Draft

Report to the 2022 Montana Water Policy Interim Committee on Stream Gaging in Montana

Prepared for:
Water Policy Interim Committee

Prepared By:
Stream Gage Oversight Work Group
Drought and Water Supply Advisory Committee

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Terms and Acronyms

- BIA: Bureau of Indian Affairs
- CMF: Cooperative Matching Funds
- CSKT: Confederated Salish & Kootenai Tribes
- DNRC: Montana Department of Natural Resources and Conservation
- FIPP: Flathead Indian Irrigation Project
- FPS: Federal Priority Stream Gage Network
- FWP: Montana Fish Wildlife and Parks
- GOES Satellite: Geostationary Operational Environmental Satellite, operated by the U.S. National Oceanic and Atmospheric Administration
- NSN: National Streamflow Network
- O&M: Operation and maintenance costs
- Rating Curve: Relationship between water stage (elevation) and water discharge in a channel
- Stage: Height of water above a surveyed local datum point
- USGS: United States Geological Survey

Preface

Information on costs, sources of operation and maintenance funding, and number of stream gages operating in Montana, are accurate based on the best information available to the Stream Gage Oversight Work Group in 2022.

Cover Photo Credits: USGS and DNRC

1.0 Introduction

Water is an essential ingredient to Montana's way of life and our economy. Water supply across Montana is controlled by variability in seasonal temperature and precipitation as well as long-term climatic trends. While demand for water continues to grow, physical water availability varies from year to year and can often change dramatically between seasons in any given year. As a result, coping with supply and demand imbalances is a constant feature of water management in Montana.[1] Stream gages provide Montanans with the critical information they need to manage our water supplies today and plan for the future.

Why "gage' instead of "gauge"
When water measurement methods were first developed by the USGS in the late-1800's, the Chief Hydrologist, Frederick H. Newell adopted that spelling which was also being used in the Standard Dictionary of the time.
Source: USGS

During dry and even normal years, it is crucial for water users and managers to have access to accurate, real-time information on streamflows as it allows for informed water administration decisions related to planning and distribution of water. The primary source of Montana's streamflow information is delivered by a network of stream gages operated by the U.S. Geological Survey (USGS). Funding to support the USGS network comes from a variety of federal, state, tribal, local, and private sources. In FY22 the state of Montana, the Department of Natural Resources & Conservation (DNRC) and Department of Fish Wildlife & Parks (FWP) provided $598,985 to the USGS to support ongoing operation and maintenance (O&M) costs.

Water managers, and the public rely on the USGS network to deliver accurate real-time information on Montana's streamflows. Local governments, state, tribal and federal agencies also rely on the network for emergency response and drought planning, reservoir operations, as well as longer-term water supply planning. Montana citizens and visitors to our state rely on the network when planning recreational activities on Montana's rivers and streams.

The Stream Gage Oversight Work Group (Work Group) was created in 2019 by the 66th Montana Legislature in response to stakeholders' concerns over the shutdown of 10 USGS stream gages in 2018 because state budget reductions forced Montana to cut back State support for ongoing O&M costs. The loss of these gages came with little warning to the water user communities who depended on them for monitoring and cooperatively managing local water resource plans. The event revealed that as demand for water continues to grow, the continuity of Montana's stream gaging network is threatened by declining State funding for O&M. It also highlighted the disconnect between those entities that operate and/or fund the system and those entities or individuals who rely on it daily for real-time stream information, local planning, and response.

The Legislature established the Work Group as a subcommittee of the Drought and Water Supply Advisory Committee. §2-15-3308, MCA defines the scope of the Work Group activities. (Appendix A). Work Group members represent the seven state agencies that are voting members of the Drought and Water Supply Advisory Committee (Table 1).

The purpose of the Work Group is to engage with stakeholders in a review of the USGS stream gage network in Montana and develop recommendations to improve network resilience and continuity in light of funding challenges.

[1] 2015 Montana State Water Plan.

1.1. Work Group Achievements

1) Improved Communications. The events of 2018 exposed the need to improve both the timeliness of notifications and the distribution of the information to interested stakeholders. To address this need, the Work Group and USGS Wyoming-Montana Office developed a Stream Gage Notification Plan (Appendix B). The plan lays out the steps and processes the local USGS office and the state of Montana will take to ensure the timely exchange of information regarding funding or program changes with the potential to impact the ongoing operation of the USGS stream gage network in Montana. The end goal is to minimize network disruptions by exchanging information far enough in advance that it can be acted on before the USGS shuts down a gage.

   To date, the plan has been activated three times. While it is not possible to say whether the notification plan has "saved" any stream gages, stakeholders have expressed support and appreciation for receiving timely notifications and being given an opportunity to affect the outcome.

2) Recommendations. The Work Group developed recommendations that if implemented, they believe will provide the state and people of Montana with the information necessary to meet the complex challenges for managing our water resources to meet current uses and the needs of future generations.

1.2. Operation of Work Group

Since August 2019 the Work Group has met nine times, both in-person and virtually. The Work Group developed and adopted Terms of Reference to guide their work (Appendix C). The meeting agendas, presentations, and meeting summaries are available on the Work Group website.

Table 1: Representation on the Stream Gage Oversight Work Group

Representing	Name
Dept of Natural Resources and Conservation	Paul Azevedo – Co-Chair
Dept of Fish Wildlife & Parks	Stephen Begley – Co-Chair
Dept of Livestock	Mike Honeycutt
Dept of Agriculture	Jon Peterson
Dept of Emergency Services/Military Affairs	Andrew Long
Dept of Commerce	Cody Ferguson
Dept of Environmental Quality	Darin Kron

1.3. Outreach and Public Participation

Montana's legislature created the Work Group in response to stakeholders who use and depend on the availability of streamflow data. All Work Group meetings were open to the public and attended by multiple watershed representatives and other interested parties. Meeting notices along with draft agendas were emailed to past attendees and others that requested to be added to the distribution list. Involved groups also promoted the meetings via newsletters to their constituents.

Stakeholders attending the Work Group meetings were invested in finding a solution for keeping stream gages operating in Montana. Being able to monitor stream flows and water temperature in real-time is critical for making day-to-day decisions. While their interest is focused on local needs, they understand the critical role

stream gages play in the management of Montana's water resources. Stakeholders want to know that state government has a plan to keep stream gages operating in Montana.
In addition to the Work Group meetings, the USGS Helena office has hosted two meetings for interested stream gage stakeholders. These meetings opened additional dialogue on funding and coordination of information. Multiple representatives from the Work Group and stakeholders attended each meeting.

2.0 Introduction to Stream Gages – What they do and how they work

The stream gages discussed in this report provide a continuous record of streamflow (discharge), which is a measure of water volume (in cubic feet per second) passing a specific location over a period of time. The gages automatically take measurements at a preset schedule and relay the data via satellite to a central datacenter for processing. The data are used to generate hydrographs which show discharge over time at that specific location (Figure 1). Stream gages may also be outfitted with sensors to monitor water temperature and a variety of water quality parameters. Advances in stream gaging technology now provide end-users with accurate information on streamflow and water temperature in near "real-time."

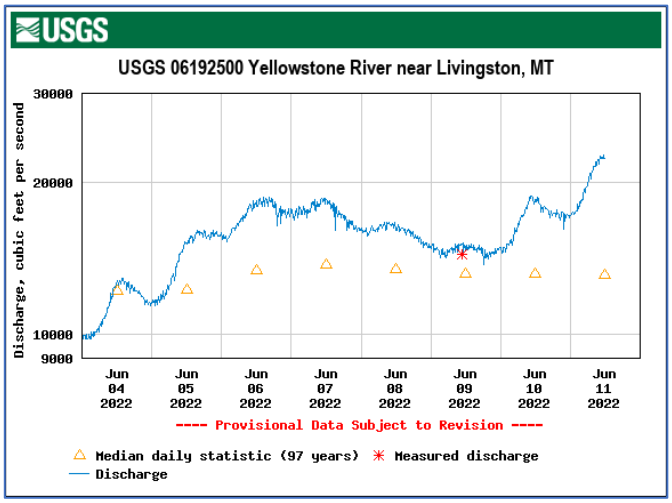


Figure 1: Hydrograph showing discharge over time on the Yellowstone River near Livingston, MT
Source: USGS

Access to real-time streamflow information supports decision-making by water managers, water users, recreationists, and the public as they adjust to changes in seasonal water supply and demand. Local governments, state, tribal, and federal agencies also rely on streamflow information for emergency planning and notification as well as longer-term water supply planning. Specific uses of the stream gage data include the following:

- planning, forecasting, and warning about floods and droughts;
- managing water rights and transboundary water issues;
- operating waterways for power production and navigation;
- monitoring environmental conditions to protect aquatic habitats;
- describing impacts to streamflow from changing land and water uses;

- assessing water quality and regulating pollutant discharges;
- determining if streams are safe for recreational activities; and
- designing reservoirs, roads, bridges, drinking water and wastewater facilities.[2]

Streamflow records collected over a long period of time are particularly valuable because they enable users to understand extreme events, hydrologic variability, long-term climatic trends, and the effect of both land uses changes, and project operations on streamflows.[3] Many stream gages have data records that are at least 50 years long, and Montana has a few with 100-year records.

2.1. Measuring Streamflow

The objective of a stream gage is to provide a continuous record of streamflow or discharge. However, stream gages do not actually measure discharge. Stream gages only measure stream stage (the height of water above a surveyed point). Stage is also referred to as gage height. Most streamflow gages in Montana use a pressure sensing device to determine the river stage (Figure 2). Pressure readings increase as the river stage gets higher and decrease as the water level drops. Pressure reading measurements are taken every 15 minutes, providing a near continuous record of stream stage. These data are transmitted to a GOES satellite (Geostationary Operational Environmental Satellite) at a preset schedule once every hour.

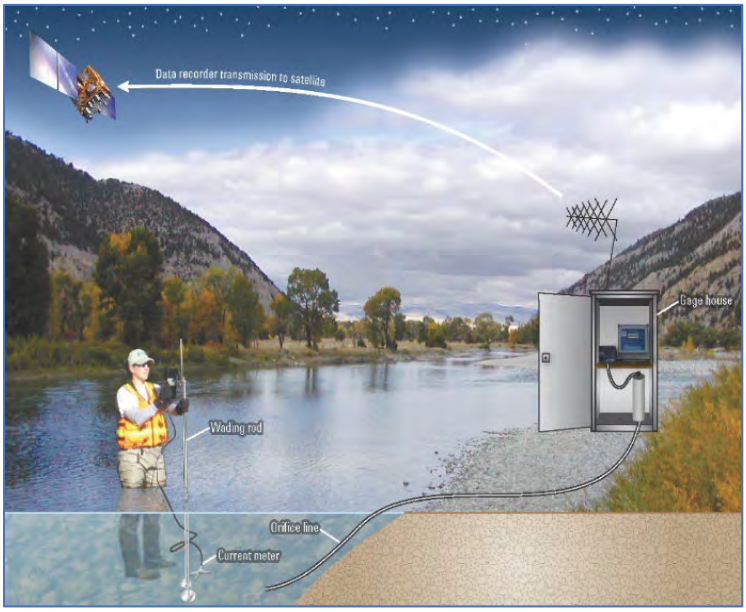


Figure 2: Diagram of typical stream gage installation with equipment used to measure stage.
Source: USGS

To convert the stage (measured by the gage) to discharge requires knowing the mathematical relationship between stage and discharge. The stage-discharge relationship depends on the shape, size, slope, and roughness (uneven or irregular surface) of the channel at each gage site and is different for every stream gage. The stage-discharge rating curve is developed by taking numerous physical stream discharge measurements over time and

[2] https://www.usgs.gov/mission-areas/water-resources/science/federal-priority-streamgages
[3] National Hydrologic Waring Council. Benefits of USGS Streamgaging Program. March 7, 2006

over a range of stages (from low flow to flood stage). Each point on the stage-discharge graph represents one physical discharge measurement - or data gathering visit - to a gage. Connecting each point with a smooth line allows estimating the discharge at any given stage (Figure 3). Developing and ensuring the ongoing validity of the stage-discharge rating curve is the crux of accurate stream gaging.

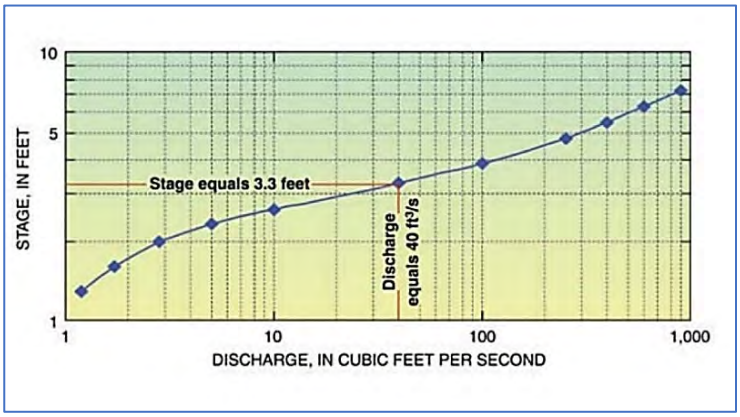


Figure 3: Example of a typical stage-discharge relation or rating curve. In this example, a stage of 3.3 feet gives a streamflow of 40 cubic feet per second.
Source: USGS Fact Sheet 2007-3043

Since rivers and streams are dynamic environments, the rating curve for almost every stream gage will vary over time due to changes in the stream channel resulting from sedimentation, scour, bank erosion, ice, and the collection of debris (Figure 4). For example, aquatic vegetation growth in late summer when flows are low can raise the measured stream stage enough to create an error, or drift, in the stage-discharge curve. To keep rating curves accurate and up to date, hydrologists visit each stream gage eight - ten times per year over the life of the gage to verify gage height and make a physical discharge measurement. This requires time, travel, field work in all conditions, special equipment, and a specifically trained workforce. Hydrologists will also visit a site after an extreme weather event or if they notice unexpected variations in the data transmitted from the gage. Unanticipated variations in the data may indicate faulty equipment, or that a collapsed bank or fallen tree has altered the stream flow in the vicinity of the gage.

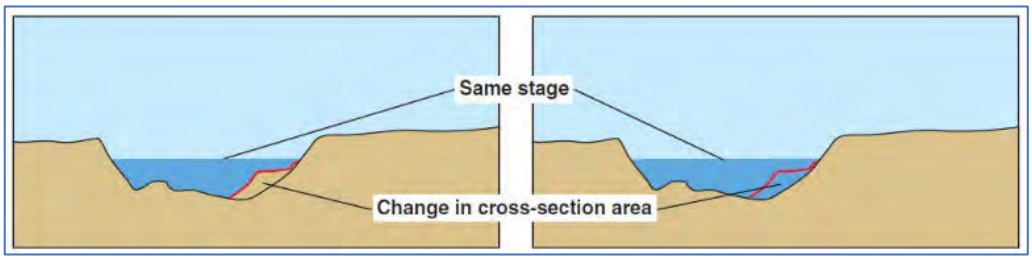


Figure 4: Because stream channels change with time, additional manual measurements must be made to maintain the accuracy of the rating curve.
Source: USGS Source: USGS Fact Sheet 2007-3043

Site visits to collect stage and discharge measurements generally involve several steps. These include inspecting equipment for damage, running system checks on electronic equipment, downloading a copy of all data collected

since the previous site visit, taking a physical stage and discharge measurement, and documentation of all actions taken, and observations made. Each site visit will generally take one - four hours depending on the width and stage of the river. Weather conditions, along with the need to replace or repair broken/damaged equipment add time to each site visit.

Each site visit requires several additional hours in an office running quality assurance/quality control checks on all the stream flow data collected. This includes comparing the record of streamflow data transmitted by the satellite to the backup copy downloaded from the gage. On occasion, atmospheric conditions will interrupt data transmissions to and from the satellite, resulting in an incomplete discharge record. Data discrepancies are then corrected and documented.

To make a discharge measurement, hydrologists use a current velocity meter to measure both the velocity and depth of water at 25 – 30 spaced points across the river or stream channel (Figure 5). These velocity and depth measurements are used to compute the total volume of water flowing past the gage. The results of these physical measurements are used to apply adjustments or "shifts" to the rating curve as stream channel conditions change.

