WETLANDS AND CLIMATE CHANGE: Management Options

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Wetlands in Rhode Island, USA

MANAGEMENT OPTIONS

- What can states, local governments, federal agencies, land trusts and others do to reduce the impacts of climate change on wetland ecosystems?
- What can these entities do to protect wetland carbon stores and reduce methane emissions from wetlands?

MANAGEMENT OPTIONS?

- Examples:
  - Mapping or other identification of wetlands sensitive to climate change in a locality, state, region
  - Setbacks to allow coastal wetlands to migrate
  - Water level manipulation to prevent wetlands in areas with increased temperatures and reduce precipitation from drying out
  - Protection and restoration of “connectivity” to all plants and animals to migrate
  - Tightened regulation of wetlands with large carbon stores such as bogs and some riverine wetlands

WETLANDS AND CLIMATE CHANGE WORKSHOPS

Wetlands and Climate Change Workshop, February 3-4, 1999
Laurel, Maryland, International Institute,
Association of State Wetland Managers

Wetlands, Carbon Cycling and Future Climate Change Workshop,
April 25-26, 2000. Laurel, Maryland, International Institute,
Association of State Wetland Managers

Wetlands and Climate Change Symposium, Millennium Wetland
Event, Quebec 2000, Quebec City, August 10 and 11, 2000,
Wetlands International and the International Institute,
Association of State Wetland Managers

U.S./Canadian
Wetlands and Climate Change Symposium
Society of Wetland Scientists Annual Meeting
June 6-7, Lake Placid, New York, 2002
SWS, International Institute, Association of State Wetlands Managers

National Symposium, Wetlands 2008
Wetlands and Climate Change,
Portland Oregon

WETLANDS AND CLIMATE CHANGE: MANAGEMENT CHALLENGES

- Complex science
- No easy broad scale adjustments
- Science and management require consideration of feedback loops; impact of climate change on wetlands; impact of wetlands on climate change

CHALLENGES (CONTINUED)

- There are millions of wetlands (an estimated 25 million Prairie Pothole wetlands alone) and active management of more than a small portion of these wetlands is impossible.
- Wetlands have often been fragmented and cut off from other wetlands and broader ecosystems, complicating management.
- There is a “downside” to many management options such as installation of water control structures:
  - Adverse ecological impacts;
  - Too costly

THE GOOD NEWS

- **Increasing scientific certainty concerning climate changes and primary (e.g. sea level rise) and secondary impacts (e.g., destruction of salt marshes)**
- **Some measures to reduce the impacts of climate change are “low risk” because they are justified on other grounds such as pollution control, flood control, and outdoor recreation**

CLIMATE CHANGE FACTORS IMPACTING WETLAND ECOSYSTEMS

- **Sea level rise.**
- **Increases in severe meteorological events such as hurricanes and coastal storms.**
- **Increased Co2 and increased biomass production.**

- **Increased mean annual temperatures, low temperatures, high temperatures with resulting change in plant and animal species, hydrologic regimes**.

- **Changes in the total amounts of precipitation**, **intensities of precipitation, and timing of precipitation; resulting changes in hydrologic regimes including runoff, soil moisture, and ground water levels.**

WHAT WILL BE THE IMPACTS OF CLIMATE CHANGE ON WETLANDS?

- **Destroy many coastal wetlands which are not able to migrate inland with sea level rise**
- **“Dry out” and destroy some freshwater wetlands and reduce in size others where precipitation decreases or temperatures and evaporation and transpiration increase without increases in precipitation**
- **Flood or increase in size and number other freshwater wetlands where precipitation increases;**

