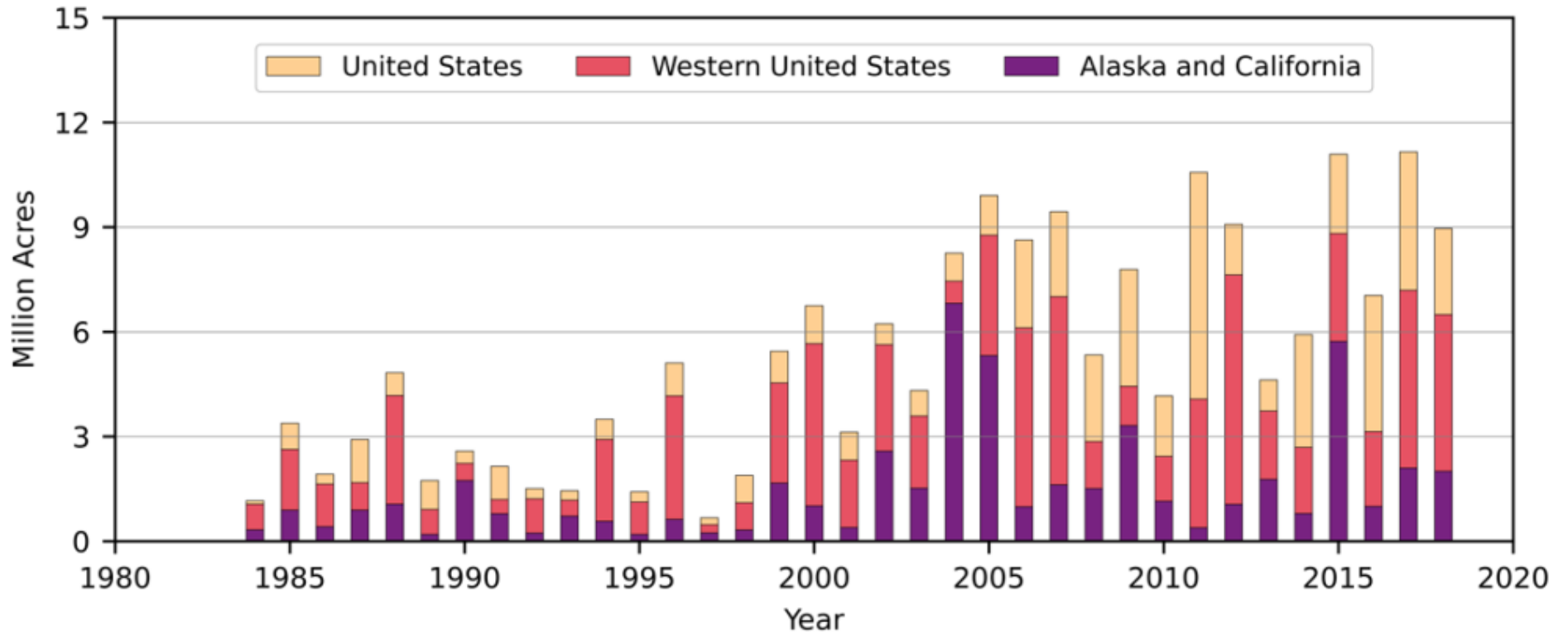
Klamath Funding Workshop
Ashland, Oregon - March 21, 2023

# Wildfire Impacts on Water Supplies For People and Aquatic Ecosystems

Dr. Anke Mueller-Solger
Director
USGS California Water Science Center
amueller-solger@usgs.gov

# INCREASING and INCREASINGLY LARGE and SEVERE wildfires INCREASINGLY threaten water supplies for people and ecosystems

## Annual area burned from 1984 to 2018 in the United States



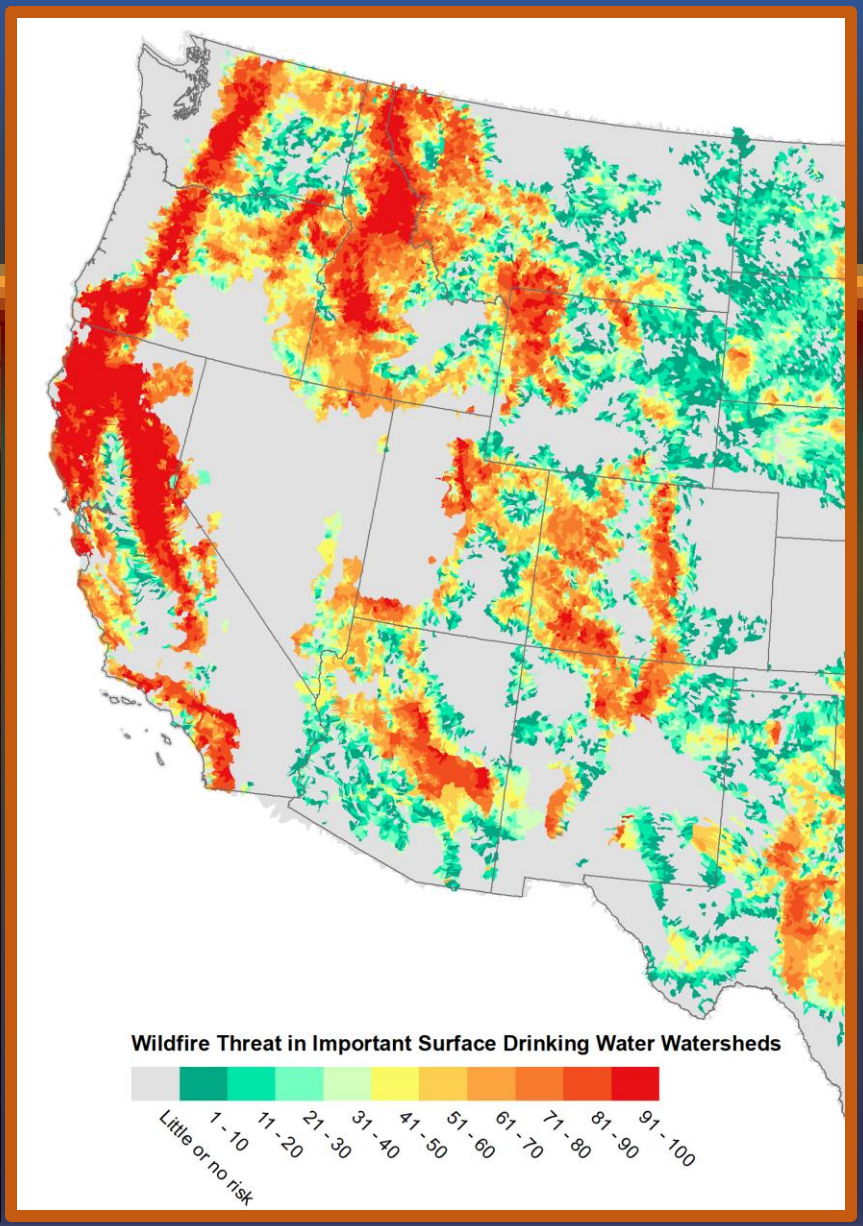

Fu et al., 2021, *EOS*
https://eos.org/opinions/tackling-challenges-of-a-drier-hotter-more-fire-prone-future

# High-severity wildfires threaten water supplies for people and ecosystems

Map from USDA-Forest Service's Forest to Faucets project 2.0

Map integrates watersheds with high or very high wildfire risk with watersheds important to surface drinking water

2022 McKinney Fire,
Photo Credit: DAVID MCNEW - AFP

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Mack et al. 2022, *USDA Forest Service Gen. Tech. Rep. WO-99*.
https://www.fs.usda.gov/research/publications/wo/gtr_wo99.pdf

# High-severity wildfires threaten water supplies for people and ecosystems

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2020-2022 wildfire perimeter overlay by Sheila Murphy, USGS

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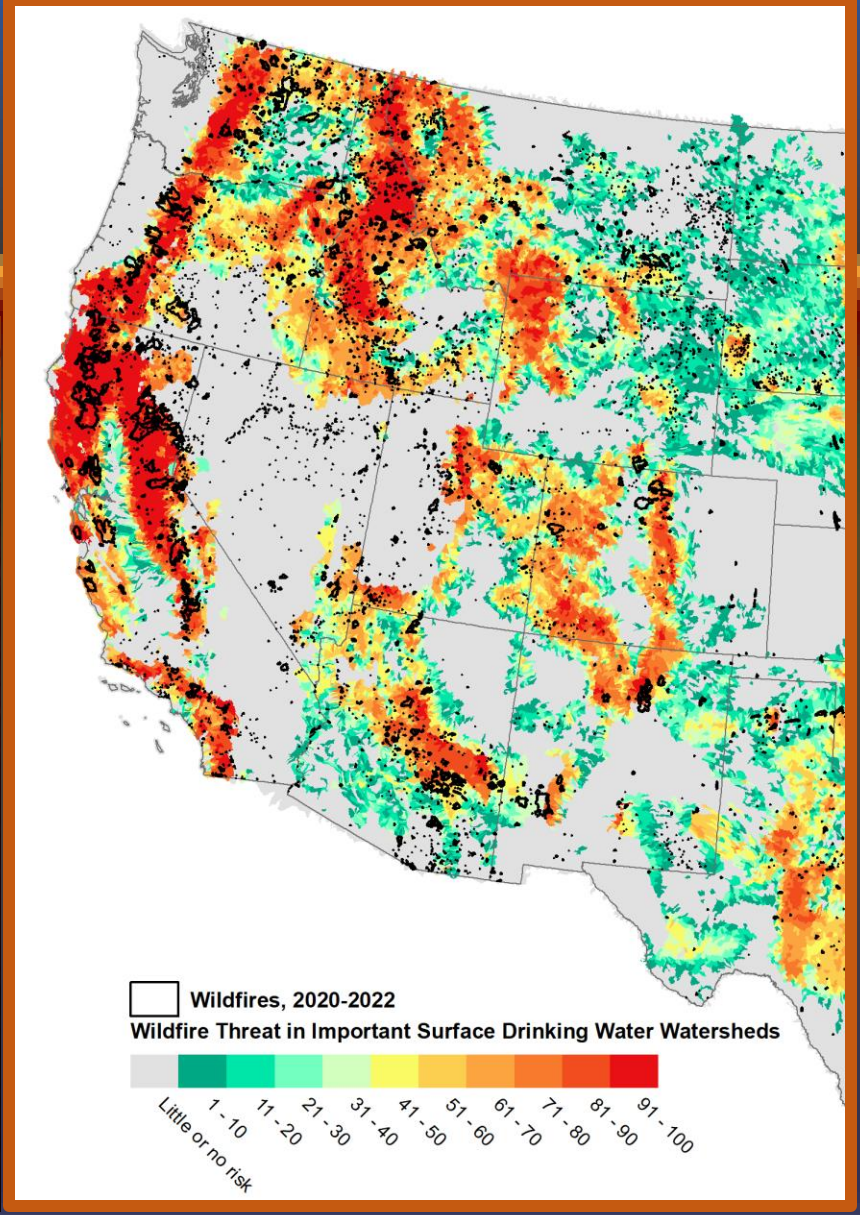


USGS science for a changing world



Mack et al. 2022, *USDA Forest Service Gen. Tech. Rep. WO-99*.
https://www.fs.usda.gov/research/publications/wo/gtr_wo99.pdf

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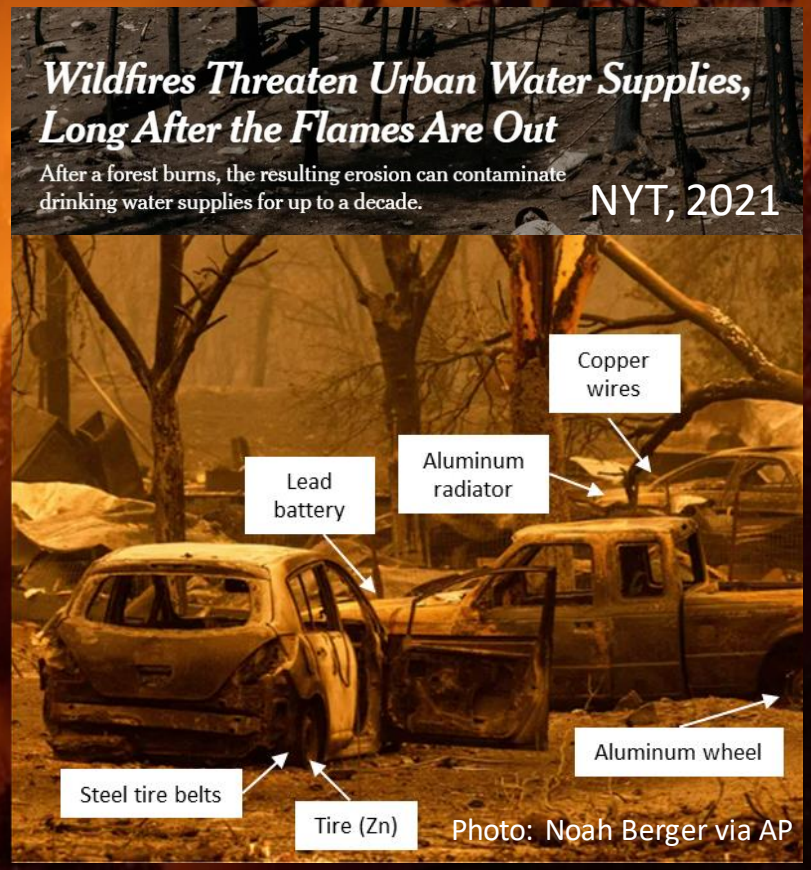
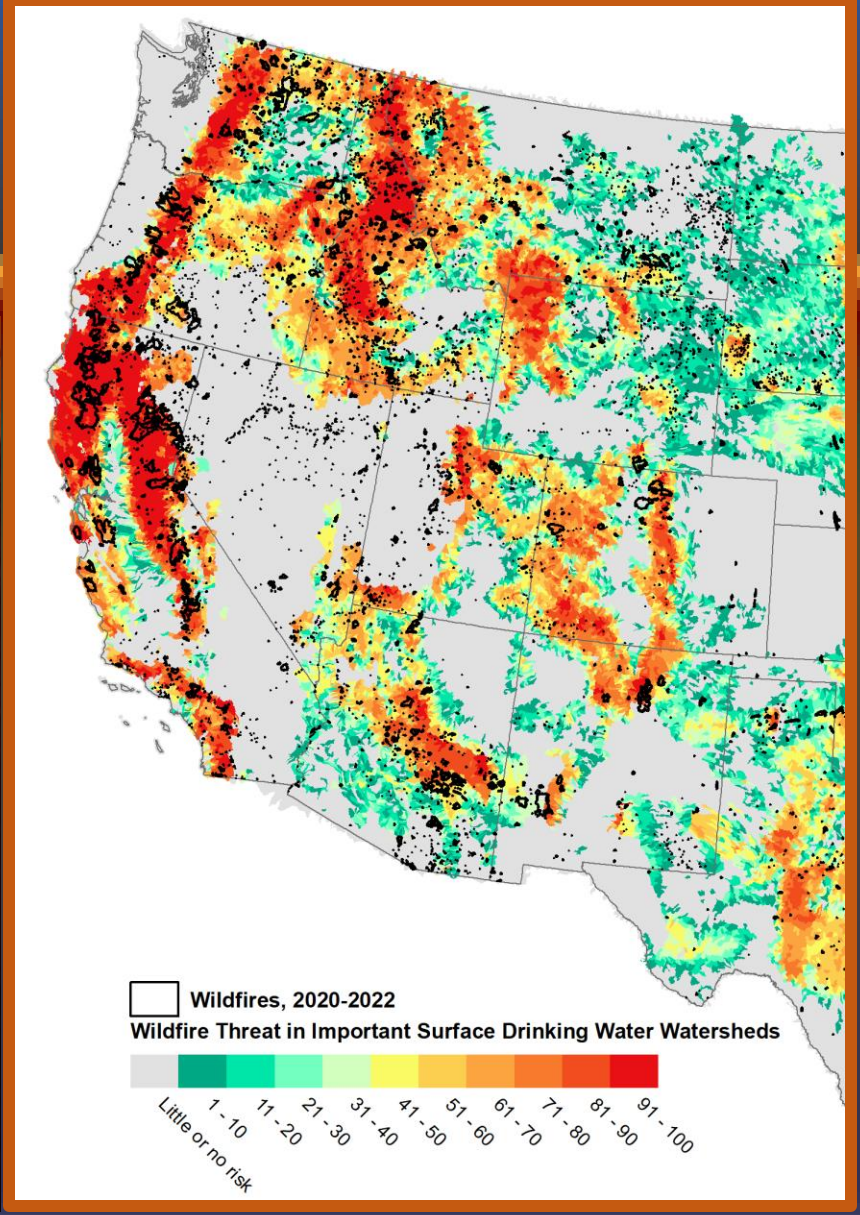



From USDA-Forest Service's Forest to Faucets project 2.0
2020-22 wildfire perimeter overlay by Sheila Murphy, USGS

