation and response costs. This is also assuming that CPN continues to provide the same level of services to

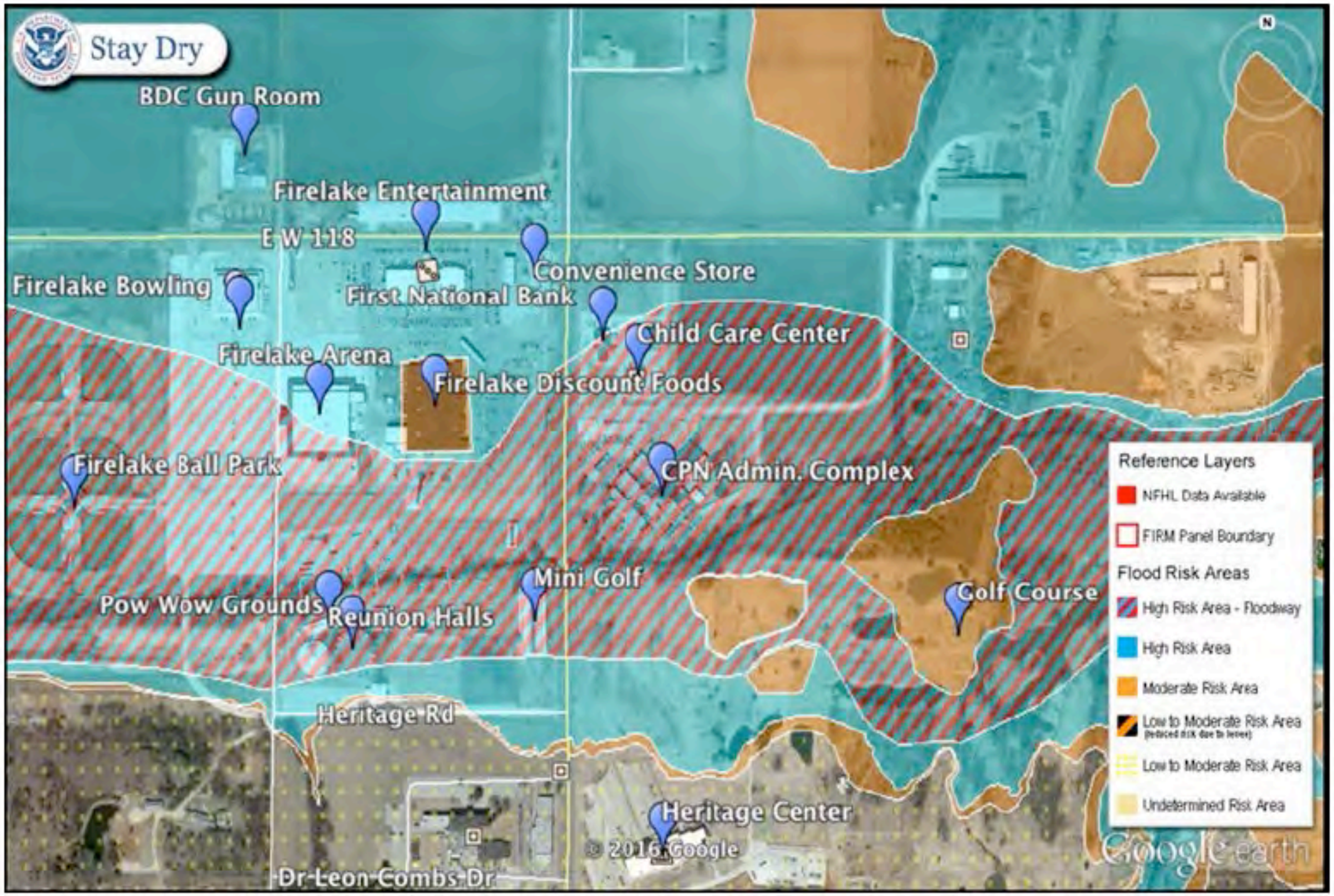


Figure 3: Citizen Potawatomi Nation Main Campus

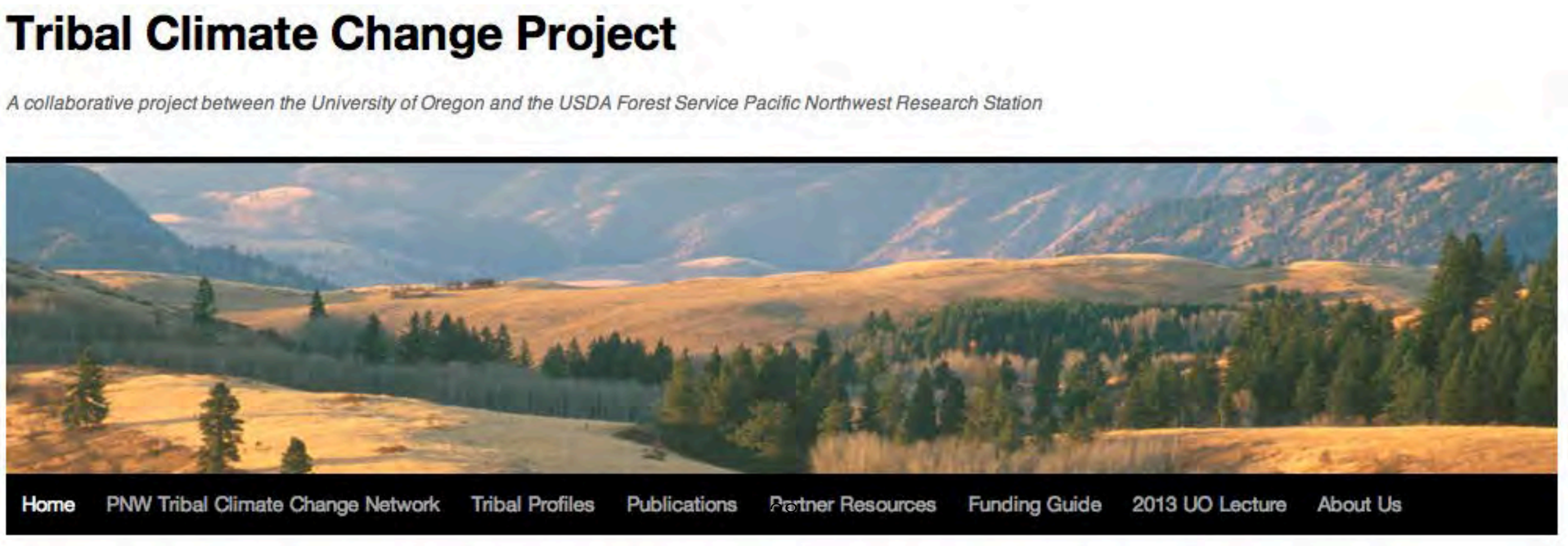
Figure 5: The Grand Casino

Vulnerability Assessment Examples

Extensive information on how tribes in the Pacific Northwest are addressing climate change can be found through the Tribal Climate Change Project.

Notable examples include work by the Jamestown S'Klallam and Swinomish Tribes.

