Changes in Thermal Structure and Water Quality of Lake Mead Due to Lower Lake Levels

LMSS

Las Vegas, NV
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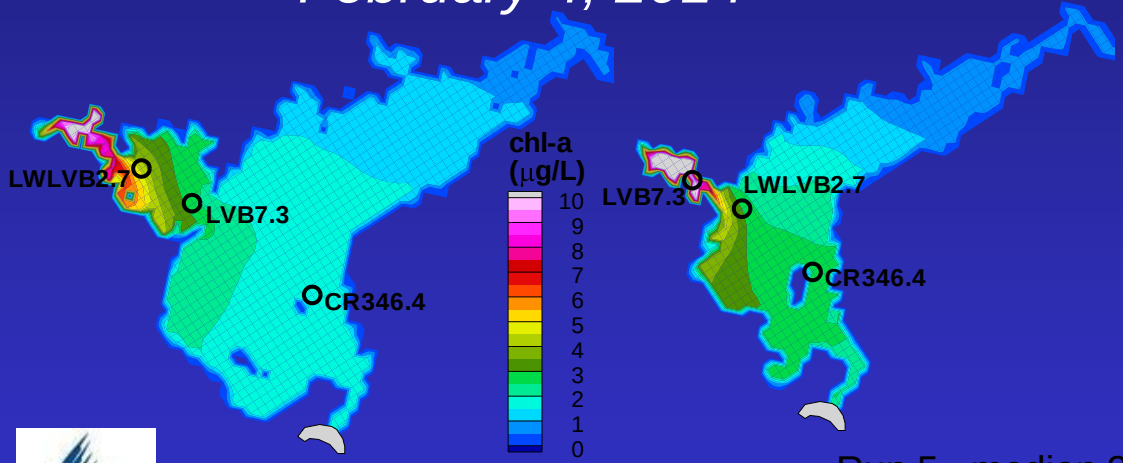
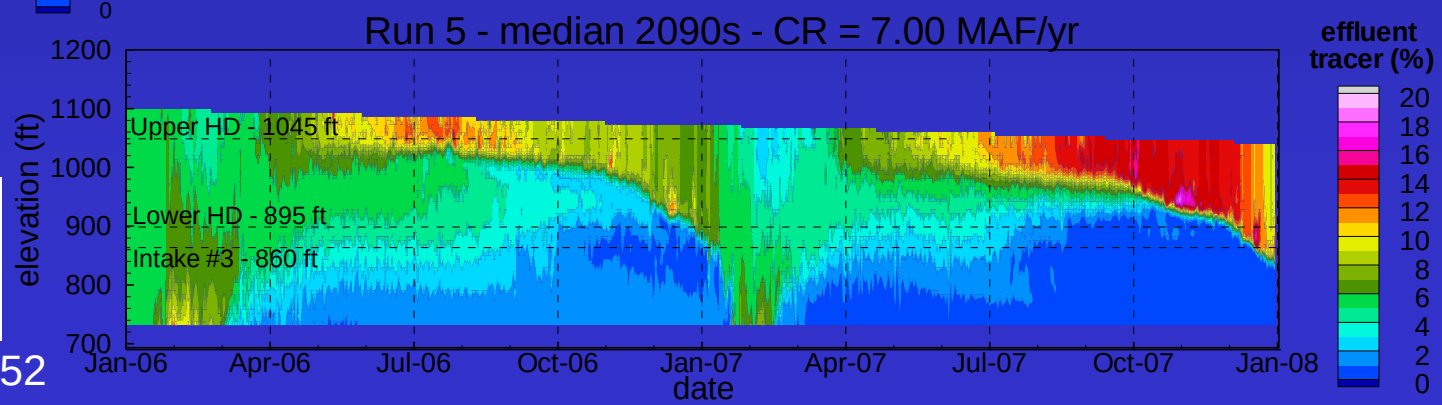
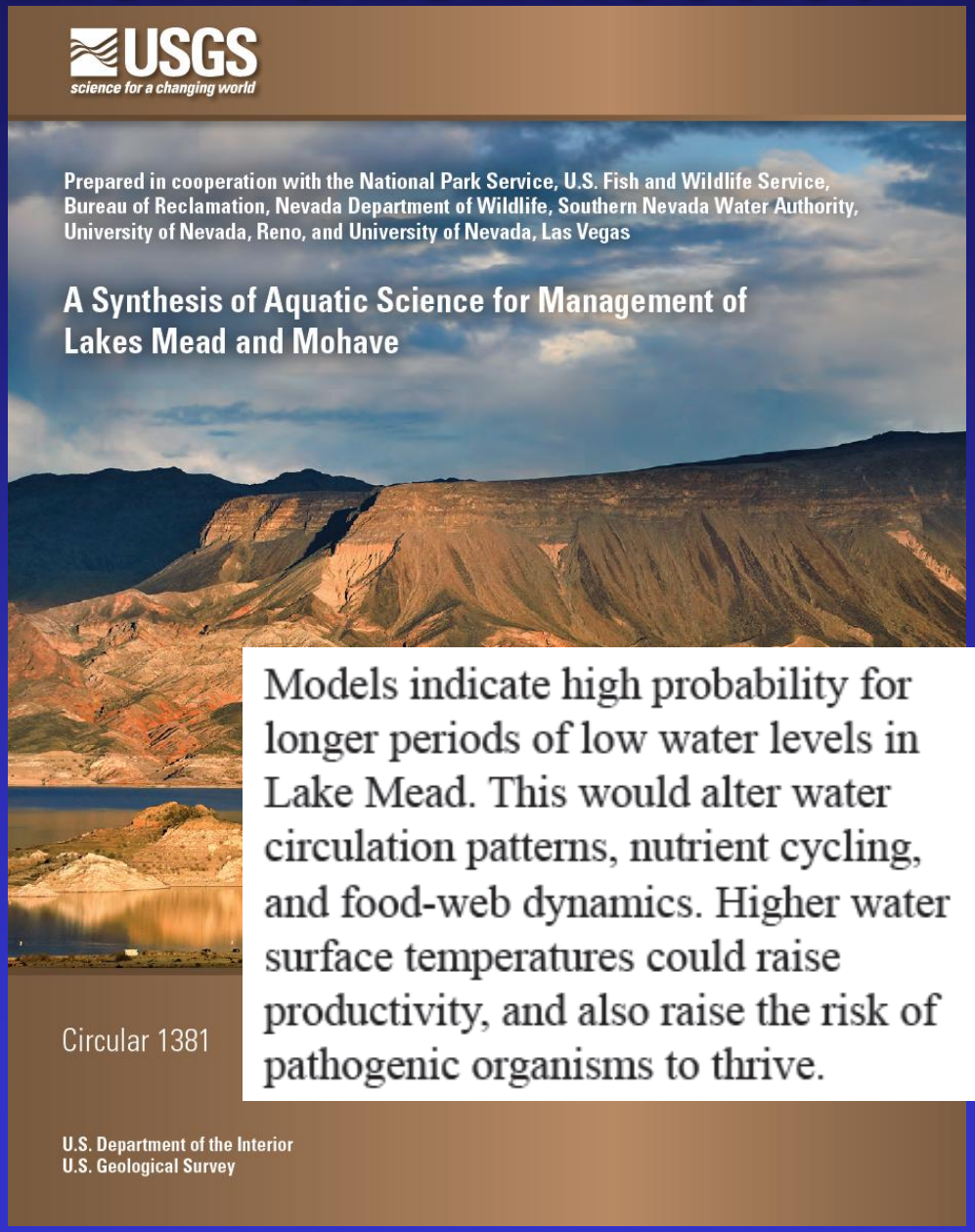
2. Southern Nevada Water Authority





Agreement # R11AP81452

Information Needed



Models indicate high probability for longer periods of low water levels in Lake Mead. This would alter water circulation patterns, nutrient cycling, and food-web dynamics. Higher water surface temperatures could raise productivity, and also raise the risk of pathogenic organisms to thrive.

Information needed for Lakes Mead and Mohave relates to potential impacts of low flows, lower water levels, increased air temperatures, and increased water temperatures on limnology, ecosystems, fish and wildlife, and recreation and potential pathogens.

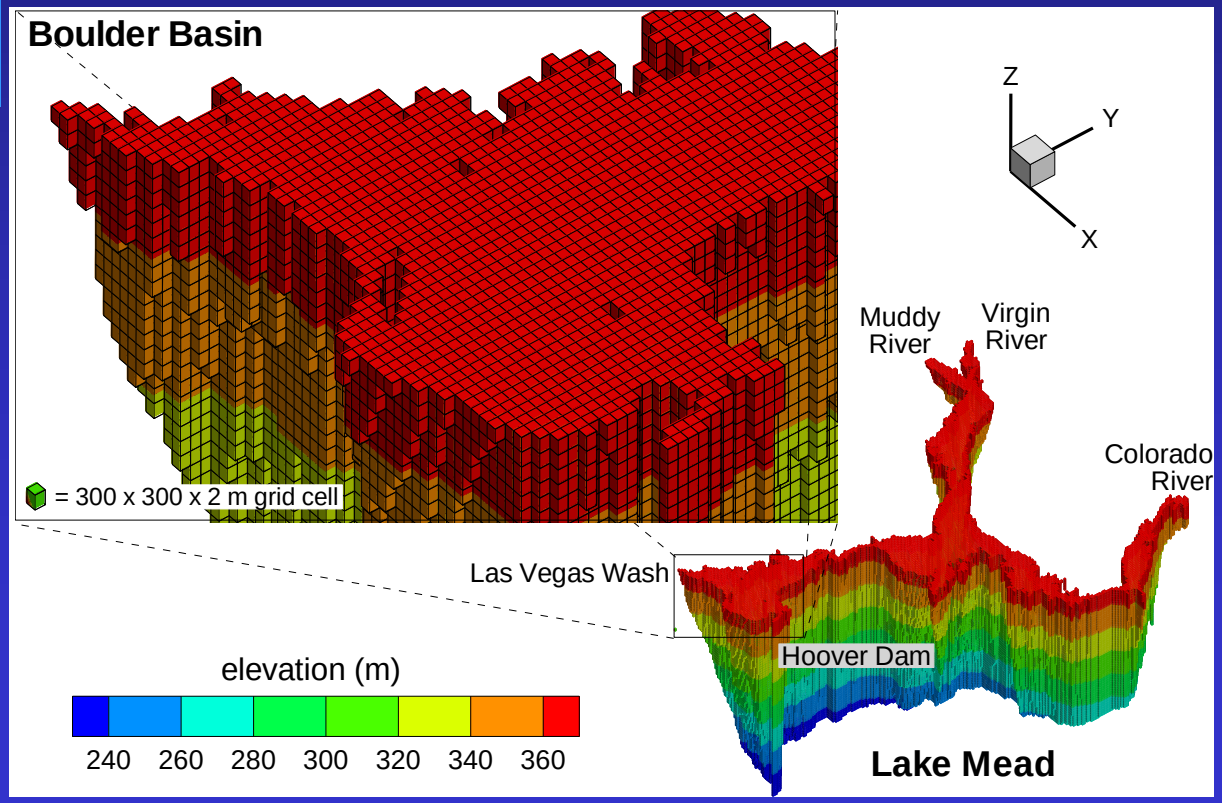
Lake Mead

SOUTHERN NEVADA WATER AUTHORITY

Nevada

Lake Mead Model

- Lake Mead Model (LMM) uses ELCOM/CAEDYM codes
- ELCOM
  - 3-D hydrodynamic model, stratification, wind mixing, temperature, salinity, conservative tracers
- CAEDYM
  - Water quality module, algae (chl-a), nutrients, TOC, DO, pH



- ELCOM/CAEDYM developed by Centre for Water Research (UWA)
- LMM Funded by Clean Water Coalition, SNWA and National Park Service

Adjustment of LMM inputs

- Air temperature
- Inflow water temperature

} Primary drivers
CMIP3 projections

- Inflow rates
- WSEL

} Difficult to quantify. Uncertainty.
Upstream inflows are controlled.
Examined extremes.