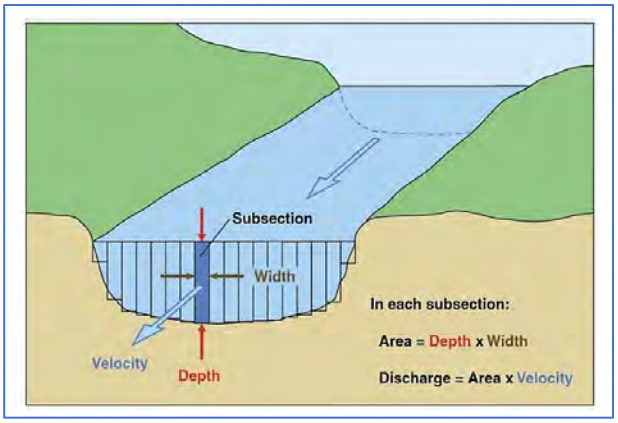


Figure 5: Diagram of channel cross section with subsections
Source: USGS Fact Sheet 2011-3001

3.0 Stream Gaging in Montana

The USGS network is the primary source of stream gage data in Montana. Funding for this network comes from a diversity of federal, state, Tribal and local sources. This network is complimented by smaller, state, and tribal networks that, in combination, provide the information Montana needs to manage its water resources. The common theme linking these networks together is the need for reliable, secure operation and maintenance funding to support the gages we have and to expand the networks to meet future demands. These networks are discussed in the following sections.

3.1. USGS Stream Gage Network

The first recorded measurement of streamflow in Montana by the USGS occurred in 1890 on the Yellowstone River at Corwin Springs. Montana currently hosts 218 USGS stream gages, measuring discharge, water temperature, or a combination of both (Figure 6). As discussed in Section 3.1.3, funding for USGS network in Montana comes from a variety of federal, state, tribal, local, and private sources. However, all streamflow information generated by the network is freely available to every citizen with access to the internet. As a result, the financial burden for supporting the network is carried by relatively few entities, while the benefits accrue directly or indirectly to every citizen in Montana.

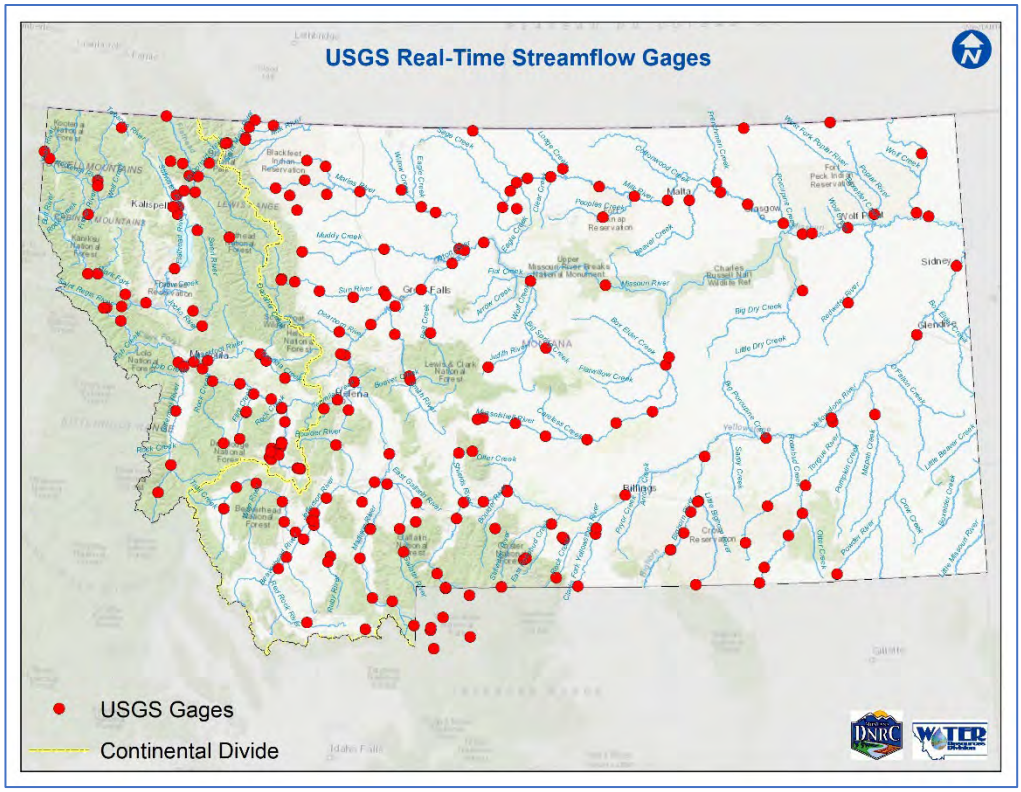


Figure 6: Location of USGS gages in Montana

3.1.1. USGS Network Cost

USGS activities to collect, manage, disseminate, and analyze streamflow data incur a real cost. Equipment to collect, transmit and manage the data must be purchased, operated, maintained, repaired, and replaced. Highly skilled personnel including scientists, engineers, and technicians must be employed for these tasks and for the task of applying knowledge to convert the collected data into information that is useful to the broad user community.

Stream gaging costs are broken into two categories: installation and O&M. The installation costs vary widely depending on location and site conditions. Three recent installations in Montana at sites with easy access on wadable streams averaged about $7,800[4] each. This cost does not include the stream gage equipment itself. In comparison, recent replacement of cableway across the Clark Fork River near Missoula cost over $100,000.[5]

Installation is considered a one-time expense that includes:

- Site reconnaissance and selection.
- Site elevation surveying.
- Site preparation and construction.
- Database configuration, and
- If necessary, cableway installation or other means for measuring streamflow at sites that are too wide and/or swift to wade.

[4] August 12, 2020, presentation by the USGS to the Stream Gage Oversight Work Group.
[5] August 12, 2020, presentation by the USGS to the Stream Gage Oversight Work Group.

O&M costs include everything that goes into collecting and publishing publicly accessible streamflow data. This is often referred to as "Gage to Page." O&M costs include:

- Continuous year-round collection of gage-height and streamflow data at 15-minute intervals,
- Establishment and maintenance of stage-discharge relation (i.e., rating curve),
- USGS personnel collecting eight - ten discharge measurements per year,
- Satellite telemetry,
- Quality assurance measures, including field validation of stream gage datum; analysis and approval of all measurements and records,
- Repair and/or replacement of equipment and instrumentation,
- Database maintenance and permanent archival of all data and records, and
- Support, which includes:
    - USGS National Streamflow Information Program – access to technical specialists, periodic audits, and database enhancements, and
    - Local USGS Science Center – management, administrative functions, IT infrastructure, facilities, vehicles

For the purposes of allocating O&M costs, the USGS manages the network as a complete system. Total O&M cost is equally allocated to each gage in the network. The annual O&M cost in FY22 was $17,300 for a year-round stream gage, $13,500 for an eight-month seasonal gage and $12,150 for a seven-month seasonal gage.

3.1.2. Why Does it Cost So Much?

According to USGS, salary is the largest driver of O&M cost.[6] Although the gages are fully automated, each one must be visited eight-ten times per year to maintain the validity of the stage-discharge rating curve. This requires time, travel, field work in all conditions, special equipment, and a skilled workforce. The second largest cost driver is System Support, which includes management, administrative functions, IT infrastructure, and facilities. Vehicles, travel, equipment, and supplies account for approximately 18% of annual O&M costs.

3.1.3. Who Funds the USGS Network in Montana?

Funding for the 218 USGS stream gages in Montana comes from a variety of federal, state, tribal, local, and private sources (Figure 7). Sharing the cost over multiple funding sources results in the operation of far more stream gages than would be possible if funded solely by USGS. Current USGS appropriations from Congress are enough to cover approximately 39% of the stream gage network cost in Montana. There are 160 gages supported by a single source of O&M funding. Other gages may be supported by as many as five different sources of O&M funds.

[6] August 12, 2020, presentation by the USGS to the Stream Gage Oversight Work Group.

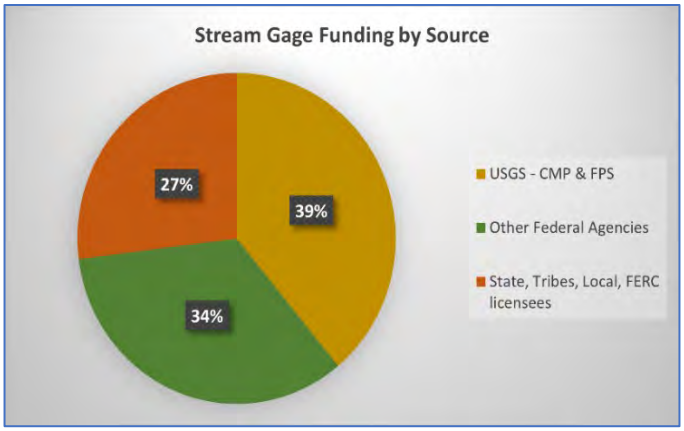


Figure 7: Source of O&M funding for USGS stream gages in MT
Source: USGS

3.1.4. Federal Funding

The largest share of federal funding is directly through the USGS (Figure 7). Congress appropriates funds to the USGS stream gaging program via two sources:

- Cooperative Matching Funds. These funds support studies and data collection serving both partner and USGS objectives. The USGS can use Cooperative Matching Funds to cost share with partners up to 50% of costs on stream gages. However, congressional appropriations have not kept pace with cost increases and partner demands, therefore, the USGS cost share is now closer to 40%. Cooperative Matching Funds are only available to partner entities having taxing authority, i.e., state and local governments. Cooperative Matching Funds support 77 gages in Montana.

  Federal Priority Stream Gage (FPS) Funds. These funds can be used to cover 100% of the costs for gages in the Federal Priority Network. Gages within the FPS network must meet one or more of five congressionally authorized criteria[7]: Montana has 158 sites eligible for FPS funds. However, only 47 are fully funded by FPS dollars. Congressional appropriations have not kept pace with rising costs forcing the USGS to either deactivate an FPS-eligible gage or find another source of funding. Currently seventy-one sites in Montana that are eligible for FPS funds are also funded by other sources of federal, state, tribal, or other funds. Another 40 FPS eligible gages are currently inactive due to lack of funding.

Additional federal funding support is provided by seven different federal agencies listed below and shown in Figure 7.

1. US Bureau of Reclamation
2. US Army Corps of Engineers
3. US Environmental Protection Agency
4. International Joint Commission
5. US Department of Energy - Bonneville Power Authority
6. US Fish and Wildlife Service

[7] https://www.usgs.gov/mission-areas/water-resources/science/federal-priority-streamgages.

7. US National Park Service – Yellowstone National Park.

3.1.5. State Funding

The State of Montana provides annual O&M funding support to 98 USGS stream gages. 96% (94 gages) of these gages are supported by DNRC and FWP. In FY22 DNRC spent $384,759 in general funds to support 47 USGS stream gages (Figure 8). USGS provides cost share support on 40 of the 47 gages DNRC supports.

FWP supports streamflow and/or water temperature monitoring on 47 individual gages. FWP's stream gage funding is provided through general license dollars. In FY22, Fish Wildlife & Parks provided $214,226. All 47 gages supported by FWP are cost-shared with USGS.

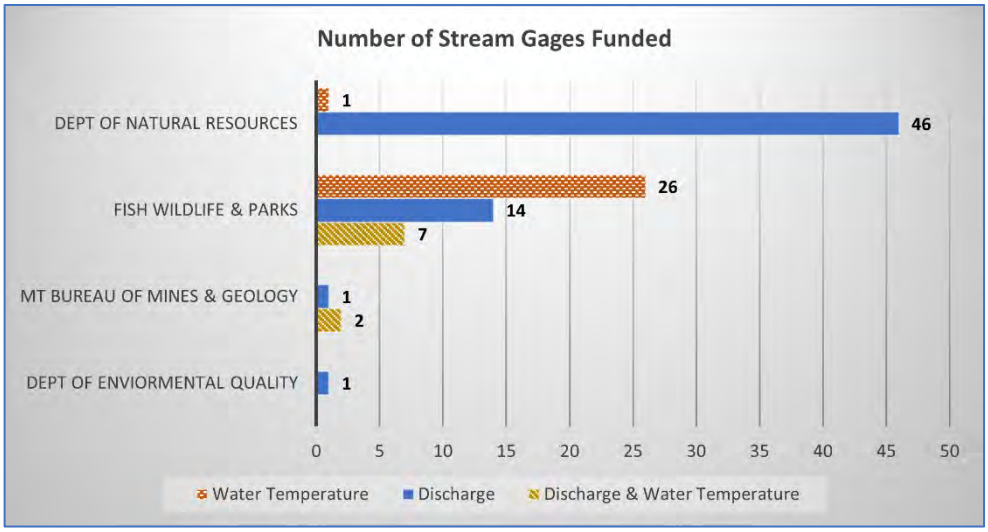


Figure 8: USGS stream gages receiving State O&M funding support

Although FWP and DNRC financially contribute to a portion of the overall network, the ability of both agencies to meet their natural resource management objectives and statutory responsibilities is dependent upon streamflow information generated across the entire state network.

In addition, Montana water users often turn to DNRC and FWP for assistance when a stream gage is in danger of being lost due to lack of funding. Both agencies report that new funding partners are more willing to participate if they see state government willing to contribute too. As a result, both DNRC and FWP will often assume additional funding obligations in support of local stewardship of Montana's water resources. Absent an available source of funds to bridge over, or cover, funding gaps, both DNRC and FWP must use funds from other programs within their departments.

3.1.6. Tribal Nation Funding

Five of Montana's seven Tribal Nations provide funding support to 15 USGS gages. Nine of these gages also receive USGS cooperative matching funds (Figure 9).

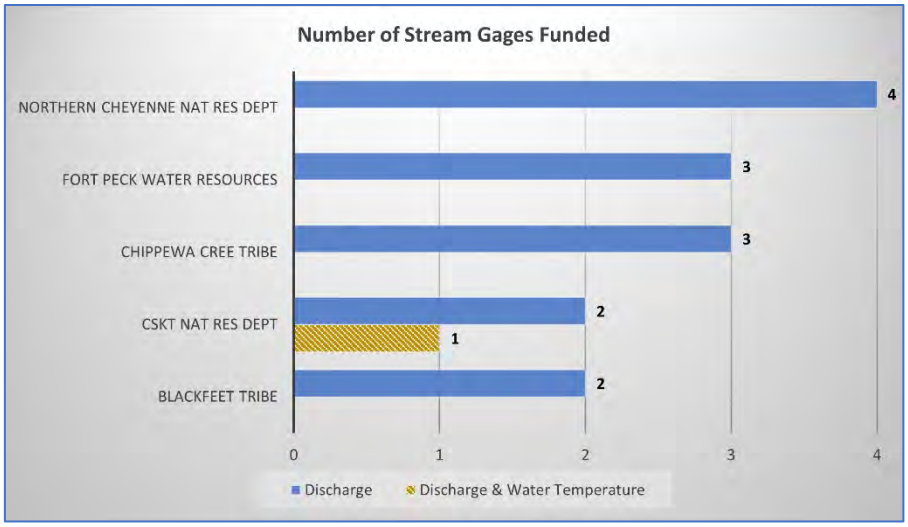


Figure 9: Stream gages receiving O&M funding from Tribal Nations

3.1.7. Local, and Other Funding

Forty-three USGS gages are supported by a variety of local and other sources of funding (Figure 10).

