REQUEST FOR PROPOSALS

University of Wyoming Office of Water Programs
Water Research Program
FY2023

The Office of Water Programs/Water Research Program (OWP/WRP) welcomes proposals covering topics involved in Wyoming's water resources. Each proposal shall include a "Non-technical Statement of Relevance" with an explanation of:

- how the study could be used by governmental agencies in the management of Wyoming's water resources,
- how this project will meet the research needs of State and Federal agencies regarding Wyoming's water resources,
- how this project will support water related training and education,
- specifically, how technology transfer will occur.

Principal Investigators are encouraged to consult with state agencies concerning the following topics prior to submitting proposals. Letters of support from local, state and federal agencies are also encouraged to be submitted with proposals.

Proposals will be evaluated on the following:

- Benefits
- Likelihood of success
- Scientific merit
- Methods
- Timeline
- Overall presentation

Protecting Public Health

Wyoming citizens and out-of-state visitors enjoy fishing, boating, swimming, floating and other recreational opportunities provided by Wyoming's lakes, reservoirs, rivers and streams. However, recreational activities, particularly those that result in full-body immersion, can pose a risk to public health if individuals are exposed to pollutants in the water that cause adverse health effects. In addition, pollutants in surface water and groundwater used for drinking water can pose a risk to human health.

- **Water borne pathogens** (as typically measured by the indicator *E. coli*) cause the majority of Wyoming's surface water quality impairments. Research addressing pathogens is of significant importance to the State of Wyoming. Additional tools are needed to better allow state and local water managers, regulators, conservation groups and others to minimize public health risk by 1) better assessing and prioritizing public health risk, 2) identifying sources of pathogens, and 3) identifying effective management measures to reduce pathogens and mitigate public health risk. In particular, the following topics are identified as priority research areas:
    - Studies related to evaluating the ability of indicators other than *E. coli* (e.g.

enterococci, coliphage) to accurately assess public health risk from waterborne pathogens in Wyoming waterbodies.
    - Epidemiological studies relating pathogen levels to incidence of water borne pathogen exposure and illness in Wyoming streams and rivers.
    - Studies that evaluate the effectiveness of conservation practices in reducing pathogen (*E. coli*) loading to surface waters.

- **Nutrients** (nitrogen and phosphorus), in appropriate amounts, are essential to healthy aquatic ecosystems. However, excessive nutrients, or nutrient pollution, can lead to harmful cyanobacteria blooms (HCBs) in lakes or reservoirs. HCBs are dense concentrations of cyanobacteria or blue-green algae that pose a risk to human, pet and livestock health. HCBs can produce poisons called cyanotoxins and may be associated with other irritants that can cause adverse health effects such as rashes, itching, numbness, nausea, fatigue, disorientation, abdominal pain, vomiting and diarrhea. In extreme cases, cyanotoxins may lead to pet or livestock death. HCBs can also cause fish kills and interfere with drinking water supplies. Recreational use health advisories were issued on 28 Wyoming reservoirs in 2021 due to HCBs. Research on nutrient pollution and HCBs would help state and local entities better identify, assess and respond to HCBs in order to reduce public health risk from exposure to cyanotoxins and other cyanobacteria- related irritants.

  Excess nutrient pollution in surface water and groundwater used for drinking water can also represent a public health risk. High nitrates in drinking water can affect the ability of the blood to carry oxygen and can cause methemoglobinemia. Understanding sources of nutrient pollution within a watershed (e.g., wastewater, fertilizer, animal waste) can help local, state, and federal agencies protect water quality for drinking water.

  The following topics are identified as priority research areas:
    - Studies evaluating the effectiveness of conservation practices or advanced treatment septic systems in reducing nutrient loading to surface waters and groundwater.
    - Studies on the types and levels of toxins (or other compounds causing health effects) in cyanobacteria blooms in Wyoming surface waters.
    - Studies evaluating the health risks to humans, pets, livestock and wildlife associated with cyanobacteria blooms with and without toxins.
    - Studies related to the presence of benthic cyanobacteria blooms and potential toxin production in streams and rivers.
    - Studies evaluating the risks of using irrigation water from lakes and reservoirs where HCBs are occurring.
    - Studies evaluating sources of nutrient pollution in areas of the state where high nitrates are being detected in groundwater used for drinking water.
    - Studies that help management agencies understand and use methods to identify nutrient sources (e.g., nutrient isotope analysis).

- **Antibiotic Pollution** is increasing worldwide and there is an increasing concern over the fate and transport of these substances in surface waters. Research on these and similar medication toxins would help state and local health officials determine if and where in Wyoming this issue is emerging. In particular, the following topics are identified as priority research areas:
    - Studies on the types and magnitude of antibiotic and/or other medication toxins in

Wyoming surface waters.
    - Studies related to the fate and transport of antibiotic and/or medication toxins in Wyoming surface waters.

Dam Operation and Sediment Management and Transport

The accumulation of sediment in stream systems and behind dams presents challenges. Effective dam operations require the ability to meet water user needs while still protecting downstream uses (e.g., fisheries, aquatic life). Additional research is needed to help understand how to prevent heavy sediment releases and how to effectively respond when they occur. Areas of research include, but are not limited to:

- Additional studies describing the fate and transport of sediments in Wyoming's erosive watersheds and what measures can assist with reducing sediment inputs.
- Further studies on using "flushing flows" to address downstream sediment deposition following releases.
- Studies on economically feasible ways to remove sediment accumulated behind dams.
- Information on ways to most effectively manage sediment at dams and reservoirs to protect and maintain downstream surface waters.
- Best management practices (BMPs) for reducing sediment transport from contributing watersheds.
- Studies evaluating the negative impacts of sediment deposition on land use and land features, such as rangelands and wetlands.
- Analysis of data collected in response to addressing sediment releases from Willwood Dam. Using data gathered from previous and ongoing OWP/WRP projects, the United States Geological Survey (USGS), Wyoming Department of Environmental Quality (WY DEQ), Wyoming Game and Fish Department (WY G&F) and local conservation districts, complete needed data analysis to help address monitoring objectives of Working Groups 2 and 3 (https://wyowillwood.org/working-groups/).