- Inflow water quality

} Difficult to quantify.
Not considered.

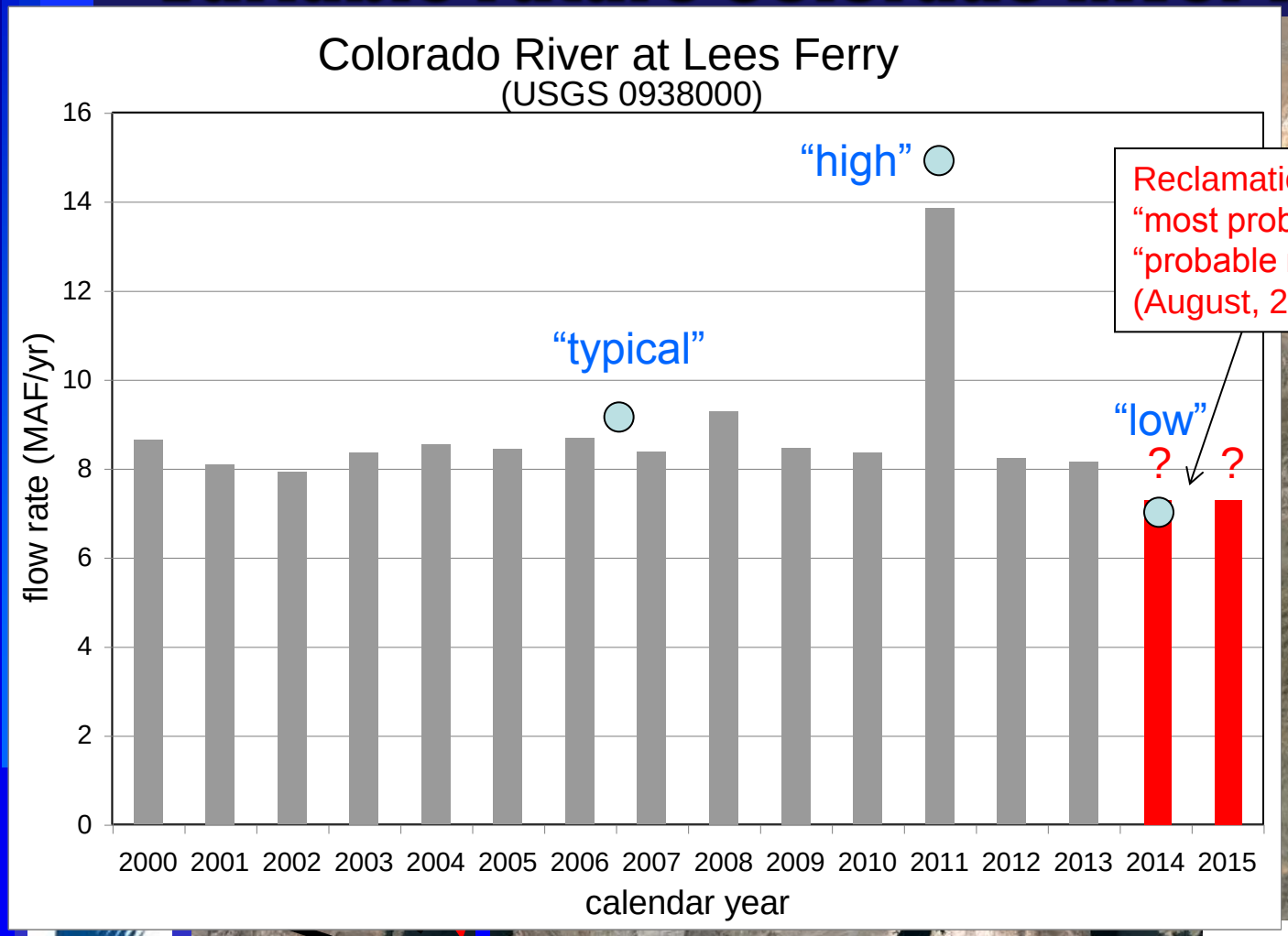
- Wind speed
- Rainfall

} Climate projections indicate generally small changes.
Not considered.

- Relative humidity
- Solar radiation / cloud cover

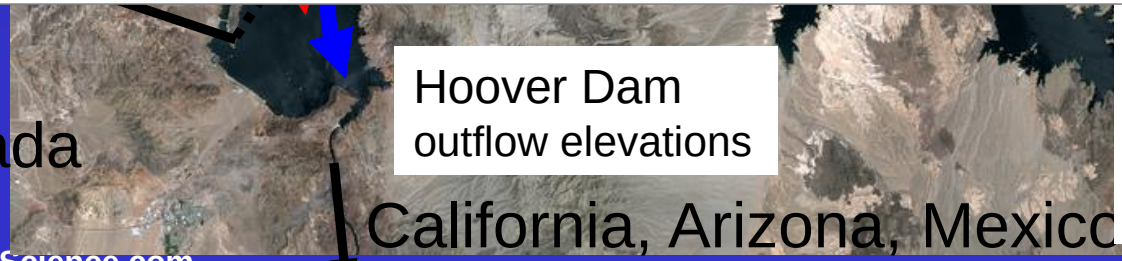
} Climate projections did not provide direct information.
Not considered.

Variable Future Colorado River Inflows



Reclamation projections "most probable" and "probable minimum" (August, 2013)

Colorado River
dilution, DO
lower future flows?