- Eighteen gages receive 100% of their funding from entities licensed by FERC to generate hydroelectric power in Montana. Northwestern Energy supports 11 gages and is the largest single funder in this category. Stream gages funded by FERC licensees are not eligible for USGS cooperative matching funds.
- The Wyoming State Engineers Office provides funding to seven gages directly tied to the interstate administration of water under the 1951 Yellowstone River Compact. These funds are combined with funding provided by DNRC and USGS.
- Funding provided by Talen Energy and Sibanye-Stillwater mining is tied to conditions in their operating permits.
- Sixteen gages are partially supported by the following local entities:
    - Big Hole Watershed Committee
    - Clark Fork Coalition
    - Montana Trout Unlimited
    - Madison River Foundation
    - Teton County Conservation District
    - Madison County Conservation District
    - Petroleum County Conservation District
    - East Bench Irrigation District
    - Greenfields Irrigation District
    - Tongue River Water Users Association
    - Big Sky Water and Sewer District
    - City of Bozeman
    - Granite County
    - Lewis & Clark County

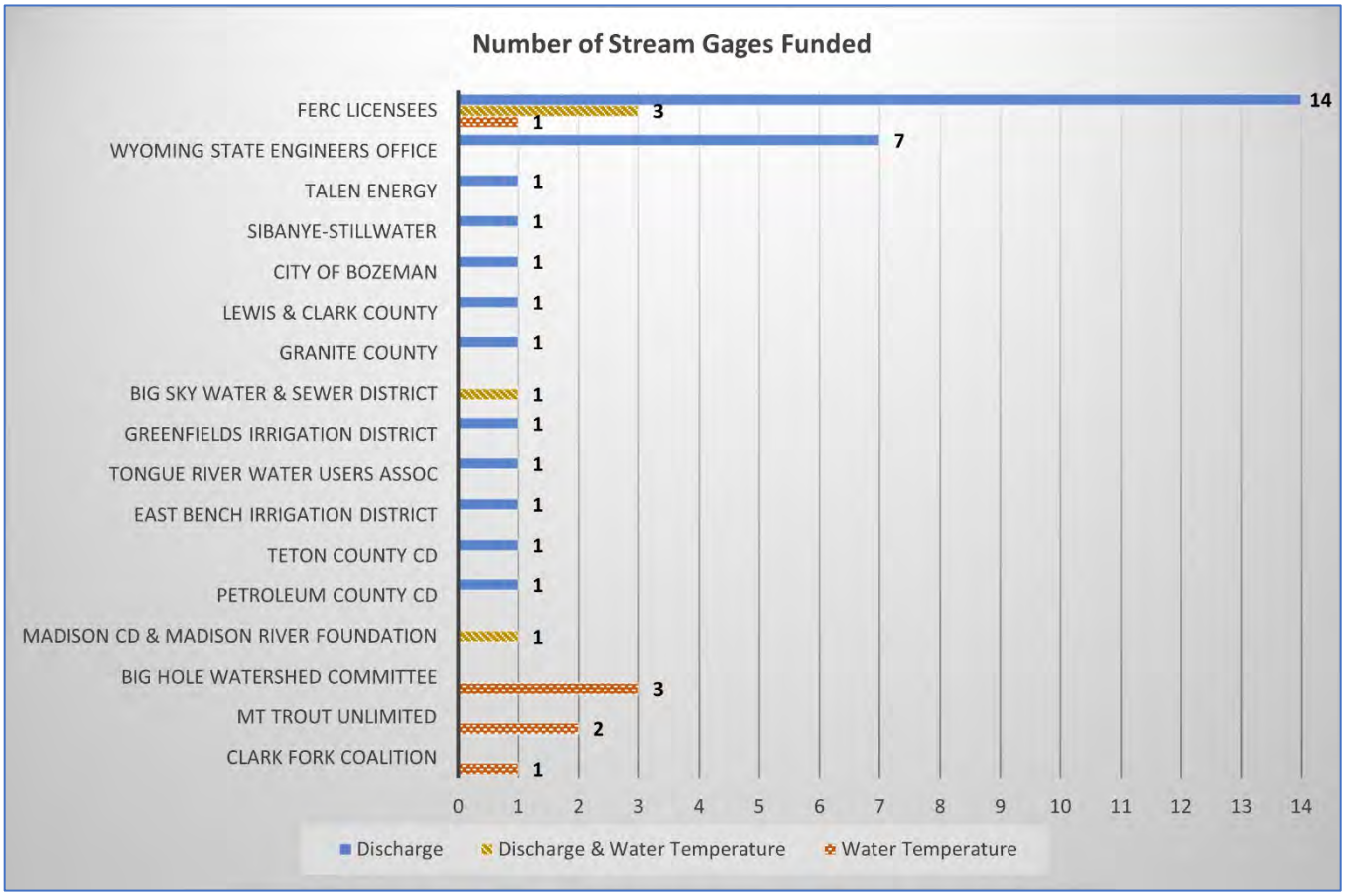


Figure 10: Stream gages receiving O&M funding from local or other sources

These 16 gages are the only examples the Work Group is aware of where local Montana citizens are contributing financially to the annual O&M of USGS stream gages. Each of these organizations raise funds directly from their members to support stream gages in their local watersheds. For many, their contributions place an additional burden on already strained budgets.

Stakeholders who contributed to discussions with the Work Group feel that stream gages are a fundamental tool in the toolbox of local water management. The USGS network provides them the best information available to quantify water supplies and availability, which they use to develop and implement local water management and drought plans in real-time. While stakeholders acknowledge the importance of having "skin in the game" they also struggle with raising funds to support their local stream gage. Even the most dedicated local organizations struggle to raise adequate cost-share funds on an annual basis.

3.2. DNRC Stream Gage Program[8]

The importance of ensuring an adequate supply of water to meet current beneficial uses and future demands is a theme echoed by the four Basin Advisory Councils who assisted DNRC in developing Montana's 2015 State Water Plan. The 2015 State Water Plan identified the need to improve Montana's water supply and distribution monitoring network to support planning, policy development and decision making at local, state, and federal levels. To meet this need, the 2015 State Water Plan recommends Montana develop a network of 100 state-operated, permanent, year-round stream gages to gather and distribute real-time streamflow information on smaller streams and tributaries not monitored by the USGS. In 2015, DNRC started a Stream Gage Program (DNRC Program) within the Water Resources Division to implement this recommendation.

The DNRC Stream Gage Program provides critical real-time stream flow data to water commissioners, watershed groups, water resource professionals, fisheries managers, and other stakeholders to aid them in day-to-day water management decisions. To date, the DNRC Program operates 36 year around, real-time stream gages.

Montana DNRC's Stream Gage Program Goals:

- Collect, analyze, and present accurate, high quality, real-time streamflow data on Montana's rivers, streams, and other critical surface water locations not monitored by the national USGS network.
- Install and maintain up to 100 permanent real-time stream gages by 2025.
- Provide real-time streamflow information to the public via a user-friendly website.
- Support individual, local and regional water resource allocation, distribution, and management goals.

Montana DNRC's Stream Gage Program Benefits:

- Enable water users and managers to make water use and distribution decisions based on real-time information.
- Collect and provide essential information on the amount of water physically available for new appropriations.
- Expand the capability for both short and long-term water resource planning, such as developing basin water budgets, evaluating local and regional water supplies, and evaluating opportunities for increased storage.
- Support the local enforcement of decrees and distribution of water-by-water commissioners, ditch riders, and reservoir and canal operators.
- Support the efforts of Montana citizens to develop and implement local drought management plans.
- Promote public awareness of Montana's water resources.
- Support work carried out by other state agencies such as Montana Bureau of Mines & Geology, Department of Fish, Wildlife & Parks, Department of Environmental Quality, Department of Agriculture, and Department of Transportation.

DNRC Program hydrologists work with managers in DNRC's regional offices, water commissioners, and/or local stakeholders to identify locations where access to streamflow information would support the administration of water rights, contribute to the resolution of local water resource conflicts, and/or support the development of local water management and drought plans.

[8] The DNRC Water Resources Division operates two separate, but related stream gage networks. The State Water Plan network discussed in this report is distinct from the network of 21 gages operated by the State Water Projects Bureau for the operation and management of state-owned dams and canals.

To date, existing resources have allowed the DNRC Program's two full-time hydrologist to install, operate, and maintain 36 real-time gages (Figure 11). Data collection, processing, management, review and QA/QC procedures follow USGS protocols.

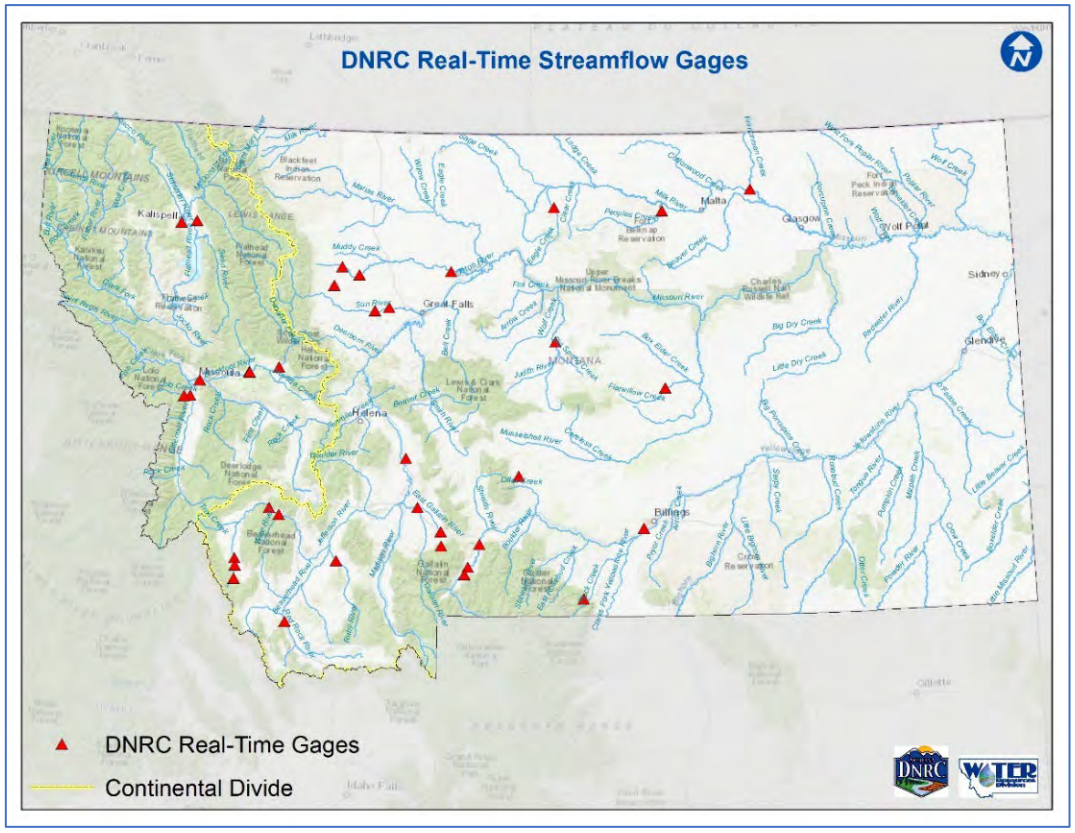


Figure 11: Location of stream gages operated by DNRC's Stream Gage Program

All streamflow information generated by the DNRC Program is publicly available on DNRC's Stream And Gage Explorer (StAGE) website at https://gis.dnrc.mt.gov/apps/StAGE/. StAGE is designed to quickly get streamflow information into the hands of water users whether they are using a desktop, tablet, or mobile device.

Features of StAGE include a user-friendly map interface, the ability to query the gages by name or location, and a data downloader that allows users to download stream gage data and statistics as needed (Figure 12). StAGE also provides the public one-stop access to historical and seasonal streamflow data collected by DNRC hydrologists, water measurement sites at state-owned dams and canals, ground water elevations at selected sites, and stream flow data collected by Montana FWP (Figure 13). Users of StAGE can also access links to information collected by USGS.

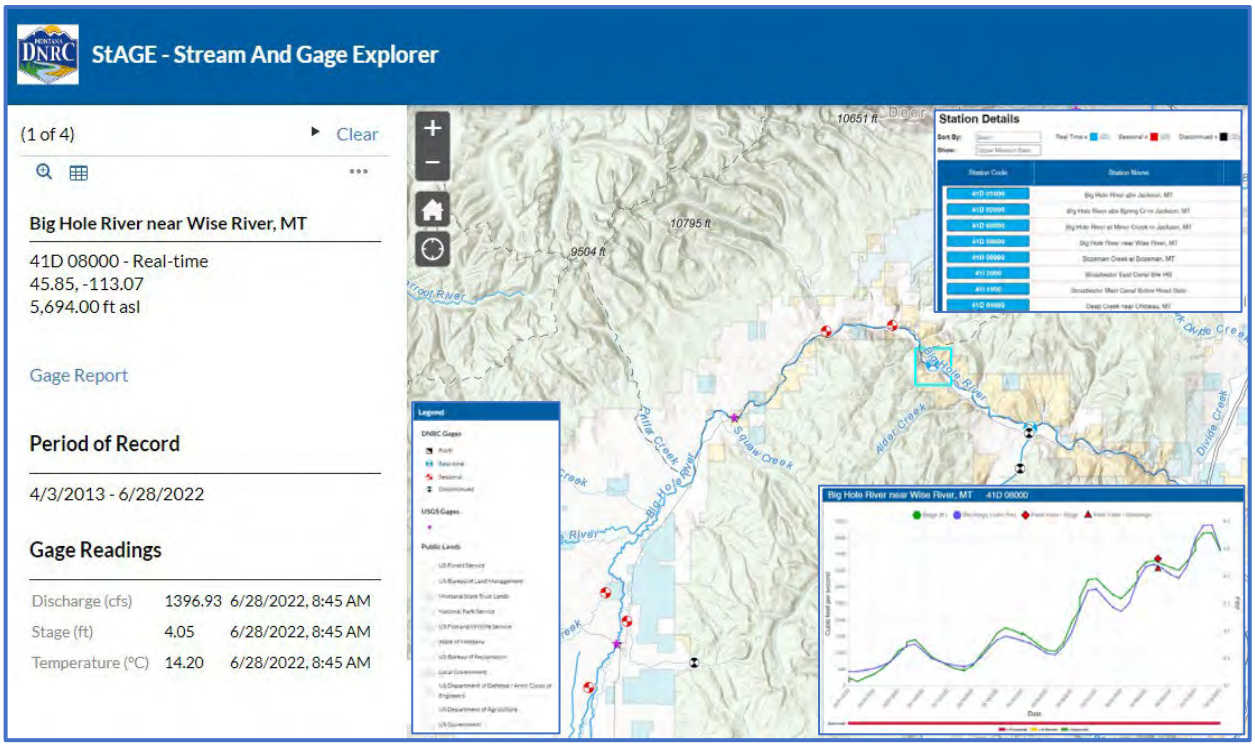


Figure 12: StAGE allows users to explore stream gage data in its spatial context, query gage by name or location, and see the latest discharge readings with a single click.