Proposals may also address dam infrastructure issues and dam operation.

Investigating the Hydrologic and Physical Effects of Voluntary Fallowing of Fields

Extended drought conditions in the Southwest have had major effects on water supplies, especially reservoir levels. In the Upper Colorado River basin, which includes the Green and Little Snake River basins, this may result in eventual curtailment of water rights per existing interstate compacts. In an attempt to enhance water levels, the Upper Colorado River basin states, including Wyoming, are currently analyzing the public's interest and the technical feasibility of a temporary, compensated and voluntary demand management program. A major component of this program could include fallowing fields. Information gathered to date has identified the need for further research and data gathering. Research results should have applicability to other basins in Wyoming. Areas of research include:

- The short- and long-term effects, both beneficial and detrimental, of fallowing fields on stream health, including quality and quantity of flow. Research should consider both split season and full season fallowing as well as sprinkler and basic flood irrigation methods. Research should also include analyzing the effects of fallowing on the local shallow aquifers.
- The effects of fallowing on harvest yields. Research should take into account same-year yields of fields that are fallowed for half a season and/or the post-season effects on yields

of fields fallowed in the prior season(s).
- The effects, both beneficial and detrimental, on field health related to invasive species due to fallowing. Research should consider split season and full season fallowing time frames as well as flood and sprinkler irrigation methods

Understanding and Responding to Future Change in Hydrologic Variability

Hydrologic variability is predicted to change as climate variability changes. Climate projections indicate Wyoming will become significantly hotter by 2040-2069 (https://wgfd.wyo.gov/habitat/habitat-resources). Precipitation projections are less certain but it is possible there will be increases in springtime flooding, droughts and intensity of precipitation events. Soil moisture projections are also uncertain but with an increase in climate variability, evapotranspiration is likely to increase as well. Better understanding of future changes in hydrologic variability and assessment of on-the-ground management actions will help the State of Wyoming plan for how best to mitigate and adapt to those changes. Areas of research include:

- Evaluating and/or developing models to best predict watershed-specific frequencies, magnitudes, durations and timing of snowfall, rainfall and runoff affecting baseflows, bankfull flows, flooding and droughts in Wyoming.
- Assessing and prioritizing watersheds by their vulnerability to future hydrologic variability.
    - Identify watersheds most susceptible to increased flooding, droughts and evapotranspiration and to reduced availability of water for agricultural, municipal, industrial, domestic and other beneficial uses. This could include assessment of past, current and projected future categorization of streams as ephemeral, intermittent or perennial.
    - Identify watersheds most likely to experience higher rates of erosion and/or sedimentation due to changes in frequency or magnitude of bankfull and flood flows.
    - Determine which watersheds are most likely to show adverse effects to stream, riparian and wetland habitats and species due to changes in water quantity, hydrologic connectivity and water quality (including water temperature).
    - Assess potential for increased threats of invasive aquatic and riparian species due to changes in water quantity, water quality (including water temperature) and habitat availability and/or condition.
    - Develop remote sensing, GIS and/or other tools to identify, monitor and show stream, riparian, wetland and watershed vulnerability to change in hydrologic variability. Such tools will be most useful if they can be updated as additional information and modeling projections become available.
- Identify and assess watershed-specific effects (beneficial and detrimental) of on-the ground restoration and management actions to mitigate long-term change in hydrologic variability and its effects. For example:
    - Upland, wetland and stream restoration to affect water quality and timing and quantity of water availability.
    - Actions that favor native species over invasive aquatic and riparian species.

Proposals may build upon research needs for specific areas of the state (ie. Upper Colorado River Basin).

Enhanced Streamflow Estimation and Water Supply Forecasting

The Wyoming Water Strategy identified the need to better understand watershed, atmospheric, and climatic variables and their effects on streamflows and water supply, as well as the need to update, improve and/or develop water supply forecasts in river basins of Wyoming.

Areas of research include:

- Innovation of new approaches to complement or replace existing methods of streamflow estimation and flow forecasting tools that analyze the response of various combinations of climate, water demand and land use on streamflow as well as general watershed hydrology. New and improved tools will aid in watershed planning, water management planning, and feasibility studies. Particular emphasis should be placed on:
    - Developing new or improving weighted averaging approaches for combining regional regression methods and partial-year concurrent discharge measurements for estimating year-round mean monthly flows and exceedance flow statistics in small basins without long-term gauging stations. Ideally approaches will include statistical tools, such as confidence intervals, to characterize inherent uncertainty of such streamflow estimates.
    - Use of geospatial models and statistical analyses to better understand the important drivers of streamflow (including drivers that determine whether a stream is intermittent or perennial in a given basin) in small stream basins (<50 square miles).
    - Calibration of forecasting tools in hybrid plains/mountain streams with highly variable climates during low flow years. This could include an evaluation of temperature predictions in relation to water demand factors as well as research aimed at enhancing understanding of transitional zones (i.e. foothills that typically receive intermittent to seasonal snowpack) and lower-elevation (i.e. high plains) contributions to streamflow. Two examples of basins of interest in Wyoming that have large datasets that can contribute to the initiation of research are the Tongue River and Upper North Platte River Basins.