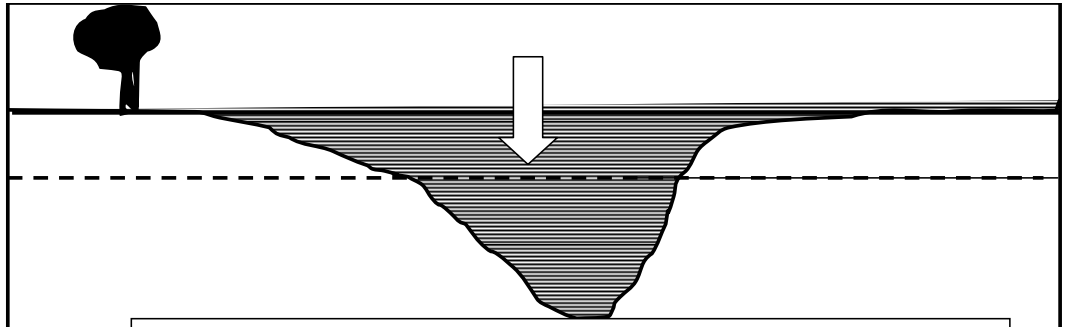
- **Change one type** of wetland **to another (e.g., marsh to forested);**

- **Damage or destroy flora/fauna** including endangered species which cannot adapt/move; and

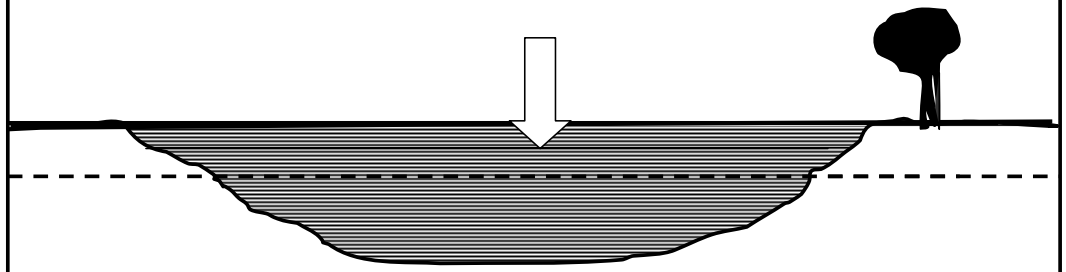
- **Release carbon stores and/or methane** due to melting of permafrost, drying, fires.

WETLANDS HAVE HIGH SENSITIVITY

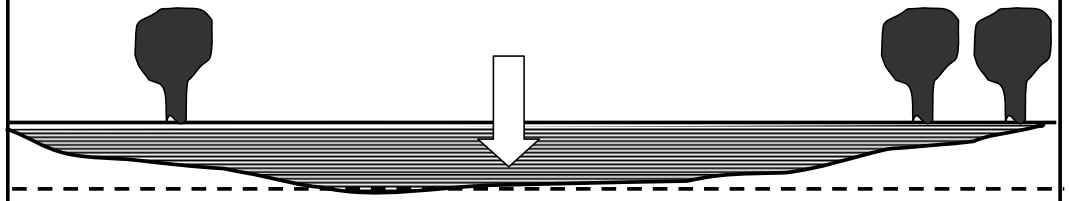
- Small changes in ground/surface water levels may change wetlands to dry ground or open water;
- Some plant and animal species at edge of their ranges are particularly sensitive to changes in water regimes and temperatures.



RIVER
Falling water levels of 18 inches reduce the depth of water but the river habitat for larger rivers remains.



LAKE
Falling water levels of 18 inches affect lake ecology but the lake habitat remains.



WETLAND
Falling water levels of 18 inches will dry out many wetlands. Plants and animal communities are greatly affected.

