

Water Quality Planning Criteria and Design Standards

Ed Means
Vice-President
Malcolm Pirnie, Inc.

A project sponsored by the Water Research
Foundation (WRF)

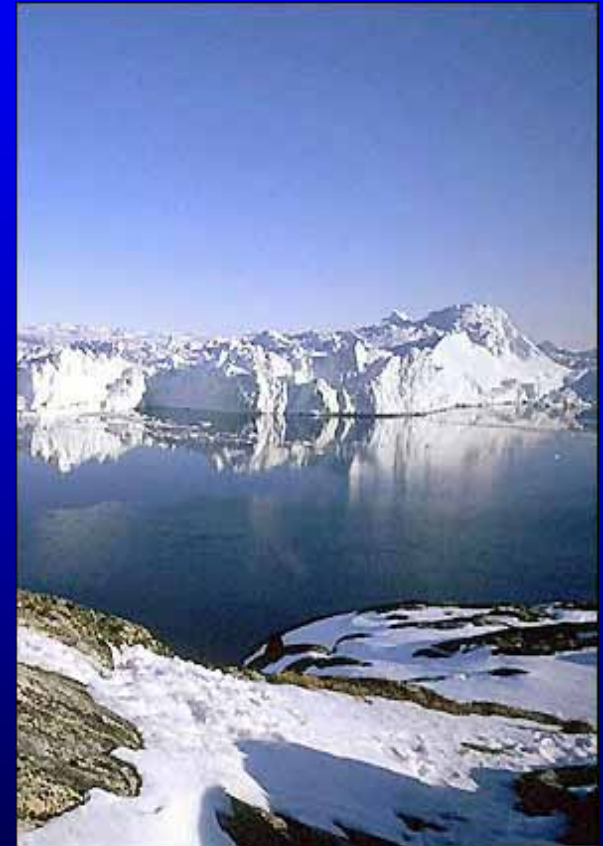
Outline



- Background
- Impacts
- Utility Tools
 - Mitigation
 - Adaptation

Recent Climate Trends for Western U.S.

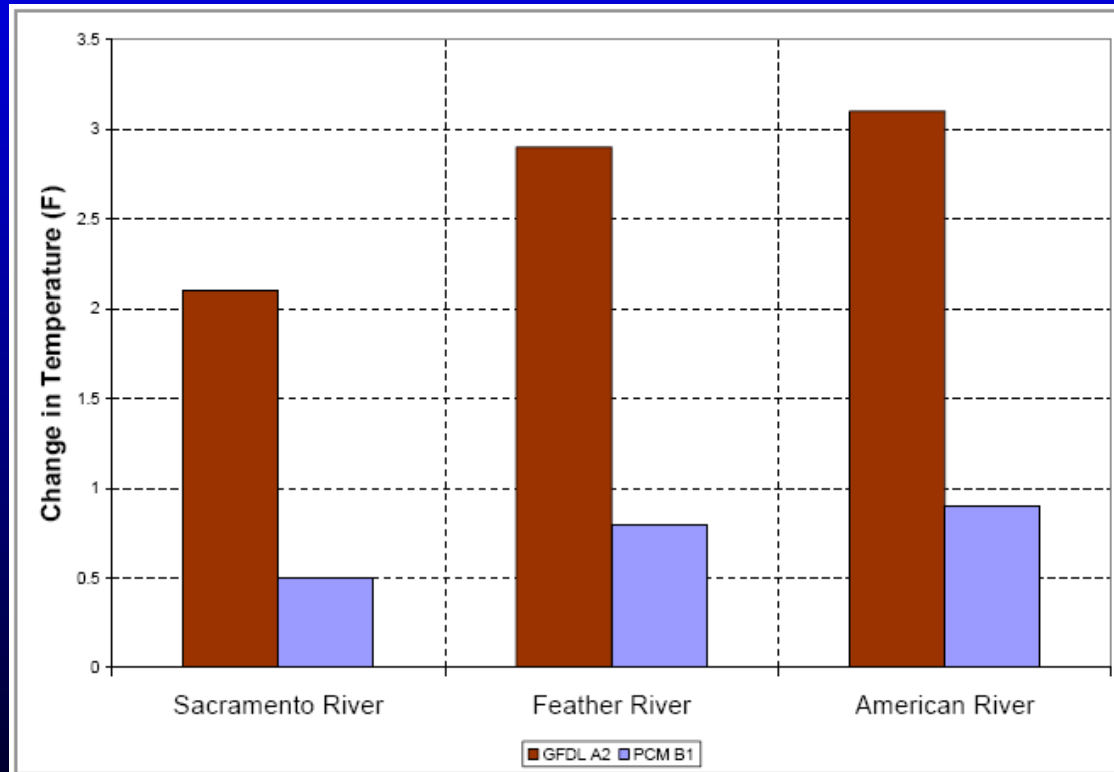
- Precip. continues to fluctuate over a several-year cycle
- Average temp has increased
- Average daily min temp has increased $>$ the max temp (heat island effects)
- Frequency of extreme climate events is increasing