Online:
http://tribalclimate.uoregon.edu

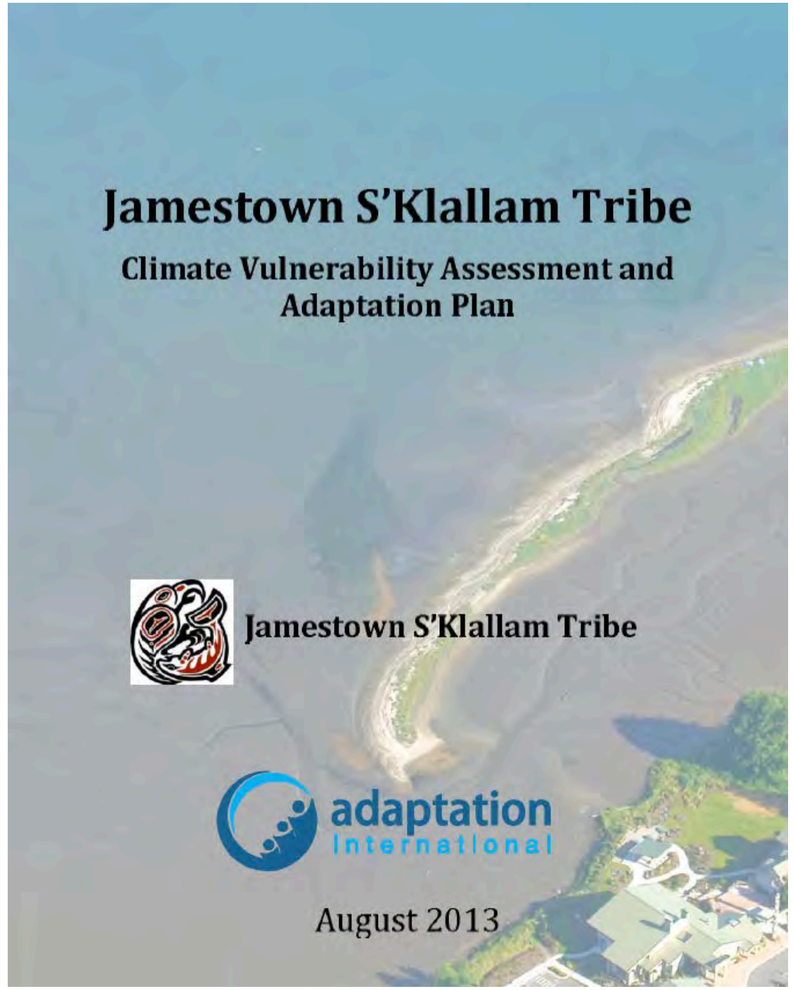


Vulnerability Assessment Examples

The Jamestown S'Klallam plan resulted from a two day workshop the tribe completed where they identified the most important climate impacts to the community, such as:
- Increasing temperatures and changing precipitation
- Sea level rise and coastal flooding

Also identified were key areas of concern important to the tribe, such as:
- Salmon
- Clams and Oysters
- Wildfires

Online:
http://tribalclimate.uoregon.edu/files/2010/11/Jamestown_Sklallam_Adaptation_Plan_Profile_FINAL-1qqgd7e.pdf



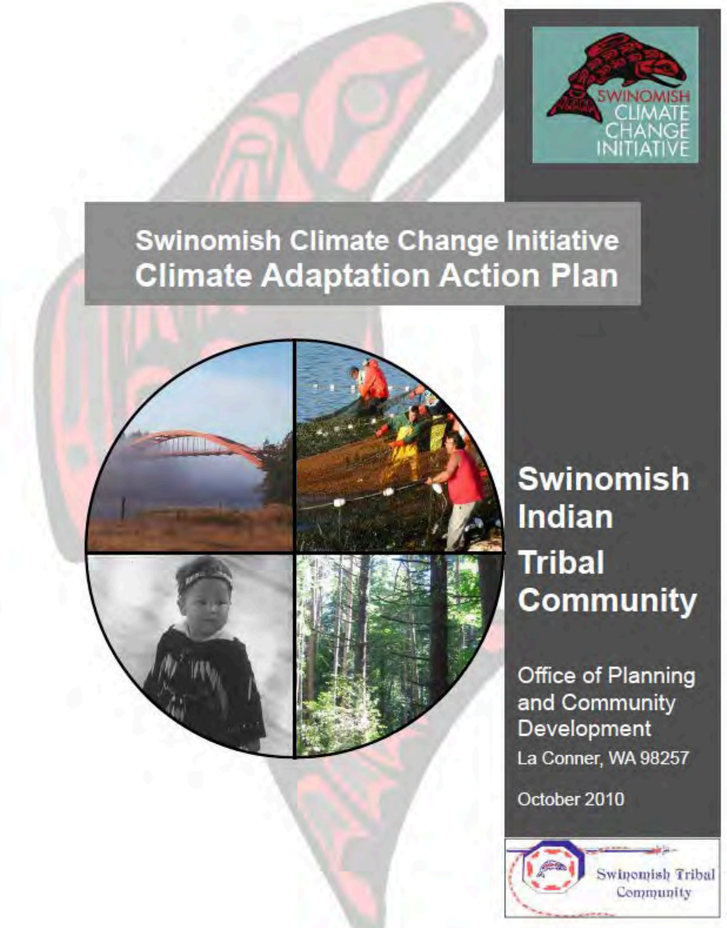
Vulnerability Assessment Examples

The Swinomish Climate Change Initiative was initially a two year study on the impacts of climate change on tribe resources, assets and community.

The plan also identified recommended actions relating to coastal resources, upland resources, physical health, and community infrastructure and services.

The initiative continues to guide tribal interests through the Swinomish Office of Planning and Community Development.

Online:
http://www.swinomish-nsn.gov/climate_change/climate_main.html



QUESTIONS?