Hoover Dam
outflow elevations

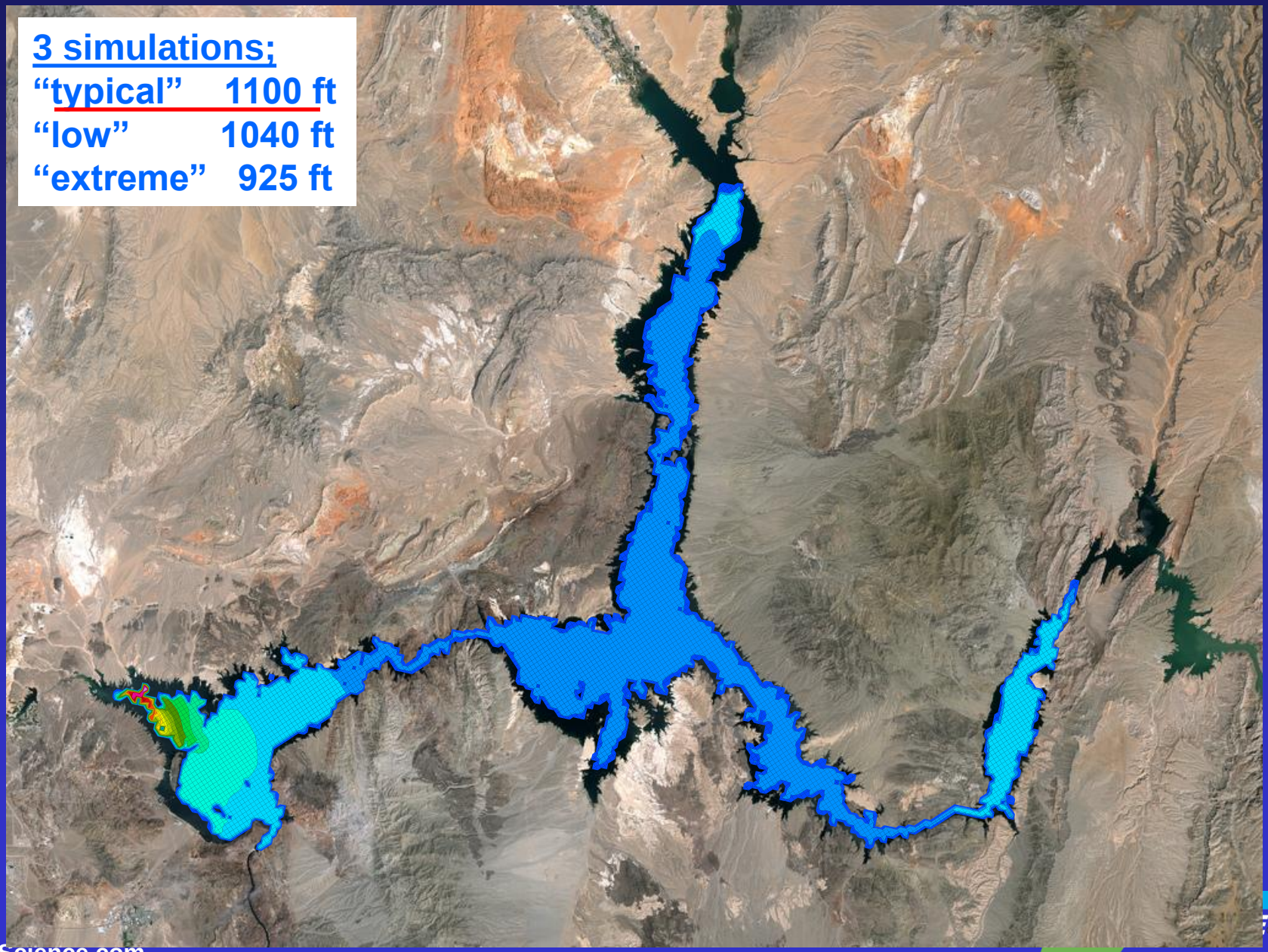
Nevada

California, Arizona, Mexico

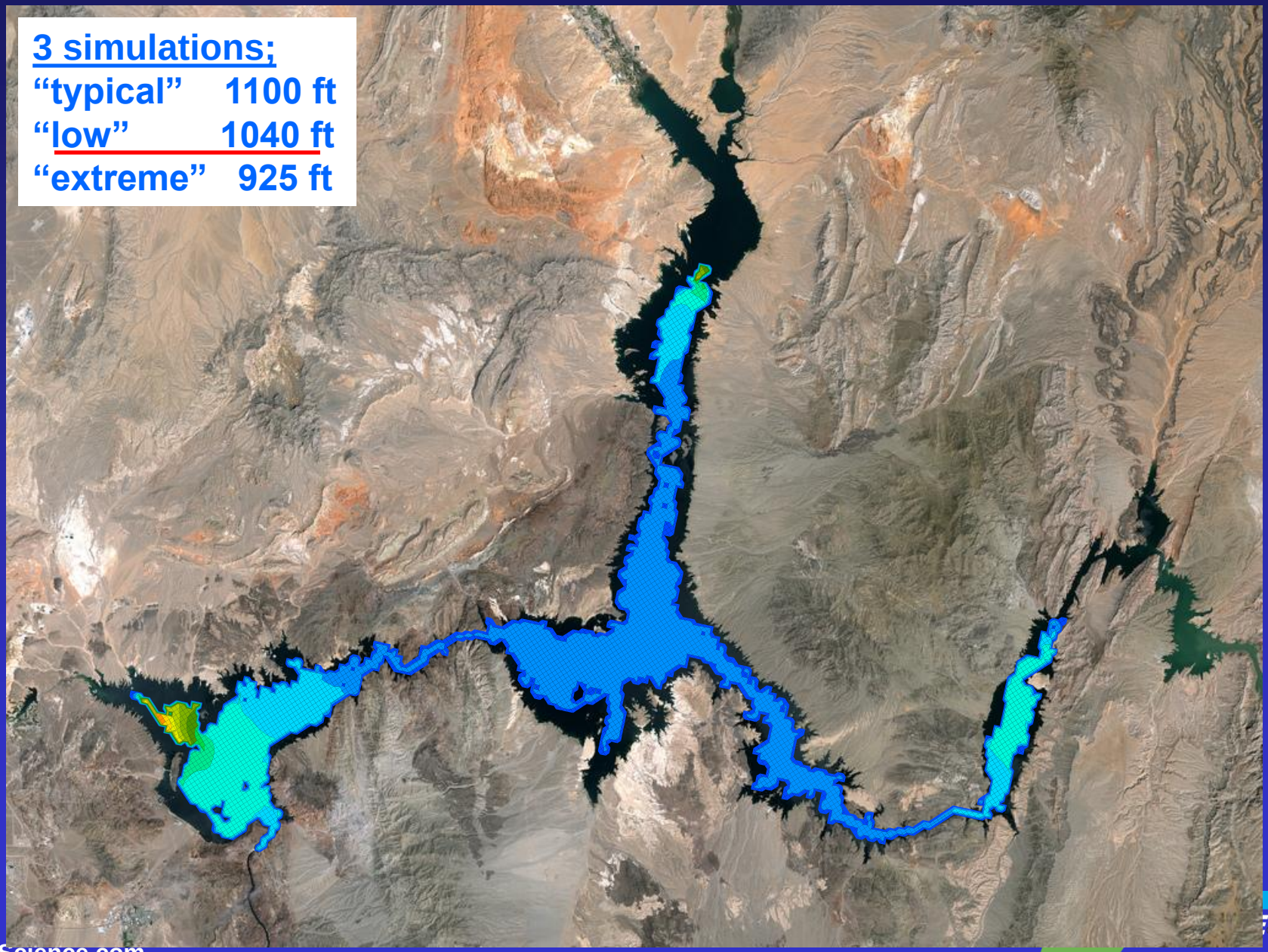
3 simulations;

"typical" 9.23 MAF/yr
"high" 14.78 MAF/yr
"low" 7.00 MAF/yr

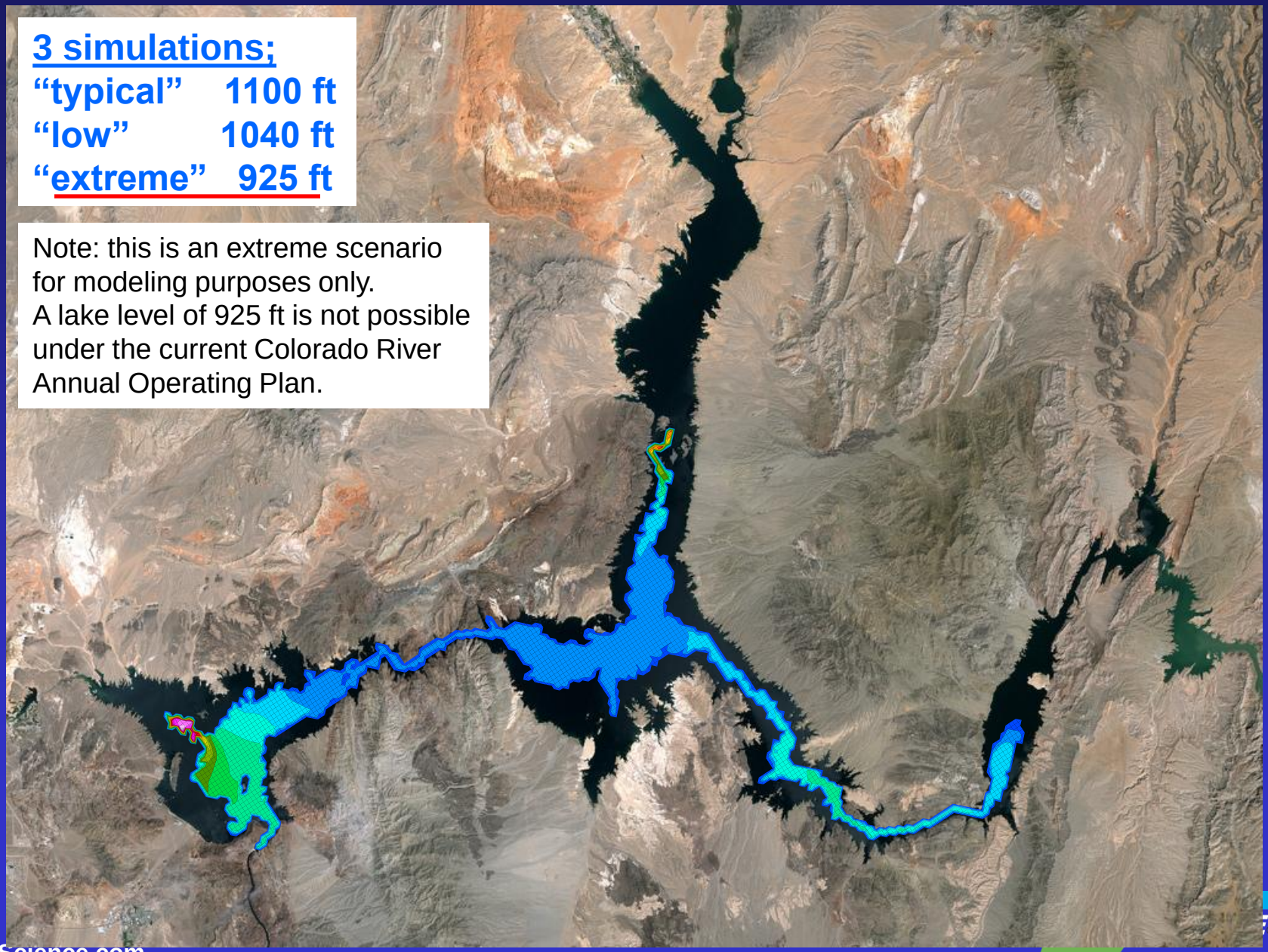
Lower Water Surface Elevation



Lower Water Surface Elevation



Lower Water Surface Elevation

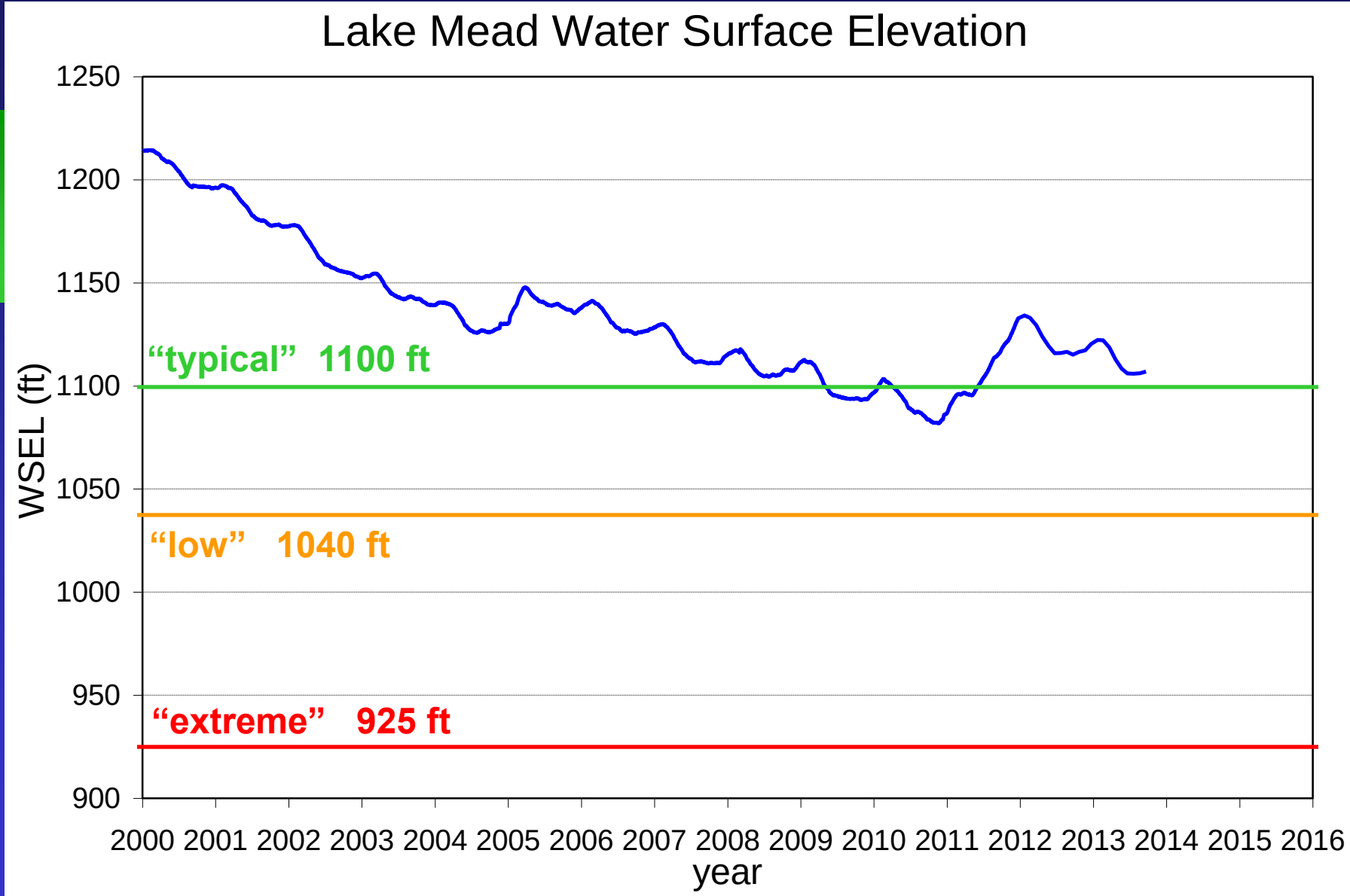


3 simulations;