# High-severity wildfires threaten water supplies for people and ecosystems

**PRESS ADVISORY**
KARUK TRIBE
**FIRES LEAD TO KLAMATH FISH KILL**


Photo Credit: Stormy Staats - Karuk Fisheries

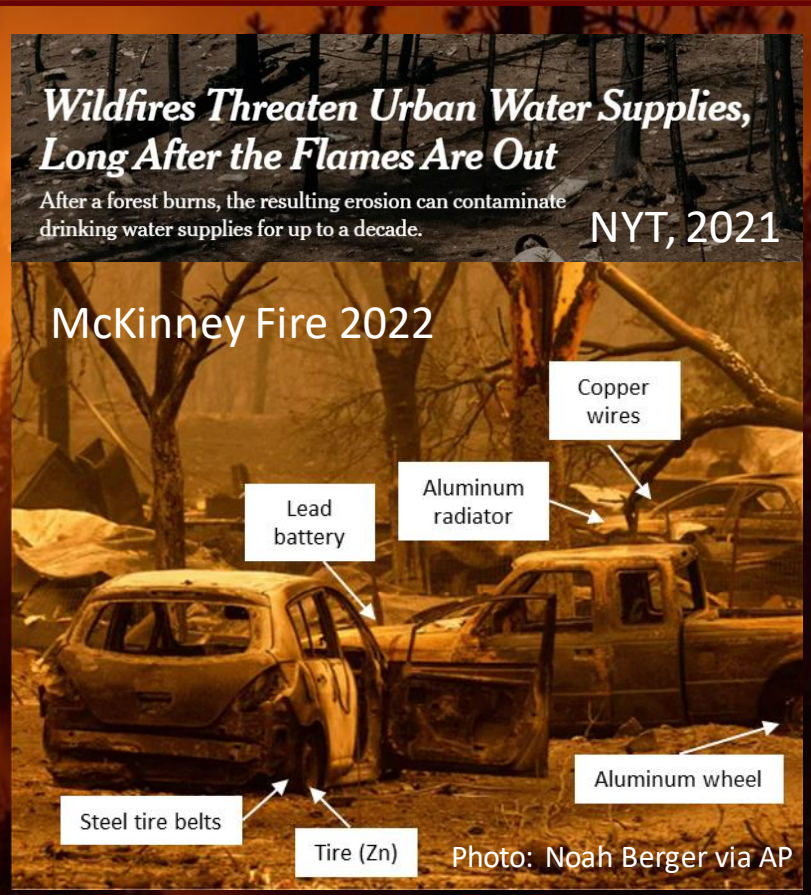
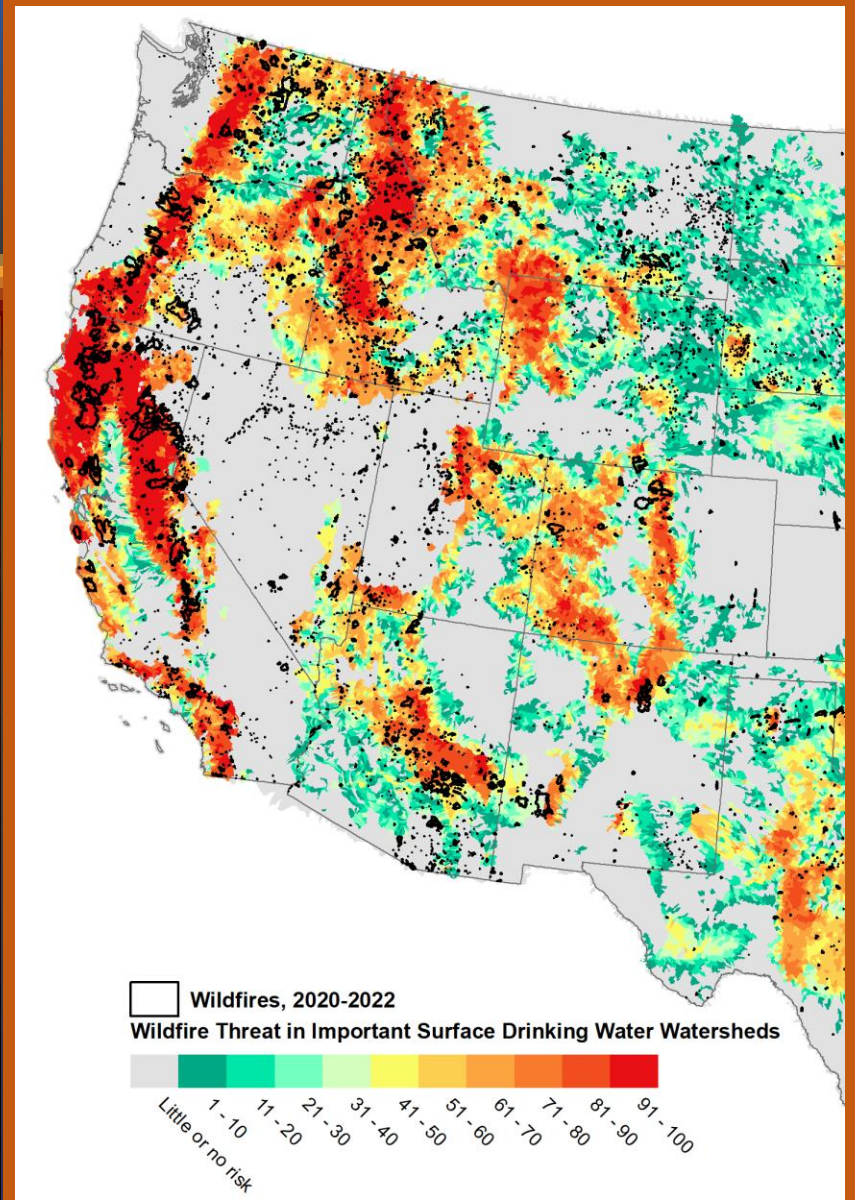


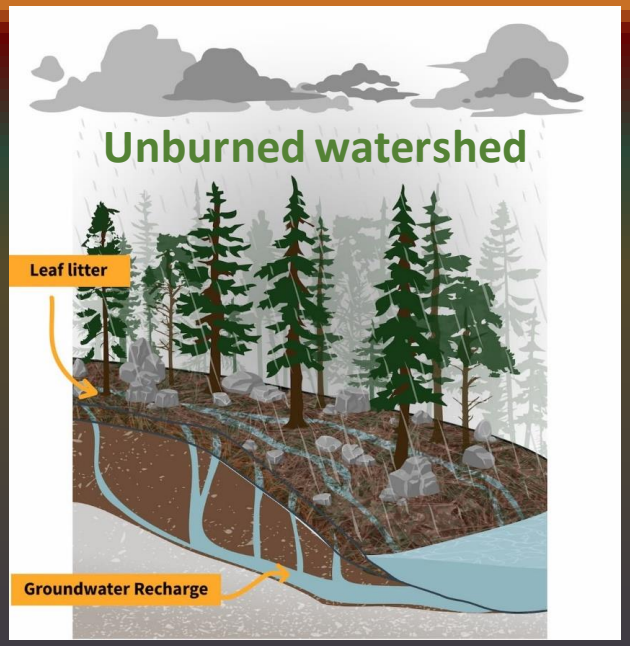

Photo: Noah Berger via AP




From USDA-Forest Service's Forest to Faucets project 2.0
2020-22 wildfire perimeter overlay by Sheila Murphy, USGS

USGS science for a changing world

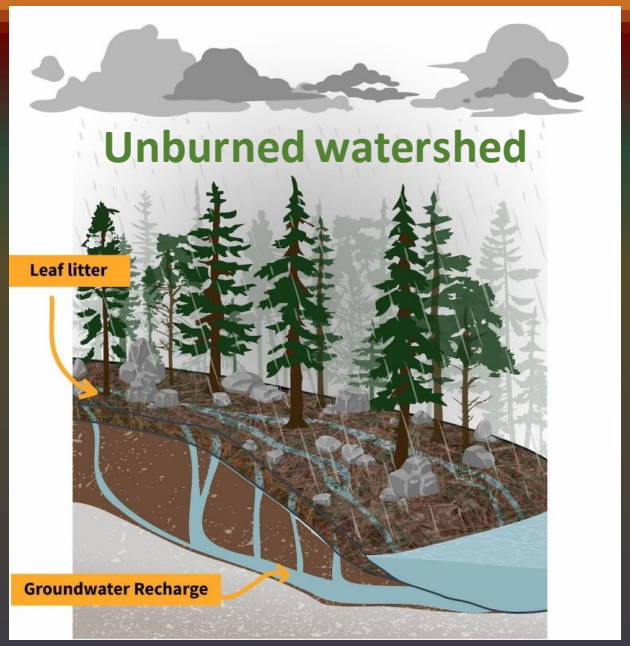
# High-severity wildfires threaten water supplies for people and aquatic ecosystems - in many ways

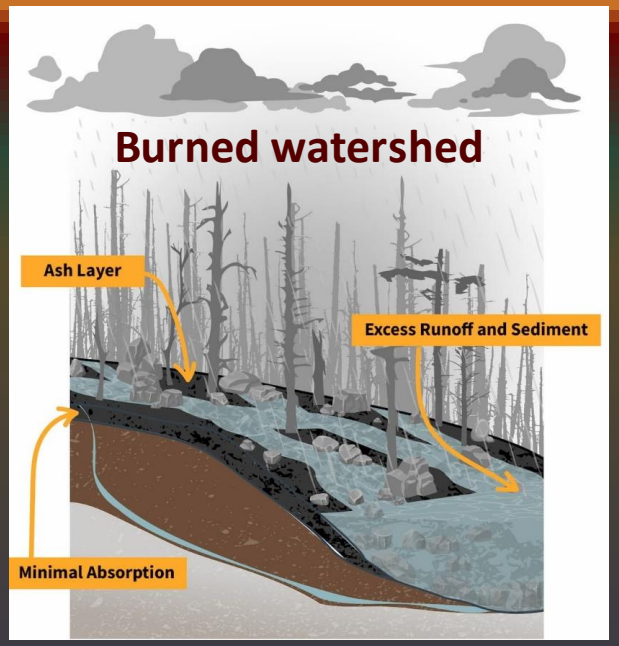



- Vegetation and unburned soils act as filter and sponge, slowing and cleaning water and recharging aquifers
  - ➢ Good water quality, supply

Klamath River,
Photo by Bob Wick, BLM

# High-severity wildfires threaten water supplies for people and aquatic ecosystems - in many ways





2022 McKinney Fire
Photo by DAVID MCNEW/AFP via Getty Images

- Vegetation and unburned soils act as filter and sponge, slowing and cleaning water and recharging aquifers
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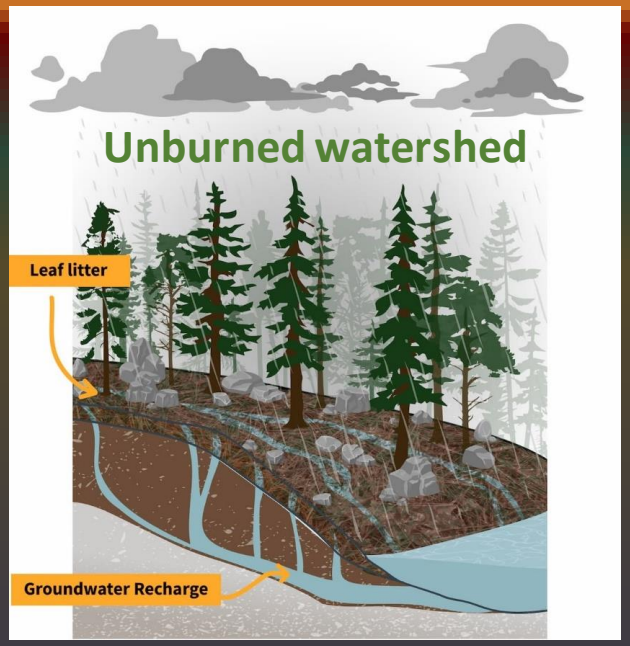
- Decreased infiltration, storage
- Overland flow can cause water, sediment, ash, & debris to move quickly to streams, causing mud and debris flows, flooding, high turbidity

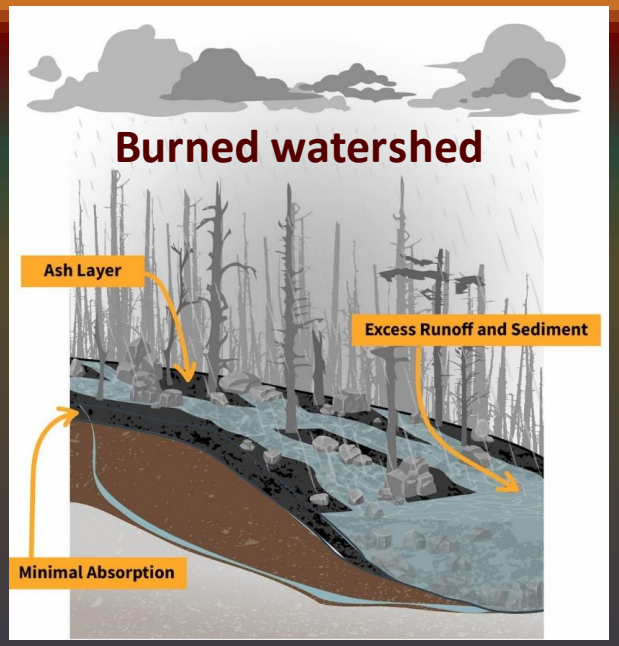


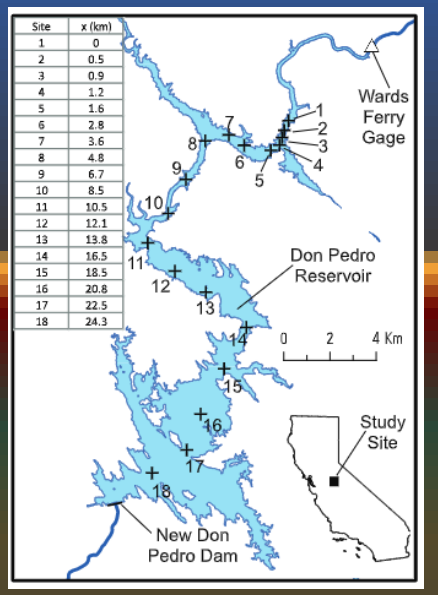


USGS Story Map: How Wildfires Threaten U.S. Water Supplies
https://labs.waterdata.usgs.gov/visualizations/fire-hydro/

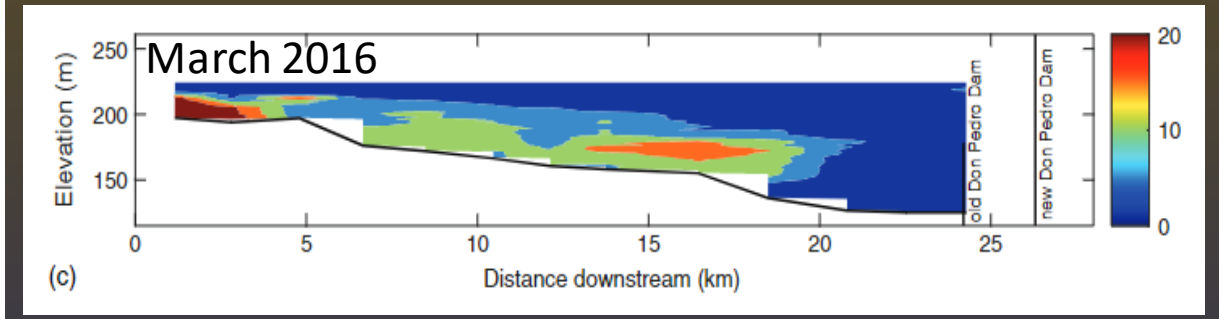
# High-severity wildfires threaten water supplies for people and aquatic ecosystems - in many ways