WETLAND CLASSES AFFECTED

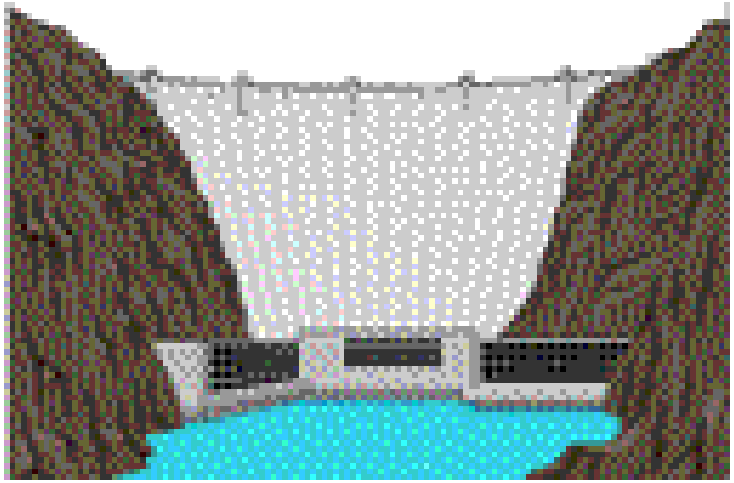
- Coastal and Estuarine Fringe Wetlands
- Riverine Wetlands
- Depressional Wetlands
- Organic and Mineral Flats
- Slope Wetlands

WETLANDS AT GREATEST RISK

- **Coastal and estuarine wetlands.** Causes: Sea level rise and lack of room for migration (e.g., dikes)
- **Depressional wetlands and flats in some regions.** Causes: Rising temperatures and reduced precipitation (e.g., Prairie Potholes).
- **Permafrost wetlands** (far north). Causes: Rising temperatures and melting.
- **Bogs, peatlands** (Maine and north into Canada). Causes: Rising temperatures, reduced precipitation.
- **Vernal pools, playas**. Causes: Rising temperatures, reduced precipitation.

LIKELY HUMAN RESPONSES (ALSO A THREAT)

- More coastal levees, dikes, and beach nourishment to address floods, increase in sea level, more extreme events.
- More damming of rivers to decrease floods, provide water for drier areas.
- Drainage of wetlands to reduce malaria, cholera, and other diseases which will migrate northward with increased temperatures and decreased frosts.



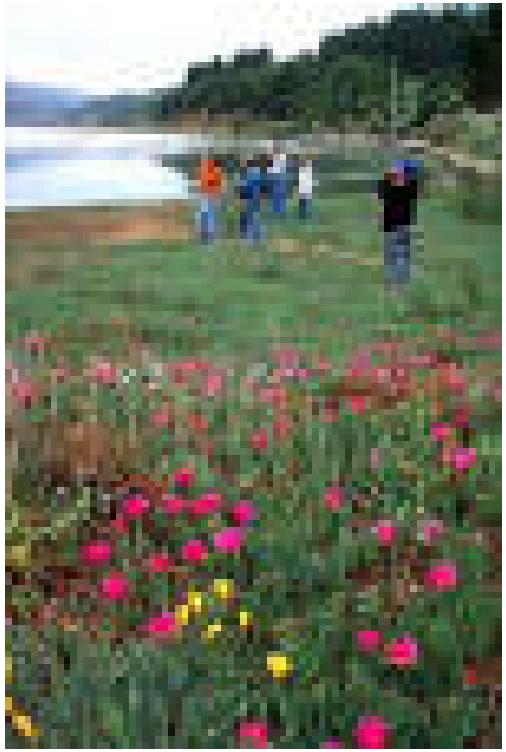
OPTIONS FOR REDUCING THE IMPACTS OF CLIMATE CHANGE ON COASTAL/ESTUARINE WETLANDS