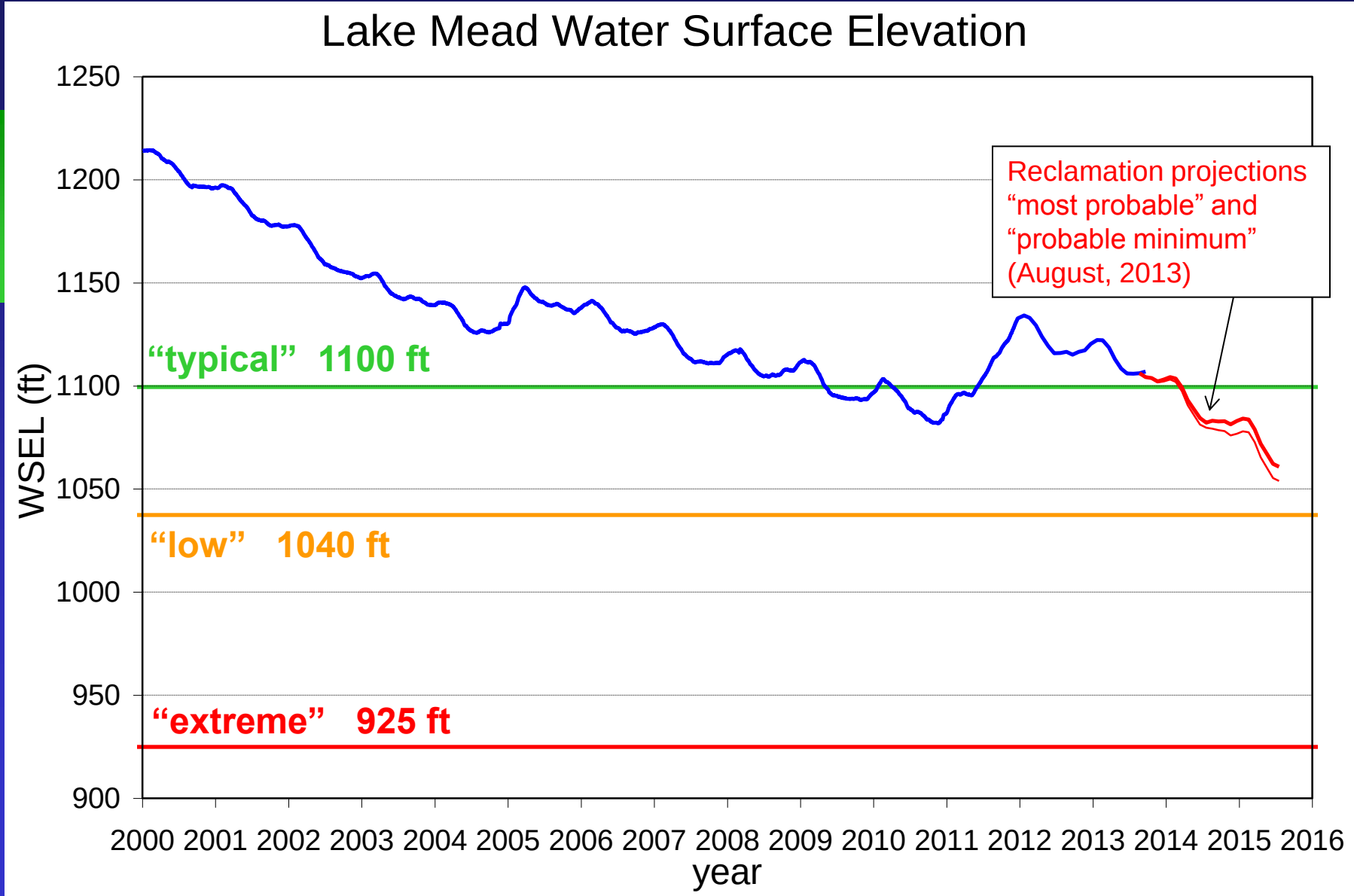
"typical"	1100 ft
"low"	1040 ft
"extreme"	925 ft

Note: this is an extreme scenario for modeling purposes only.
A lake level of 925 ft is not possible under the current Colorado River Annual Operating Plan.

Lower Water Surface Elevation



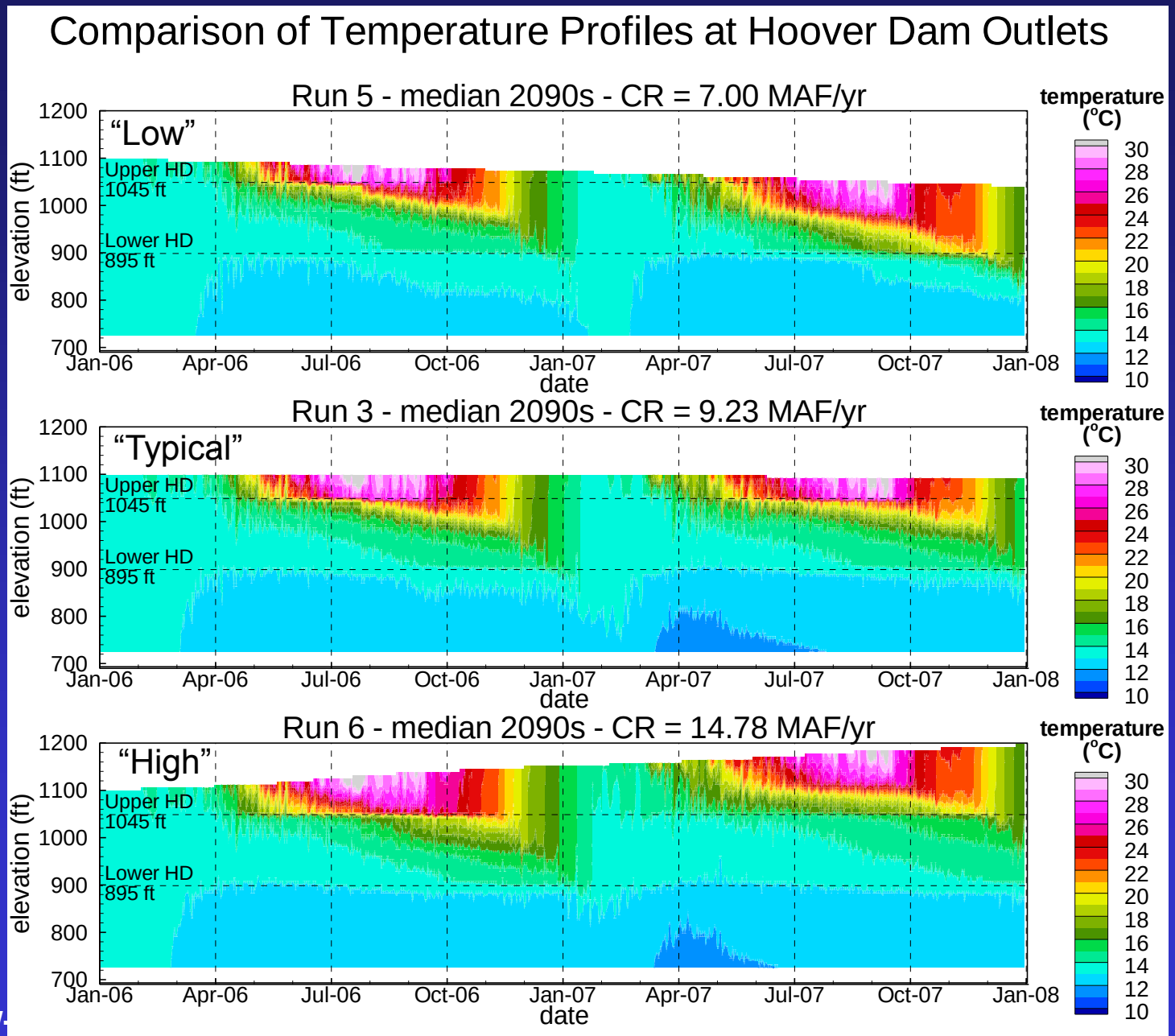
Lower Water Surface Elevation



Results

- **"Hoover Dam effect"**
  - Withdrawals from epilimnion
- **WSEL**
  - SNWA Intake #3
- **Algae (Chlorophyll a)**

“ Hoover Dam Effect ”



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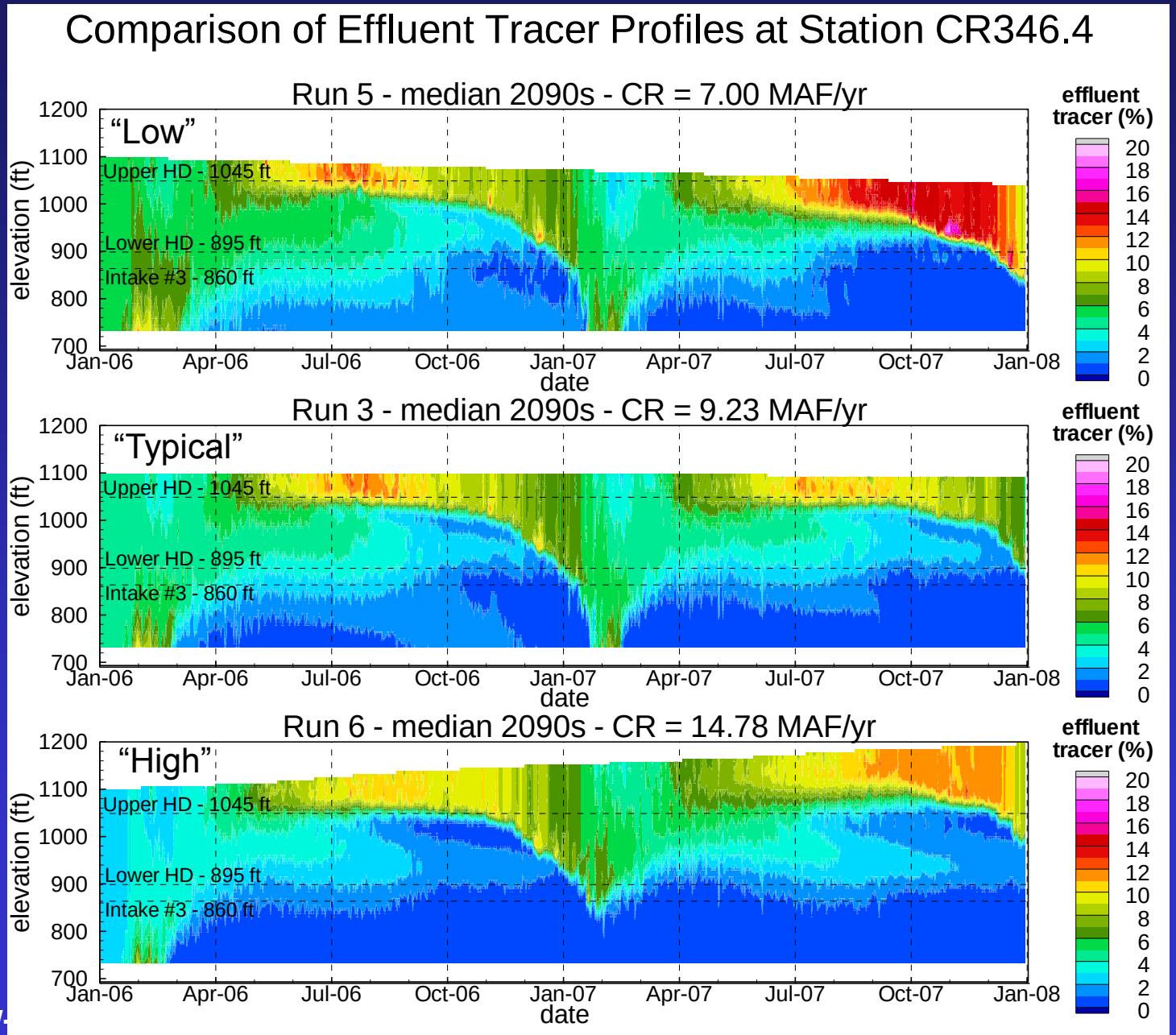
“ Hoover Dam Effect ”