Turbidity current in Don Pedro Reservoir, CA, after the 2013 Rim Fire

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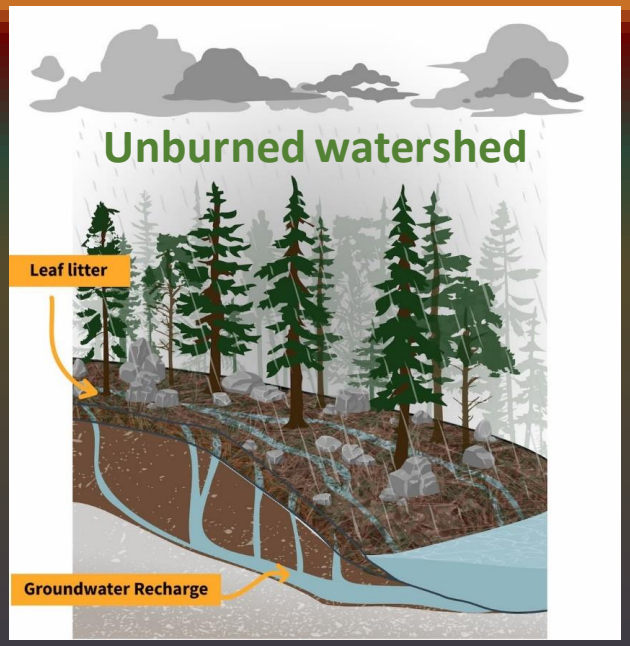
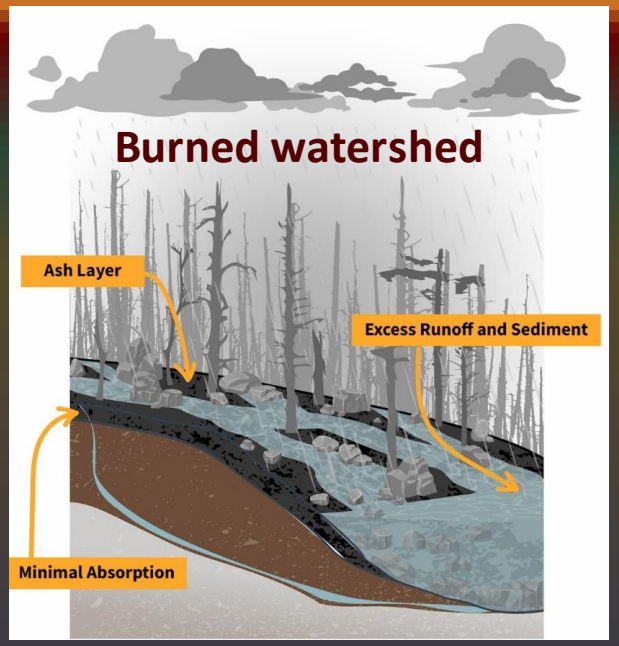
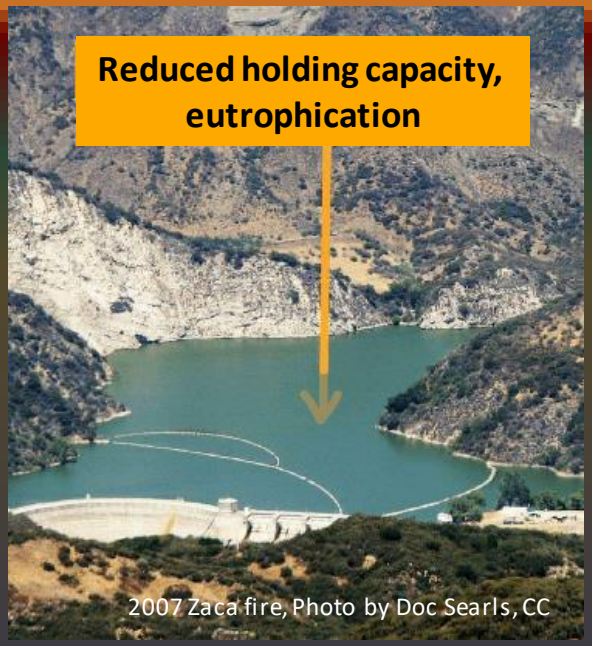
Wright & Marineau, 2019, J. Hydraul. Eng.
https://ascelibrary.org/doi/epdf/10.1061/%28ASCE%29HY.1943-7900.0001611

# High-severity wildfires threaten water supplies for people and aquatic ecosystems - in many ways








- Vegetation and unburned soils act as filter and sponge, slowing and cleaning water and recharging aquifers

➢ Good water quality, supply

- Decreased infiltration, storage
- Overland flow can cause water, sediment, ash, & debris to move quickly to streams, causing mud and debris flows, flooding, high turbidity, pollution, low DO, fish kills, altered stream channels and habitat, and reservoir sedimentation & eutrophication

➢ Impaired water quality, supply; increased treatment costs





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https://labs.waterdata.usgs.gov/visualizations/fire-hydro/

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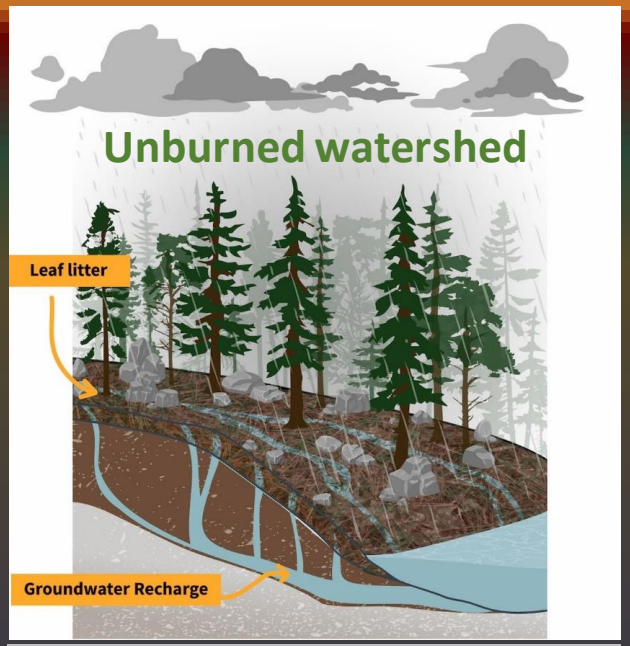
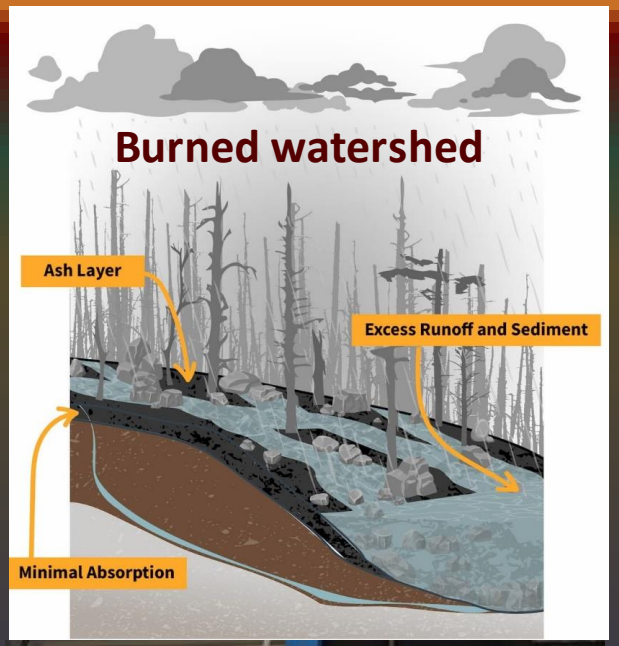
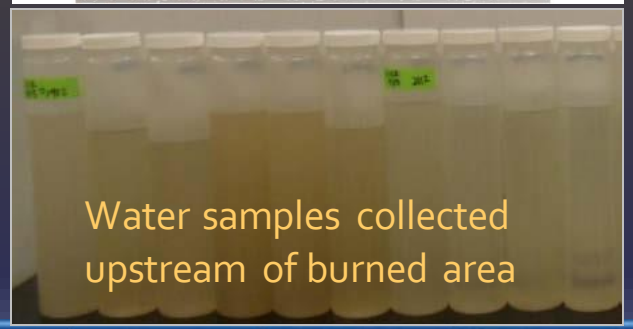
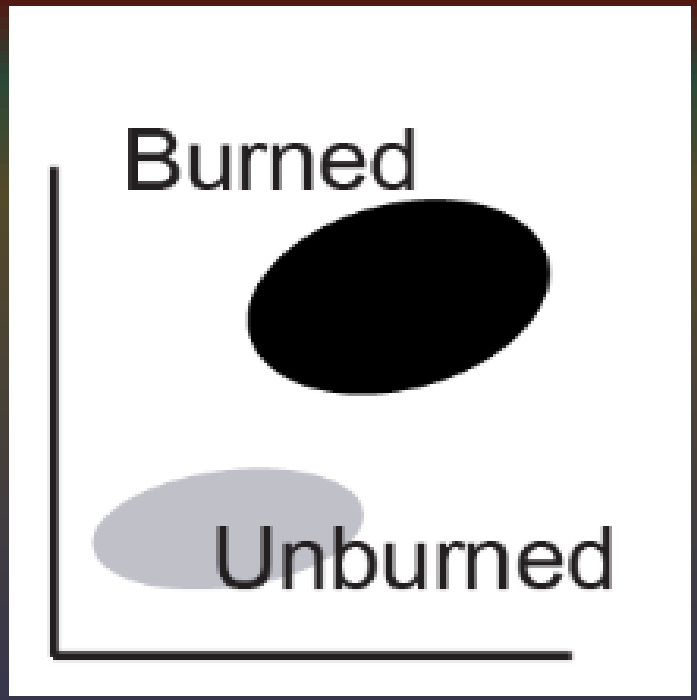




Stream concentration (sediment, carbon, nutrients)




Stream discharge

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Murphy et al., 2018, *JGR-Biogeosciences*

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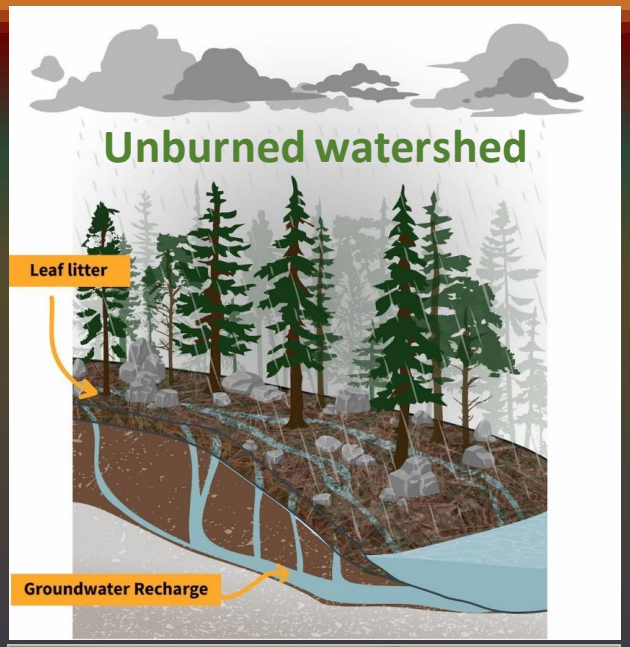


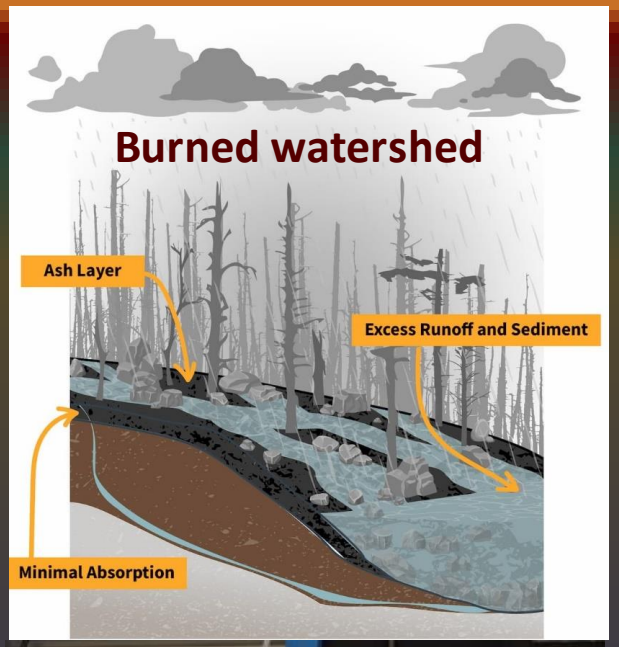


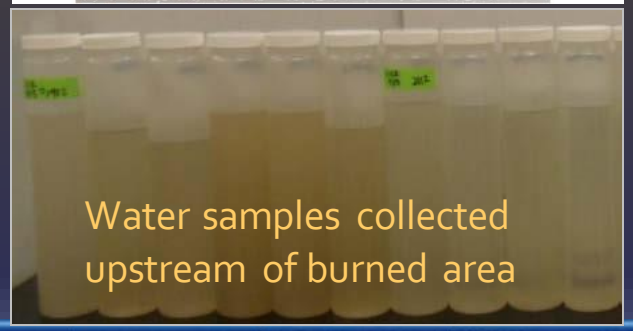



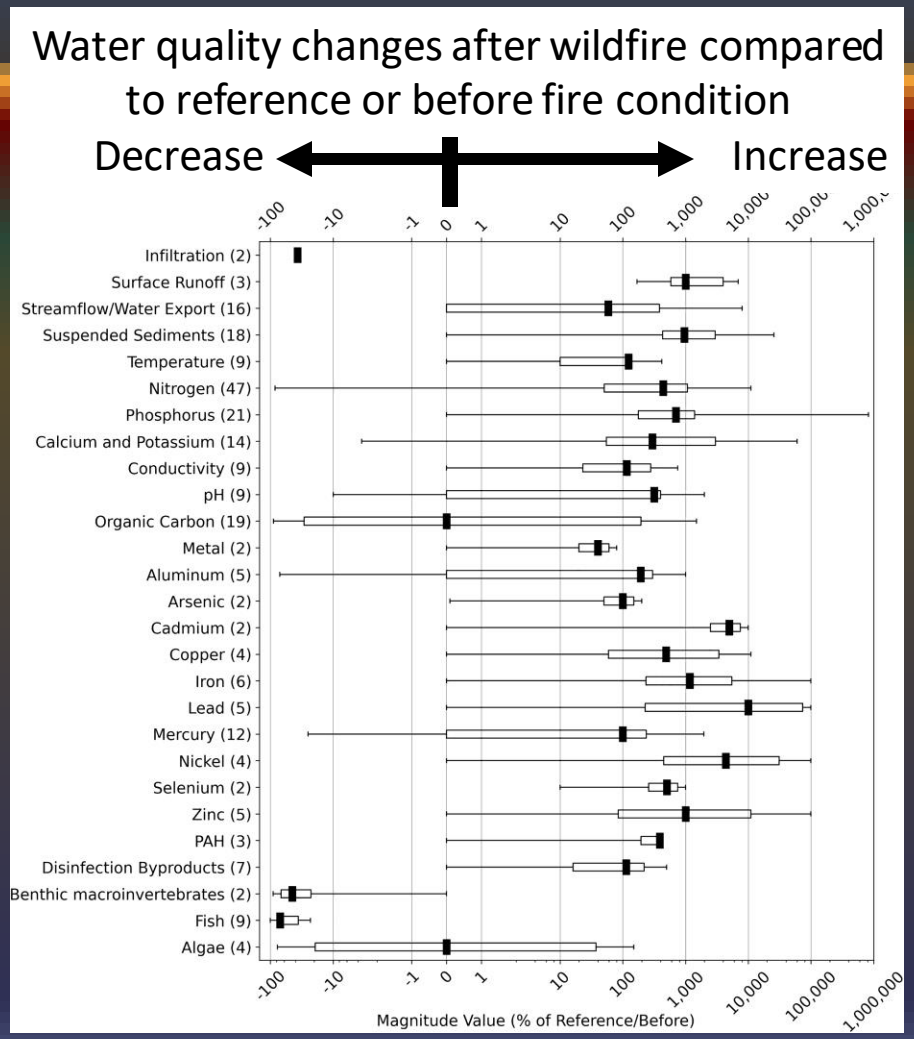


USGS science for a changing world

Photos: Sheila Murphy, Brian Ebel, Kurt Carpenter, USGS

Paul et al., 2022, *Water Resources Research*
https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021WR030699

