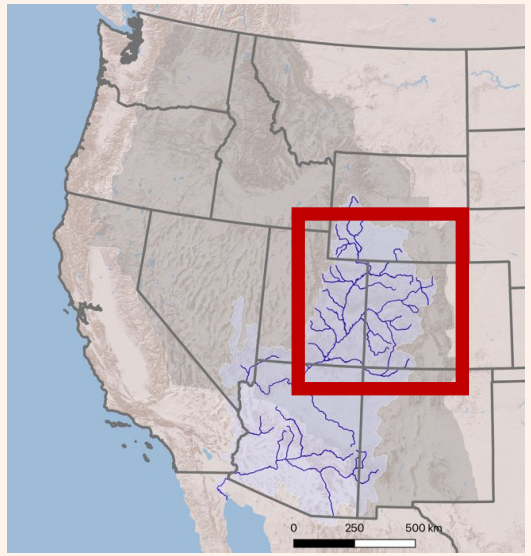
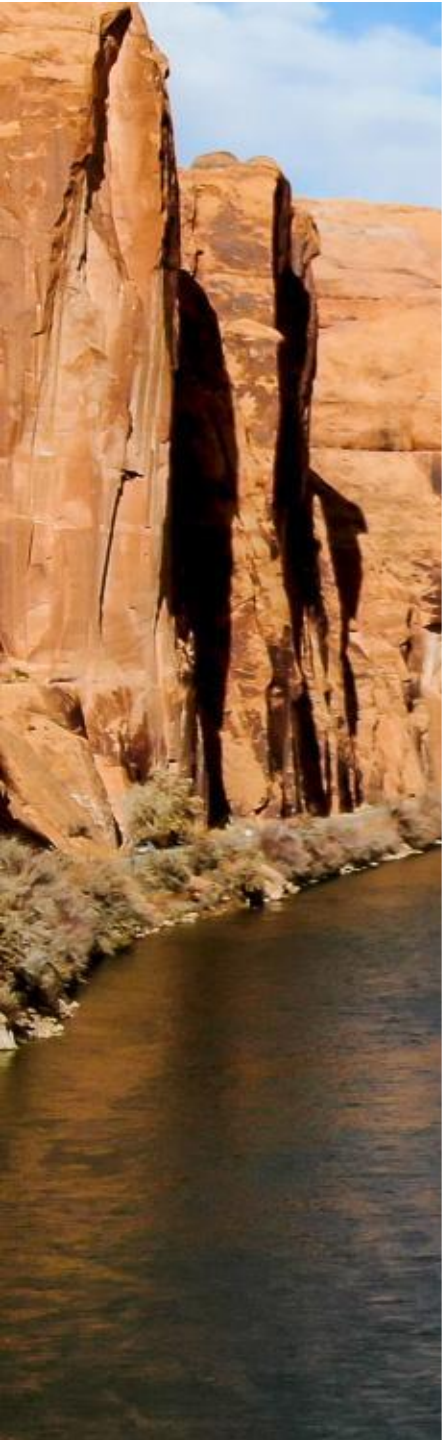


Next Generation of Test Beds to Advance Hydrological Sciences

A 21st Century Collaborative Test Bed for Mountain Hydrology

Julie Vano (AGCI); Tanya Petach (AGCI); Jeffrey Deems (ASO Inc); Mark Raleigh (Oregon State); Joseph Hamman (Earthmover); Elise Osenga (AGCI); James Arnott (AGCI)

NASA Award:
80NSSC21K0984



TIMELINE of LISTENING TOUR

14 Events (Dec 2021 – May 2023)

DECEMBER 2021
AGU Fall Meeting 2021 (New Orleans, LA)

JANUARY 2022
AMS Annual Meeting (Virtual)

JANUARY 2022
Colorado River Climate and Hydrology Work Group conversation (Virtual)

FEBRUARY 2022
GEWEX Regional Hydroclimate Project Affinity Group (Virtual)

JUNE 2022
AGU Frontiers in Hydrology Meeting (San Juan, Puerto Rico)

SEPTEMBER 2022
Yampa Basin Rendezvous (Steamboat Springs, CO)

SEPTEMBER 2022
AGU Chapman Conference: Solving Water Availability Challenges through an Interdisciplinary Framework (Golden, CO)

OCTOBER 2022
Sustaining Colorado Watersheds Conference (Avon, CO)