1. Coastal/Estuarine

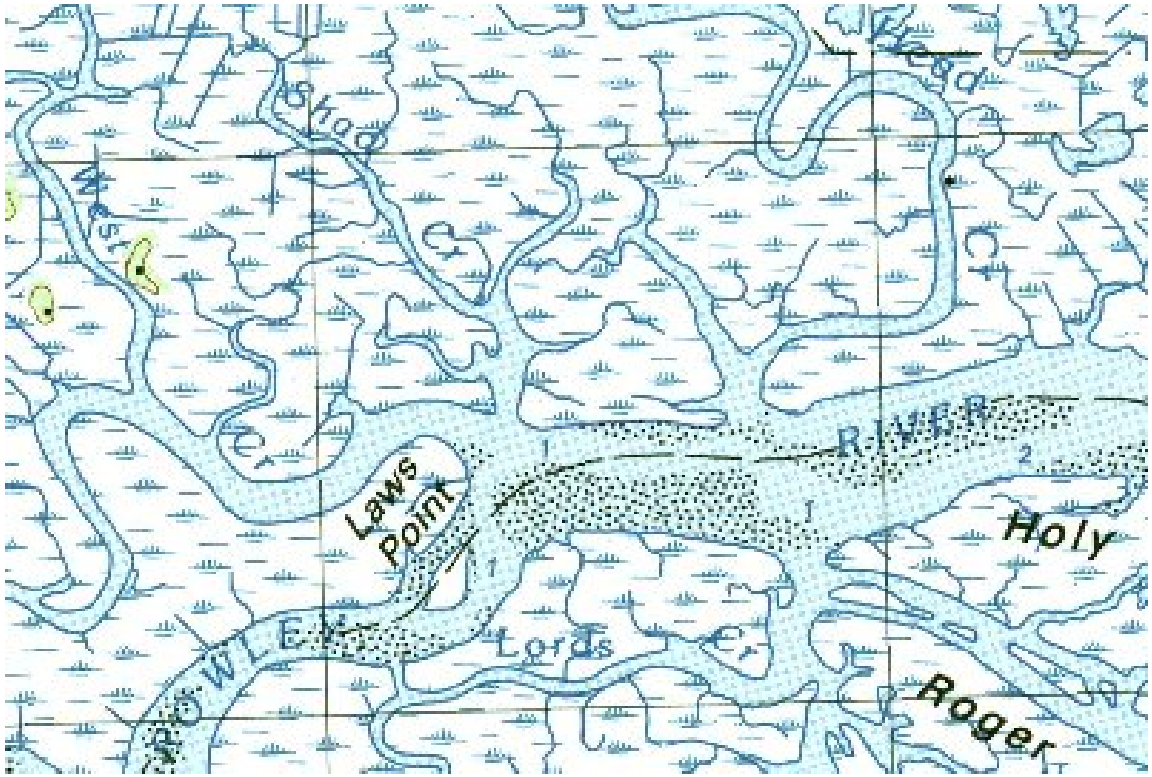
- **Identify coastal/estuarine wetlands at greatest risk**
- **Better protect existing wetlands**
- **Adopt setbacks, buffers.**
- **Dike.**
- **Carry out "managed retreat" strategies.**
- **Relocate buildings, roads, and other infrastructure after flood or hurricane disasters.**
- **Adopt measures to facilitate sediment transport. Require low flow release of water from reservoirs to maintain estuaries.**

IDENTIFY COASTAL/ESTUARINE WETLANDS AT GREATEST RISK

- Wetlands with no room to migrate due to steep natural topography, dikes, levees, sea walls, other development
- Wetlands with sediment deprivation due to upstream dams and reservoirs
- Wetlands with temperature sensitive endangered or threatened species