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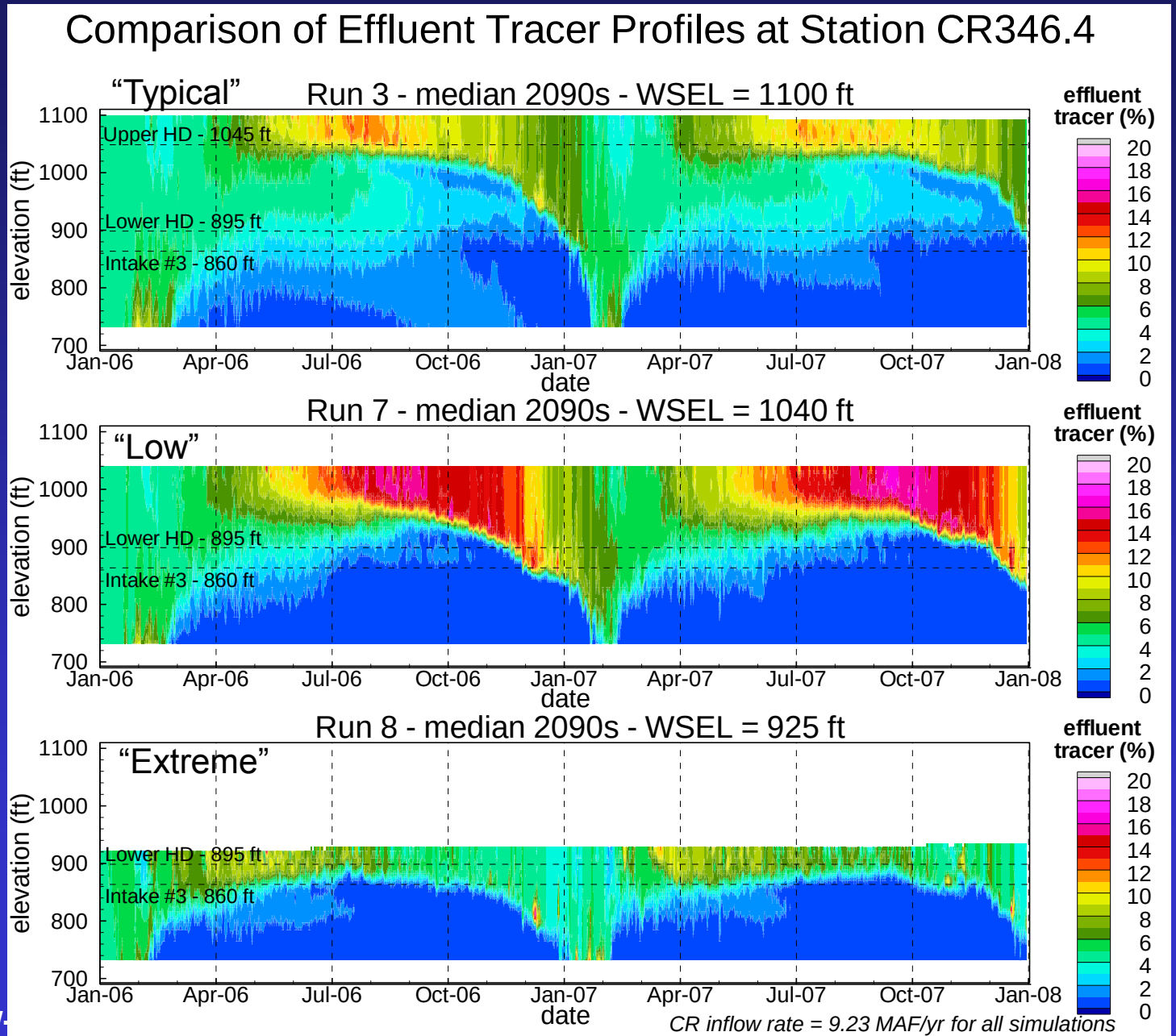
WSEL (and Hoover Dam Effect)



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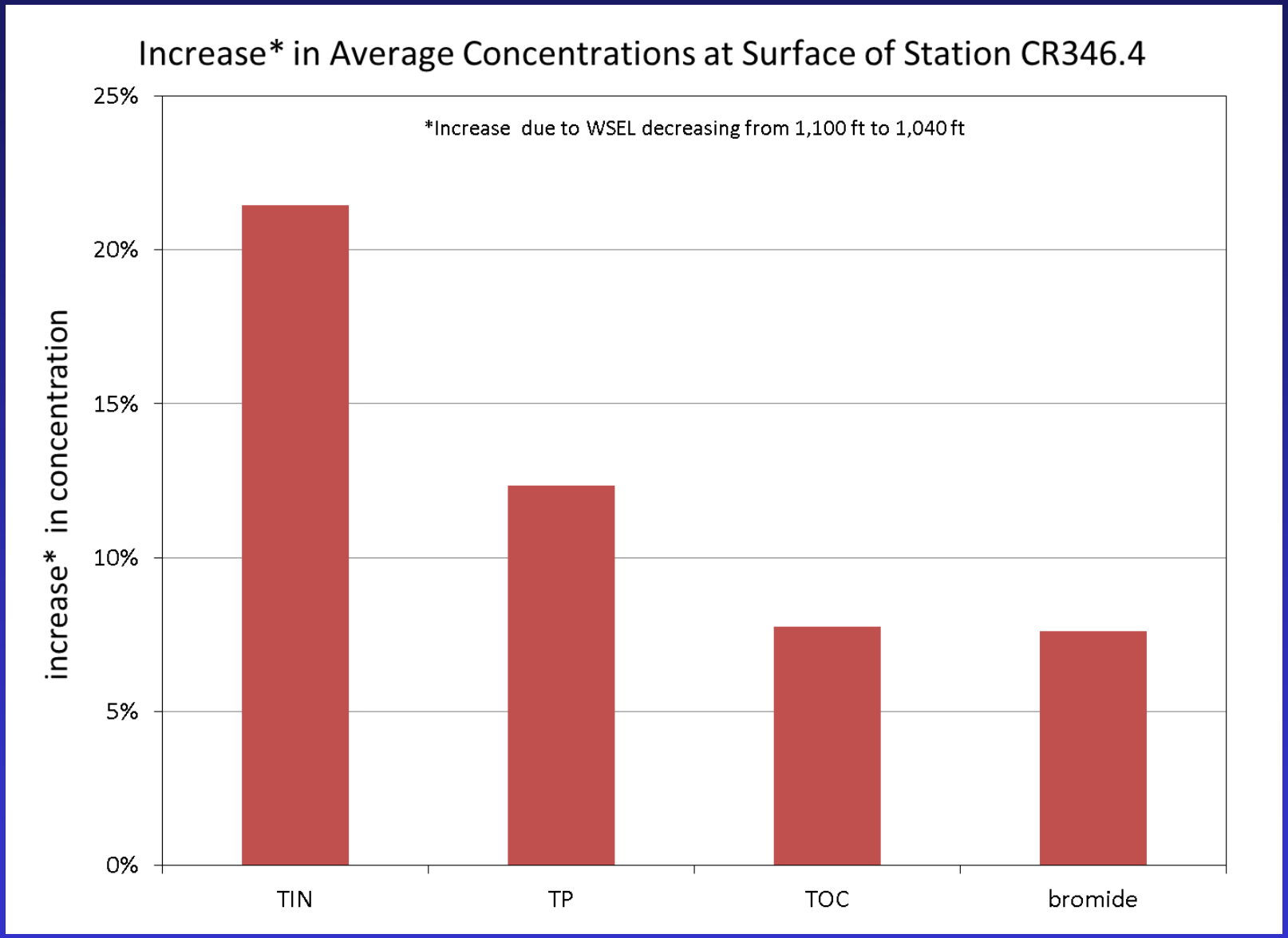
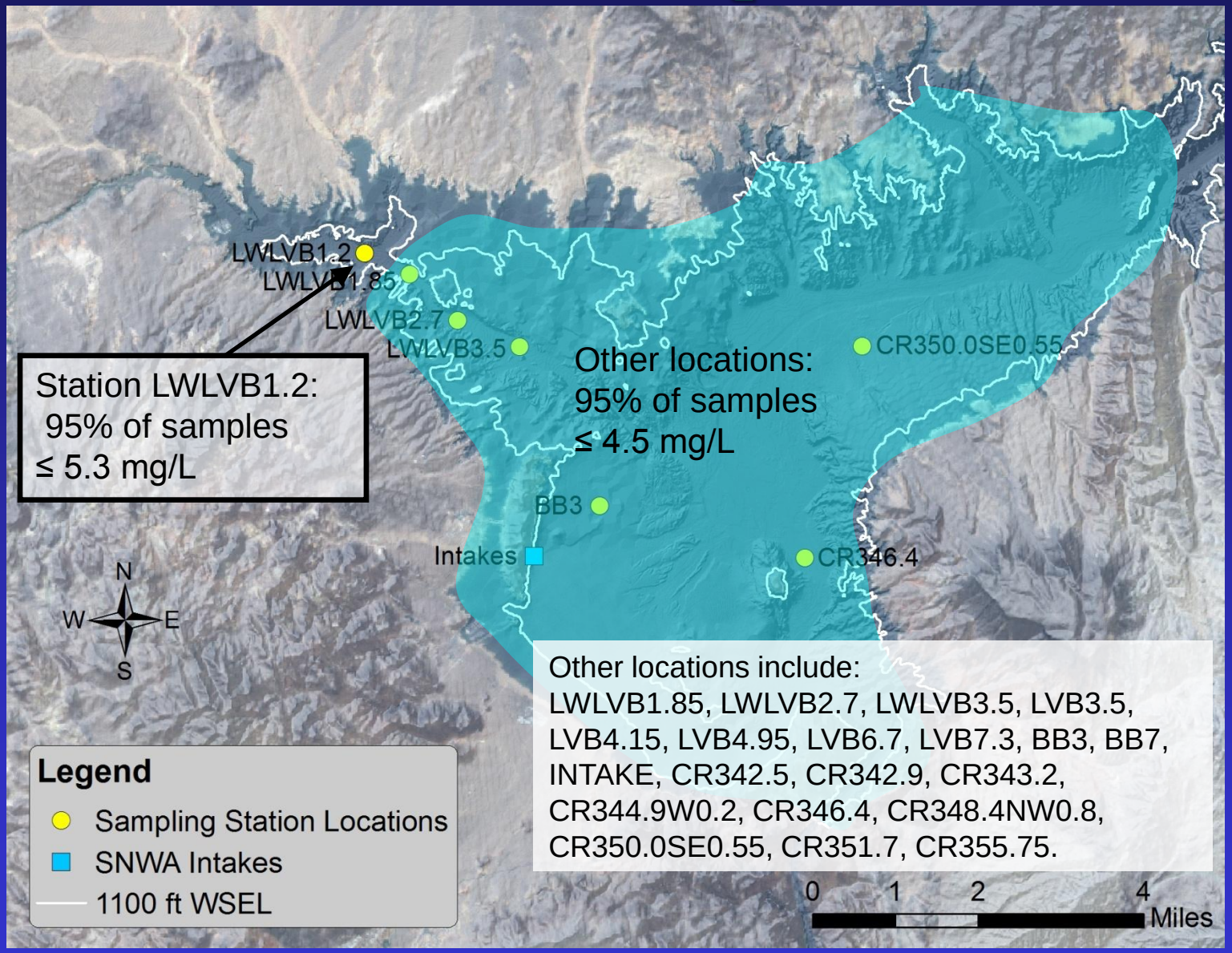
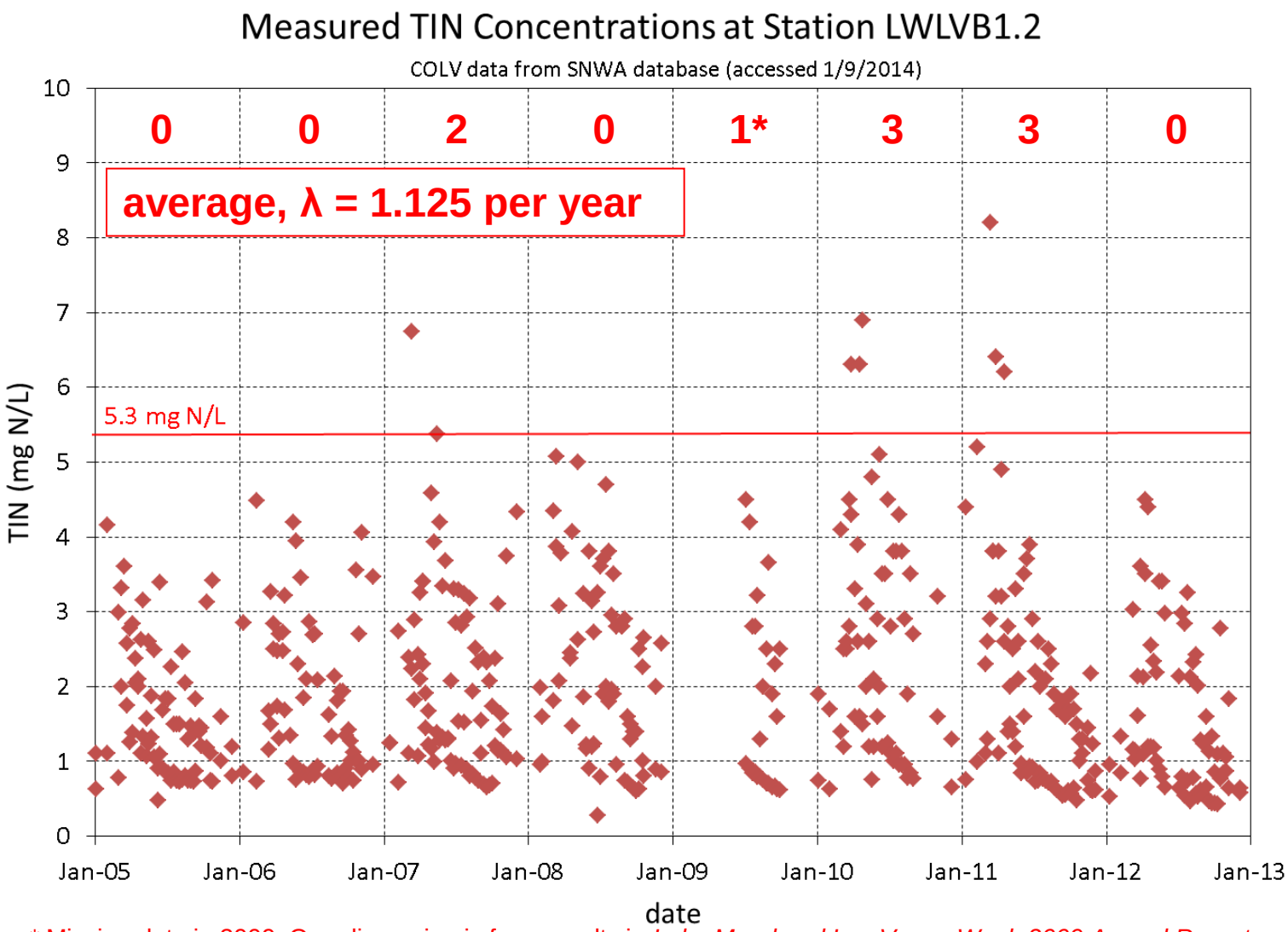