DECEMBER 2022
AGU Fall Meeting (Chicago, IL)

FEBRUARY 2023
Snow Research Meets Water Resources Operations in the San Juans (Silverton, CO)

FEBRUARY-APRIL 2023
USGS ASIST Colorado River Basin Workshop Series (Virtual)

APRIL 2023
Colorado River "state of the river" basin roundtable (Grand Junction, CO)

MAY 2023
Roaring Fork Watershed Collaborative meetings (Carbondale, CO)

MAY 2023
Yampa Basin Rendezvous (Steamboat Springs, CO)

Example highlights:

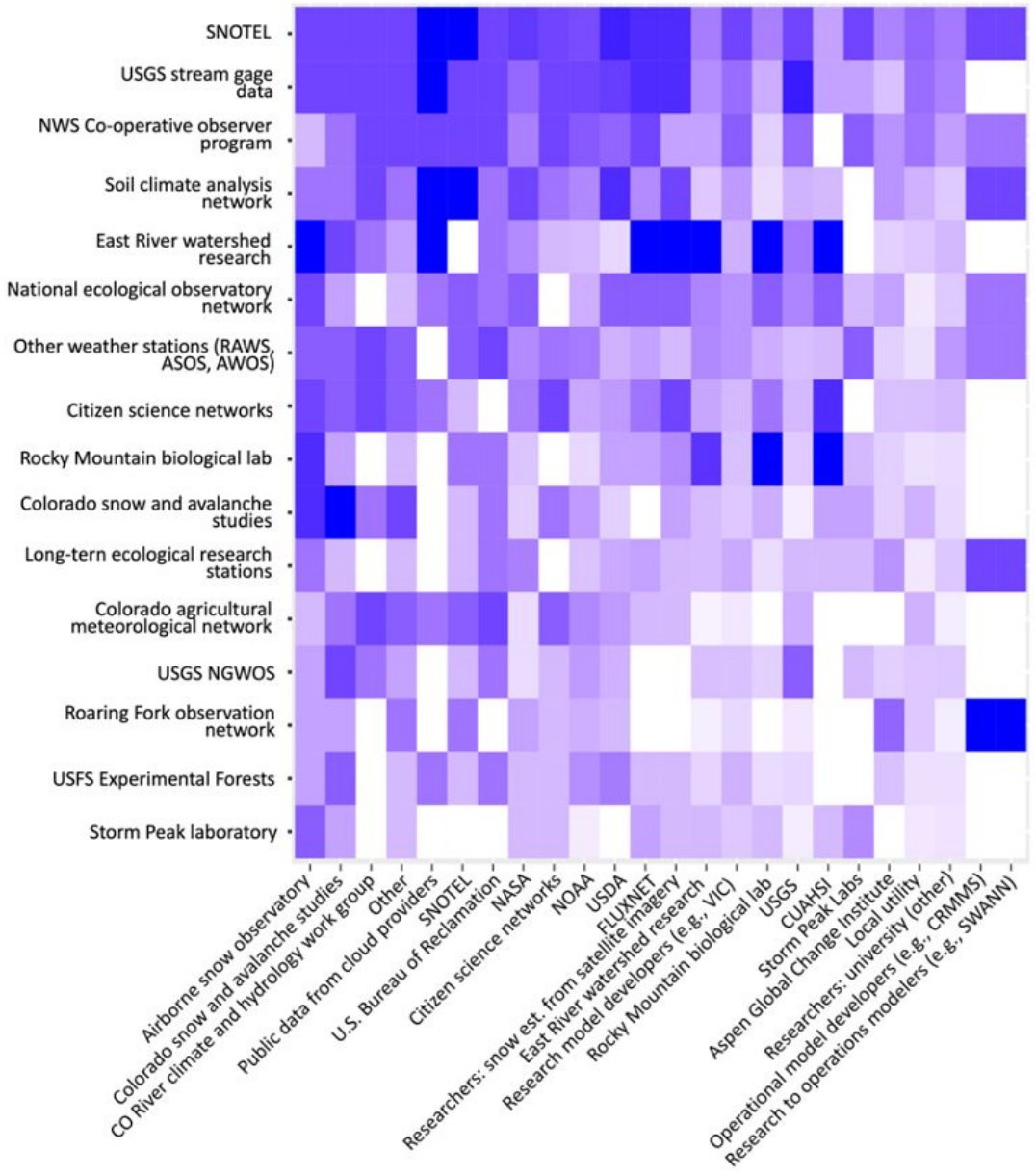
Building relationships can be invaluable but building meaningful, reciprocal relationships takes time