# Example: 2022 McKinney Fire; 60,109 acres

## High-Severity Fire + Rain = High Flows, Debris Flows, High Turbidity, Low D.O., Fish Kill

Photo Credit: DAVID MCNEW - AFP

# 2022 McKinney Fire; 60,109 acres

## High-Severity Fire!

https://ca.water.usgs.gov/wildfires/california-wildfire-data.html

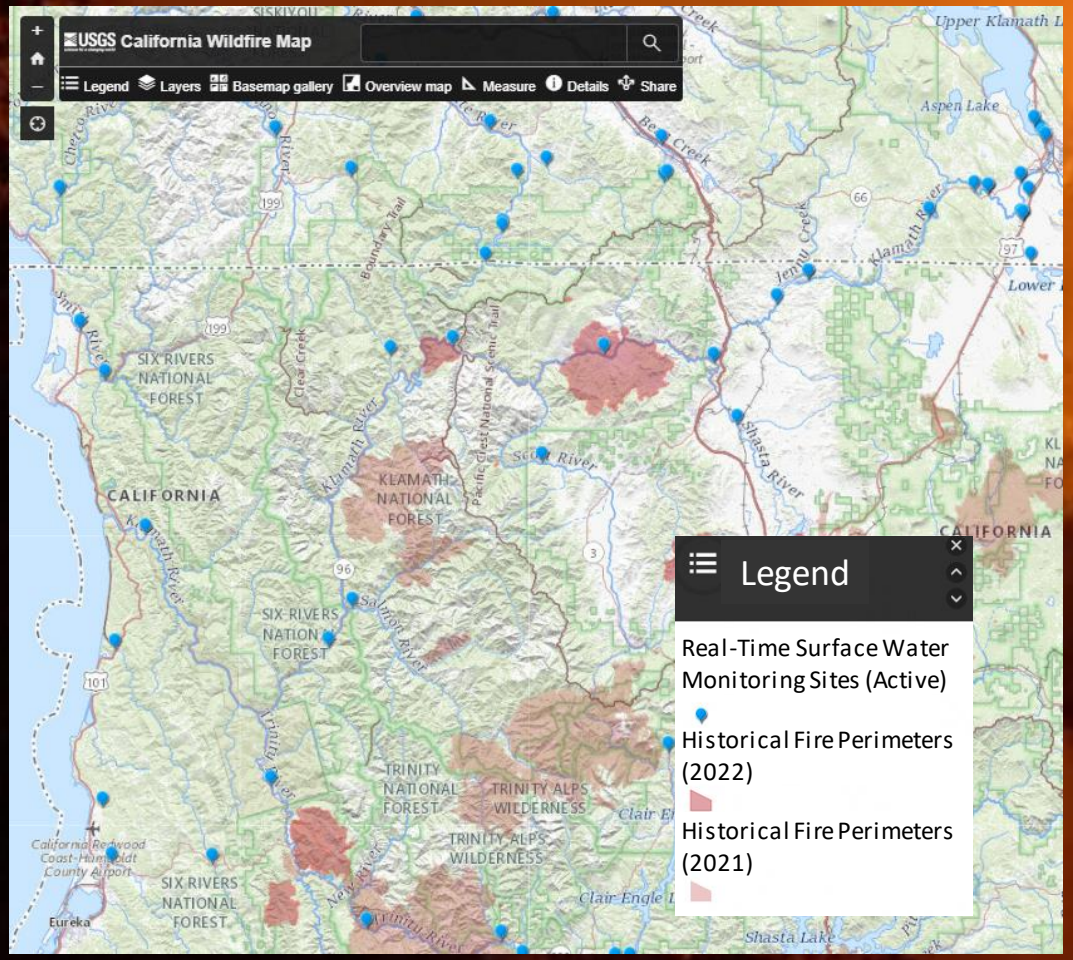


Photo Credit: DAVID MCNEW - AFP

# 2022 McKinney Fire; 60,109 acres

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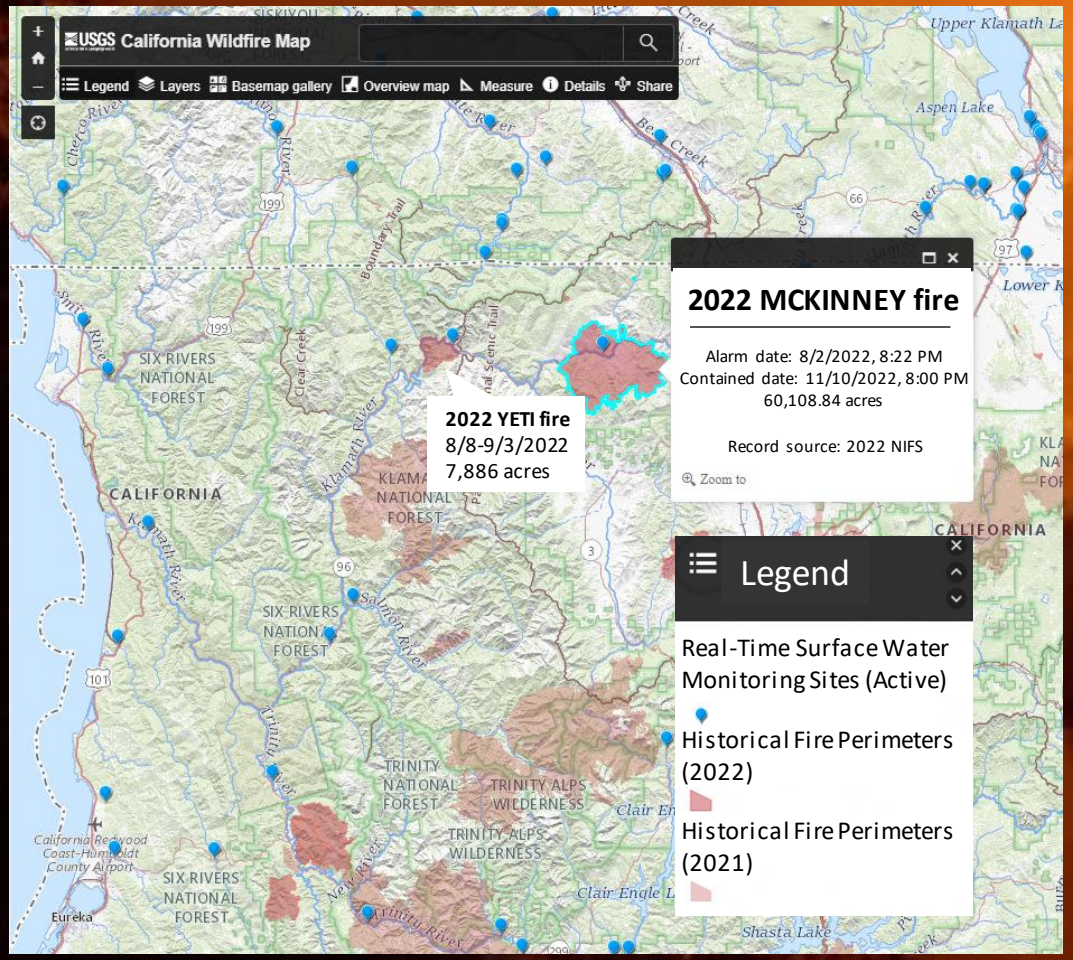


Photo Credit: DAVID MCNEW - AFP

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Fire Incident Data: NIFS (The National Incident Feature Service (**NIFS**) is an ArcGIS Online (AGOL)-hosted feature service of the National Wildfire Coordination Group, https://www.nwcg.gov/)

# 2022 McKinney Fire; 60,109 acres

# High-Severity Fire + Rain!

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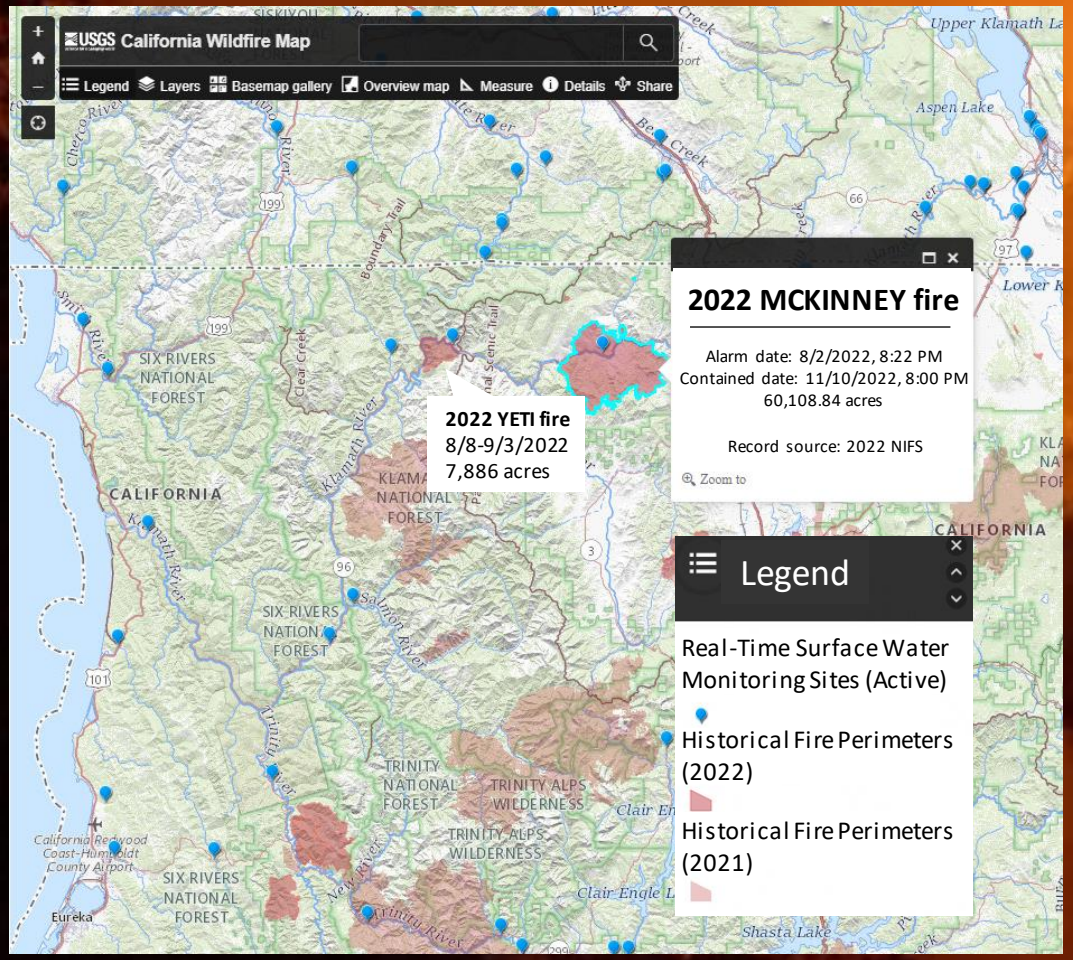
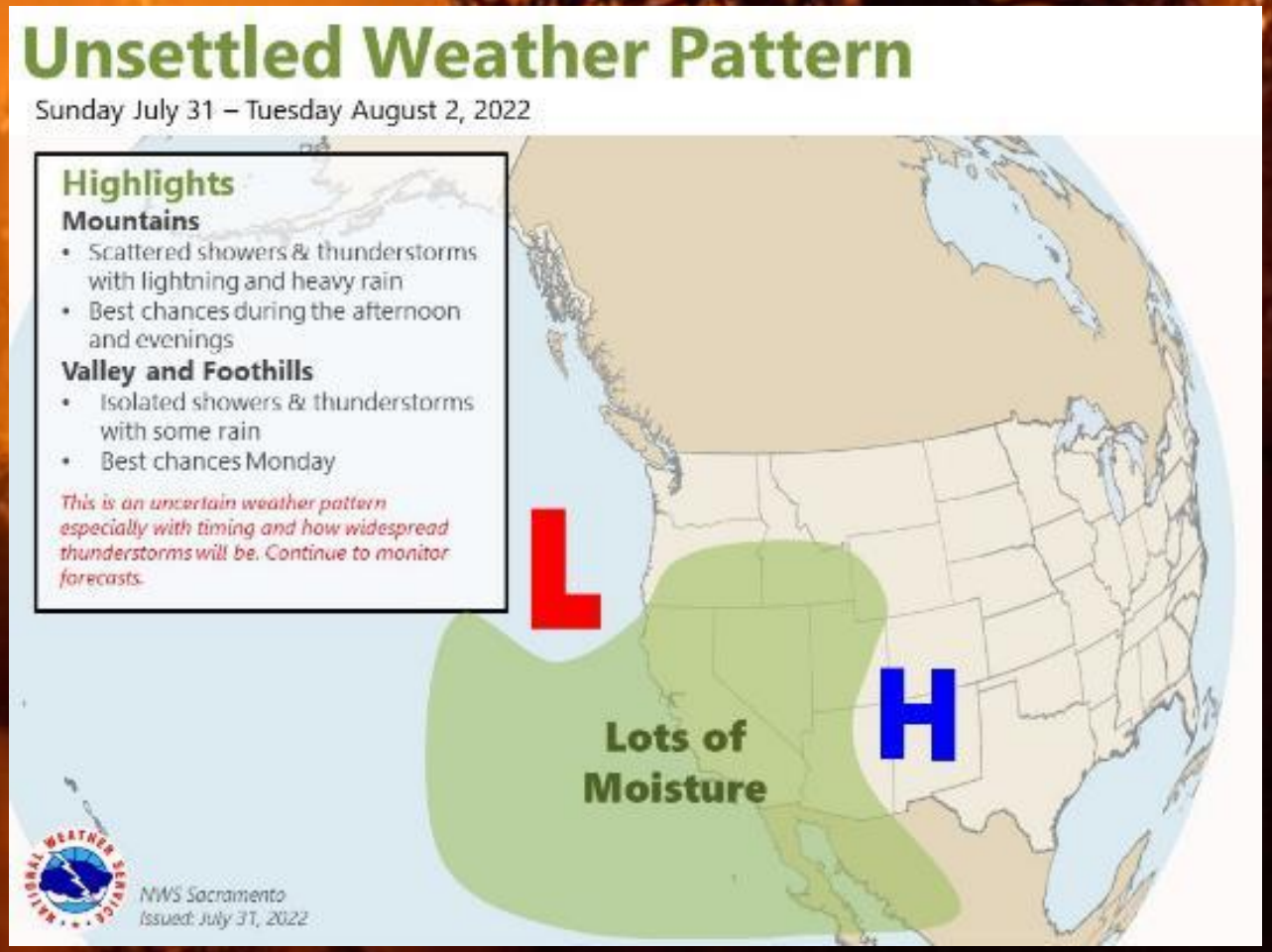