CR inflow rate = 9.23 MAF/yr for all simulations

Boulder Basin TIN WQS

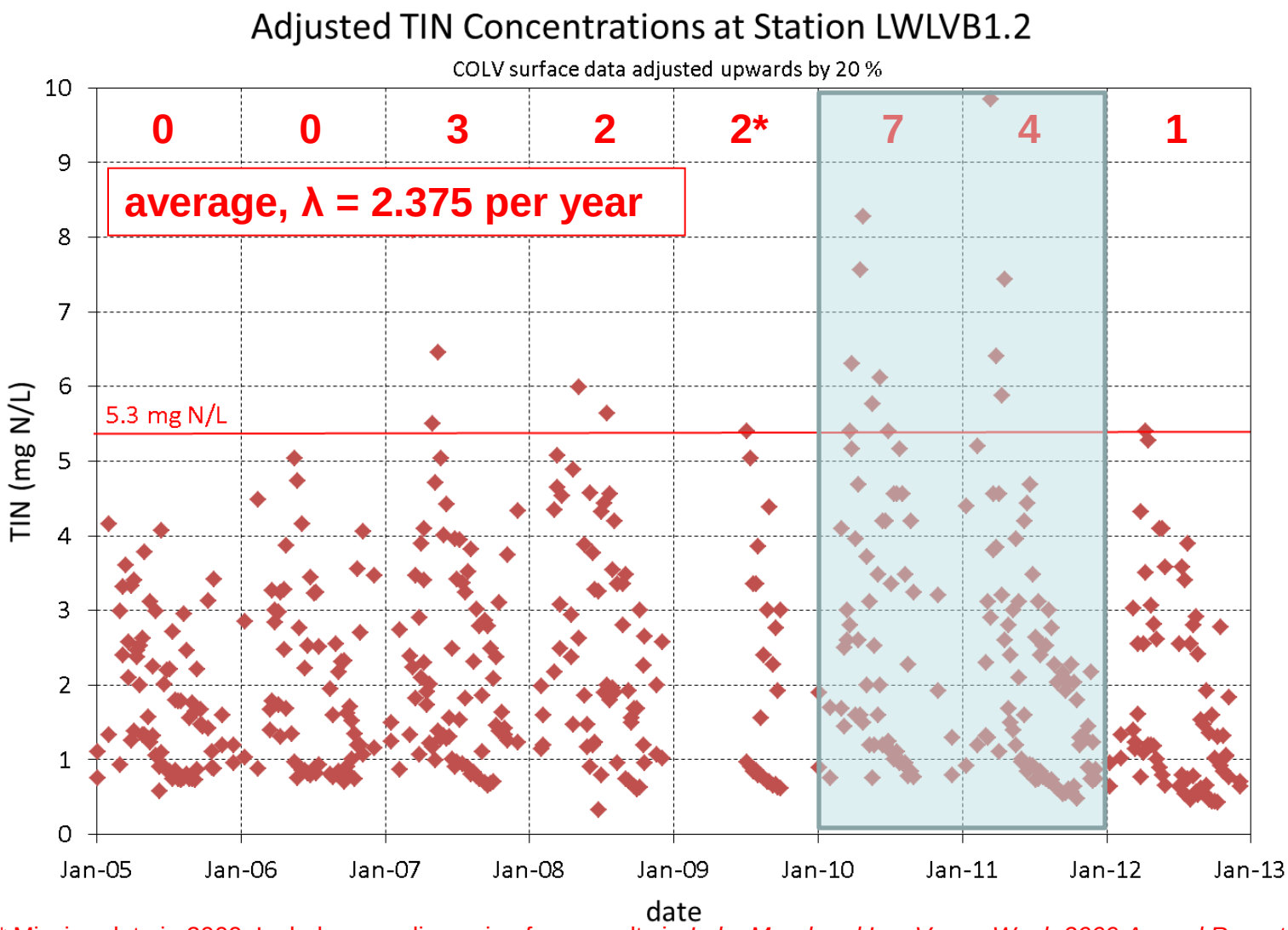


WSEL (and Hoover Dam Effect)



* Missing data in 2009. One digression is from results in *Lake Mead and Las Vegas Wash 2009 Annual Report*

WSEL (and Hoover Dam Effect)