Translating research into practice is important, however, translating decision maker needs into research questions is another very important aspect

Colorado River Research Landscape

Field

- **SNOTE**
- **USGS s**
- **NWS V**
- **Station**
- East Ri
  Resear
- NRCS S
  Analysi
- Nation
  Observ
- Citizen
- Rocky
  Biologi
- Weath
- USGS N
  Water
  System
- Long T
  Resear
- Center
  Avalan
- USFS E
  Forests
- AGCI R
  Obs. N
- CO Ag
- Storm



search communities

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  changes
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- ational Resources
  onservation Service
- SGS data platforms
- ational Snow Ice
  ata Center
- JAHSI Hydroshare
- ublic Data
- ASA Land Processes
- istributed Active
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- angeo Cloud

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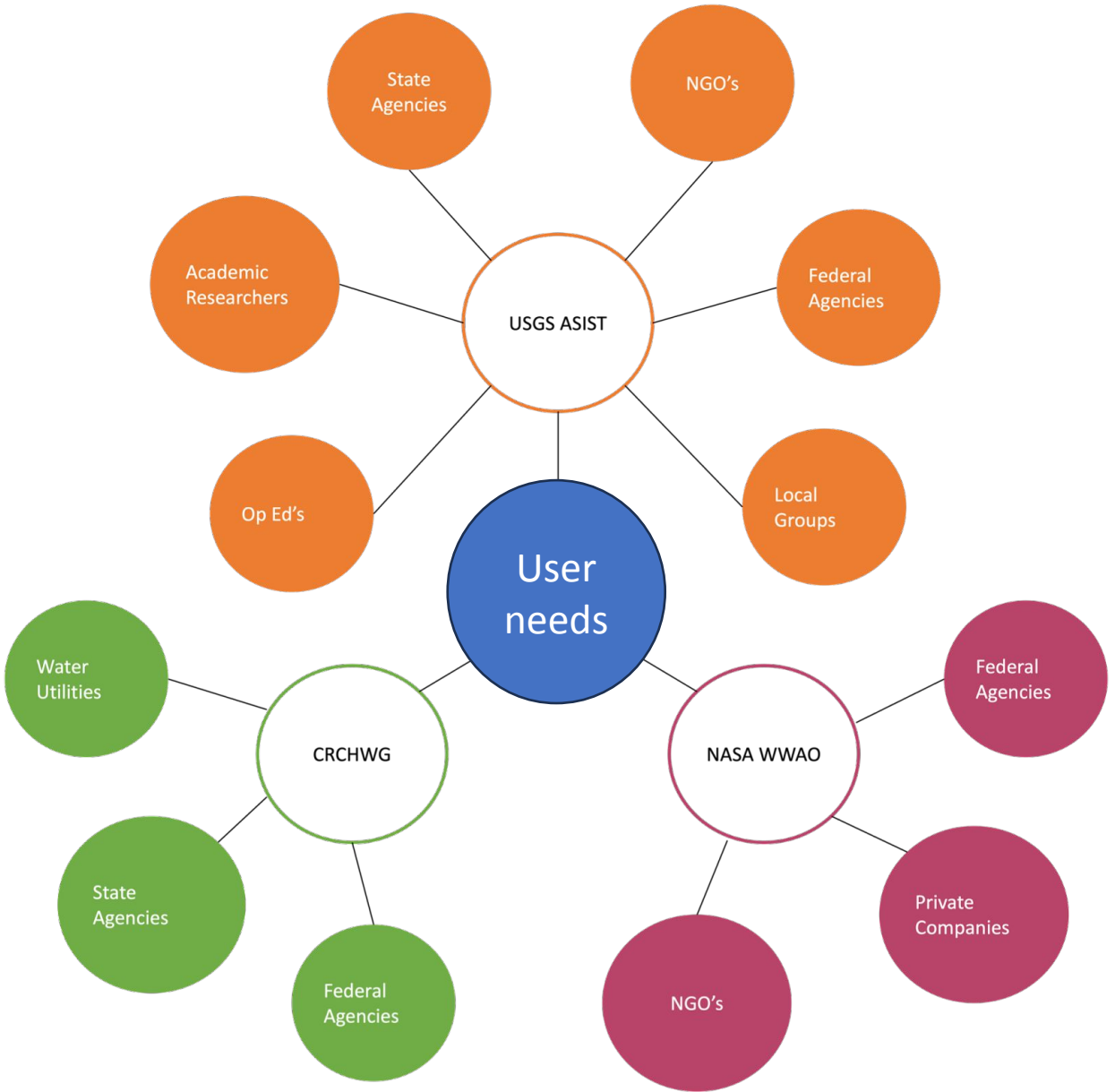
d post survey