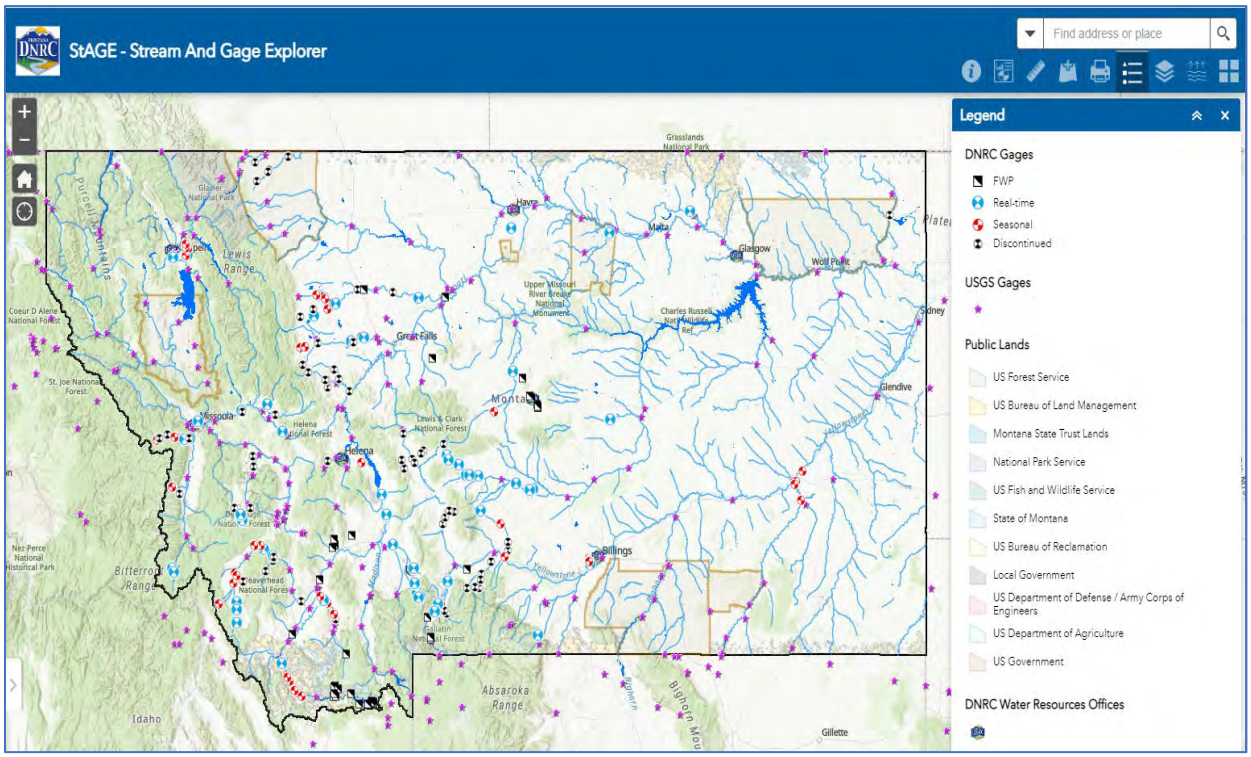


Figure 13: StAGE provides users with access to streamflow information collected by DNRC, FWP and the USGS.

Annual O&M costs of approximately $7,200 a year are covered by the existing DNRC Program budget. This cost does not include start-up costs or support provided by personnel in the Water Resources Division's regional offices, who support O&M activities as time permits. Salary is the largest driver of O&M cost. Support for DNRC's Program comes from the Water Resources Division budget, with no special appropriation from the legislature. Current annual DNRC Program costs are approximately $259,200, in addition to the $384,759 used to support the USGS as a cooperative funder.

DNRC Program staff receive five - ten unsolicited inquiries per year from stakeholders working on local water issues that would benefit from the information a real-time stream gage can provide. These inquires demonstrate the unmet need for additional stream gages. However, the DNRC Program has reached the limit of its current resources and cannot expand beyond 36 gages. Without additional funding for personnel, operating expenses, and equipment, the DNRC Program cannot fulfill requests by stakeholders for additional stream gages.

3.3. Confederated Salish & Kootenai Tribes Water Measurement Program

Several of Montana's Tribal Nations also operate stream gage networks to support the administration of water under Tribal jurisdiction. The Confederated Salish & Kootenai Tribes Stream Measurement Program is an example of one of these Tribal operated networks. The information below was provided to the Work Group by Seth Makepeace, Water Management Program Manager for the Confederated Salish & Kootenai Tribes.[9]

The Flathead Reservation of the Confederated Salish & Kootenai Tribes (CSKT) covers 1.3 million acres in western Montana. Contained within the Reservation boundaries is the 130,000-acre Flathead Indian Irrigation Project (FIIP), the largest Bureau of Indian Affairs (BIA) project in the nation. In 1906, the USGS began measuring streamflow on the Reservation to characterize water availability for developing the FIIP. In the 1940's – 1960's, water measurement was conducted by the BIA for water supply forecasting, reservoir management, canal operations, and on-farm water allocation. The CSKT Water Measurement Program (CSKT Program) was started in 1982 and now manages the water measurement activities previously conducted by the USGS and BIA.

Today, the CSKT Program operates and maintains a network of 82 real-time gaging stations within the boundaries of the Reservation. The focus of the CSKT Program is to support implementation of the Tribe's Federal Reserved Water Rights Compact by measuring natural streamflows, regulated streamflows, canal diversions, return flows, and reservoir levels. Approximately 50% of these gages are in the large canals of the FIIP.

CSKT Program staff include one lead Hydrologist, a Data Management Hydrologist, a Chief of Field Operations and four Hydrographers. All data collection, processing, management, review, and QA/QC procedures follow USGS protocols. All streamflow information generated by the CSKT Program is publicly available on the CSKT Hydrology Data WebPortal at https://cskt.aquaticinformatics.net/AQWebPortal (Figure 14).

The CSKT Program's current annual budget of approximately $500,000 is funded by a combination of Tribal funds and Compact Settlement Funds. The annual O&M costs for gages in the CSKT Program is approximately $6,000 - $6,500/yr. Mr. Makepeace attributed the lower O&M costs to the following factors:

- Staff costs are lower because most of the field work is conducted by hydrographers rather than hydrologists.

[9] February 17, 2021, Presentation to Work Group by Seth Makepeace, Water Management Program Manager for the Confederated Salish & Kootenai Tribes.

- Lower travel costs, because all the gages are within the boundaries of the Reservation.
- The O&M cost of operating a gage on a canal is lower than a natural stream channel. Canals operate seasonally and the stage-discharge rating curves on large canals are generally stable over a season. Thus, gages on large canals require fewer site visits to conduct discharge measurements.

In addition, DNRC's Compact Implementation Program partners with Blackfeet, Chippewa Cree, and Northern Cheyenne Tribes on gages tied to the administration of the Tribes' Federal Reserved Water Rights. DNRC's Compact Implementation Program will continue to work with and support Tribal governments' efforts to build internal capacity to measure and monitor stream flows on Tribal lands.

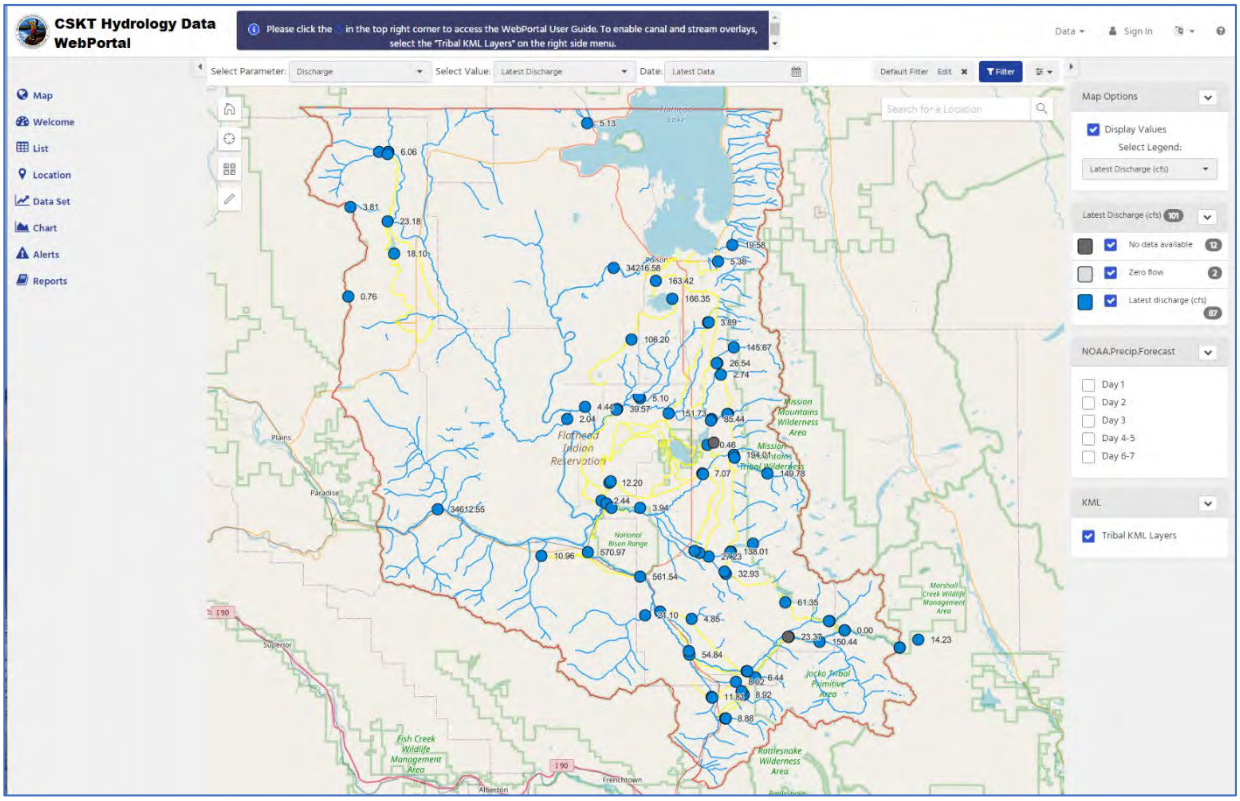


Figure 14: CSKT Hydrology Data WebPortal provides users with access to streamflow information collected by the CSKT Water Measurement Program.

4.0 Cost Effective and Reasonable Alternatives

§2-15-3308, MCA instructed the Work Group to investigate "cost effective and reasonable alternatives to stream gages, including gages that are not part of the USGS stream gage network".

4.1. Alternative Stream Gage Networks

As discussed in Sections 3.2 and 3.3, DNRC and several of Montana's Tribal nations operate and maintain real-time stream gage networks. DNRC's network focuses on smaller streams and tributaries not monitored by the USGS. Networks operated by Tribal governments support the administration and distribution of water under

Tribal jurisdiction. The Work Group believes these networks are complementary to, and not a replacement for Montana's USGS network.

4.2. Alternative Methods to Monitor Streamflow

Stream gages providing continuous real-time information on discharge and gage height are the most familiar method for monitoring streamflow conditions. This type of gage is used when you need to know the discharge and gage height at any given time throughout the season or year. Continuous discharge gages are the most appropriate for managing and administering water real-time in rapidly changing conditions.

However, there are other "traditional" methods and "alternative" methods for deriving streamflow information. Kirk Miller with the USGS Wyoming and Montana Science Center gave a presentation to the Work Group on a variety of methods that can be used to derive information on stream flow.[10] Some methods described by Mr. Miller provide a continuous record of information while others provide only a periodic record. Mr. Miller stressed that the choice of method should be determined by the end user's data needs and monitoring objectives.

A summary of five "traditional" monitoring methods along with information they provide, infrastructure requirements, and associated O&M costs and four "alternative" methods the USGS currently uses or are testing and evaluating for future use are found in Appendix D. Examples of both are given below.

Examples of "traditional" monitoring methods

1. Continuous Stage Monitoring – AKA stage-only site. Continuous stage-only monitoring sites provide the end user with a continuous record of gage height. These stations do not compute stream discharge. Data collected from these sites is primarily used in flood forecasting. Stage-only sites use the same equipment and telemetry as the real-time stream gages discussed in this report. However, the annual O&M cost of $5,000 - $6,000 is less because there is no need to take periodic discharge measurements to develop and maintain a stage-discharge rating curve.
2. Annual Maximum Monitoring – AKA Crest stage-only site. Crest stage-only monitoring is a good choice if all the end user needs to know is how high the water got and related maximum discharge at a single point in time during any given year. A crest stage gage is nothing more than a 2" galvanized pipe filled with cork. As the water rises in the pipe, the cork marks the maximum water level (Figure 15). O&M costs for these sites is typically $1,500 - $2,000 per site per year. The cost is related to the need to make periodic site visits to survey the cork line and take discharge measurements which are used to compute the annual maximum discharge value.
3. Discharge Only Monitoring – AKA Staff gage. A staff gage only site is good alternative if the end user only needs to monitor stream flow on a periodic basis. The annual O&M cost of approximately $1,500 - $2,000 per year is related to the need to make periodic site visits to read the staff gage and take a discharge measurement which are used to develop a stage-discharge rating curve (Figure 16).

[10] November 4, 2020 – presentation to Work Group by Kirk Miller with the USGS Wyoming and Montana Science Center

Figure 15: The cork line marks the maximum water level in a crest stage gage. Source: USGS

Figure 16: Staff gage coupled with a crest stage gage (left hand side of photo).
Source: USGS

Examples of "alternative" monitoring methods

1. Large -Scale Particle-Image Velocimetry (LSPIV) – LSPIV uses video to capture particles on the surface of the water passing beneath the instrument (Figure 17). Surface water velocity is calculated based on the time it takes for particles to flow pass 4 known points in the video frame. Discharge (volume/time) can be estimated if you know the relationship between channel discharge and surface velocity i.e. Velocity-Discharge curve. The USGS Wyoming and Montana Science Center is currently testing this method is several locations. According to Mr. Miller, the method appears to provide a reliable estimate of discharge. The accuracy LSPIV is dependent on maintaining the viability of Velocity-Discharge curve by taking periodic discharge measurements as discussed in Section 2.1. Current drawbacks to using LIPIV include the method does not work at night, and surface velocity cannot be monitored on a continuous basis because the video files are too large to transmit in real-time. According to Mr. Miller, it is difficult to estimate the cost of using LSPIV because the technology is still being developed and method is not widely used.

Figure 17: Large -Scale Particle-Image Velocimetry (LSPIV) uses video to capture particles on the surface of the water passing beneath the instrument.
Source: USGS

2. Pulsed Radar – Pulsed radar uses a bridge mounted device very similar to a radar speed gun to measure the velocity of the water passing beneath the instrument. As with LSPIV, discharge can be estimated if you know the relationship between channel discharge and surface velocity i.e. Velocity-Discharge curve. Pulsed radar can provide continuous monitoring because the method works at night and the data files are small enough to transmit in real-time. According to Mr. Miller the USGS Wyoming and Montana Science Center has not tested pulsed radar and the cost is difficult to estimate because the technology is still under development.

5.0 Identifying Priorities and Needs

Streamflow data are used by a variety of public and private users, including government agencies, researchers, agricultural interests, and recreational interests. The 2019 Legislature instructed the Work Group to review the priorities, needs, and expectations of both the entities providing O&M funding to the network and those who use the data collected by the network. To better understand the priorities and needs of both sides, Work Group members collaborated with the USGS, and stakeholders to develop and conduct a survey of stream gage funders and a separate survey of stream gage users.

5.1. Stream Gage Funders

Governmental agencies and other entities providing O&M funding to the USGS stream gage network play an important role in keeping the network operational across our state. The Work Group collaborated with the USGS WY-MT Science Center to conduct a survey of federal agencies contributing O&M funding to the USGS network in Montana to understand their priorities and needs. The Work Group also conducted a survey of the four state agencies who contribute funding for O&M. In addition, Work Group reached out to the five tribal governments providing O&M support. (Appendix E).

All respondents reported that they fund the stream gages deemed most critical to meeting their natural resource management objectives and/or statutory responsibilities (Table 2). In addition, funders also reported that they rely on information generated from a wider array of gages from the ones they fund demonstrating the importance of the network as a whole and the benefits it provides. Finally, several funders identified data gaps that could be filled if additional USGS gages were installed.