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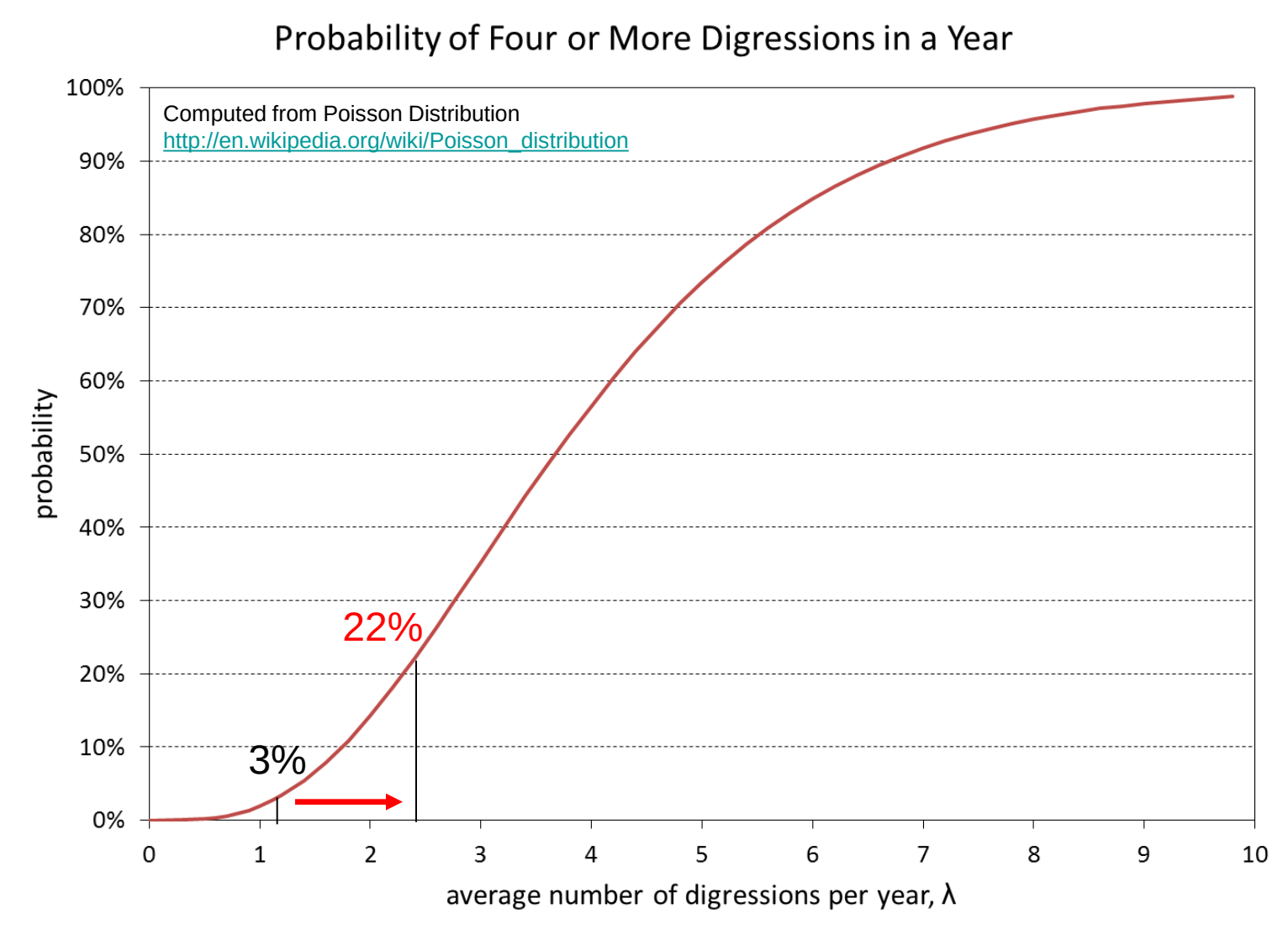
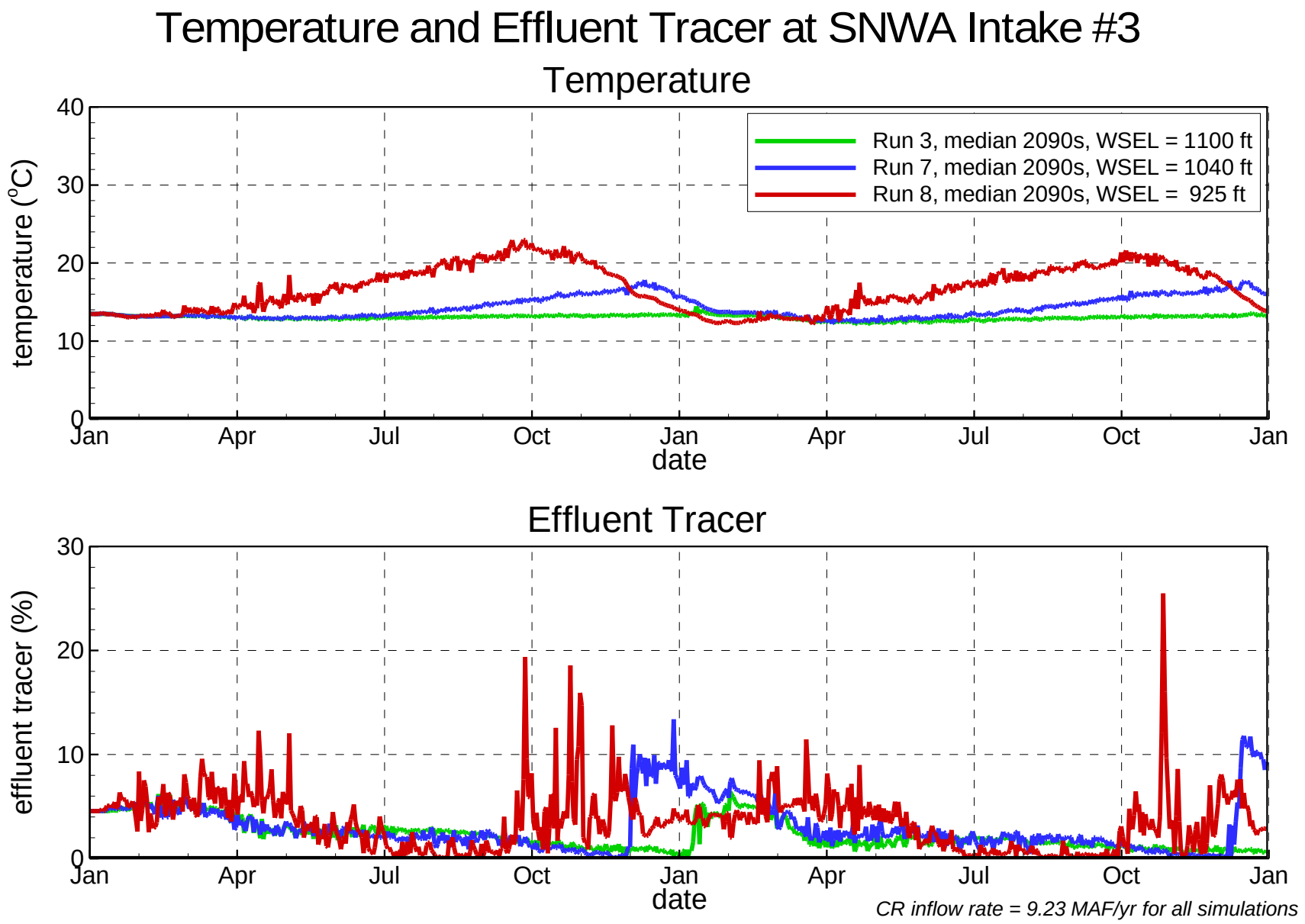
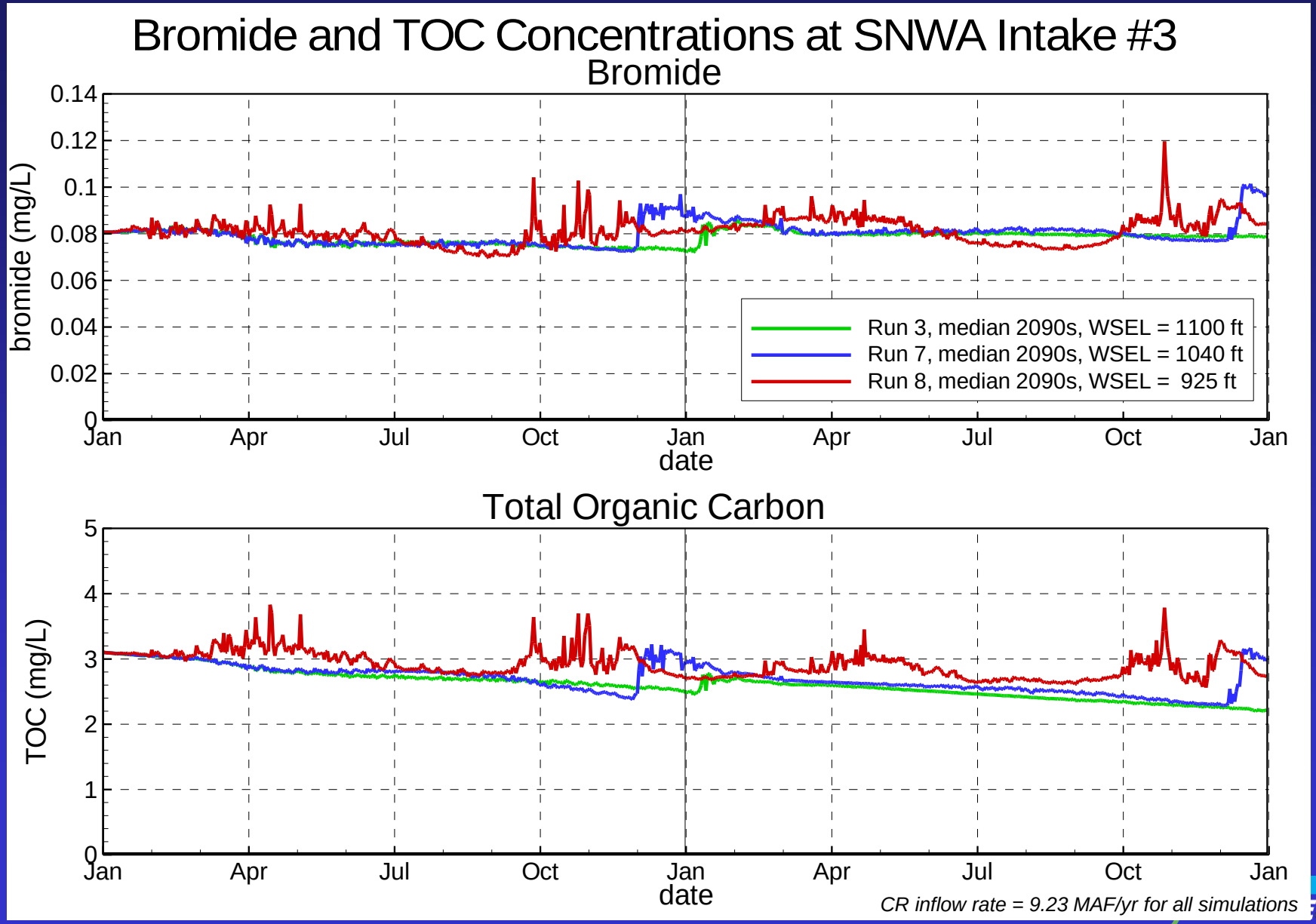
WSEL (and Hoover Dam Effect)