These factors impact our water quality

Impacts: Chemistry

- Temp up in 2 climate change scenarios, substantially in one.



Overview of Impacts to Water Quality for Western U.S.

- Water Chemistry
 - Warmer water temp.
 - Lower DO
 - Higher potential for DBP in distribution systems
- Concentration
 - Increased erosion and wildfires
 - Increased turbidity, sedimentation, scour events
- Ecosystems
 - Vulnerability of sensitive species
 - Invasive species more prevalent

Impacts: Chemistry

Practical effects of temp rise:

- Effects on cold water species
 - ammonia chemistry & aquatic sp.
 - DO levels;
 - sensitivity to pollutants, parasites & pathogens
- Photosynthesis rate (T&O issues)
- Metabolic rates; DO demand; organics decay rates
- Effect on corrosion rates ($2C = 25\% \uparrow$)
- Effect on chlorine residual



Impacts: Chemistry

Un-ionized NH₃ as a percent of total ammonia (by temp & pH). % NH₃ of total ammonia

Temp (F)	pH 8.5
68	11.2%
77	15.3%
82	18.2%
86	20.3%



Lethal levels for dissolved or unionized ammonia for salmonids ranges from 0.083 to 1.09 mg/L (U.S. EPA, 1986)

Impacts: Concentration

Practical effects:

- Runoff variation can affect contaminant concentration
- Wastewater discharge mixing zone impacts
- Impacts on sensitive aquatic species