Table 2: Summary Responses to Funders Survey

Entity	USGS Gages funded	Management objectives	Other USGS gages relied on	Additional gages needed
Federal Agencies				
US. Fish and Wildlife Service	2	Adhere to conditions of 2 Federal Reserved Water Right Compacts	7	2
Bureau of Reclamation – Pacific NW Region	2	Reservoir operations, water supply forecasting	16	---
Bureau of Reclamation – MT Area Office	19	Reservoir operations, irrigation water deliveries, support of flood control planning	34	---

Entity	USGS Gages funded	Management objectives	Other USGS gages relied on	Additional gages needed
Army Corps – Seattle Office	5	Reservoir regulation, flood control operations at Albeni Falls and Libby dams	---	---
Army Corps – Omaha District	12	Flood control operation of Fort Peck, Garrison, Canyon Ferry, Tiber, and Yellowtail dams	110	2
US Environmental Protection Agency	17	Monitoring post-mining water quality in the Clark Fork Basin	---	---
National Park Service – Yellowstone Nat Park	4	No response	No response	No response
Bonneville Power Administration	3	No response	No response	No response
International Joint Commission	3	No response	No response	No response
State Agencies				
Department of Natural Resources and Conservation (DNRC)	46	Physical and legal availability, reservoir operations, interstate appropriation of water, support of Tribal Water Right Compacts, and support of water commissioners.	172	65
Montana Fish, Wildlife & Parks	47	Administration of instream flow water rights and drought monitoring (fishing restrictions and closures).	35	--
Montana Bureau of Mines and Geology (MBMG)	3	Monitoring contract obligations of Superfund Program and compliance with Consent Decree requirements	Variable*	6
Montana Department of Environmental Quality (DEQ)	1	Protect and restore water quality and administration of water quality standards.	217	1
Tribal Governments				
Confederated Salish and Kootenai (CSKT)	3	Mission Creek and SF Jocko gages are used for hydrologic analysis that includes determining wet/normal/dry year hydrologic conditions which determine Minimum Enforcement Flows and River Diversion Allowances as called for by the CSKT-Montana Water Compact. Flathead gage is critical for the operation of the Séliš Qlispé Ksanka Dam	Yes. Energy Keepers inc. Relies heavily on multiple upstream gages on the Flathead River System.	2 gages were cut due to funding constraints
Fort Peck	3	Monitor instream flows in relation to Fort Peck-Montana Water Compact and Tribal Water Code; monitor instream flow compliance with a water rights legal settlement.	None currently	None currently

Entity	USGS Gages funded	Management objectives	Other USGS gages relied on	Additional gages needed
Northern Cheyenne	4	Response Pending[1]	--	--
Blackfeet	2	Response Pending[1]	--	--
Chippewa Cree	3	Response Pending[1]	--	--

* Varies based on stream flow and groundwater studies being conducted by MBMG Scientists

[1] Responses have yet to be received by the Working Group.

5.2.Stream Gage Users

The Work Group collaborated with several stakeholder groups to collect user stories and conduct a survey to understand the priorities and needs of local water users and communities.

5.2.1. Montana Stream Gage Story Map

The Montana Stream Gage Story Map was a collaborative effort between the Work Group and stakeholders to highlight the role stream gages play in managing Montana's water resources. Below are three examples of users' stories showcasing how access to stream flow data benefits local water users and communities. Additional stories along with interactive maps that allow users to explore the source of O&M funding for each gage can be found on the Montana Stream Gage Story Map.

Gage # 06088500 Muddy Creek at Vaughn

The USGS stream gage on Muddy Creek has been collecting data for over 82 years and is one of the longest data sets among USGS gages in Montana. According to the Sun River Watershed Group, the stream gage on Muddy Creek is essential for understanding how much irrigation water is coming off the Fairfield bench, between the towns of Power and Vaughn, and returning to the Sun River. Data from this gage was key for the Sun River Watershed Group and Montana's Department of Environmental Quality to complete the Sun River Watershed Restoration Plan in 2012.

Gage #06115200 – Missouri River Near Landusky

One of the most basic services stream gages provide is giving local authorities real-time information from areas at risk for flood danger. The Missouri River Near Landusky gage has been recording water discharge data for over 38 years. The gage is operated to monitor water going into the Fort Peck Reservoir and partially for the Fergus County Emergency Management. Hydrologists and meteorologists at the National Weather Service (NWS) monitor river conditions around the clock, watching for potential flooding conditions. This is crucial during times of high water particularly for the James Kipp Campground and surrounding recreation area. This area is popular among fisherman and rafters on the Missouri River, and during flood season, there is a lot of camping occurring in the area. Because of the elevation drop from the prairie to the river, there is no cell service, and it doesn't take much high water for the campground to flood, making it impossible for people to evacuate if they wait too long. If the NWS hydrologists see potential for flooding to occur, the Fergus County Sherriff's office is called and a deputy is sent out to the campground to knock on the doors of campers and tents, evacuating the campground. These events can be fast moving and unexpected, the campground has been evacuated at 3 a.m. Historically this occurs about every other year, with the evacuations saving lives and property. This gage is operated by the USGS Wyoming-Montana Science Center in cooperation with the U.S. Army Corps of Engineers.

Gage # 76F 03500 – North Fork of the Blackfoot at Ryan Bridge -

The North Fork of the Blackfoot River is a major bull trout spawning tributary, and home to the North Fork of the Blackfoot at Ryan Bridge gage. This gage tracks important flow and temperature data and allows the Blackfoot Challenge, along with FWP to watch for potential fish passage issues in late summer during low water years.

This gage provides critical information for irrigators and managers concerned with bull trout migration and spawning. Jennifer Schoonen, Water Steward for the Blackfoot Challenge, reports that "Although there are no specific flow-related drought plan restrictions for this tributary, we do ask for voluntary water conservation from North Fork irrigators in years when there may be fish passage concerns for spawning bull trout. Our landowners in this area are very cooperative with voluntarily reducing water use to ensure the bull trout can move in and out of the North Fork in August and September."

In addition, the North Fork has a temperature trigger, which is followed for the Blackfoot Drought Response Plan. If the water rises above 65 degrees Fahrenheit for more than three consecutive days, FWP may enact partial or all-day fishing restrictions. This gage is operated by the DNRC Stream Gage Program.

5.2.2. Stream Gage Users Survey

The Gage User Survey (Survey) was a collaborative effort between the Work Group and stakeholders to get a better understanding of the priorities and needs of individuals who use streamflow. The Survey was open between mid-April through early-October 2020. It was promoted and distributed via newsletters, emails, meetings, social media, listservs and flyers posted in communities. Organizations that assisted in publicizing the survey included federal, state, city, and county agencies; watershed groups; conservation districts; and water related nonprofits. Below is summary of the survey results. Full results are found in Appendix F.

- There were 576 individual respondents.
- Responses came from 122 zip codes from 30 counties in Montana and nine other states.
- A majority of the respondents accessed stream gage data either daily or weekly and had been doing this for over seven years.
- Personal/recreation, emergency management, and drought information were the top reasons cited for accessing stream flow information.
- Streamflow data was accessed the most between March and August.
- The primary source for the data was the USGS website.

The Work Group received additional input on the importance of stream gaging from stakeholders who attended Work Group meetings. The importance of stream gaging to water users and communities is summed up best by Bill Milton, a dryland rancher and facilitator for the Musselshell Watershed Committee.

> "Gaging stations are essential and essentially public infrastructure. These water measuring stations area a fundamental tool to support water managers (often court appointed water commissioners) to best optimize and leverage local understanding and decision-making to respond to daily changes of water availability in real-time particularly for irrigation water

> delivery and flood risk mitigation. The improved predictive skillfulness of these managers who rely on these stations, have immeasurable economic implications for river dependent rural communities. For state water planners and their respective agencies, gages provide the historic record and trend line that will influence and inform state water policy overtime."

From the users' stories and survey results of both gage funders and data users, consistent and common themes emerged.

- Stream gage data are used by a large number of public and private users, including government agencies responsible for water management and emergency response, utilities, environmental agencies, universities, colleges, consulting firms, and recreational interests.
- Users access the data for a wide variety of uses, including decision making related to water supply, hydropower, flood control, forecasting floods and droughts, water quality, environmental and watershed management, research, and water-based recreation.
- Stream gage funders support the stream gages deemed most critical to meeting their own natural resource management objectives and/or statutory responsibilities.
- Stream gage funders, particularly federal and state government agencies, often rely on information generated from a wider array of gages from the ones they fund, demonstrating the importance of the network as a whole and the benefits it provides.
- As demands for water continue to grow, both water users and water managers cite the need for additional stream gages.

6.0 Future Challenges

Montana's economy and quality of life rely on water for everything from agriculture, livestock, fisheries, recreation, hydropower, industry, and municipal uses. The importance of ensuring an adequate supply of water to meet current beneficial uses and future demands is a theme echoed throughout the 2015 Montana State Water Plan. Water supply across Montana is controlled by variability in seasonal temperature and precipitation as well as long-term climatic trends. While the demand for water continues to grow, physical water availability varies from year-to-year and can often change dramatically between seasons in any given year. As a result, coping with supply and demand imbalances is a constant feature of water management in Montana.

Adding to the challenge of managing supply and demand imbalances is the complex nature of the water right laws and rules used to administer it. As demand for water grows, effective water management and distribution will increasingly depend on accurate real-time measurements of streamflow.

6.1. New Water Use Permits

As of 2020, there were at least 135 water rights conditioned on a trigger flow requirement at one or more of 36 USGS stream gages. Owners of these rights cannot legally divert water if the flow as measured by the identified gage on the source of supply falls below the trigger flow threshold identified as a condition on their water right. O&M funding for these 36 gages is provided by 10 different sources including US Army Corp of Engineers, US EPA, Northwestern Energy (FERC licensee), MT FWP and MT DNRC. Eighty-eight water rights are dependent on the nine gages listed in Table 3.

If any of the funding entities listed in Table 3 decide to scale back their level of support, the ongoing operation of that gage could be at risk. Affected water right holders may then find themselves in violation of the conditions of their water use permit.

As water right administration becomes ever-more dependent on accurate real-time measurements of streamflows, Montana and its water users will have an increasingly vested interest in maintaining a stable network of stream gages.

Table 3: USGS stream gages associated with 5 or more water right/water use permits

Basin	Site (Gage) Number	Site Name	Number of Water Rights/ Permits	O&M Funding
Upper Missouri	06078200	Missouri River near Ulm	14	US Army Corps
Clark Fork	12324680	Clark Fork at Gold Creek	14	MT FWP
Upper Missouri	06089000	Sun River near Vaughn	13	NW Energy
Yellowstone	06192500	Yellowstone River near Livingston	12	USGS-FPS
Yellowstone	06309000	Yellowstone River at Miles City	9	US Army Corps
Yellowstone	06214500	Yellowstone River at Billings	8	US Army Corps
Musselshell	06126500	Musselshell River near Roundup	7	USGS-FPS
Musselshell	06130500	Musselshell River at Mosby	6	USGS-FPS
Clark Fork	12340500	Clark Fork above Missoula	5	US EPA

6.2. Distribution of Water by Decree

As Montana nears completion of the adjudication of pre-1973 water rights, stream gages, whether they are part of the USGS network, DNRC Program network, or Tribal network, will play an increasingly important role in the distribution of water by decree. Currently, 47 gages in the USGS network and 10 gages in the DNRC Program network are relied on by water commissioners distributing water by decree on 20 Water Distribution Projects. O&M funding for these “decree gages” is provided by a combination of federal, state, Tribal, and other sources.

As Montana transitions to a post-adjudication future, the number of rivers and streams from which water is distributed by water commissioners is expected to grow. Montana will face the challenge of maintaining the stream gage networks we already have, and potentially expanding the number of stream gages to meet future needs.

7.0 Options and Recommendations for Funding of Streamflow Information

It is clear to this Working Group and through the numerous surveys, comments, and input from water users and managers statewide, that access to accurate, reliable, real-time streamflow information is critical for the management and distribution of Montana’s water resources, for emergency response and drought planning, reservoir operations, maintaining fish and wildlife habitat, and for recreation on Montana’s rivers and streams. Operating and maintaining a network of stream gages to deliver this information represents a long-term funding

commitment for trained personnel, specialized equipment, and IT infrastructure. To meet the demands of today, and plan for our future, Montana will need to make a long-term commitment to supporting stream gaging.

The USGS is the largest provider of streamflow information in the state. However, Montana's access to streamflow data generated by the USGS is threatened by decreasing federal funding to support ongoing operation and maintenance. Montana DNRC operates a smaller network of stream gages on streams and tributaries that are not monitored by the USGS. The gages in DNRC's network are targeted to support the administration of water rights, contribute to the resolution of local water resource issues, and/or support the development of local water management and drought plans. Both networks are critical, and work collectively to provide Montana with accurate, real-time measurements of streamflow.

The recommendations of the Stream Gage Oversight Working Group fall into the following broad categories:

1. The State of Montana should work with its elected representatives in Washington D.C. to encourage a significant and sustained federal investment in the nation's stream gage network.
2. The Montana Legislature should consider an increase in state funding to maintain its current level of support to the USGS network in Montana.
3. The Montana Legislature should consider appropriating additional funding to complete the build-out of the DNRC state-based stream gage network called for in the 2015 State Water Plan.

7.1. Encourage Federal Investment in the Nation's Stream Gage Network

The USGS provides Congressionally appropriated funding to support stream gaging through two programs: the Cooperative Matching Funds (CMF) and Federal Priority Stream Gage Network Funds (FPS).

Increasing federal funding for the USGS national stream gage program will have the greatest impact on stream gaging in Montana. Absent a significant and sustained federal investment in the nation's stream gage network, Montana's ability to support and enjoy the benefits of the USGS network is not sustainable. Therefore:

Specific Recommendations

1. The Executive and Legislative branches of State Government should consider working directly with Montana's Congressional delegation to increase federal appropriations for USGS CMF. Congress should fund the CMF program at a level that will allow the USGS to provide at least 50% of the annual O&M costs. Congressional funding must also factor in the costs associated with upgrading equipment and increases due to inflation.
2. The Executive and Legislative branches of State Government should consider working directly with Montana's Congressional delegation to increase federal appropriations for the USGS Federal Priority Stream Gage Program. Currently only 31% of Montana's eligible sites receive 100% federal priority funding. DNRC and FWP currently provide O&M funding to 22 stream gages eligible for full FPS funding. Full congressional funding of the FPS Program could allow both agencies to direct their funding to non-FPS stream gages.
3. The Executive and Legislative branches of State Government should consider working with and supporting the efforts of national organizations such as the Interstate Council on Water Policy,

Western States Water Council, and Western Governors' Association to create a unified western voice for USGS stream gages.

7.2. Increase in State Funding to Maintain Montana's Current Level of Support to the USGS Network in Montana

The State of Montana provides annual O&M funding support to 98 USGS stream gages. 96% (94 gages) of these gages are supported by the DNRC and FWP. In FY22 DNRC spent $384,759 in general funds to support 46 USGS stream gages. In FY22 FWP provided $214,226 to support streamflow and/or water temperature monitoring on 47 individual gages. Although FWP and DNRC financially contribute to a portion of the overall network, the ability of both agencies to meet their natural resource management objectives and statutory responsibilities is dependent upon streamflow information generated across the entire state network.

As previously mentioned, congressional appropriations to the USGS for operation of the nation's stream gage network have not kept pace with rising costs. As a result, the USGS is forced to pass the annual cost increases on to other funding partners. For state government, the burden falls almost entirely on DNRC and FWP. Cost has gone up 7% over the last 5 years putting an ever-increasing strain on agencies' budget.

Montana stakeholders often turn to DNRC and FWP for assistance when a stream gage is in danger of being lost due to lack of funding support. Both agencies will then work with local stakeholders to identify partners with the ability and willingness to provide funding. Both agencies report that new funding partners are more willing to participate if they see state government willing to contribute too. As a result, both DNRC and FWP will often assume additional funding obligations in support of local stewardship of Montana's water resources. Absent an available source of funds to bridge over, or cover, funding gaps, both DNRC and FWP must use funds from other programs within their departments.

There are 12 stream gages that are partially supported by voluntary contributions from local entities such as Conservation Districts, watershed groups, and non-governmental organizations. Stakeholders who contributed to discussions with the Work Group feel that stream gages are a fundamental tool in the toolbox of local water management. The USGS network provides them the best information available to quantify water supplies and availability, which they use to develop and implement local water management and drought plans. While stakeholders acknowledge the importance of having "skin in the game" they also struggle with raising funds to support their local stream gage. Even the most dedicated local organizations have difficult time raising cost-share funds on an annual basis.

The State of Montana does not have jurisdiction over funding decisions made by the federal agencies or other partners supporting USGS gages in Montana. However, Montana can stay abreast of information that may signal a change in these agencies' participation. Therefore, the Stream Gage Oversight Work Group should continue their partnership with the USGS, to ensure the timely exchange of information regarding funding or program changes that have the potential to impact the ongoing operation of the USGS stream gage network in Montana.

Specific Recommendations

1. The Montana Legislature should consider an increase in state funding to maintain Montana's current level of support to the existing USGS network in Montana.