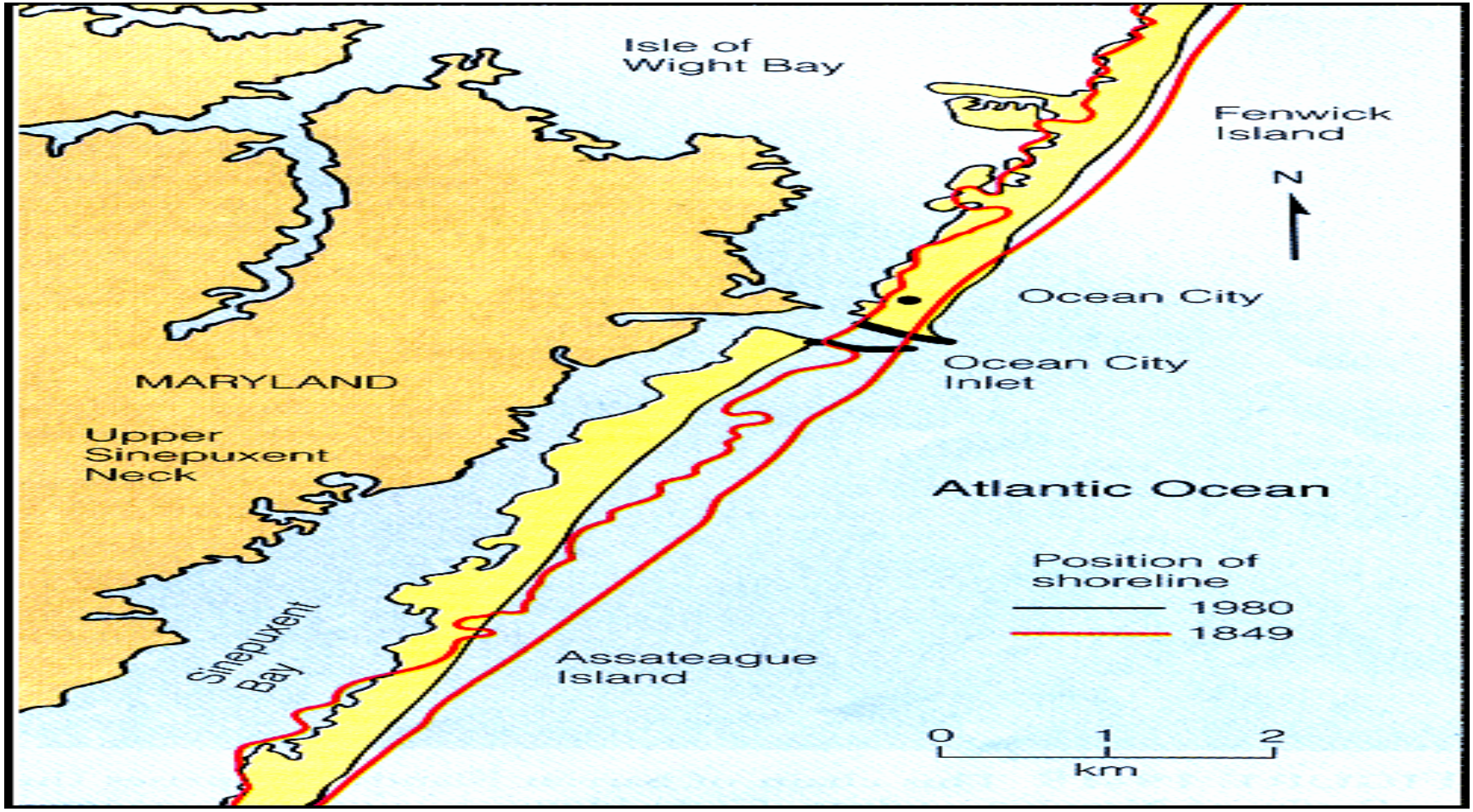
BETTER PROTECT EXISTING WETLANDS FROM DRAINAGE, FILLS WHICH MAY COMBINE WITH SEA LEVEL RISE TO DESTORY SUCH WETLANDS