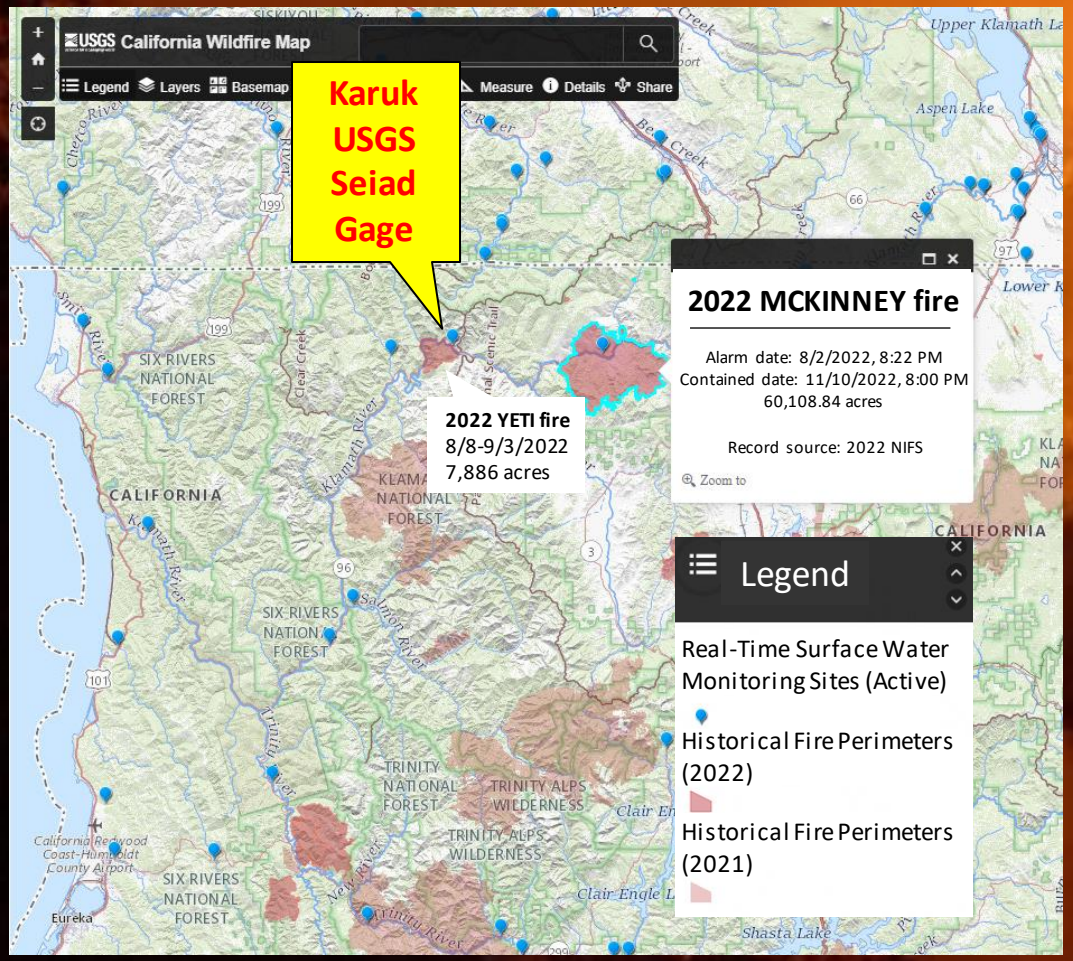



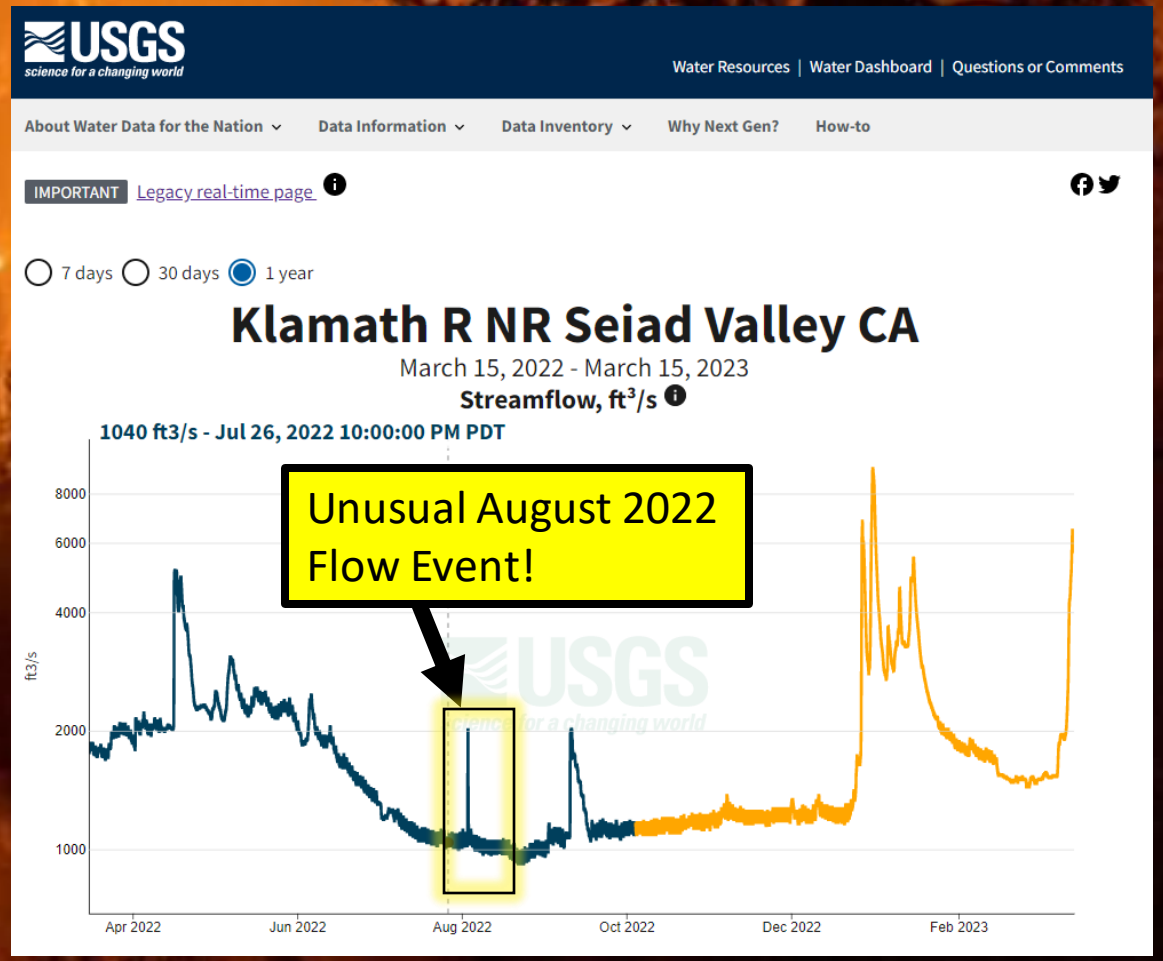
# 2022 McKinney Fire; 60,109 acres

# High-Severity Fire + Rain = High Flows

https://ca.water.usgs.gov/wildfires/california-wildfire-data.html

## 3/15/2022-3/15/2023



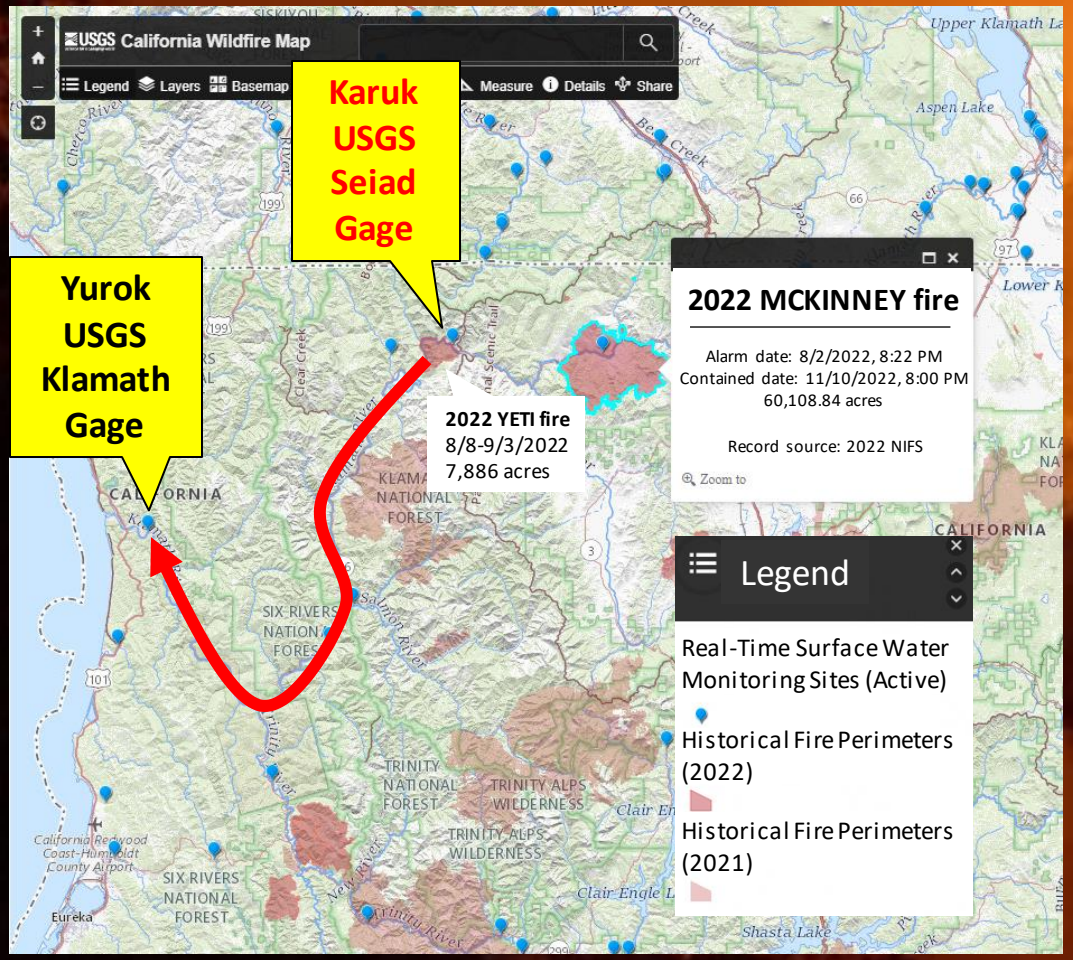




https://waterdata.usgs.gov/monitoring-location/11520500/#parameterCode=00060&period=P365D

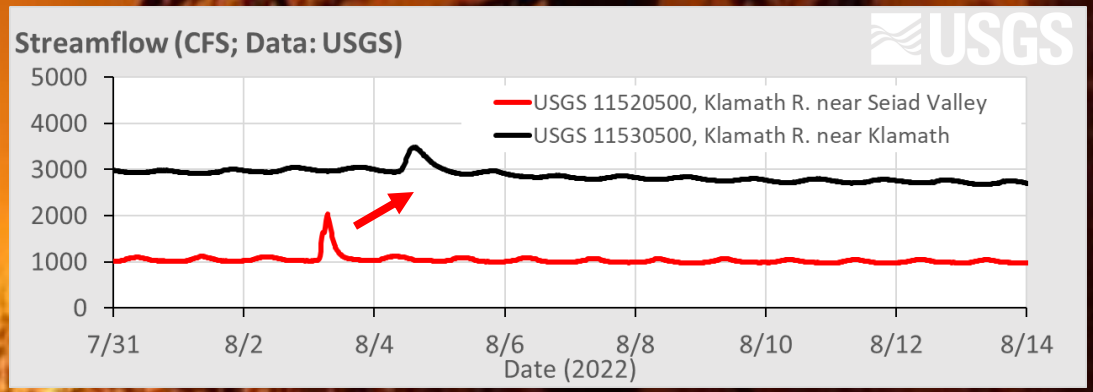
# 2022 McKinney Fire; 60,109 acres

# High-Severity Fire + Rain = High Flows

https://ca.water.usgs.gov/wildfires/california-wildfire-data.html




## 7/31-8/14/2022




Discharge Data:.https://nwis.waterdata.usgs.gov/nwis/uv?site_no=11520500%2C11530500&format=gif_mult_sites&PARAmeter_cd=00060&legacy=1&begin_date=2022-07-31&end_date=2022-08-14

# 2022 McKinney Fire; 60,109 acres

# High Severity Fire + Rain = High Flows, Debris Flows

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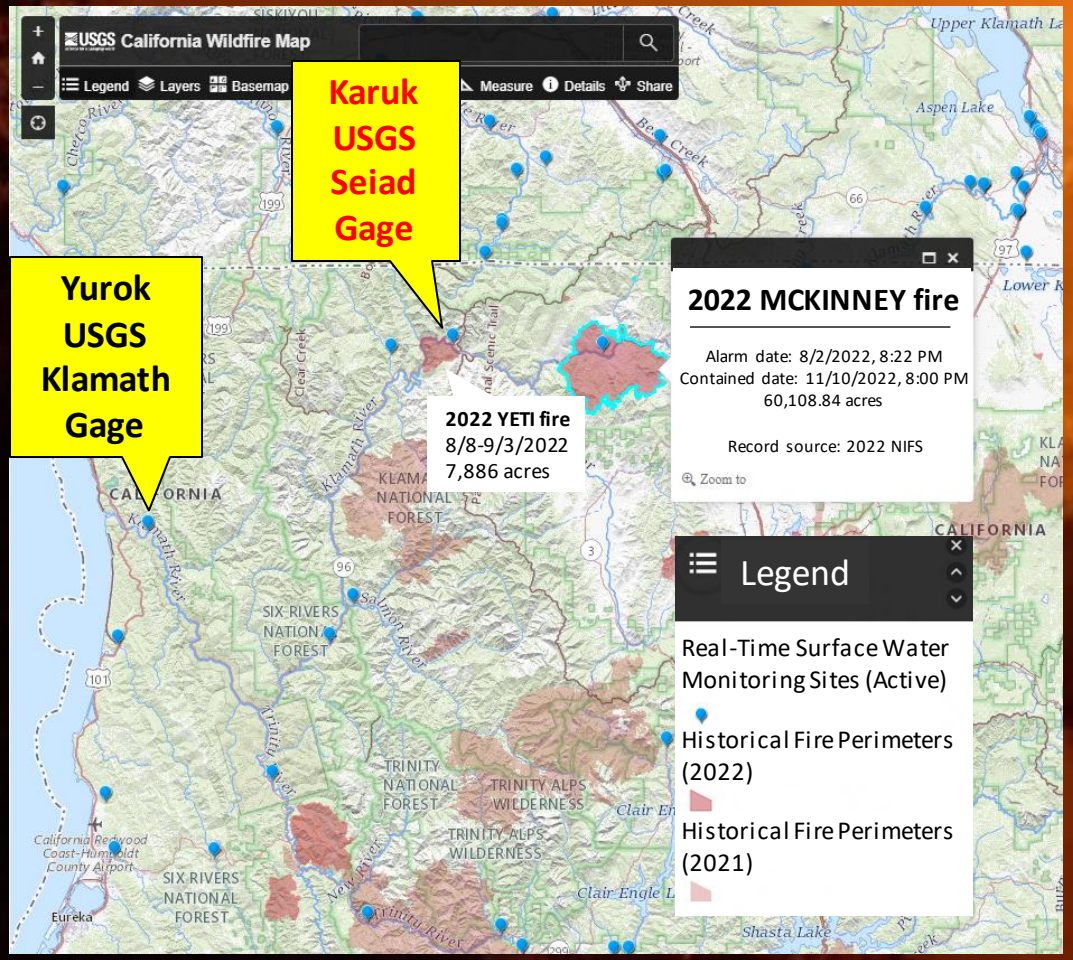