2. The Montana Legislature should consider appropriating funds to be used in cases where a stream gage is in danger of being lost due to lack of O&M funding. These funds would serve to bridge any funding gaps until other funding partners can be found.
3. The Montana Legislature could consider appropriating funds to DNRC for the purpose of transitioning the cost-share burden from local entities to the State. This will allow the affected conservation districts, watershed groups, and non-governmental organizations to stay focused on working with landowners and other stakeholders to support local stewardship of Montana's water resources.
4. The Montana Legislature should consider amending §2-15-3308, MCA, to assign the work of the Stream Gage Oversight Work Group to the Drought and Water Supply Advisory Committee.

7.3. Complete the Build-out of the DNRC State-based Stream Gage Network

In 2015, DNRC started a Stream Gage Program within the Water Resources Division to implement the 2015 State Water Plan recommendation for Montana to develop a network of 100 state operated permanent, year-round stream gages to gather and distribute real-time streamflow information on smaller streams and tributaries not monitored by the USGS. To date, existing resources have allowed the Program to install, operate, and maintain 36 real-time gages. All streamflow information collected through the network is available to the public on the departments StAGE website. DNRC needs additional funding for 4.50 FTEs, operating expenses, and equipment, to install, operate, and maintain the remaining 64 gages.

Specific Recommendations

1. The State Legislature should consider an increase in state funding for the State to complete implementation of the 2015 State Water Plan recommendation for Montana to develop a network of 100 state operated permanent, year-round stream gages.

Appendices

A. 2-15-3308 MCA
B. Stream Gage Notification Plan
C. Terms of Reference
D. Traditional and Alternative Methods to Monitor Streamflows
E. Results of Stream Gage Funders Survey
F. Results of Stream Gage User Survey

Establishment of Stream Gauge Oversight Work Group

Montana Code Annotated 2019

TITLE 2. GOVERNMENT STRUCTURE AND ADMINISTRATION
CHAPTER 15. EXECUTIVE BRANCH OFFICERS AND AGENCIES
Part 33. Department of Natural Resources and Conservation

Drought And Water Supply Advisory Committee -- Stream Gauge Oversight Work Group

2-15-3308. *(Temporary)* **Drought and water supply advisory committee -- stream gauge oversight work group.** (1) There is a drought and water supply advisory committee in the department of natural resources and conservation.

(2) The drought and water supply advisory committee is chaired by a representative of the governor and consists of representatives of the departments of natural resources and conservation; agriculture; commerce; fish, wildlife, and parks; military affairs; environmental quality; and livestock. The governor's representative must be appointed by the governor, and the representative of each department must be appointed by the head of that department. Additional, nonvoting members who represent federal and local government agencies and public and private interests affected by drought, flooding, or water supply may also be appointed by the governor.

(3) The drought and water supply advisory committee shall:

(a) with the approval of the governor, develop and implement a state plan that considers drought and flooding, mitigation, and response;

(b) review and report drought and water supply monitoring information to the public;

(c) coordinate timely drought and flooding impact assessments and maintain regular communication with the United States drought monitor, the national drought mitigation center, the division of disaster and emergency services, the national weather service, and other appropriate local, state, tribal, and federal partners;

(d) identify areas of the state with a high probability of drought or flooding and target reporting and assistance efforts to those areas in coordination with local, state, tribal, and federal agencies;

(e) upon request, assist in organizing local advisory committees for the areas identified under subsection (3)(d);

(f) request state agency staff to provide technical assistance to local advisory committees;

(g) promote ideas and activities for groups and individuals to consider that may reduce vulnerability to drought or flooding and improve seasonal forecasting of water supply; and

(h) select members of the committee to serve on a stream gauge oversight work group.

(4) The drought and water supply advisory committee shall meet, at a minimum, on or around October 15 and March 15 of each year to assess moisture conditions and forecasts and, as appropriate, begin preparations for drought or flood mitigation.

(5) By April 15 of each year, the drought and water supply advisory committee shall submit a report to the governor's office that, to the extent possible, describes the potential for drought or flooding in the coming year, describes the current water supply conditions of the state, taking into consideration winter precipitation, and provides an assessment of the cumulative water supply status.

(6) By July 1 of each year, the drought and water supply advisory committee shall submit a report to the governor's office evaluating the potential for drought for the remainder of the calendar year. If the report identifies a potential for drought that is likely to cause adverse impacts to human health and safety, environmental quality, or both, the committee shall notify the division of disaster and emergency services and county commissioners, tribal governments, conservation districts, and local watershed groups in the geographic location potentially impacted by drought and the types of impacts likely to occur.

(7) (a) The stream gauge oversight work group shall meet at least semiannually to review:

(i) locations, uses, and funding arrangements for the stream gauge network of the U.S. geological survey; and

(ii) priorities, needs, and expectations of those funding the maintenance and operations of these stream gauges and those using data measured by these stream gauges.

(b) The work group shall create annually a stream gauge infrastructure work plan, which may include:

(i) a comprehensive overview of the existing stream gauge network;

(ii) a review of options for funding the maintenance and operations of the stream gauge network, including use of private funds, consolidated agreements, or multipayer payments;

(iii) a proposal for stream gauge priorities;

(iv) cost-effective and reasonable alternatives to stream gauges, including gauges that are not part of the U.S. geological survey's stream gauge network, if applicable;

(v) oversight of recommendations and activities related to any legislative study of stream gauges; and

(vi) coordination of information regarding stream gauge funding recommendations and requests from state and federal agencies.

(c) The work group shall report to the water policy interim committee established in **5-5-231**.

(8) Nothing in this section is intended to remove or interfere with the duties and responsibilities of the governor or the division of disaster and emergency services for disaster coordination and emergency response, as provided in Title 10, chapter 3, part 1. The duties and responsibilities of the drought and water supply advisory committee supplement and are consistent with those of the division of disaster and emergency services for drought or flood planning, preparation, coordination, and mitigation. *(Terminates June 30, 2023--sec. 7, Ch. 298, L. 2019.)*

2-15-3308. *(Effective July 1, 2023)* **Drought and water supply advisory committee.** (1) There is a drought and water supply advisory committee in the department of natural resources and conservation.

(2) The drought and water supply advisory committee is chaired by a representative of the governor and consists of representatives of the departments of natural resources and conservation; agriculture; commerce; fish, wildlife, and parks; military affairs; environmental quality; and livestock. The governor's representative must be appointed by the governor, and the representative of each department must be appointed by the head of that department. Additional, nonvoting members who represent federal and local government agencies and public and private interests affected by drought, flooding, or water supply may also be appointed by the governor.

(3) The drought and water supply advisory committee shall:

(a) with the approval of the governor, develop and implement a state plan that considers drought and flooding, mitigation, and response;

(b) review and report drought and water supply monitoring information to the public;

(c) coordinate timely drought and flooding impact assessments and maintain regular communication with the United States drought monitor, the national drought mitigation center, the division of disaster and emergency services, the national weather service, and other appropriate local, state, tribal, and federal partners;

(d) identify areas of the state with a high probability of drought or flooding and target reporting and assistance efforts to those areas in coordination with local, state, tribal, and federal agencies;

(e) upon request, assist in organizing local advisory committees for the areas identified under subsection (3)(d);

(f) request state agency staff to provide technical assistance to local advisory committees; and

(g) promote ideas and activities for groups and individuals to consider that may reduce vulnerability to drought or flooding and improve seasonal forecasting of water supply.

(4) The drought and water supply advisory committee shall meet, at a minimum, on or around October 15 and March 15 of each year to assess moisture conditions and forecasts and, as appropriate, begin preparations for drought or flood mitigation.

(5) By April 15 of each year, the drought and water supply advisory committee shall submit a report to the governor's office that, to the extent possible, describes the potential for drought or flooding in the coming year, describes the current water supply conditions of the state, taking into consideration winter precipitation, and provides an assessment of the cumulative water supply status.

(6) By July 1 of each year, the drought and water supply advisory committee shall submit a report to the governor's office evaluating the potential for drought for the remainder of the calendar year. If the report identifies a potential for drought that is likely to cause adverse impacts to human health and safety, environmental quality, or both, the committee shall notify the division of disaster and emergency services and county commissioners, tribal governments, conservation districts, and local watershed groups in the geographic location potentially impacted by drought and the types of impacts likely to occur.

(7) Nothing in this section is intended to remove or interfere with the duties and responsibilities of the governor or the division of disaster and emergency services for disaster coordination and emergency response, as provided in Title 10, chapter 3, part 1. The duties and responsibilities of the drought and water supply advisory committee supplement and are consistent with those of the division of disaster and emergency services for drought or flood planning, preparation, coordination, and mitigation.

History: En. Sec. 1, Ch. 209, L. 1991; amd. Sec. 19, Ch. 418, L. 1995; amd. Sec. 1, Ch. 17, L. 1999; amd. Sec. 1, Ch. 84, L. 2013; amd. Sec. 1, Ch. 81, L. 2019; amd. Sec. 3, Ch. 298, L. 2019.

Policy Considerations

85-2-154. *(Temporary)* **Policy considerations.** (1) Article IX, section 3(3), of the Montana constitution declares that all surface, underground, flood, and atmospheric waters within the boundaries of the state are the property of the state for the use of its people and are subject to appropriation for beneficial uses as provided by law.

(2) The legal appropriation of water requires that the water be legally and physically available for appropriation.

(3) Measurement and monitoring of streamflow supports the state's ability to determine when water is physically and legally available to meet new demands while protecting existing water rights.

(4) The effective management and distribution of water depends on accurate real-time measurement of streamflow. *(Terminates June 30, 2023--sec. 7, Ch. 298, L. 2019.)*

History: En. Sec. 1, Ch. 298, L. 2019.

Intent

85-2-155. *(Temporary)* **Intent.** (1) The 2015 state water plan recognizes that improving Montana's water supply and distribution monitoring network will improve the ability of water managers and water users to adjust to seasonal supply and demand imbalances as well as plan for longer term imbalances associated with climate variability.

(2) It is the intent of the legislature to support local, state, and federal efforts and programs to collect and distribute timely and accurate information on Montana streamflows.

(3) The legislature recognizes that streamflow information is collected by numerous state and federal agencies and tribes to meet their statutory responsibilities.

(4) The legislature recognizes that streamflow information collected by state, tribal, and federal entities is critical to administration of the Montana Water Use Act, distribution of water by decree, water supply planning for municipalities, and implementation of plans and agreements that address locally developed drought, fish habitat, or water supply objectives.

(5) The legislature recognizes it is in the public interest to support and encourage coordination in the collection and distribution of streamflow information. *(Terminates June 30, 2023--sec. 7, Ch. 298, L. 2019.)*

History: En. Sec. 2, Ch. 298, L. 2019.

Appendix B

State of Montana and U.S. Geological Survey
Stream Gage Notification Plan
Approved May 19, 2022

Background

This plan lays out the steps and processes the U.S. Geological Survey Wyoming-Montana Water Science Center (USGS) and the state of Montana will take to ensure the timely exchange of information regarding funding or program changes with the potential to impact the ongoing operation of the USGS stream gage network positively, or negatively in Montana. The end goal is minimizing network disruptions by exchanging information far enough in advance that it can be acted on.

State of Montana interests in participating in this plan.

- The 2015 State Water Plan recognizes that improving Montana's water supply and distribution monitoring network will improve the ability of water managers and water users to adjust to seasonal supply and demand imbalances as well as plan for longer term imbalances associated with climate variability.
- Streamflow information collected by the USGS is critical to administration of the Montana Water Use Act, distribution of water by decree, water supply planning for municipalities, flood forecasting, and implementation of plans and agreements that address locally developed drought, fish habitat, or water supply objectives.
- It is in the public interest to support and encourage coordination in the collection and distribution of streamflow information.

USGS interests in participating in this plan.

- Greater efficiency in communicating network changes to a broader cross-section of stakeholders.
- Discovering previously unknown stakeholders and how best to communicate with them.
- Capitalizing on communications to educate more stakeholders on all aspects of USGS monitoring.

Implementation of this plan is voluntary. It does not commit either party to expend time, funding, or other resources beyond that needed to coordinate in good faith. This plan does not limit or constrain either the USGS's or state of Montana's ability to coordinate and exchange information with their respective stakeholders.

Intent of Notification

Funding for the operation and maintenance (O&M) of the USGS stream gage network is provided by federal, state, tribal, private, and local partners. The primary concern for the state of Montana and Montana stakeholders is the termination of a stream gage due to lack of partner funding or change in a partner's stream monitoring priorities. Early notification of the potential for USGS to cease operation of a stream gage allows the state of Montana and interested stakeholders to assess possible impacts and develop alternative plans. While the burden is on USGS to find O&M funding, it is in the State's and Montana stakeholder's interest to maintain a stable stream gage network. Early notification opens the possibility for the State to work with impacted stakeholders and USGS to secure O&M funding.

Method of Notification

- Representatives from the state of Montana's Stream Gage Oversight Work Group (Work Group), USGS, Tribal water resource agencies, and Montana stakeholder groups will meet semiannually to review funding status and foreseeable potential changes to the ongoing operation of the USGS stream gage network in Montana.
- Between semiannual meetings, the USGS will notify the Stream Gage Oversight Work Group's Point of Contact (PoC) of any developments with the potential to disrupt the collection of stream flow information. Method of notification will be by phone call, video conference, and/or email.
- The notification will include USGS stream gage identification number, location, and period of record, anticipated change, and the expected date of change. Multiple gages may be included in one notification.
- The Work Group's PoC will pass the notification on to interested state and tribal agencies and the PoC's for interested stakeholder groups. See Figure 1.
- Notification to interested state and tribal agencies and stakeholder groups will be by email formatted as shown in Figure 2.

Steps After Notification

- Since not every notification will require an immediate response, the Work Group's PoC will monitor ongoing developments through communication of with USGS. The Work Group's PoC will provide updates to interested state and tribal agencies, and the PoC's for interested stakeholder groups.
- It is up to each state and tribal agency, and stakeholder group to determine potential impacts to their interests and management objectives.

- When loss of a stream gage will impact the interests and management objectives of the State of Montana, Tribal Nation, or stakeholder group, the State will attempt to work with impacted stakeholders and USGS to secure O&M funding.
- The Work Group's PoC will continue to monitor developments and notify interested state and tribal agencies, and the PoC's for interested stakeholder groups of the final resolution.

Figure 1. Notification Flow Diagram

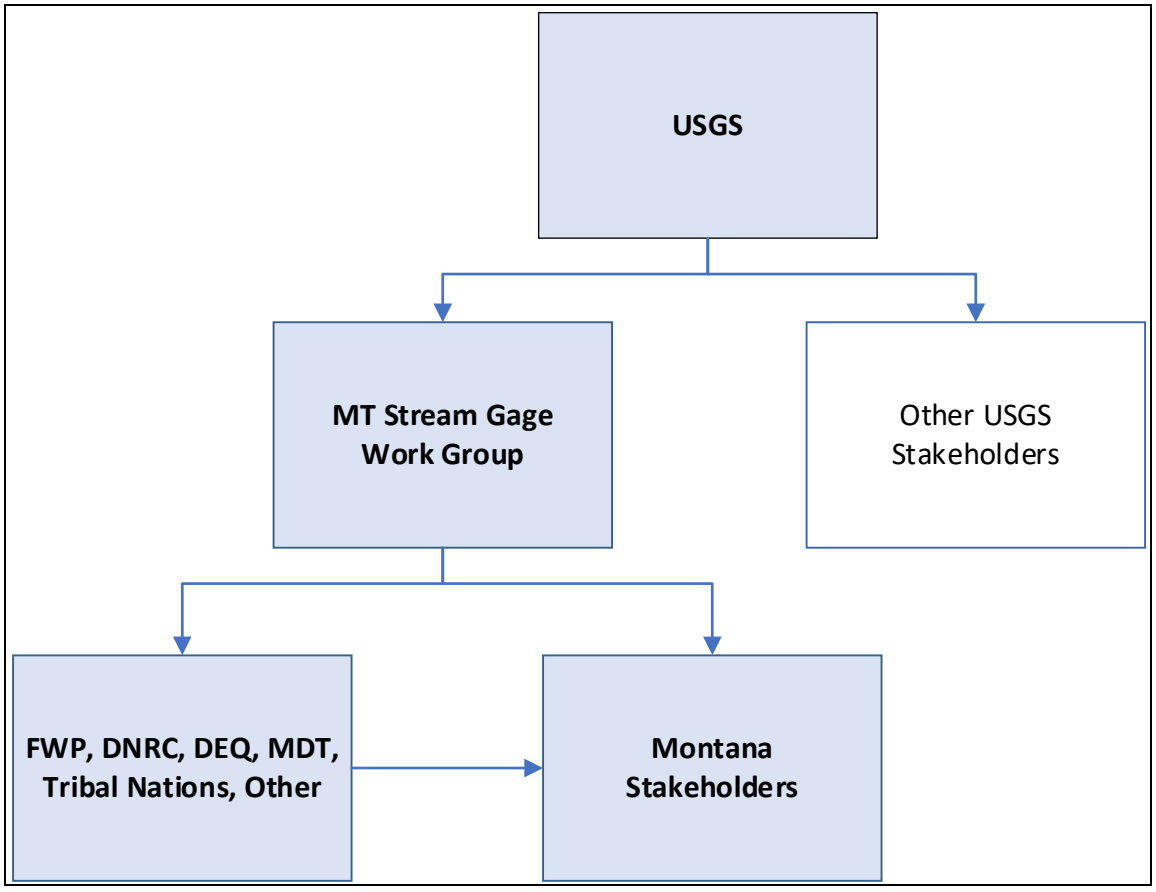


Figure 2. Example of Email Notification

You are receiving this email because you have expressed an interest in being notified of potential changes to the U.S. Geological Survey Stream Gage Monitoring Network in Montana.