User needs assessments



21ST CENTURY COLLABORATIVE TEST BED FOR MOUNTAIN HYDROLOGY

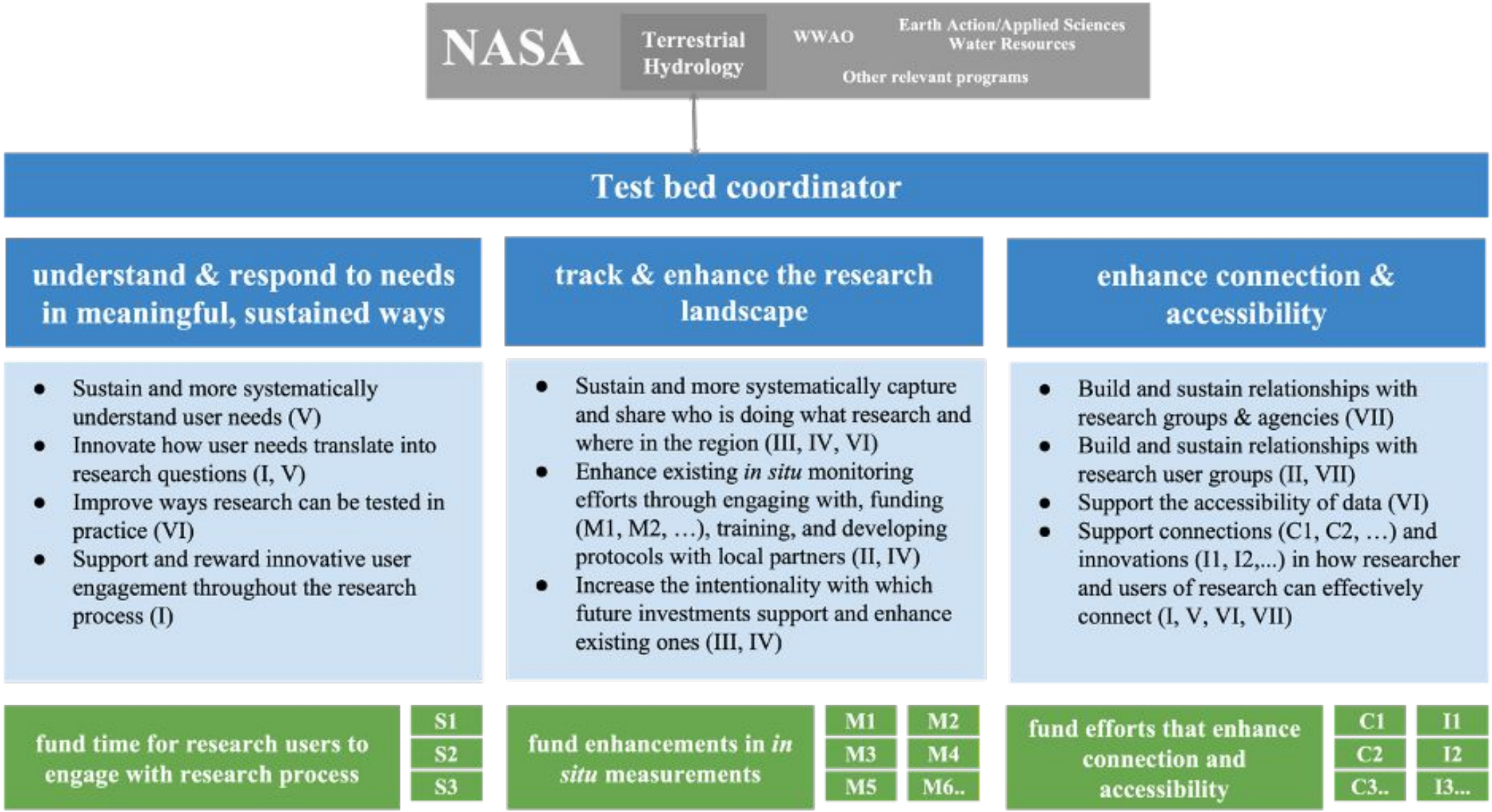
RECOMMENDATIONS

For the development of future NASA projects, partnerships, and monitoring work in the Colorado River Headwaters, this study makes the following recommendations:

I	Prioritize engagement with resource managers to help identify fundamental research needs that would improve operations
II	Support the time and effort required to build local partnerships
III	Target place-based investments that are based in existing work and connection points
IV	Invest in and connect with existing *in situ* monitoring with local research partners
V	Take stock of what is needed, but not every project should conduct a user needs assessment
VI	Improve existing tools (rather than build new ones) and recognize the value of applying and testing existing technology to new locations or decision contexts
VII	Support sustained connections, understanding, and purposeful collaborations across the research-and-practice landscape

Prioritize engagement with resource managers to help identify fundamental research needs that would improve operations

Support the time and effort required to build local partnerships


NASA
Terrestrial Hydrology
WWAO
Earth Action/Applied Sciences Water Resources
Other relevant programs
Test bed coordinator
understand & respond to needs in meaningful, sustained ways
track & enhance the research landscape
enhance connection & accessibility
Sustain and more systematically understand user needs (V)
Innovate how user needs translate into research questions (I, V)
Improve ways research can be tested in practice (VI)
Support and reward innovative user engagement throughout the research process (I)
Sustain and more systematically capture and share who is doing what research and where in the region (III, IV, VI)
Enhance existing in situ monitoring efforts through engaging with, funding (M1, M2, …), training, and developing protocols with local partners (II, IV)
Increase the intentionality with which future investments support and enhance existing ones (III, IV)
Build and sustain relationships with research groups & agencies (VII)
Build and sustain relationships with research user groups (II, VII)
Support the accessibility of data (VI)
Support connections (C1, C2, …) and innovations (I1, I2,...) in how researcher and users of research can effectively connect (I, V, VI, VII)
fund time for research users to engage with research process
S1
S2
S3
fund enhancements in in situ measurements
M1
M2
M3
M4
M5
M6..
fund efforts that enhance connection and accessibility
C1
I1
C2
I2
C3..
I3...

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Main page

Key Items

Science and applications
Data and tools
New research
Current conditions
Water law and policy
Who's who
About the river
Events calendar
Your feedback

Topics

Cross-cutting reports

- **2021 SECURE Water Act reports**
- **2020 CRB State of the Science**
- **2018 CRB Ten Tribes Partnership Tribal Water Study**
- **2012 Colorado River Basin Study**

Weather and climate

- **Climate patterns and variability**
- **Recent climate change**
- **Weather and climate monitoring**
- **Weather and climate forecasts**
- **Projected future climate**
- **Colorado River extremes**

Hydrology and water availability

- Water balance and basin water budget
- **Snowpack**
- **Soil moisture**
- **Evapotranspiration (ET)**
- Groundwater
- **Streamflow**
- **Paleohydrology**
- Hydrologic variability and trends
- **Seasonal streamflow forecasts**
- Droughts
- **Floods**
- Channel dynamics
- **Hydrologic modeling**
- **Projected future hydrology**

Water operations and planning

- **Dams, reservoirs, and other infrastructure**
- Operating guidelines and rules
- **River system models**
  - **Colorado River Mid-term Modeling System (CRMMS)**
  - **Colorado River Simulation System (CRSS)**
- Planning approaches

Water Use

- **Consumptive uses and losses**
  - **Agricultural water use**
  - **Municipal water use**
  - **Reservoir evaporation**
  - Channel and bank losses
- Instream flows
- Demand accounting and scenarios
- Future basin demand

Water quality

- **Salinity**
- **Metals and acid mine drainage**
- Other contaminants

Geomorphology and sediment

- Erosion and sediment sources
- Riverbed sediment dynamics
- Reservoir sedimentation

Ecosystems and environment

- Vegetation change
- Wildfires
- Insect infestations and disease
- **Tamarisk and invasive plants**
- **Threatened and endangered fish species**
- **Invasive mussels**
- Traditional Ecological Knowledge
- Salton Sea
- Colorado River Delta

Societal and economic issues

- Benefits of water
- Impacts of shortage and drought
- Social inequity and vulnerability