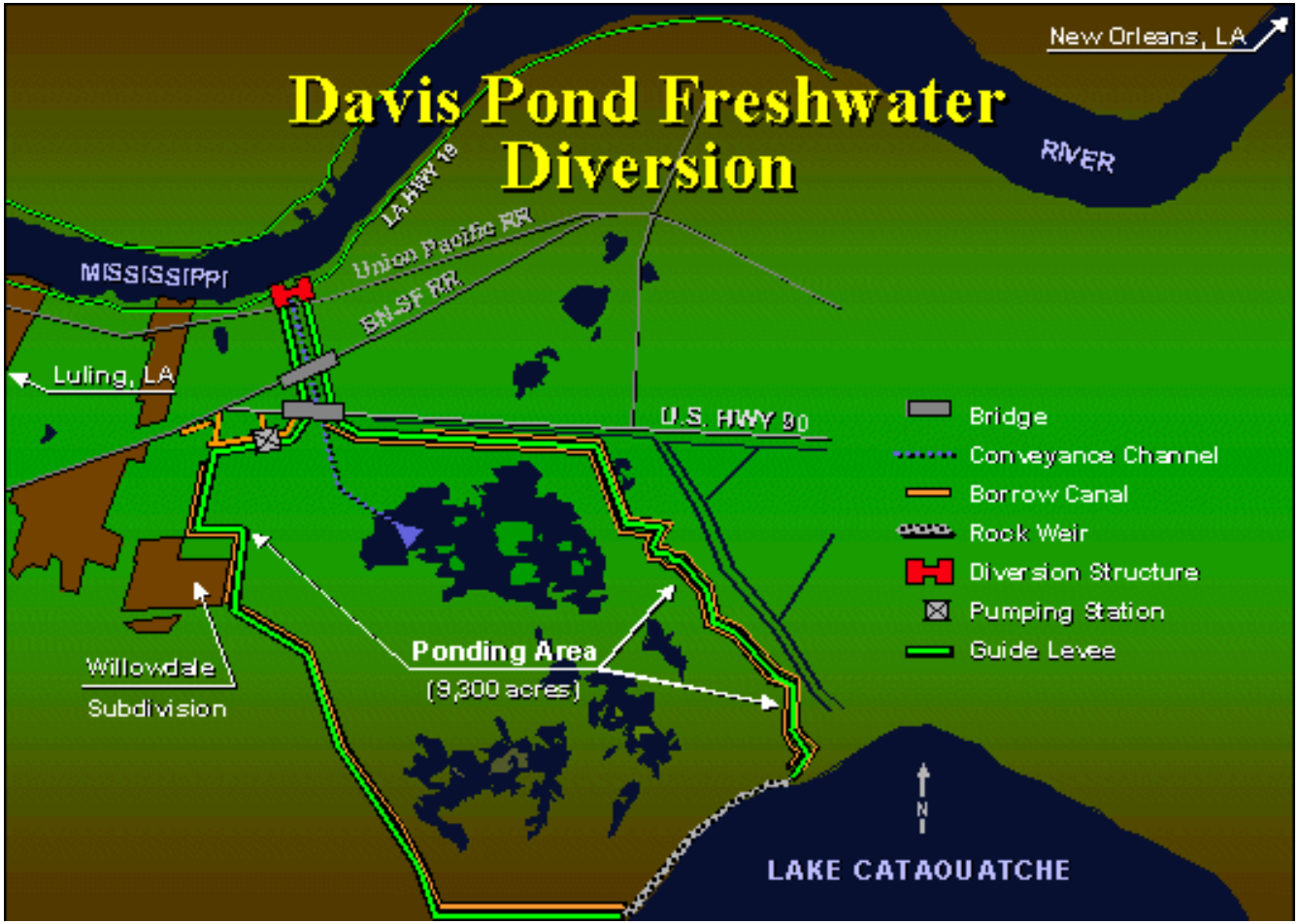
ESTABLISH BUFFERS (E.G., THE CHESAPEAKE)

REMOVE DIKES; OR, DIKE

MANAGE RETREAT



IMPLEMENT SEDIMENT DIVERSIONS



CONTROL INVASIVE SPECIES

OPTIONS FOR REDUCING THE IMPACTS OF CLIMATE CHANGE ON FRESH WATER WETLANDS

2. Freshwater Wetlands

- **Identify wetlands at risk**
- **Better protect existing wetlands from fills, drainage, pollution**
- **Restore wetlands (e.g., remove dikes, fill ditches, remove fill)**
- **Construct/operate water control structures**
- **Dike wetlands (but big negatives with this as well).**
- **Restore connectivity (e.g., dam removal).**
- **Control exotics and invasive species.**
- **Conduct stocking and captive breeding.**
- **Create wetland carbon banks.**