In accordance with the USGS & State of Montana Stream Gage Notification Plan, USGS has notified the Department of Natural Resources and Conservation and Fish Wildlife & Parks of the potential loss of USGS Gage [enter gage # and name].

Date of Notice: [enter date]

Gage #: [enter gage #]

Gage Name: [enter gage name]

Years of Record: [enter years]

Location Map: [enter link to map]

Anticipated Change: [enter information]

Expected Date of Change: [enter date]

O&M Funding Provided by: [enter funding source]

Contact: [enter contact information]

Additional Information: [enter additional clarify information if available]

Actions Taken

-

Please share this information with other interested parties

Send an email to [enter point contact]

- **If you are no longer interested in receiving notifications OR**
- **If you would like to be included in future notifications.**

Appendix C

Drought and Water Supply Committee

Stream Gage Oversight Work Group

Terms of Reference

Approved February 21, 2020

Terms of reference define the purpose and structures of a project, committee, meeting, negotiation, or any similar collection of people who have agreed to work together to accomplish a shared goal.

Source: https://en.wikipedia.org/wiki/Terms_of_reference

Table of Contents

1. Introduction

Access to accurate, publicly available, real-time stream flow information supports decision making by water managers, water users, recreationists and the public as they adjust to seasonal supply and demand imbalances. Local governments, state, tribal and federal agencies also rely on stream flow information for emergency planning and notification as well as longer-term water supply planning. The primary source of this information in Montana is a network of approximately 232 stream gages operated by the U.S. Geological Survey (USGS). and financially supported by an array of federal, state, tribal, local, and private funding sources.

The Stream Gage Oversight Work Group was created in 2019 by the 66th Montana Legislature in response to stakeholders' concerns over the shutdown of 10 USGS stream gages due to a lack of funding to support operation and maintenance (O&M). The loss of these gages came with little warning to the water user communities who depended on them for monitoring and cooperatively managing local water resource plans. The event revealed that as demand for water continues to grow, the continuity of Montana's stream gaging network is threatened by declining funding support. It also highlighted the disconnect between those entities that operate and/or fund the system and those entities or individuals who rely on it daily for real-time stream information, local planning and response.

2. Term

This Terms of Reference is intended to guide the work of the Stream Gage Oversight Work Group up through the delivery of the first stream gage infrastructure work plan.

3. Purpose

The purpose of the Work Group is to engage with stakeholders in a review of the USGS stream gage network in Montana and develop recommendations to minimize the vulnerability of the network to disruptions in O&M funding.

4. Scope

The scope of the Work Group's efforts is defined by its founding legislation (§ 2-15-3308, MCA). The following items are within the scope Work Group activities:

1. Reviewing the locations, uses, and funding arrangements for the stream gage network of the U.S. Geological Survey;
2. Reviewing the priorities, needs, and expectations of those funding the maintenance and operations of these stream gages and those using data measured by these stream gages;
3. Creating a stream gage infrastructure work plan;
4. Reviewing options for funding the maintenance and operations of the stream gage network, including use of private funds, consolidated agreements, or multipayer payments;
5. Developing a proposal for stream gage priorities;
6. Reviewing cost-effective and reasonable alternatives to stream gages, including gages that are not part of the USGS' survey's stream gage network, if applicable;

7. Oversight of recommendations and activities related to any legislative study of stream gages; and
8. Coordination of information regarding stream gage funding recommendations and requests from state and federal agencies.

Out of Scope

While the State's snowpack (SNOTEL) and soil moisture monitoring networks are important to understanding state-wide moisture conditions, these networks are beyond the scope of the Work Group's current efforts. Flow monitoring devices placed at head gates or within ditches and canals are also beyond the scope of this effort.

5. Membership

Stream Gage Work Group members represent the seven state agencies that are voting members of the Drought and Water Supply Advisory Committee (§2-15-3308, MCA).

Representing	**Name**
Dept of Natural Resources and Conservation	Paul Azevedo – Co-Chair
Dept of Fish Wildlife & Parks	Stephen Begley – Co-Chair
Dept of Livestock	Mike Honeycutt
Dept of Agriculture	Jon Peterson
Dept of Emergency Services/Military Affairs	Andrew Long
Dept of Commerce	Wayne Johnston
Dept of Environmental Quality	Darin Kron

Additional Participants

There are other individuals and organizations that are necessary to either support the Work Group or that must be communicated with and made aware of it. They include technical support personnel, direct stakeholders, and those who will receive communication notices.

Participant Type	**Individual or Organization**
Technical Support	• Dept of Natural Resources • US Geological Survey – WY-MT Science Center • MT Bureau of Mines and Geology
Direct Stakeholders	• Conservation Districts • MT Watershed Coordination Council and other Watershed Groups who have expressed interest • Tribal governments • Conservation Groups, Irrigator Groups, Water Commissioners • Recreation, fishing and guiding interests • Municipalities,

	• Current funders of USGS stream gages, including: Northwest Energy, BPA, Energy Keepers, Avista Corp, Talen Energy, East Bench ID, tribal groups, other state and federal agencies.
Communication Notice	• Drought and Water Supply Advisory Committee • Water Policy Interim Committee • Leadership of Departments represented on the Work Group

6. Procedures, Responsibilities and Expectations

Quorum

All meetings must have a quorum of participants to proceed. A quorum is a minimum of four (4) members present.

Procedures for Finding Agreement

The Stream Gage Oversight Work Group will seek consensus on all decisions and recommendations. When participants disagree with a recommendation, proposal, or action they should articulate their concern to the larger group and provide a constructive alternative(s) that seeks to accommodate the interests of all participants.

The Stream Gage Oversight Work Group will continue with this procedure until consensus is achieved or the group decides to disagree.

Procedures in the Event of Not Reaching Consensus

If the Stream Gage Oversight Work Group has tried in good faith but is unable to reach consensus, and wants to move forward on the recommendation, proposal, or action at hand, they may use the following fallback mechanisms:

- Define the issue (issue: a subject of discussion, negotiation or problem solving – the what, the problem to be solved)
- Identify interests (interest: one party's concerns, needs or desires underlying the issue – why the issue is being raised [interests may be mutual or separate]. This is the motivation to solve the problem.)
- Brainstorm options for moving ahead (option: potential – often partial – solutions to meet one or more interests – how the problem might be solved)
- Identify standards (standard: agreed upon qualities of an acceptable solution – that is – how well an option solves the problem)
- Evaluate options
- Choose an option

If the Work Group is unable to reach agreement on an issue, further follow-up may be assigned to a task group. The task group will attempt to develop additional proposals or actions to resolve the issue and report its recommendations to the Work Group.

When appropriate, external resources may be engaged to provide an independent opinion.

If none of the above helps the Work Group make progress, the members will seek further direction from the Drought and Water Supply Advisory Committee.

Responsibilities

Members are expected to:

- Attend and participate in all meetings.
- Review relevant information and be prepared to fully participate in meetings.
- Seek areas of agreement and uphold agreements that are reached.
- Explore all options and make recommendations.
- Seek the advice of their constituency throughout the process.
- Make every effort to represent and speak for their constituency.
- Keep their respective hierarchy of decision-makers informed on progress and seek direction as required to support upcoming decisions and recommendations.

Expectations

All participants are encouraged to contribute openly and professionally to discussions, share relevant information regarding the issues under consideration, and to support a transparent and collaborative process.

7. Oversight and Reporting

The Work Group is a subcommittee of the Drought and Water Supply Advisory Committee. The Work Group will report to both the Drought and Water Supply Committee and the Water Policy Interim Committee.

8. Budget

The budget for this initiative falls within the operational budget of each agency represented on the Work Group.

9. Updates and Amendments

This Terms of Reference can be updated and amended by consensus of Work Group members.

Appendix D

Comparison of "Traditional" Stream Monitoring Methods

Monitoring Method	Information Generated	Typical Uses	Required Infrastructure	Cost
Continuous Discharge AKA – Stream gage or streamflow-gaging station	Continuous record of discharge (streamflow) and stage (gage height).	• Planning, forecasting, and warning about floods and droughts • Administration of water rights • Water distribution by Water Commissioners • Determining if stream/rivers are safe for recreational activities. • Regulating pollutant discharges	• Instrumentation o Stage sensor o Data logger (recorder) o Telemetry to transmit data in real-time • Discharge measuring infrastructure such as a bridge or cableway for non-wadable streams	O&M - $17,000 - $19,000 per site per year. Installation - $7,800 average but vary widely based on accessibility.
Continuous Stage AKA – Stage-only station	Continuous stage (gage height)	• Planning, forecasting, and warning about floods and droughts	• Instrumentation o Stage sensor o Data logger (recorder) o Telemetry to transmit data in real-time	O&M - $5,000 - $6,000 per site per year.
Annual Maximum Discharge AKA – Crest-stage gage	Annual max discharge (stream flow)	• Annual maximum discharge over a period of time to estimate flood frequency.	• Crest-stage gage	• O&M - $1,500 - $2,000 per site, per year. Varies depending on site conditions and number of measurements per year.
Discharge Rating Only AKA Staff-gage, rating only site.	• Stage-discharge relationship (rating curve)	• Determining stream flow from periodic observations.	• Staff gage.	• O&M - $1,500 - $2,000 per site, per year. Varies depending on site conditions and number of measurements per year.
Periodic Discharge Measurements	Discrete discharge (stream flow) measurements	• Periodic stream flow	• None • Exception – Discharge measuring infrastructure if stream flows are non-wadable.	• Varies depending on site conditions and number of measurements per year.

Appendix D

Comparison of "Alternative" Stream Monitoring Methods

Monitoring Method	How it works	Comments	Cost
Large-Scale Particle-Image Velocimetry (LSPIV)	• Uses video to capture particles on the surface of stream. • Surface velocity is calculated based on the time it takes for particles to flow pass 4 known points in the video frame. • Discharge (volume/time) can be estimated if you know the relationship between channel discharge and surface velocity i.e. Velocity-Discharge curve.	• WY-MT USGS office is testing this method in several locations. • Results seem to provide a reliable estimate of discharge. • Must maintain viability of Velocity-Discharge curve by taking periodic discharge measurements. • Currently cannot monitor surface velocity on a continuous basis because the video files are too large to transmit in real-time. • Method does not work at night.	Difficult to estimate right now because technology is still being developed and method is not widely used.
Pulsed radar	• Surface velocity is measured with a device very similar to a radar speed gun. • Discharge (volume/time) can be estimated if you know the relationship between channel discharge and surface velocity i.e. Velocity-Discharge curve.	• WY-MT USGS office has not tested this method. • Can monitor surface velocity on continual basis because data files (surface velocity) are small enough to transmit in real-time.	Difficult to estimate right now because technology is still being developed.
Statistical Models	• Estimates of stream flow characteristics are based on statistical correlation between observed basin or environmental characteristics.	• Model accuracy depends on ability to correctly identify the underlying correlation. • Allows you to develop an estimate of discharge at locations where you do not have any monitoring data. • Estimates may be off by 50% - 100%. This may be perfectly acceptable to meet data objectives.	Cost is entirely dependent on the scope of the modeling effort.
Deterministic Models	• Estimates of stream flow characteristics are based on known hydrologic and hydraulic process.	• Model accuracy depends on ability to correctly identify the underlying hydrologic process. • Allows you to develop an estimate of discharge at locations where you do not have any monitoring data. • Estimates may be off by 50% - 100%. This may be perfectly acceptable to meet data objectives.	Cost is entirely dependent on the scope of the modeling effort.

Appendix E
Survey of federal and state agencies contributing operation and maintenance funding to the USGS network in Montana

Survey of federal agencies contributing operation and maintenance funding to the USGS network in Montana

The Stream Gage Oversight Work Group collaborated with the USGS WY-MT Science Center to conduct a survey of federal agencies contributing O&M funding to the USGS network in Montana. In addition to providing contact information, the USGS notified each agency in advance encouraging them to respond to the Work Group survey. Six of the nine agencies contacted responded to the Work Group's survey.

Federal agencies contacted:

1. US Fish and Wildlife Service - Mountain-Prairie Region, Denver
2. US Bureau of Reclamation – Columbia-Pacific NW Region, Seattle
3. US Bureau of Reclamation – Montana Area Office, Missouri Basin Region, Billings
4. US Army Corps of Engineers – Seattle District
5. US Army Corps of Engineers – Omaha District
6. US Environmental Protection Agency
7. National Park Service, Yellowstone National Park
8. Bonneville Power Administration
9. International Joint Commission

Example email

My name is Paul Azevedo with the Montana Department of Natural Resources and Conservation (DNRC). This email is a follow-up to Brian Loving's (USGS WY-MT Science Center) email of February 1st.

On behalf of the Montana Stream Gage Oversight Work Group, DNRC is gathering information on the USGS real-time stream gage network in Montana. As a provider of funding to the USGS network, the USFWS plays a key role in keeping the network operational across our state.

Background
The Stream Gage Oversight Work Group was created in 2019 by the 66th Montana Legislature in response to stakeholders' concerns over the shutdown of 10 USGS stream gages due to a lack of funding to support operation and maintenance. The Work Group is to report back to the Legislature with recommendations on steps the State can take to support the USGS stream gage network in Montana.

Information Request
There are numerous reasons why government agencies contribute funding to the USGS network. One of the Working Group's knowledge gaps concerns the priorities, needs, and expectations of the federal agencies who support USGS stream gages in Montana.

We would like to close that knowledge gap, so our report to the Montana Legislature accurately reflects why USFWS believes it is important to fund USGS gages in Montana. You can assist us by responding to the 3 questions below.

According to the information Brian shared with me, USFWS Denver Office funds the following two USGS gages.

	Station No	Site Name	Record
1	**06006000**	Red Rock Cr ab Lakes nr Lakeview MT	Discharge
2	**06166000**	Beaver Cr bl Guston Coulee nr Saco MT	Discharge

1. What are USFWS's primary management objectives for funding these two USGS gages in Montana?
2. Does USFWS rely on information generated from USGS gages other than the two listed above? Please identify the station number and location of these other gages.
3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

Your response by Thursday February 10th will be greatly appreciated.

Thank you for your cooperation.

Responses

US Fish and Wildlife Service Mountain-Prairie Region, Denver

USGS gages in Montana funded by the USFWS Denver Office.

	Station No	Site Name	Record
1	**06006000**	Red Rock Cr ab Lakes nr Lakeview MT	Discharge
2	**06166000**	Beaver Cr bl Guston Coulee nr Saco MT	Discharge

Responses provided by:

- Carrie Cordova, Water Rights Specialist, Denver
- Kyle Cutting, Red Rock Lakes NWR
- Jaron Andrews, Hydrologist, Denver

1. What are USFWS's primary management objectives for funding these two USGS gages in Montana?
   A: USFWS funds the 2 gages to adhere to conditions in the Federal Reserved Water Right Compacts for Red Rock Lakes and Bowdoin National Wildlife Refuges.