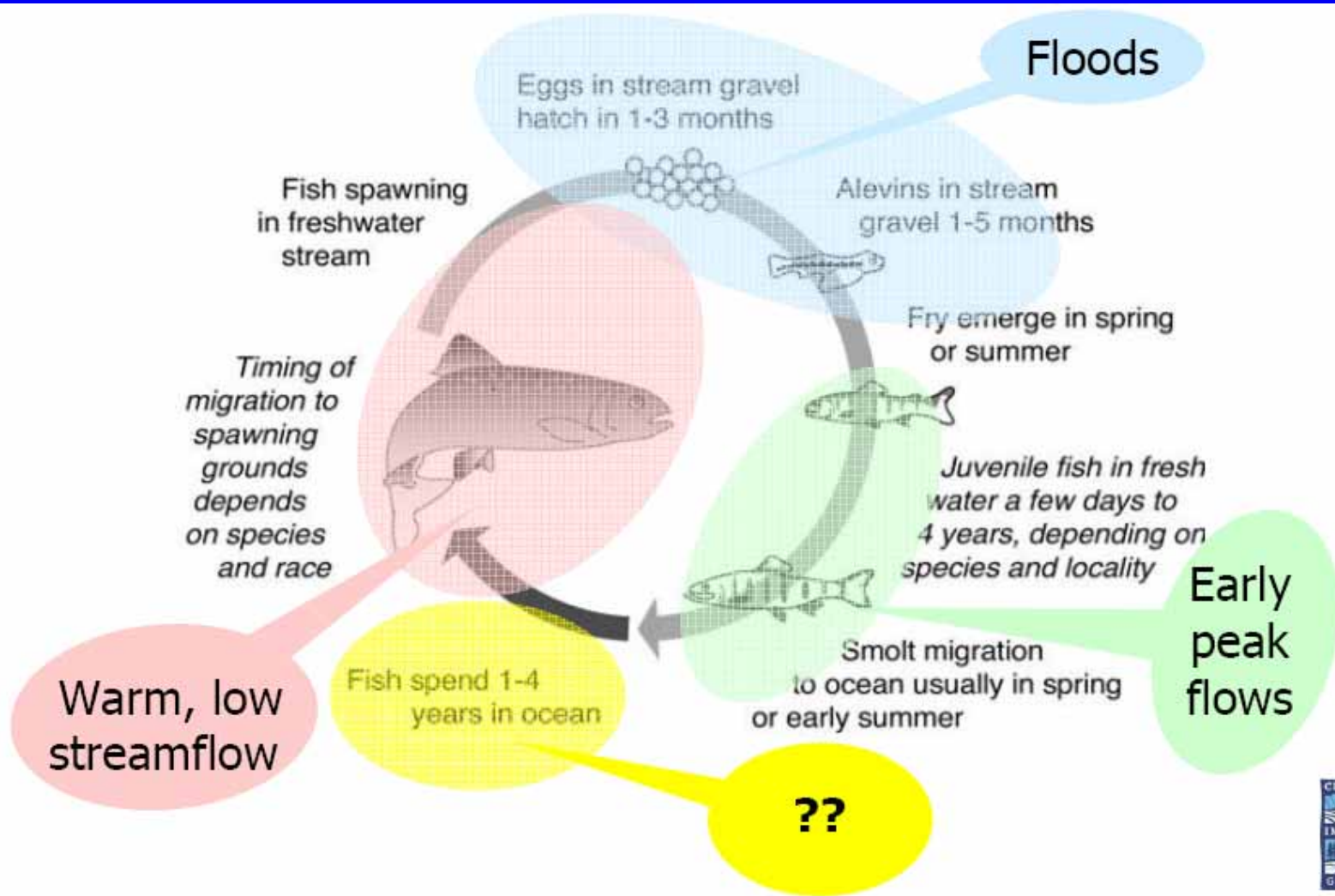


Combined Sewer Overflow (CSO)
Plume in Lake Michigan
(Milwaukee Harbor).