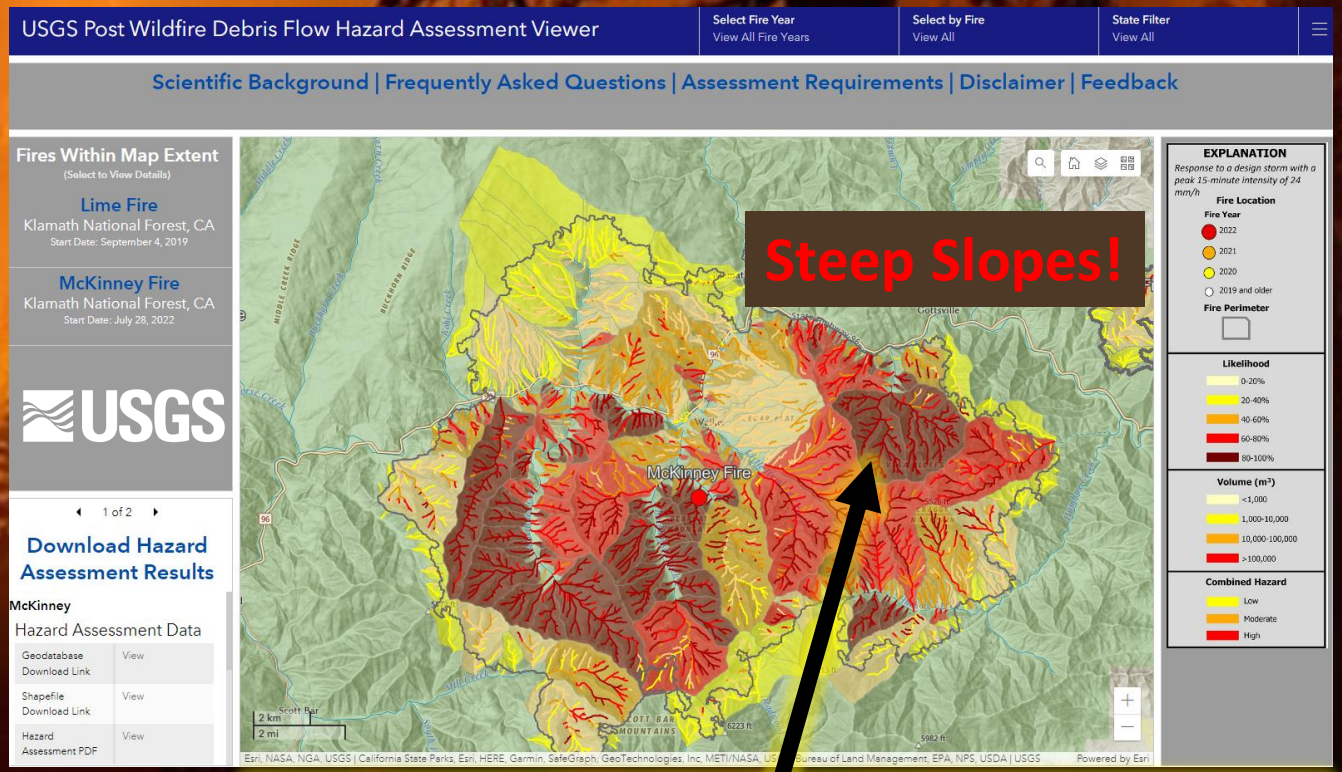



https://landslides.usgs.gov/hazards/postfire_debrisflow/detail.php?objectid=427

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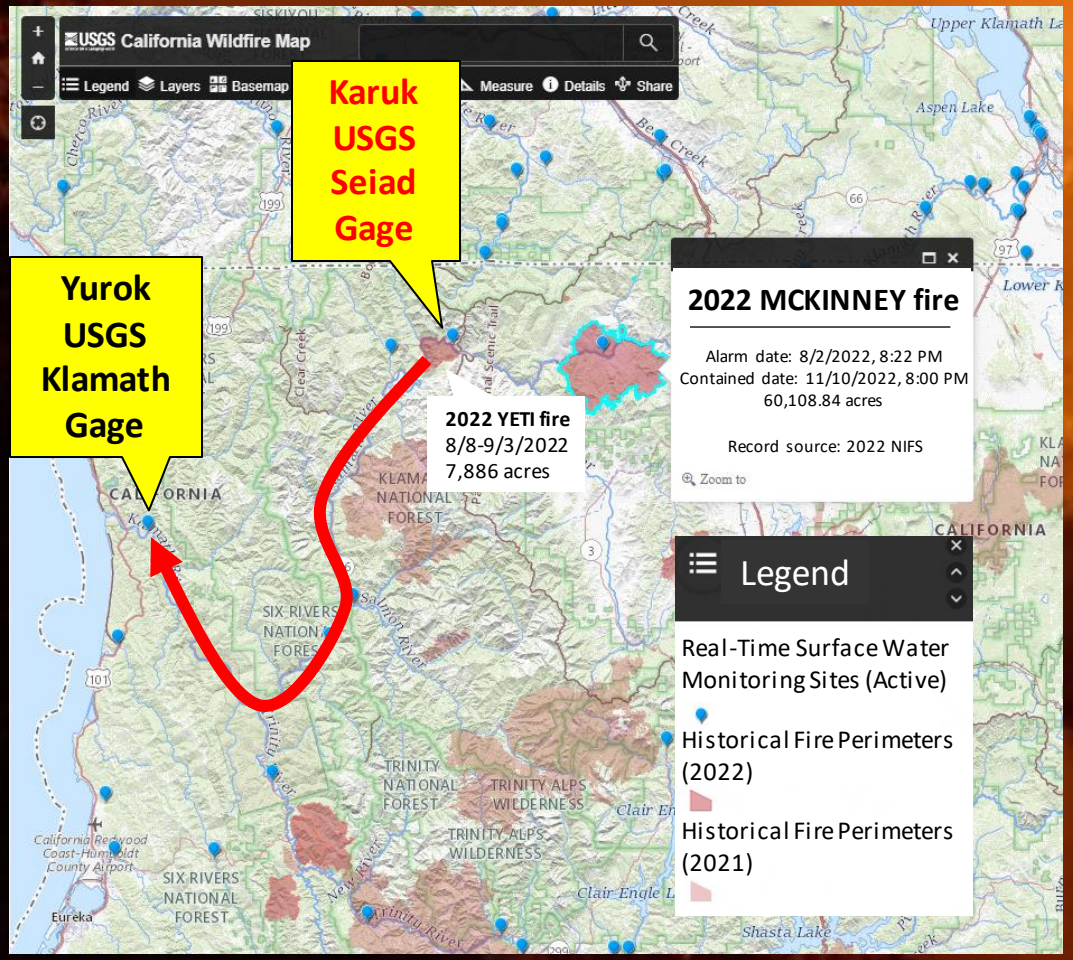
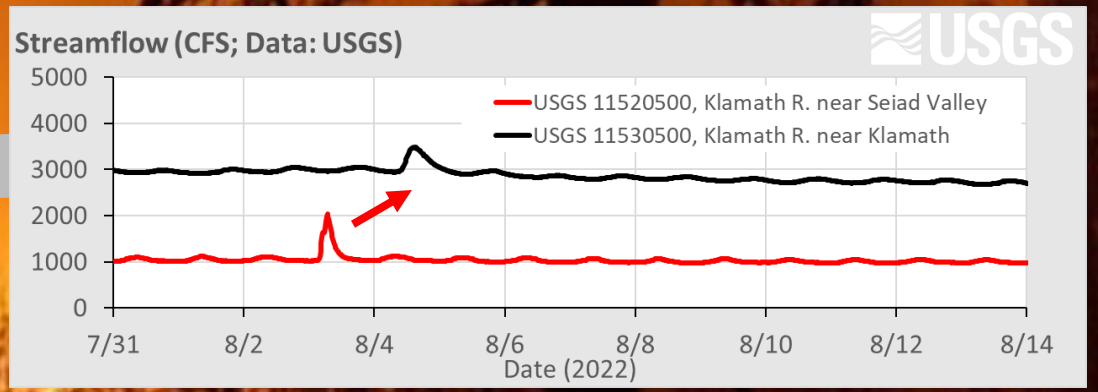
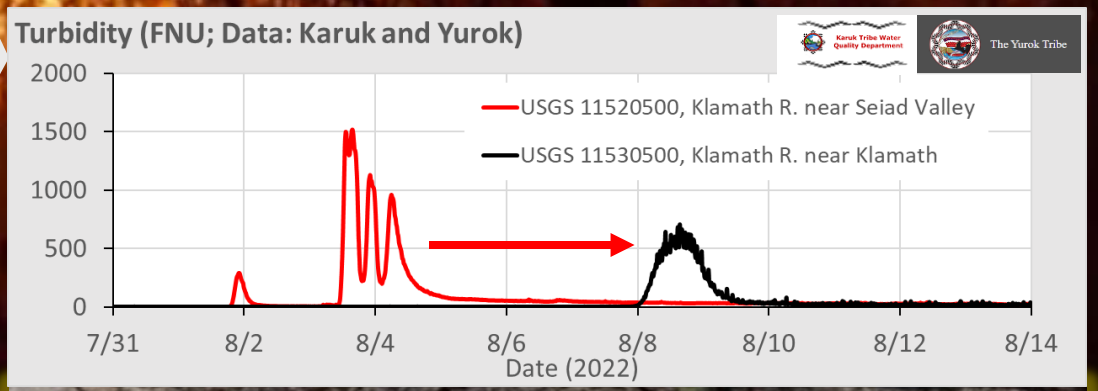
# 2022 McKinney Fire; 60,109 acres

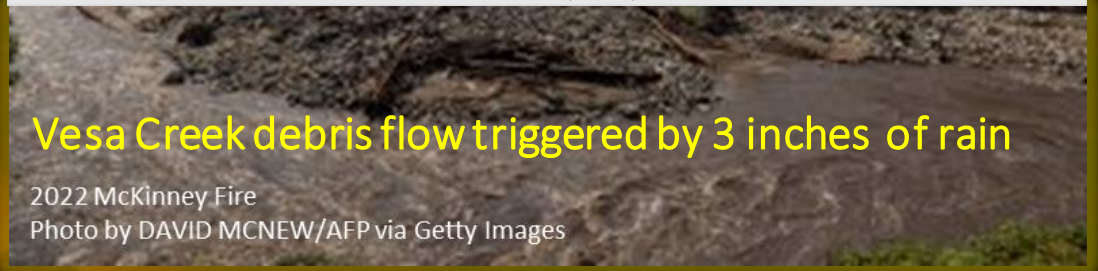
# High-Severity Fire + Rain = High Flows, Debris Flow, High Turbidity!

https://ca.water.usgs.gov/wildfires/california-wildfire-data.html

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Discharge Data: https://nwis.waterdata.usgs.gov/nwis/uv?site_no=11520500%2C11530500&format=gif_mult_sites&PARAmeter_cd=00060&legacy=1&begin_date=2022-07-31&end_date=2022-08-14

Turbidity Data: https://nwis.waterdata.usgs.gov/nwis/uv?site_no=11520500%2C11530500&format=gif_mult_sites&PARAmeter_cd=63680&legacy=1&begin_date=2022-07-31&end_date=2022-08-14

# 2022 McKinney Fire; 60,109 acres

# High-Severity Fire + Rain = High Flows, Debris Flow, High Turbidity, Low D.O.!

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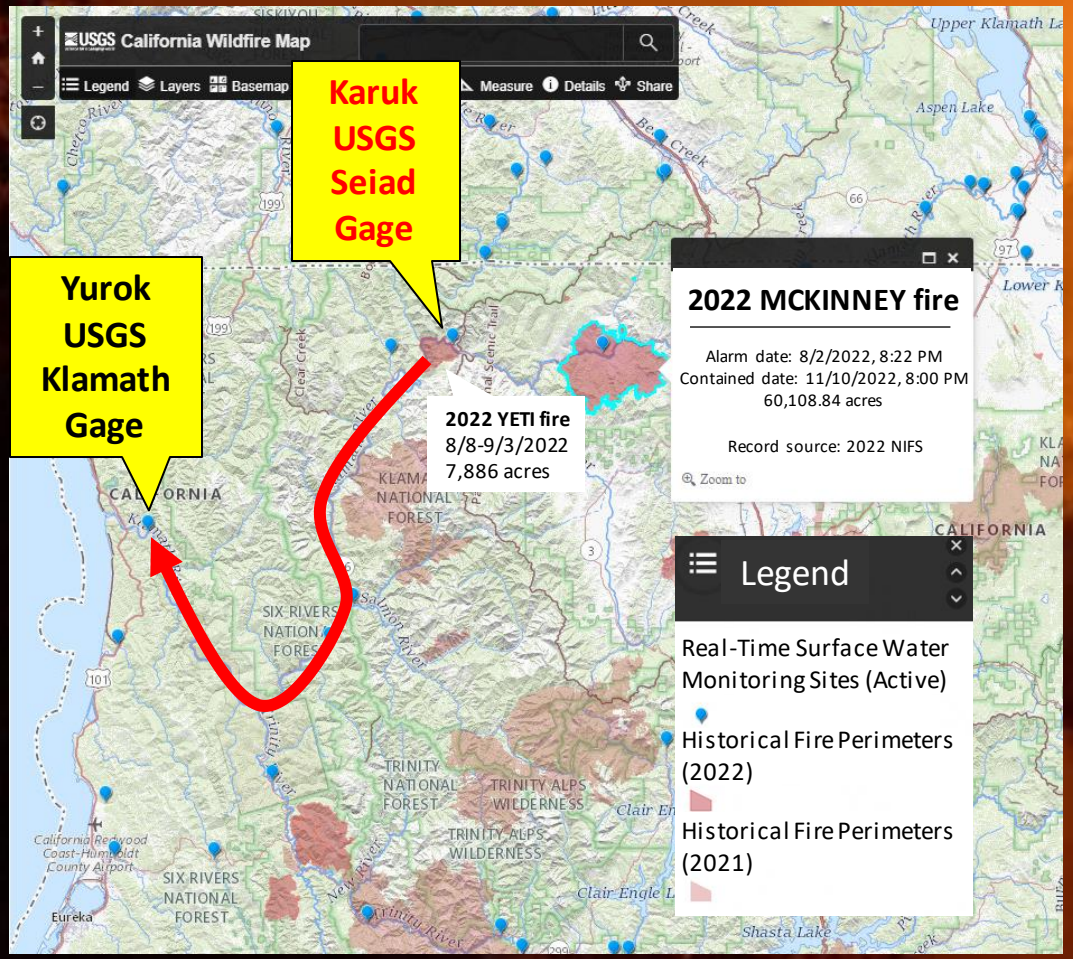
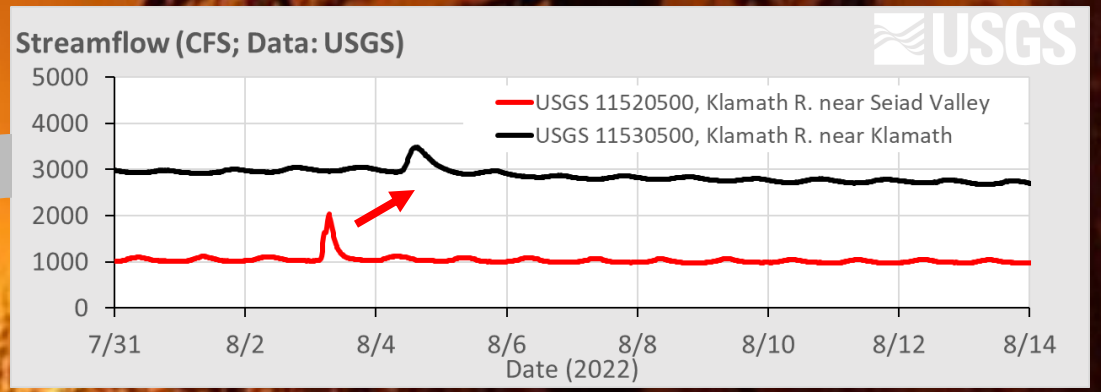
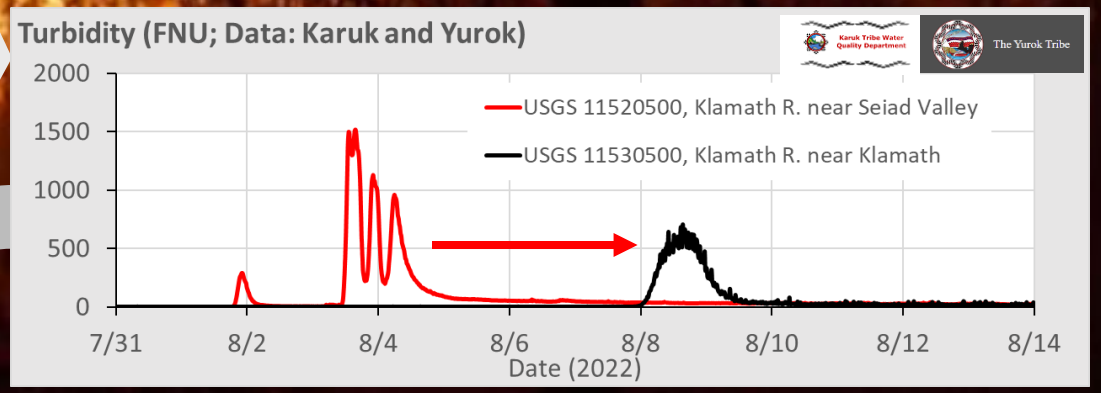
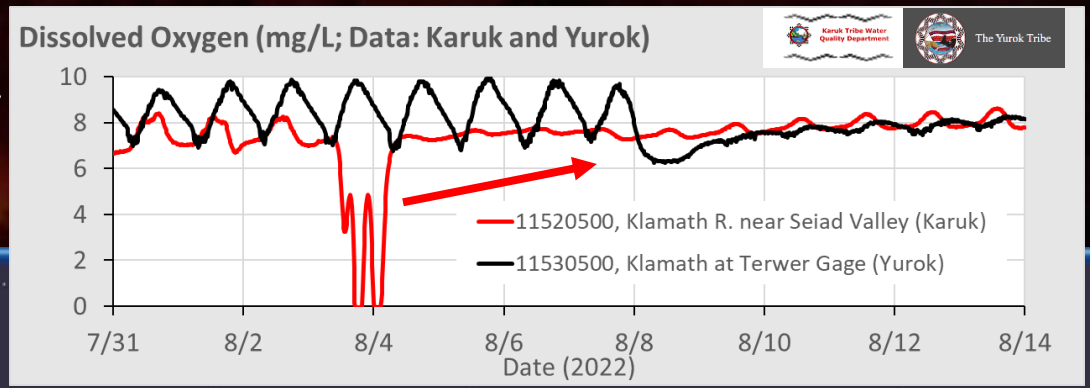



USGS science for a changing world

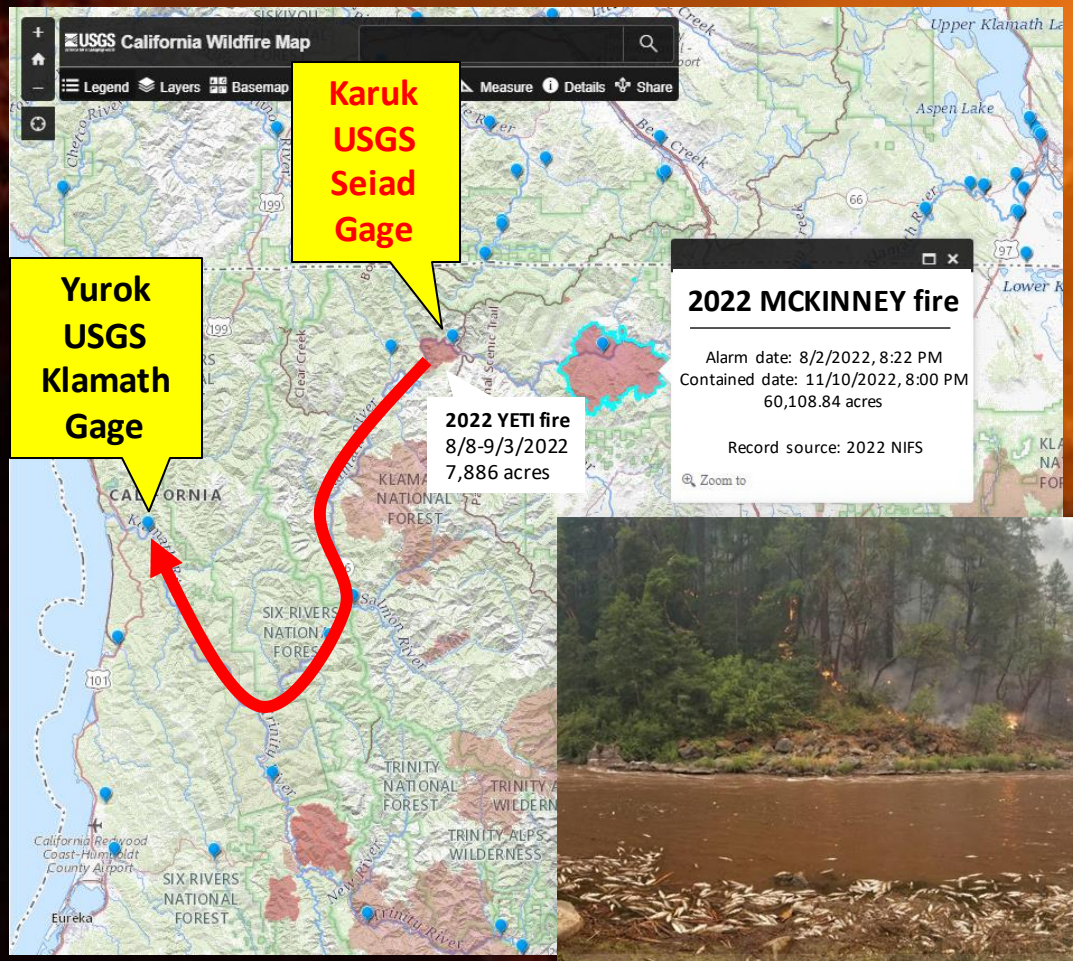
Discharge & Turbidity Data: https://nwis.waterdata.usgs.gov/
Turbidity & D.O. data: https://waterquality.karuk.us/, https://aqwebportal.yuroktribe.nsn.us/

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

# 2022 McKinney Fire; 60,109 acres

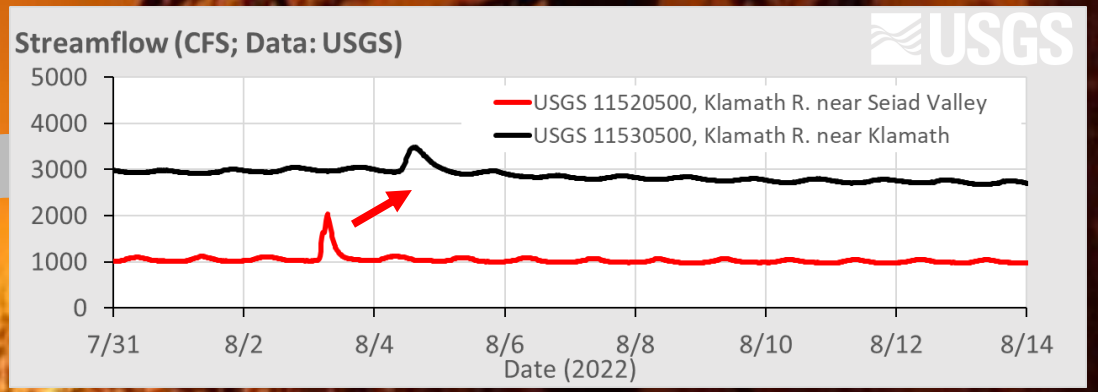
## High-Severity Fire + Rain = High Flows, Debris Flow, High Turbidity, Low D.O., Fish Kill!