SNWA Intake #3

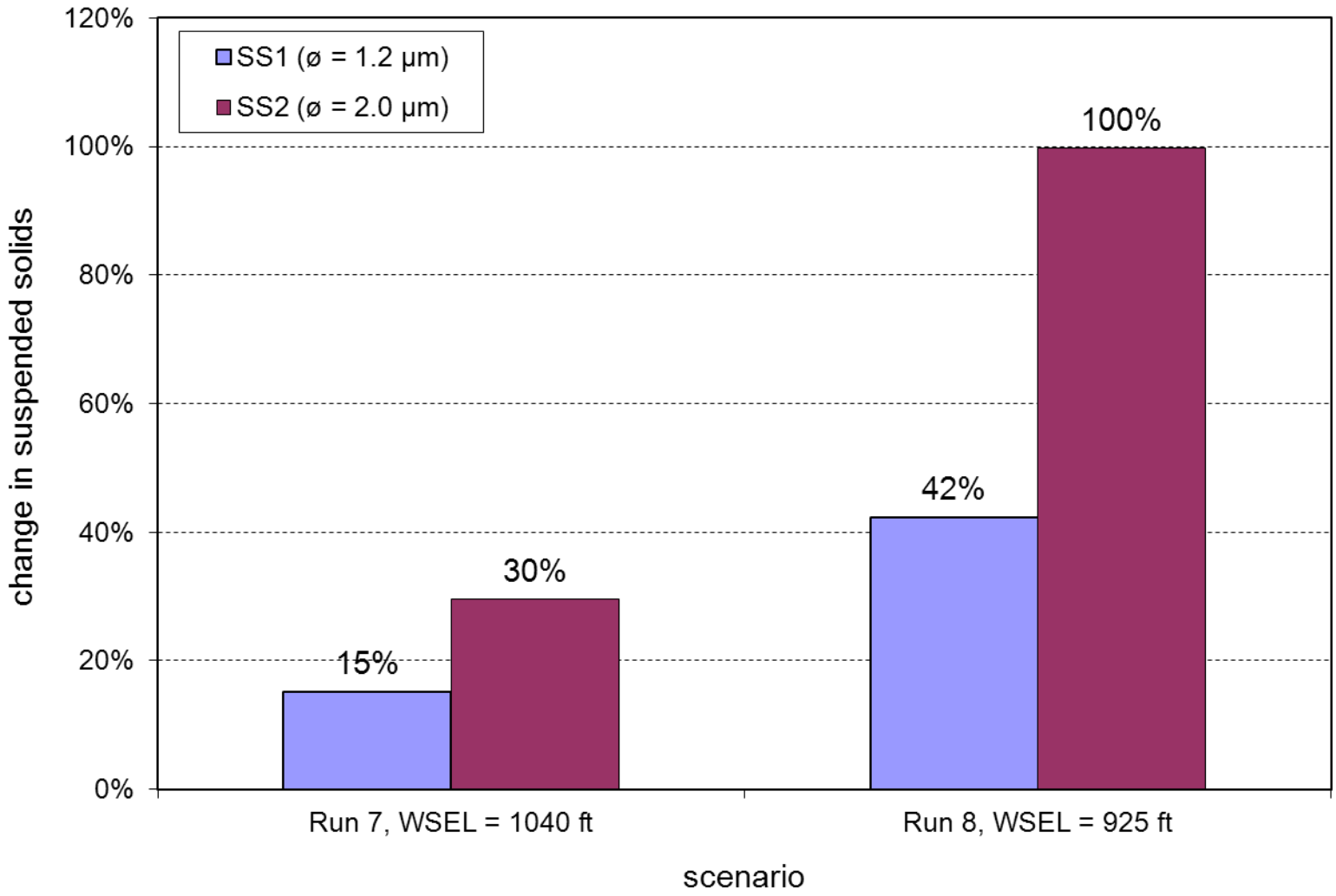


SNWA Intake #3



SNWA Intake #3

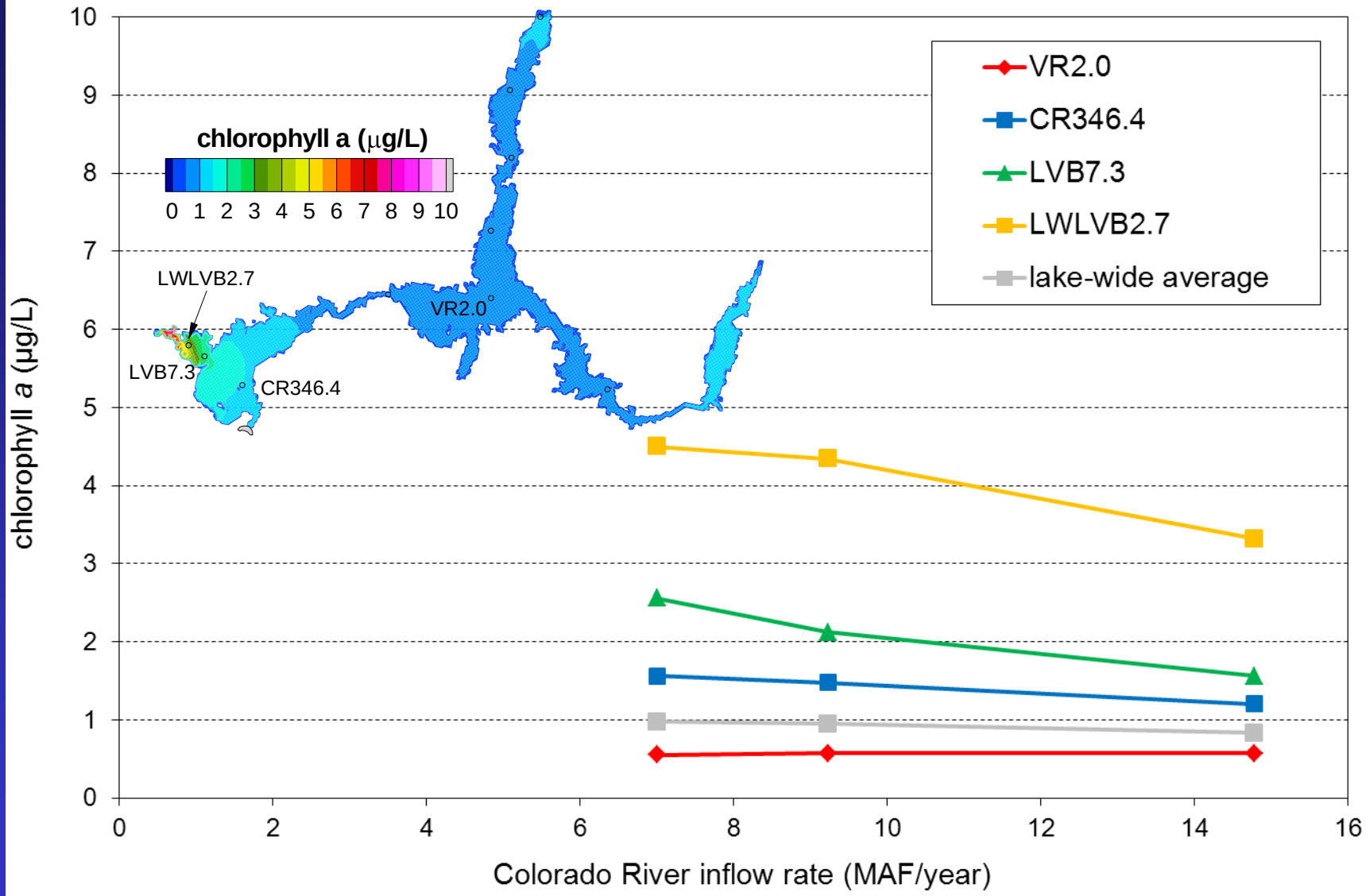
Change[1] in Average[2] Suspended Solids Concentrations at SNWA Intake #3



1. Change is percent change in concentration relative to Run 3, WSEL = 1100 ft.
2. Average is annual average for second simulation year.
3. CR inflow rate = 9.23 MAF/yr for all simulations.

Algae (Chlorophyll a)

Annual Average Chlorophyll *a* Top 5-m Average versus Colorado River Inflow Rate



Initial WSEL = 1,100 ft for all simulations.
Values are for the second simulation year.

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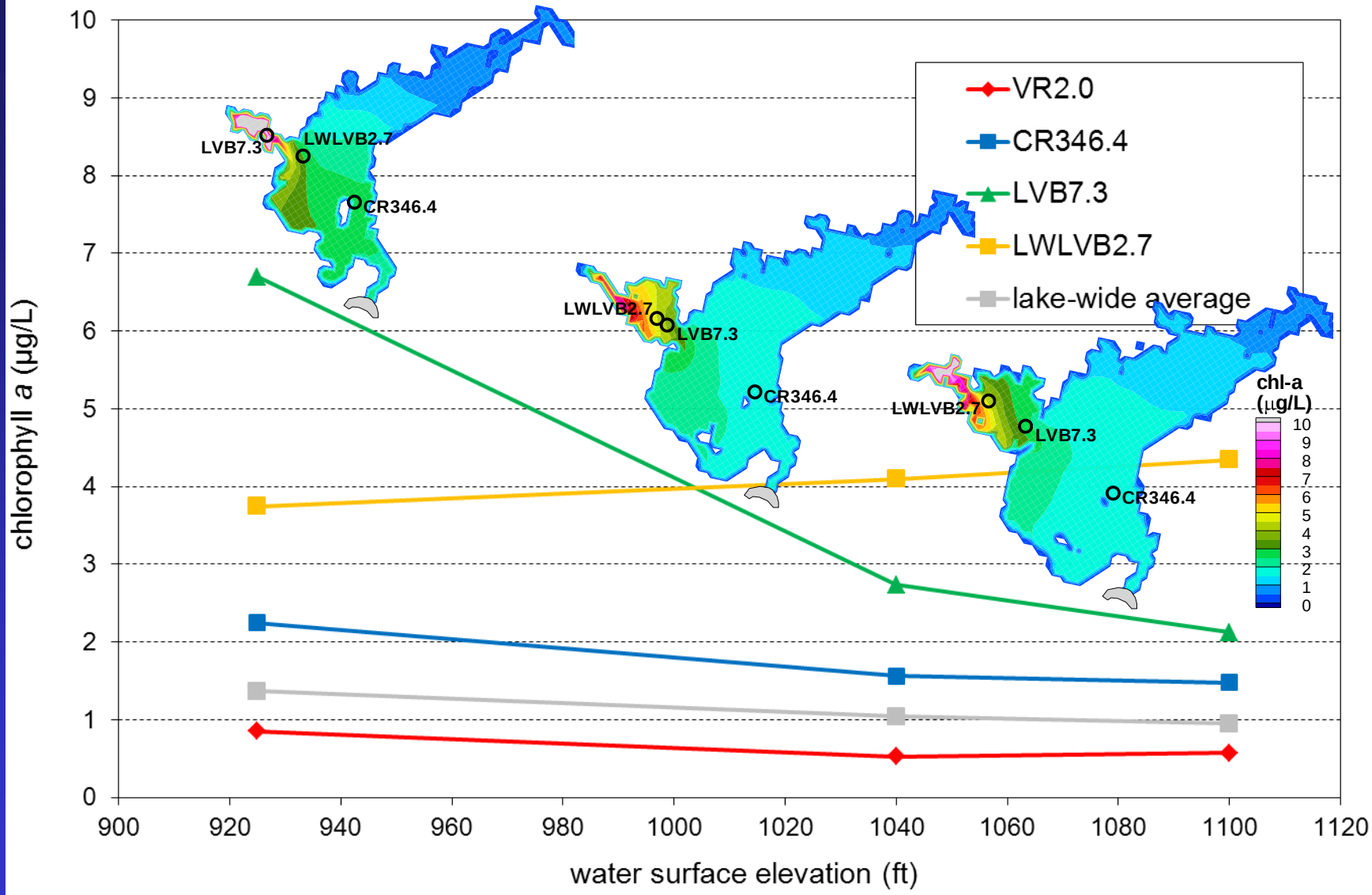
Annual Average Chlorophyll *a* Top 5-m Average versus Water Surface Elevation



CR inflow rate = 9.23 MAF/yr for all simulations.
Values are for the second simulation year.

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Conclusions

- **Hoover Dam effect**
  - Withdrawals from epilimnion
  - TIN at Station LWLVB1.2
- **Lower WSELs**
  - Higher suspended-solids concentrations
  - Higher water temperatures, bromide, and TOC concentrations at SNWA Intake #3
- **Chlorophyll a Concentrations increase due to**
  - Lower WSEL
  - Lower Colorado River inflow rate
- **These changes could occur in the near future!**

Acknowledgements

- U.S. Bureau of Reclamation
- Southern Nevada Water Authority
- Clean Water Coalition
  - City of Las Vegas
  - City of Henderson
  - City of North Las Vegas
  - Clark County Water Reclamation District

Questions

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