Impacts: Sensitive Species

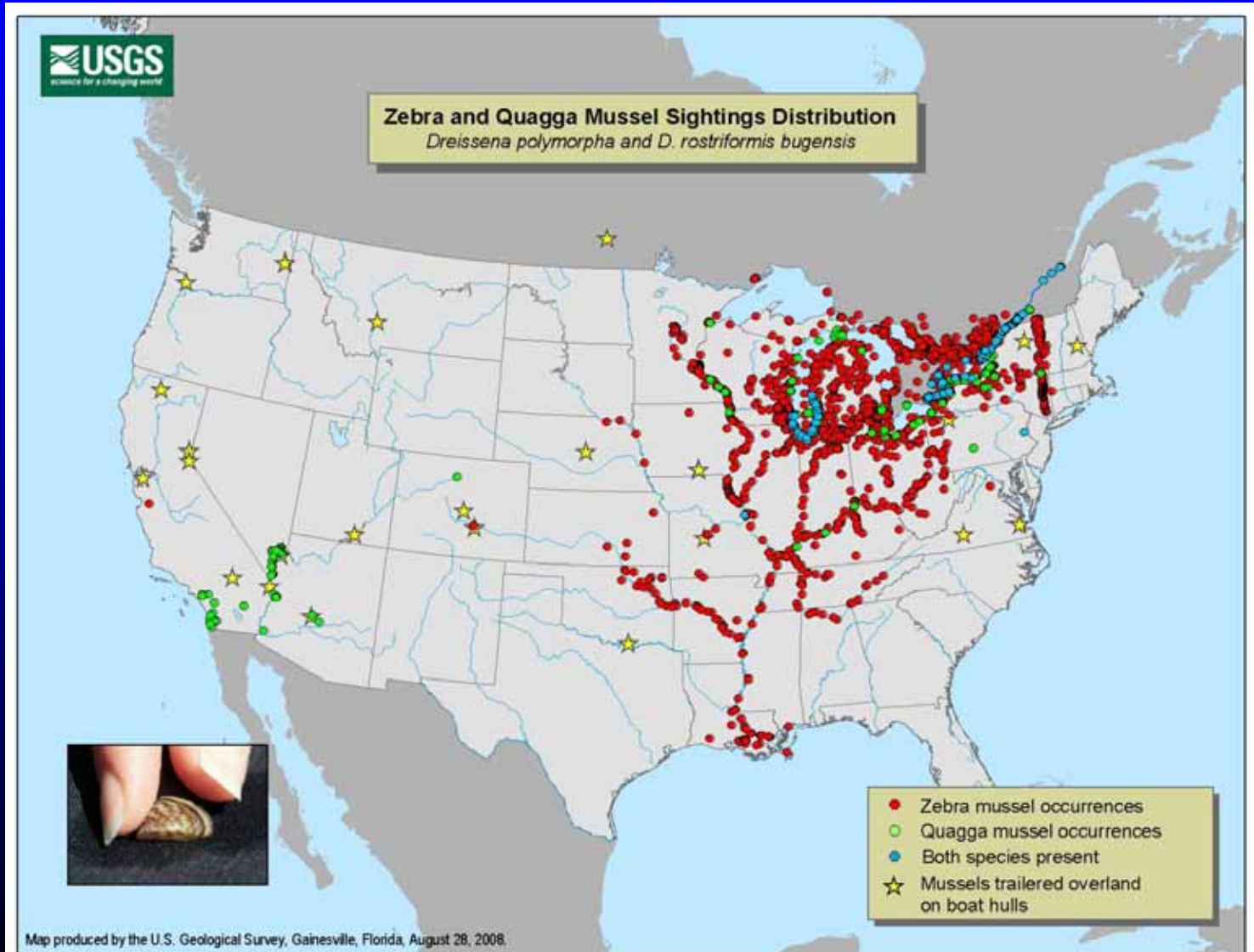
Impacts to cold water species



Impacts: Invasive Species

Increased occurrence of invasive species

Water Quality



WRF Project Objectives

- Evaluate planning & design criteria for potential climate change impacts.
- Climate variations in the Western U.S.
- How utilities can adapt and prepare for climate change.
- Build off previous AwwaRF study, *Climate Change and Water Resources: A Primer for Municipal Water Providers*.

Utility Survey

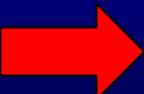
- Online survey of 39 utilities (24 responded)
 - Utility overview
 - Planning criteria evaluation for climate change
 - Design standards evaluation for climate change
 - Water quality impacts
- Assess current standards and observed/anticipated climate impacts

Survey : Design Standard Assessment

- 3 of 24 utilities assessed existing design criteria that may be susceptible to the impacts of climate change.
 - Design capacity & operational capacity of most concern
- 8 of 24 agencies see increased volatility or changes in magnitude associated w/ changing climatic conditions having a greater impact on design standards.

Survey : Water Quality

- 3 of 23 assessed existing design criteria for water treatment & disinfection facilities that may be susceptible to the impacts of climate change.
 - Poor WQ impacts on design standards for current & future treatment & disinfection facilities rated high (12 of 23) and low (6 of 23).
- 9 of 24 utilities heard about WQ impacts associated w/ climate change mentioning
 - Algae growth in reservoirs, THM increase
 - Spread of vectors, invasive species, & pathogens that could be related to changing climate



Raw water quality events have been observed BUT NOT been linked to climate change by surveyed utilities

Utility Tools: Mitigation

- Implementing monitoring programs (temps, chem parameters, sensitive species).
- Implementing fire protection programs in the watershed.
- Managing reservoirs to modify in-stream flows.
- Developing ability to by-pass source during scour events.
- Controlling reservoir water temp using tiered releases.
- Controlling invasive species (e.g., early chlorination).
- Relocating vulnerable facilities.
- Bolster treatment to handle events.

Utility Tools: Adaptation

- Communicating w/ planning & watershed departments.
- Accounting for WQ impacts on CIPs.
- Select treatment to account for WQ changes.
- Integrating energy-efficient processes & designs.
- Incorporating WQ modules in GCMs.
- Minimizing prediction uncertainties:
 - Funding more research on WQ impacts.
 - Understanding timing of occurrence.
- Build in supply buffers

Questions

emeans@pirnie.com

(949) 450-7921