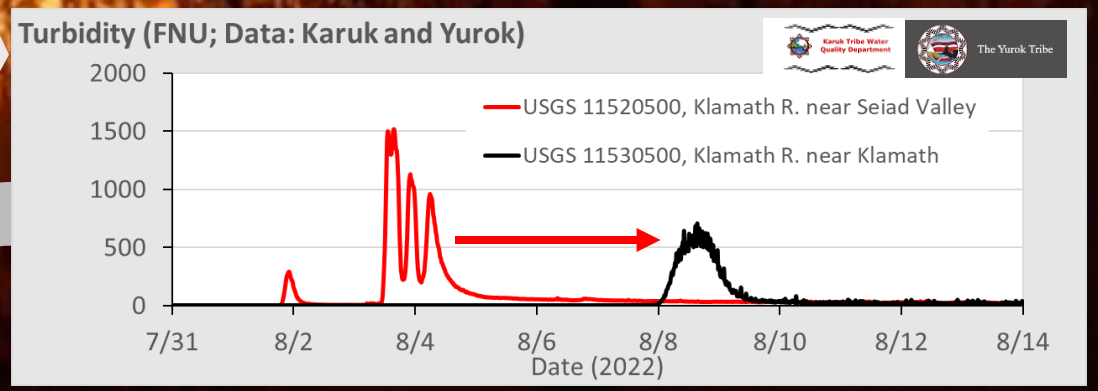
https://ca.water.usgs.gov/wildfires/california-wildfire-data.html

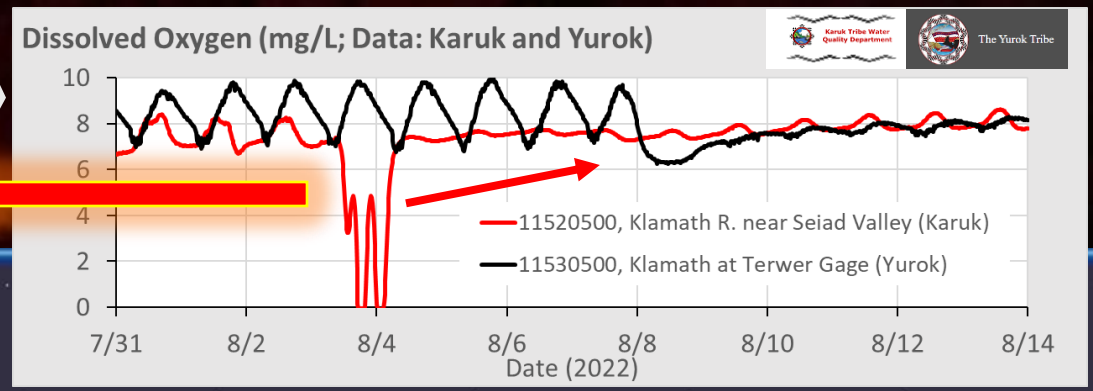






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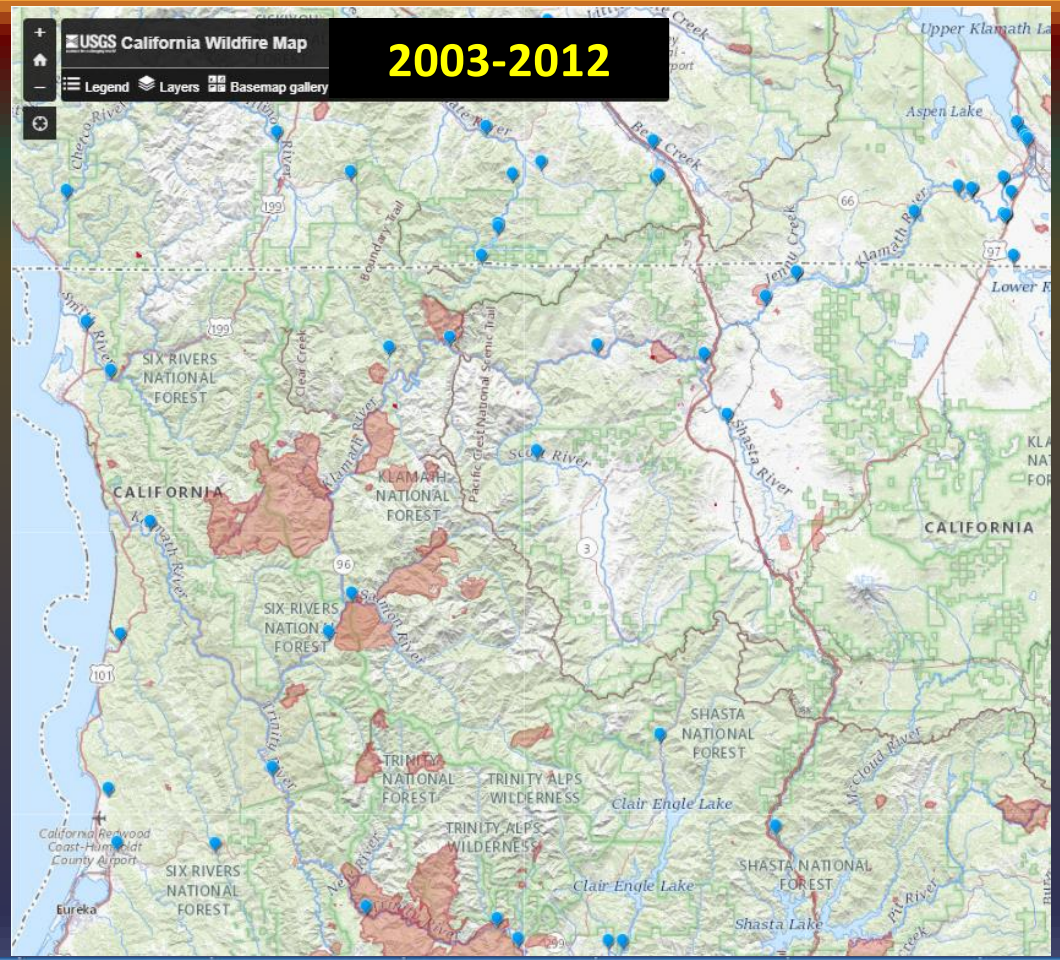
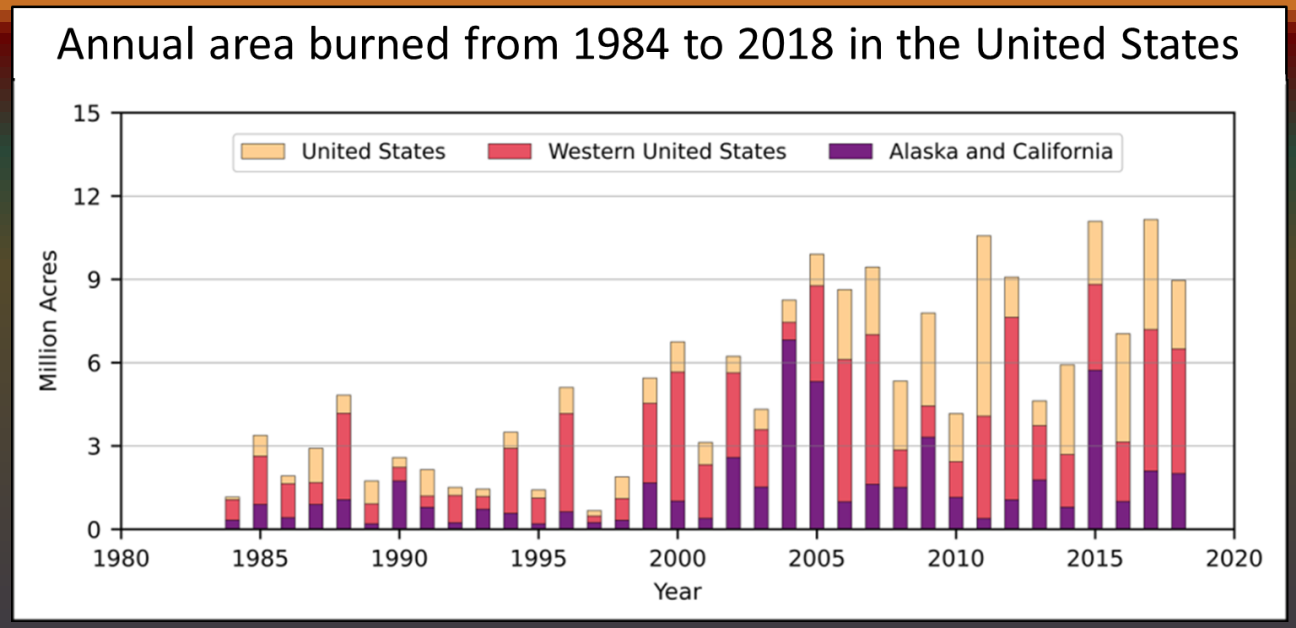
Discharge & Turbidity Data: https://nwis.waterdata.usgs.gov/
Turbidity & D.O. data: https://waterquality.karuk.us/, https://aqwebportal.yuroktribe.nsn.us/

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

# INCREASING and INCREASINGLY LARGE and SEVERE wildfires INCREASINGLY threaten water supplies for people and ecosystems

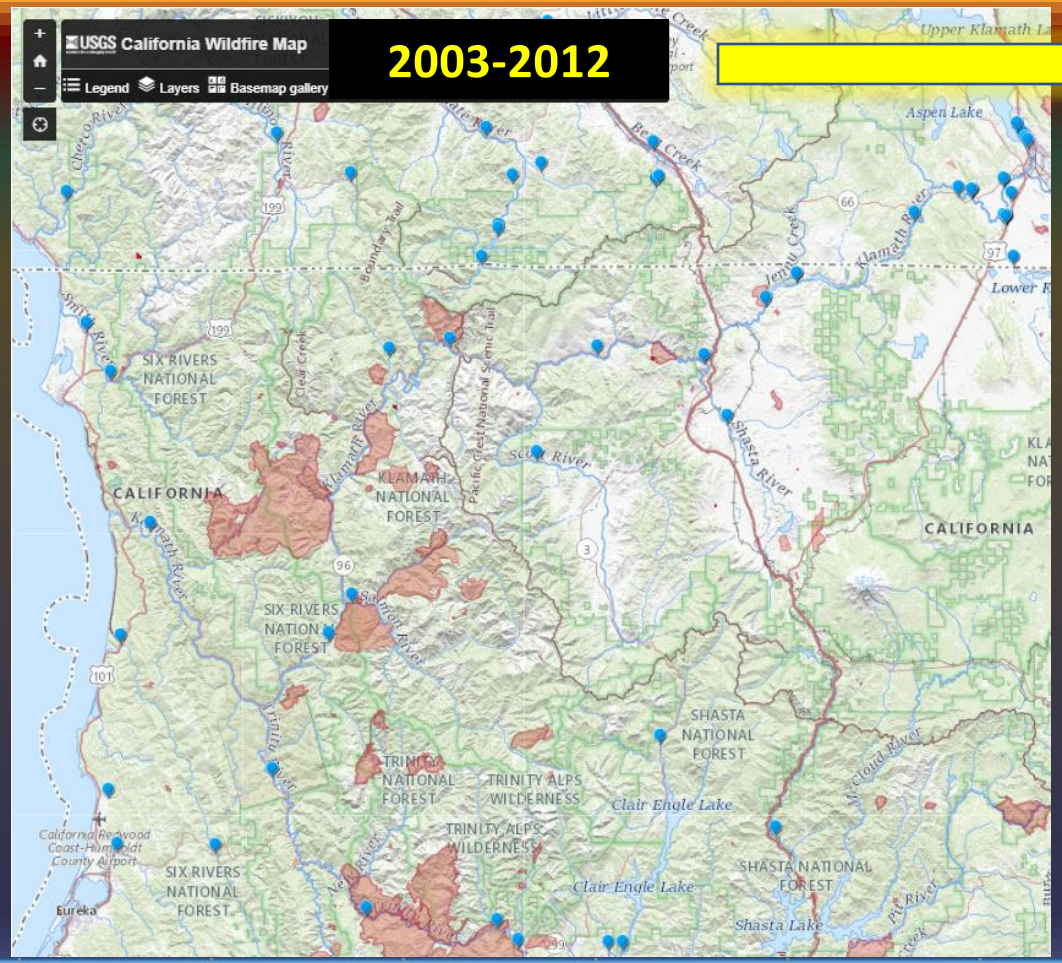


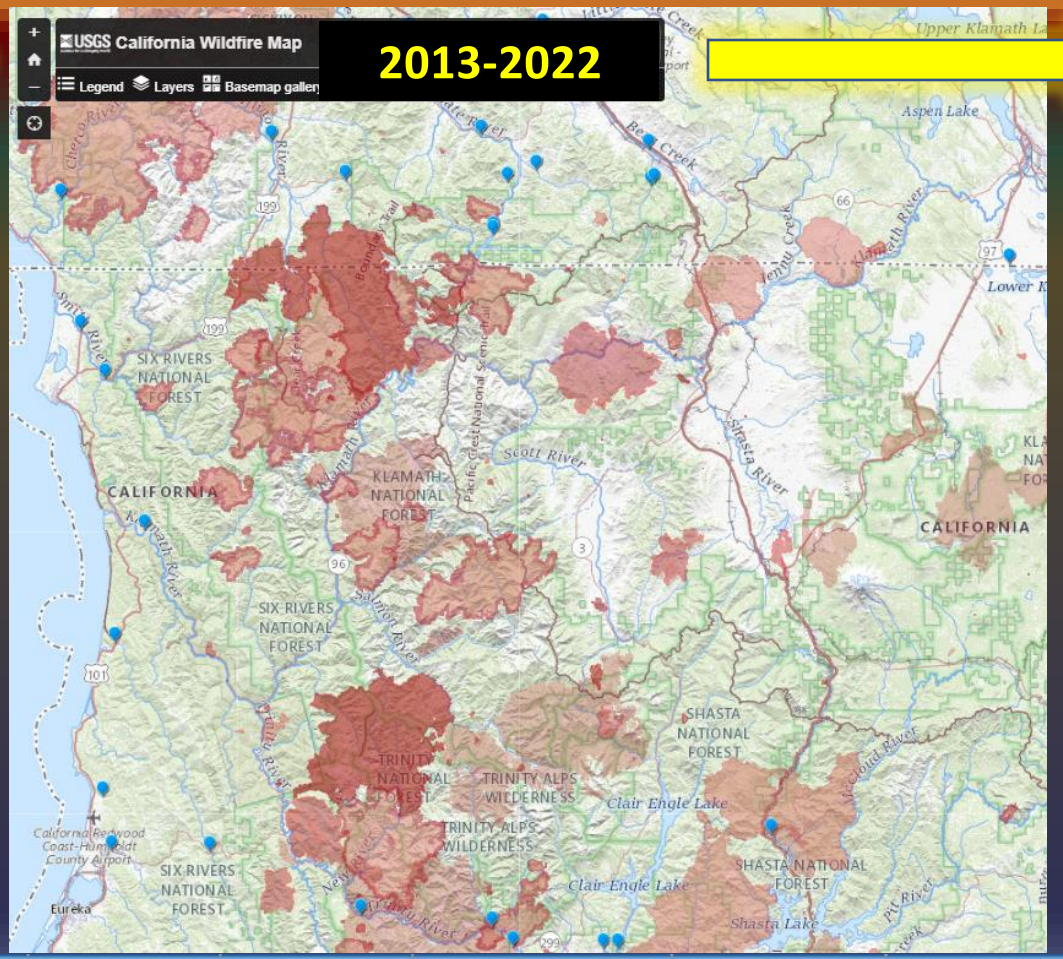




https://ca.water.usgs.gov/wildfires/california-wildfire-data.html

Fu et al., 2021, *EOS*
https://eos.org/opinions/tackling-challenges-of-a-drier-hotter-more-fire-prone-future

# INCREASING and INCREASINGLY LARGE and SEVERE wildfires INCREASINGLY threaten water supplies for people and ecosystems

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https://ca.water.usgs.gov/wildfires/california-wildfire-data.html

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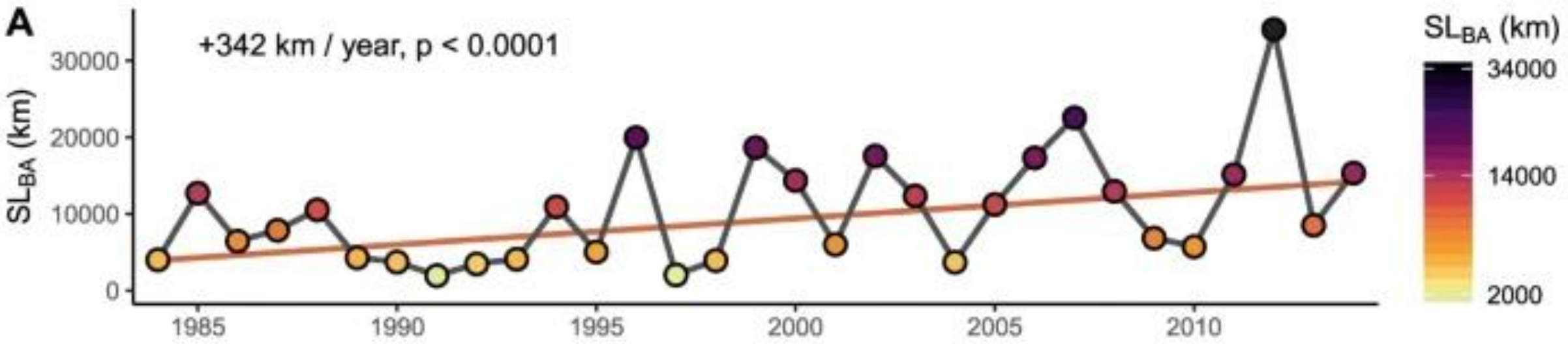
# INCREASING and INCREASINGLY LARGE and SEVERE wildfires INCREASINGLY threaten water supplies for people and ecosystems

Stream + river length within burned areas increased at a rate of 342 km/year between 1984 and 2014

This does not include downstream impacts!