IDENTIFY WETLANDS AT RISK (E.G., VERNAL POOLS)

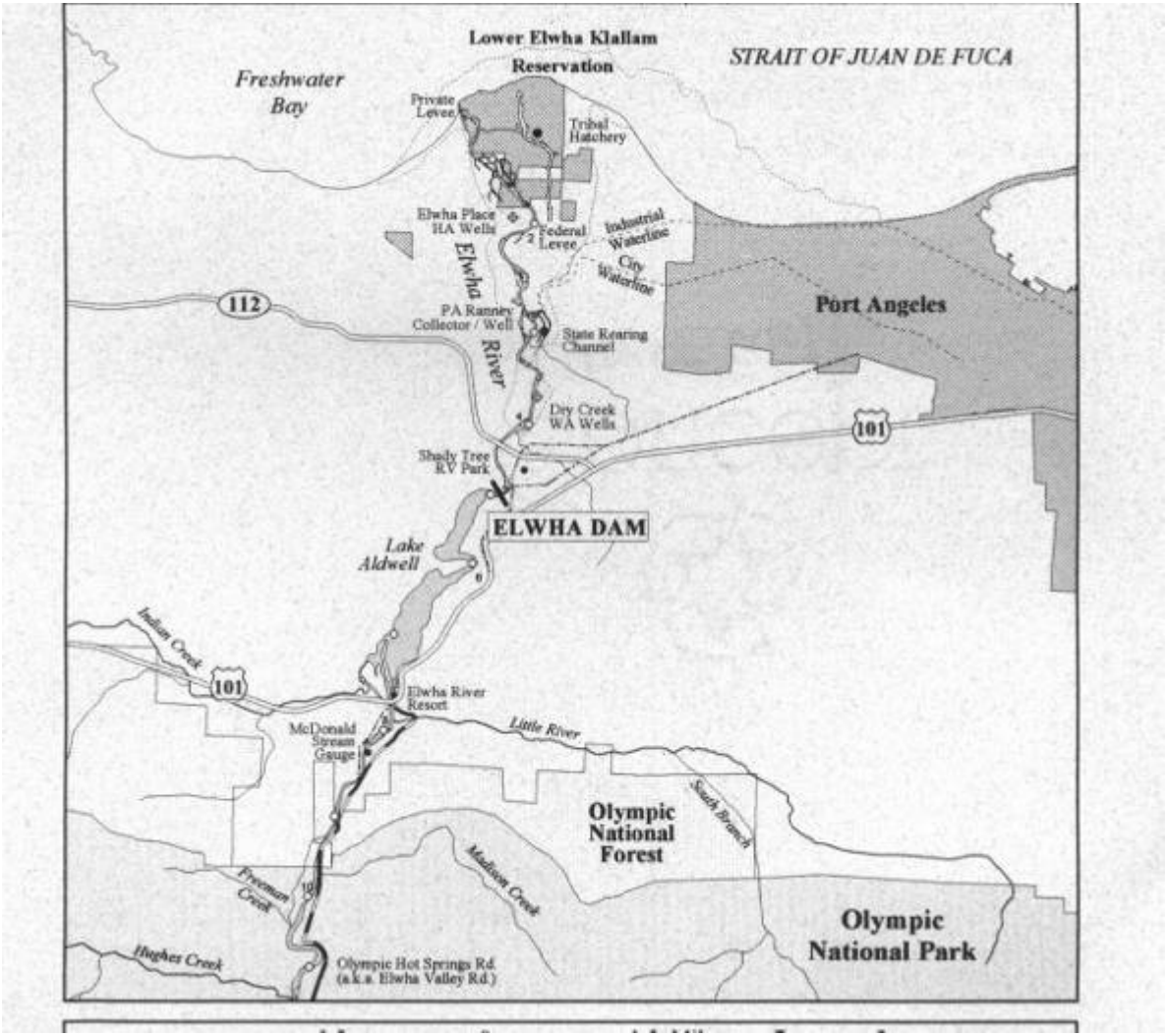
BETTER PROTECT WETLANDS AND ASSOCIATED BUFFERS