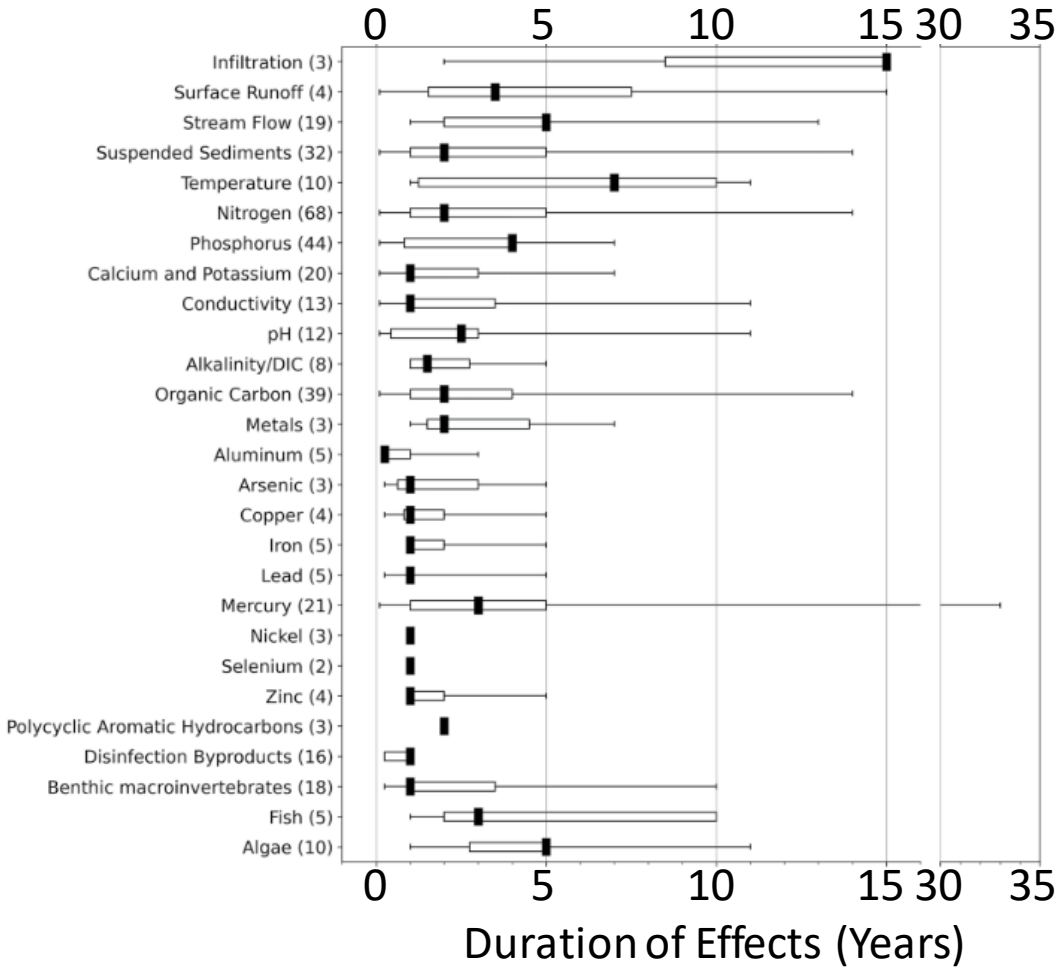





Ball et al., 2021, *Nature Communications*
https://www.nature.com/articles/s41467-021-22747-3

# INCREASING and INCREASINGLY LARGE and SEVERE wildfires INCREASINGLY threaten water supplies for people and ecosystems

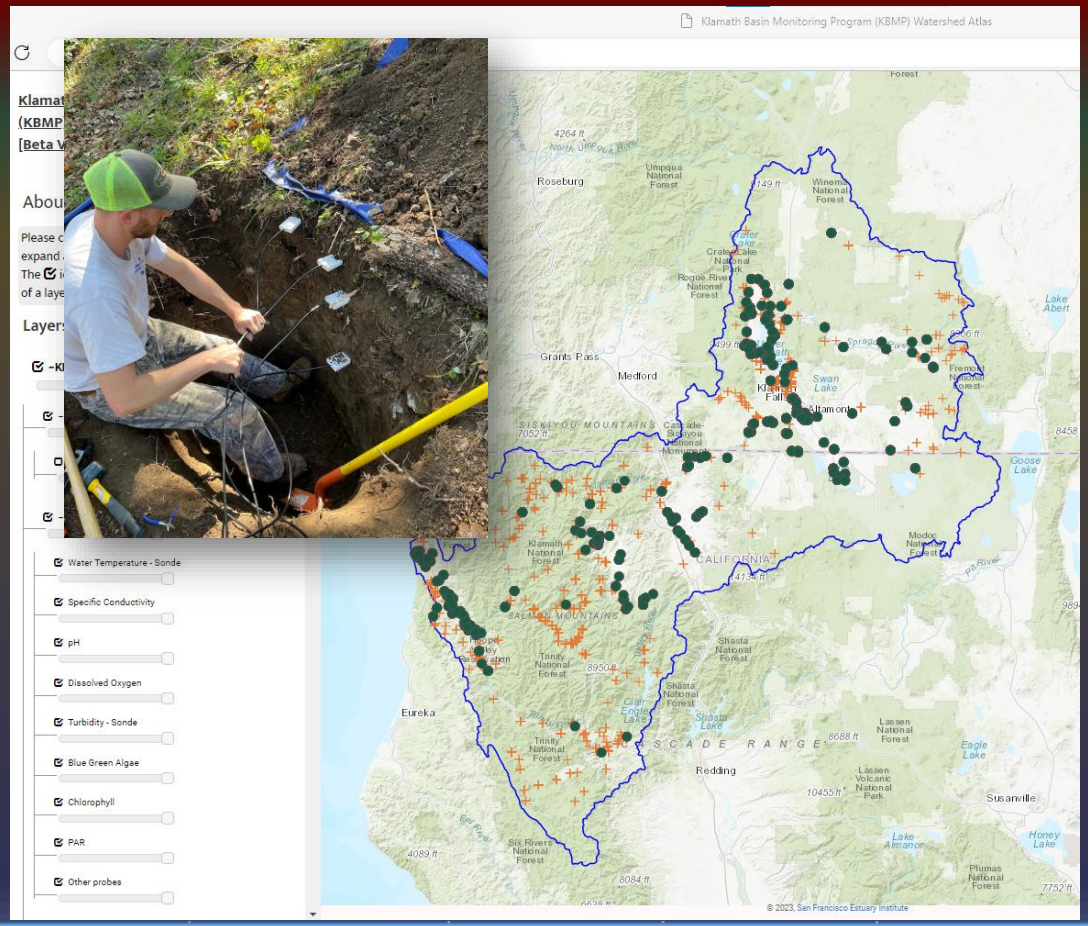
## Impacts can last from days to decades


Paul et al., 2022, *Water Resources Research*
https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021WR030699

# Tracking and forecasting wildfire impacts on human water supplies and aquatic ecosystems in burn areas & downstream is hard

- Impacts depend on numerous factors; are difficult to forecast
- Fire effects vary greatly in space and time; comprehensive monitoring is important
- Much to learn on how impacts vary with differing fire severity patterns and among different types of water supplies (including in soils, aquifers)




https://kbmp.ecoatlas.org/map.php

# Acknowledgements and References:

# Thank you!

amueller-solger@usgs.gov


- The Karuk Department of Natural Resources and the Yurok Tribe Environmental Department gave permission to display data downloaded from https://waterquality.karuk.us/ and https://aqwebportal.yuroktribe.nsn.us/ - thank you!
- The following USGS employees provided information and/or reviewed this talk: Jenny Curtis, Travis Apo, Sheila Murphy, Kurt Carpenter, Sally House, Eric Reichard, Darrin Thome, Terrence Conlon, and Jeff Ziegeweid - thank you!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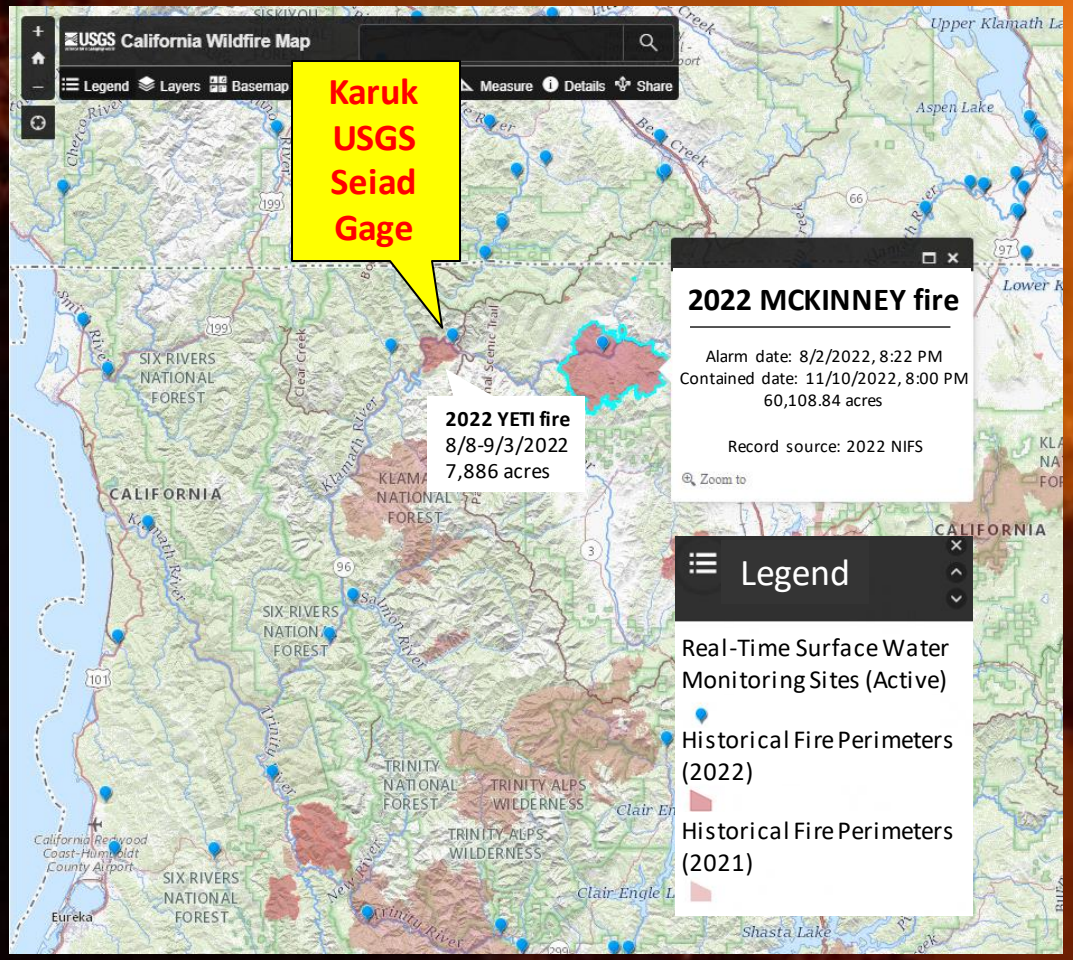
# Extra slide

# 2022 McKinney Fire; 60,109 acres

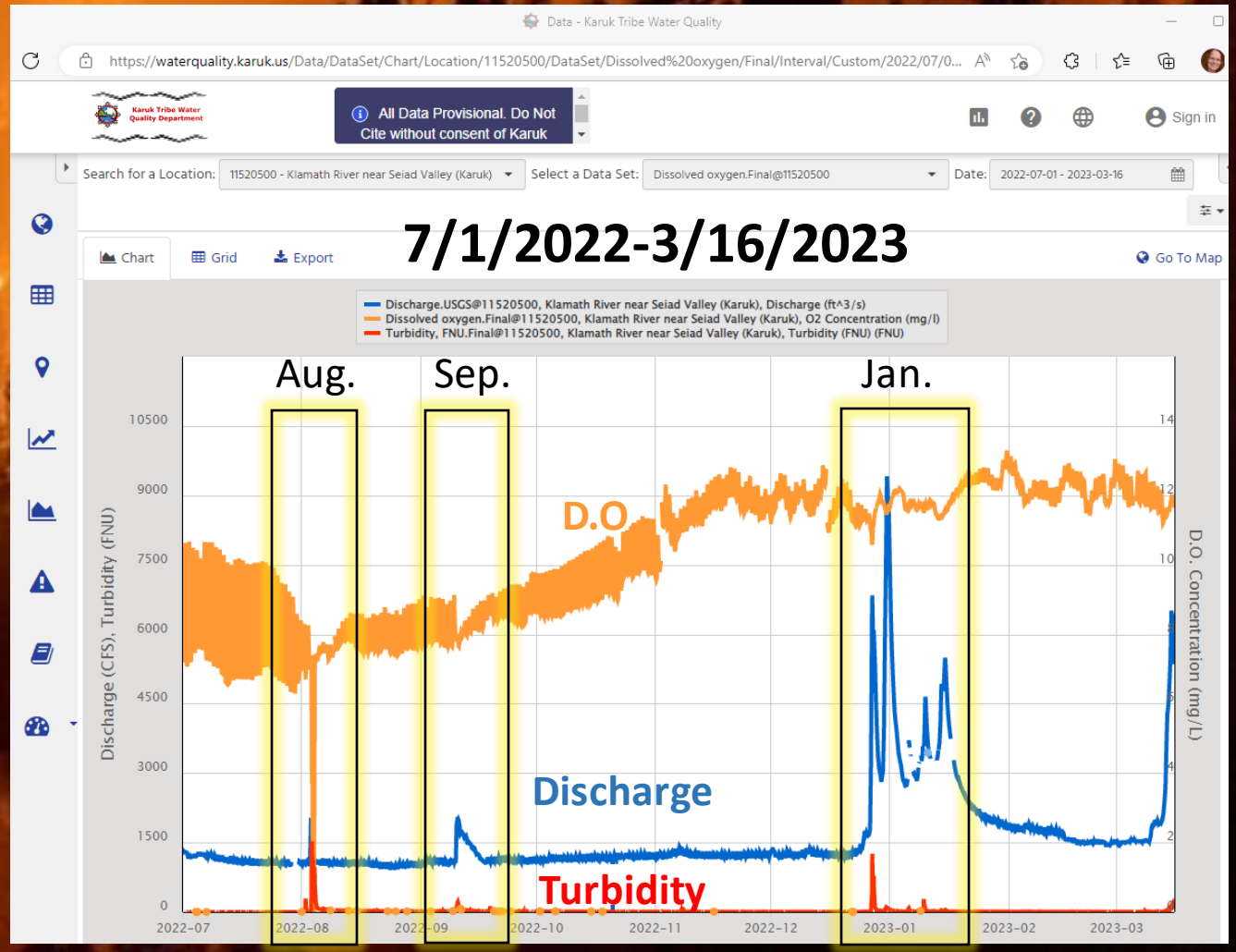
## Beyond the “first flush”

https://ca.water.usgs.gov/wildfires/california-wildfire-data.html





Karuk Tribe Water Quality Department

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Data: https://waterquality.karuk.us/