RESTORE WETLANDS

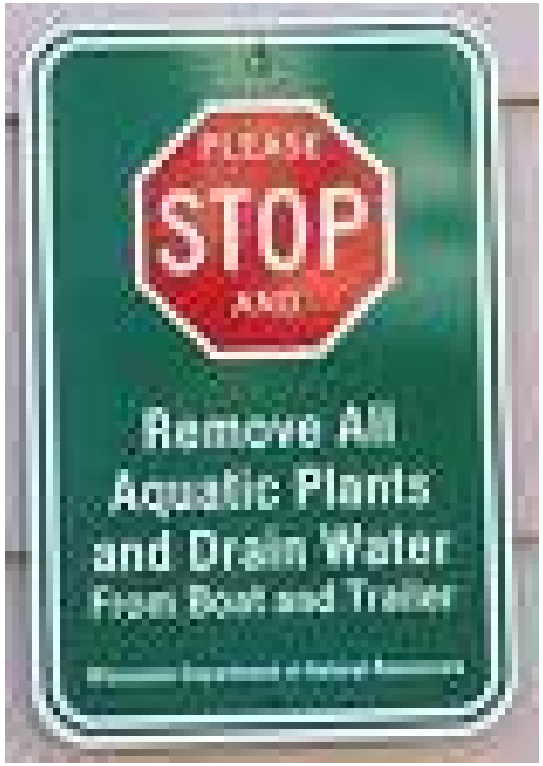
(Emphasis upon types which may be damaged or destroyed by climate change.)

INSTALL, OPERATE WATER CONTROL STRUCTURES

RESTORE CONNECTIVITY, CORRIDORS



CONTROL INVASIVE SPECIES



STOCK, CARRY OUT CAPTIVE BREEDING

CREATE WETLAND “CARBON BANKS”

- **Protect existing wetlands with large amounts of carbon from drainage, fills. Forested wetlands may be particularly attractive due to both above ground and below ground carbon stores.**
- **Restore wetlands, create new wetlands. Forested wetlands may, again, be particularly attractive.**
- **Manage existing wetlands, restored, or created wetlands to maximize carbon storage, minimize methane production. For example, water levels may be controlled to maintain saturation much of the year, conducive to storage of carbon. However, a small aerated zone in the soil may be maintained to encourage bacterial destruction of methane.**

IMPLEMENT OPTIONS FOR REDUCING METHANE PRODUCTION IN WETLANDS

- **Manipulate water levels to produce an oxygenated zone in existing or restored/created wetlands.**
- **Design wetland restoration, creation, and enhancement projects to favor oxygenated conditions.**
- **Increase sulfate levels, otherwise manipulate water chemistry.**

CONCLUSIONS

- **Climate change will have substantial impact on wetlands with resulting impacts on fisheries and shellfish and other wetland functions and values. However, impacts will be varied. Destruction of wetlands (e.g., melting of permafrost, drainage, drying out) will accelerate climate change.**

- **There are no broad scale ways to prevent these impacts except to reduce increased production of greenhouse gases. "Adjustment" is not a practical alternative for the majority of wetlands.**

- **A variety of adjustment measures are available to reduce impacts on particular wetlands. States, federal agencies, local governments, land trusts and private landowners should incorporate these measures into management, regulatory permitting, and compensatory mitigation.**

THANKS!