2. Does USFWS rely on information generated from USGS gages other than the two listed above? Please identify the station number and location of these other gages.

	Gage	**Reason**
1	Red Rock Creek gauging station (06006000).	Red Rock Lakes NWR relies on information from the Red Rock Creek gauging station (06006000). Another historic USGS gauging station located on Odell Creek (also on Red Rock Lakes NWR) was discontinued. The Odell Creek (443533111471601) station would allow us to better manage water resources if this was in operation.
2	Gage No. 06183450 – Big Muddy Creek near Antelope MT (discharge)	Medicine Lake National Wildlife Refuge and the Fort Peck Tribes entered into an agreement and the parties rely on Gage No. 06183450 – Big Muddy Creek near Antelope MT (discharge) to determine releases that USFWS agreed to make from Big Muddy Creek. The Agreement is associated with Adjudication Case Nos. 40R-6, 40R-7, 40R-8 and 40R-141
3	*Site Number: 06130500, Site Name: Musselshell River at Mosby MT*	The 2015 Charles M. Russell National Wildlife Refuge (NWR) Water Rights Compact specifies a 70 cfs instream flow right from March 1 to June 30 and I believe this is the closest gage to measure the instream flow)
4	*Site Number: 12370000, Site Name: 'Swan River near Bigfork, MT*	(General situational awareness regarding the discharge rates - the Swan River 5NWR is located upstream and the river r6uns through the Refuge.)
5	*Site Number: 06155500, Site Name: Milk River at Malta MT*	(Water Management and water rights associated with the Bowdoin NWR)

	Gage	**Reason**
6	*Site Number: 06166000, Site Name: Beaver Cr bl Guston Coulee nr Saco MT*	Water Management and water rights associated with the Bowdoin NWR and 2014 Water Rights Compact)
7	*Site Number: 06088500, Site Name: Muddy Creek at Vaughn MT*	Water management and water rights associated with the Benton Lake NWR and the ability of others to divert water)

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial
    - A: I communicated with USFWS Montana project leaders and for the most part the answer is no. There is a non-functioning gage on Willow Creek near Lake Mason National Wildlife Refuge; however, refuge and USFWS Water Resources Division staff have installed our own monitoring equipment to satisfy a Stipulation with the Lake Mason Grazing Association, and Anita and Loren P. Rech Trust. The Stipulation is associated with Adjudication Case Nos. 40C-54, 40C-7 and 40C-9.
    - A: I advocate for the reinstalment of the Odell Creek gauging station (443533111471601). This would allow us to better manage both the water and fishery resources including the arctic grayling.
    - *A: Mill Creek near Creston National Fish Hatchery* - the DNRC currently has a gage at this site: https://gis.dnrc.mt.gov/apps/stage/gage-report/location/6b67bcd1b83043d5bea8e8fac0815294 [gcc02.safelinks.protection.outlook.com] but I am unsure of future operation plans. (This site measures the total spring discharge into Jessup Mill Pond (minus Hatchery well inputs) and is an important indicator of total spring discharge.

US Bureau of Reclamation – Columbia-Pacific Northwest Region, Seattle

USGS gages in Montana funded by the USBR CPNW, Seattle.

	Station No	Site Name	Record
1	**12359800**	S F Flathead R ab Twin C nr Hungry Horse MT	Discharge
2	**12362500**	S F Flathead River nr Columbia Falls MT	Discharge

Response provided by Joel Fenolio, Water Management - Operations Team Supervisor

1. What is USBR's primary management objectives for funding these two gages in Montana?

   The S F Flathead R ab Twin C nr Hungry Horse MT gage is a key indicator for Hungry Horse Dam and Reservoir's inflow and used for operations of the Dam.

   The S F Flathead River nr Columbia Falls MT is used to measure the discharge from Hungry Horse Dam and is used for real time operations as well as for developing water supply forecasts that inform both fisheries and flood risk operations for the Dam. This is a very importation gage for the operation of the dam.

2. Does USBR rely on information generated from USGS gages other than the two listed above? Please identify the station number and location of these other gages.

   Yes we rely on the following gages:

	Station No	Site Name
1	12355000	Flathead River at Flathead British Columbia
2	12355500	N F Flathead River nr Columbia Falls MT
3	12358500	M F Flathead River near West Glacier MT
4	12355000	Flathead River at Flathead British Columbia
5	12363000	Flathead River at Columbia Falls MT
6	12363500	Flathead River near Kalispell, MT
7	12365700	Stillwater River at Lawrence Park, at Kalispell
8	12366000	Whitefish River near Kalispell MT
9	12370000	Swan River near Bigfork, MT
10	12372000	Flathead River near Polson MT
11	12388700	Flathead River at Perma MT
12	12389000	Clark Fork near Plains MT
13	12389500	Thompson River near Thompson Falls MT
14	12344000	Bitterroot River near Darby MT
15	12350250	Bitterroot River at Bell Crossing nr Victor MT
16	12352500	Bitterroot River near Missoula MT

I'll probably come up with 10 more in the next few days and email you them if I think of any more.

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.
   I cannot think of any data gaps at the moment.

US Bureau of Reclamation – MT Area Office, Billings

USGS gages funded by the USBR MATO

	Station No	Site Name	Record
1	**05018000**	St. Mary Canal at intake near Babb MT	Discharge
2	**06012500**	Red Rock R bl Lima Reservoir nr Monida MT	Discharge
3	**06016000**	Beaverhead River at Barretts MT	Discharge
4	**06079000**	South Fork Sun River near Augusta MT	Discharge
5	**06080900**	Sun River bl Diversion Dam nr Augusta MT	Discharge
6	**06082200**	Sun River bl Willow Cr nr Augusta MT	Discharge
7	**06091700**	Two Medicine River bl South Fork nr Browning MT	Discharge
8	**06093200**	Badger Cr bl Four Horns Canal nr Browning MT	Discharge
9	**06101500**	Marias River near Chester MT	Discharge
10	**06139500**	Big Sandy Creek near Havre MT	Discharge
11	**06142400**	Clear Creek near Chinook MT	Discharge
12	**06151500**	Battle Creek near Chinook MT	Discharge
13	**06154100**	Milk River near Harlem MT	Discharge
14	**06155030**	Milk River near Dodson MT	Discharge
15	**06167500**	Beaver Creek near Hinsdale MT	Discharge
16	**06286490**	Big Horn Canal near St. Xavier MT	Discharge
17	**06287000**	Bighorn River near St. Xavier, MT	Discharge
18	**06287800**	Bighorn River at bridge, at St. Xavier, MT	Discharge
19	**06288400**	Bighorn River at Two Leggins Bridge, near Hardin	Discharge

Response provided by – Clayton Jordan, Supervisor

1. **What is the MT Area Office's primary management objectives for funding these 19 USGS stream gages in Montana?**

Reclamation's Montana Area Office (MTAO) requires streamflow data for the operation of reservoirs in the State of Montana and delivery of irrigation water to federal irrigation projects. Planning and performance of projects is enhanced with the collection of real time hydrologic data.
MTAO in conjunction with the U.S. Army Corps of Engineers use streamflow data downstream of MTAO's dams at select sites for flood control operations. Streamflow data at locations upstream of

reservoir sites along with known streamflow travel times is used to plan for snowmelt runoff or runoff from rain events.

2. Does the MT Area Office's rely on information generated from USGS gages other than the 19 you currently support? Please identify the station number and location of these other gages.

MTAO does rely on information generated from USGS gages other than the 19 gage presently funded by MTAO. Other stations of various levels of importance to the MTAO are:

St. Mary River Basin
- Swift Current Creek at Many Glacier (05014500)
- St Mary River near Babb (05017500)
- St Mary Canal at St Mary Crossing near Babb (05018500)
- St Mary River at Boundary (05020500)

Milk River Basin
- North Fork Milk River above Canal near Browning (06133500)
- Milk River at Eastern Crossing of International Boundary (06135000)
- Milk River at Havre (06140500)
- Milk River at Juneberg Bride near Saco (06164510)
- Milk River at Tampico (06172310)

Marias River Basin
- Marias River near Shelby (06099500)
- Marias River near Loma (06102050)
- Teton River at Loma (06108800)

Upper Missouri River Basin
- Ruby River below reservoir near Alder (06020600)
- Big Hole near Melrose (06025500)
- Jefferson near Three Forks (06036650)
- Madison below Hebgen (06038500)
- Madison below Ennis Lake (06041000)
- Gallatin River at Logan (06052500)
- Missouri River at Toston (06054500)
- Missouri River below Hauser (06065500)
- Missouri River below Holter (06066500)
- Dearborn near Craig (06073500)
- Smith River near Eden (06077500)
- Missouri River at Cascade (06074000)
- Missouri River near Ulm (06078200)
- Missouri River at Fort Benton (06090800)

Sun River Basin
- North Fork Sun River near Augusta (06078500)
- Sun River at Simms (06085800)

Yellowstone River Basin

- Little Bighorn River near Hardin (06294000)
- Bighorn River above Tullock Creek near Bighorn (06294500)
- Yellowstone River at Forsyth (06295000)
- Yellowstone River at Miles City (06308500)
- Yellowstone River at Glendive (06327500)
- Yellowstone River near Sidney (06329610)

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

Currently, MTAO is not aware of any streamflow data gaps.

US Army Corps of Engineers – Seattle District

USGS Gages funded by the US Army Corps of Engineers – Seattle District

	Station No	Site Name	Record
1	**12301933**	Kootenai R bel Libby Dam nr Libby MT	Discharge
2	**12302055**	Fisher R nr Libby MT	Discharge
3	**12304500**	Yaak R nr Troy MT	Discharge
4	**12353000**	Clark Fork below Missoula MT	Discharge
5	**12363500**	Flathead River near Kalispell, MT	Discharge

Response provided by: Brian Bell, Water Management Section - Hydrology, Hydraulics and Coastal Engineering Branch, Engineering Division

4. What is the USACE Seattle Region's primary management objectives for funding these 5 USGS stream gages in Montana?

Those gages are used to support reservoir regulation for Albeni Falls and Libby dams. Additionally, they are used to support Corps emergency management and flood plain services work.

5. Does your office rely on information generated from USGS gages other than the 5 listed above? Please identify the station number and location of these other gages.

The ones we pay for are critical for reservoir regulation. All the other gages in those basins (Pend Oreille and Kootenai) we may use occasionally and have potential use for supplementary information.

6. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

Since the Flathead near Kalispell has come back on line we have not seen data gaps.

US Army Corps of Engineers – Omaha District

USGS Gages funded by the US Army Corps of Engineers – Omaha District

	Station No	Site Name	Record
1	**06052500**	Gallatin River at Logan MT	Discharge
2	**06074000**	Missouri River at Cascade MT	Discharge
3	**06078200**	Missouri River near Ulm MT	Discharge
4	**06101200**	Willow Creek near Galata, MT	Discharge
5	**06109500**	Missouri River at Virgelle MT	Discharge
6	**06115200**	Missouri River near Landusky MT	Discharge / Water Temp
7	**06174500**	Milk River at Nashua MT	Discharge
8	**06177000**	Missouri River near Wolf Point MT	Discharge
9	**06185500**	Missouri River near Culbertson MT	Discharge
10	**06214500**	Yellowstone River at Billings MT	Discharge
11	**06309000**	Yellowstone River at Miles City, MT	Discharge
12	**06329500**	Yellowstone River near Sidney MT	Discharge

Response provided by: Alex Flanigan, P.E. Water Control & Water Quality Section. USACE Omaha District

1. What is the USACE Omaha Region's primary management objectives for funding these 12 USGS stream gages in Montana?

Our primary objective for funding these gages is for flood control operation of Fort Peck, Garrison, Canyon Ferry, Tiber, and Yellowtail. These gages are either a downstream flow target specified in our water control manual or a major tributary inflow used in predicting reservoir inflow.

2. Does your office rely on information generated from USGS gages other than the 12 your currently fund? Please identify the station number and location of these other gages.

Yes we rely on numerous other USGS and state gages for the flood control operation of Fort Peck, Garrison, Clark Canyon, Canyon Ferry, Tiber, Boysen, and Yellowtail. The gages we use are listed below. They have varying levels of importance we can discuss in more detail if needed.

	Station No	Site Name
1.	6006000	Red Rock Cr ab Lakes, nr Lakeview, MT
2.	6012500	Red Rock R bl Lima Reservoir nr Monida MT
3.	6016000	Beaverhead River at Barretts MT
4.	6017000	Beaverhead River at Dillon MT
5.	6018500	Beaverhead River near Twin Bridges MT

	Station No	Site Name
6.	6019500	Ruby River above reservoir near Alder, MT
7.	6020600	Ruby River below reservoir near Alder, MT
8.	6023000	Ruby River near Twin Bridges MT
9.	6023100	Beaverhead River at Twin Bridges, MT
10.	6024450	Big Hole River bl Big Lake Cr at Wisdom MT
11.	6024540	Big Hole River bl Mudd Cr nr Wisdom MT
12.	6025250	Big Hole River at Maiden Rock nr Divide MT
13.	6025500	Big Hole River near Melrose MT
14.	6026210	Big Hole River near Glen MT
15.	6026500	Jefferson River near Twin Bridges MT
16.	6027600	Jefferson River at Parsons Bdg nr Silver Star, MT
17.	6033000	Boulder River near Boulder MT
18.	6035000	Willow Creek near Harrison MT
19.	6036650	Jefferson River near Three Forks MT
20.	6036905	Firehole River near West Yellowstone MT
21.	6037100	Gibbon River at Madison Jct, YNP
22.	6038500	Madison River bl Hebgen Lake nr Grayling MT
23.	6038800	Madison River at Kirby Ranch nr Cameron MT
24.	6040000	Madison River near Cameron MT
25.	6040800	Madison River ab powerplant nr McAllister MT
26.	6041000	Madison River bl Ennis Lake nr McAllister MT
27.	6043500	Gallatin River near Gallatin Gateway, MT
28.	6048650	E Gallatin R ab Water Reclamation Fa nr Bozeman MT
29.	6052500	Gallatin River at Logan MT
30.	6054500	Missouri River at Toston MT
31.	6061500	Prickly Pear Creek near Clancy MT
32.	6063000	Tenmile Creek near Helena MT
33.	6065500	Missouri River bl Hauser Dam near Helena MT
34.	6066500	Missouri River bl Holter Dam nr Wolf Cr MT
35.	6073500	Dearborn River near Craig MT
36.	6074000	Missouri River at Cascade MT
37.	6076690	Smith River near Ft Logan MT
38.	6077500	Smith River near Eden MT
39.	6078200	Missouri River near Ulm MT
40.	6078500	North Fork Sun River near Augusta MT
41.	6079000	South Fork Sun River near Augusta MT
42.	6080900	Sun River bl Diversion Dam nr Augusta MT
43.	6082200	Sun River bl Willow Cr nr Augusta MT
44.	6085800	Sun River at Simms MT
45.	6088500	Muddy Creek at Vaughn MT

	Station No	Site Name
46.	6089000	Sun River near Vaughn MT
47.	6090000	Missouri River at Great Falls MT
48.	6090800	Missouri River at Fort Benton MT
49.	6091700	Two Medicine River bl South Fork nr Browning MT
50.	6092020	Two Medicine River ab Badger Cr, nr Piegan, MT
51.	6093200	Badger Cr bl Four Horns Canal nr Browning MT
52.	6094900	Birch Cr bl Heart Butte Road, nr Heart Butte, MT
53.	6098120	Birch Creek at Bullhead Bridge, nr Valier, MT
54.	6098800	Cut Bank Cr ab Gillam Coulee, nr Sundance, MT
55.	6099000	Cut Bank Creek at Cut Bank MT
56.	6099500	Marias River near Shelby MT
57.	6101200	Willow Creek near Galata, MT
58.	6101500	Marias River near Chester MT
59.	6101630	Marias River at Highway 223 bridge near Chester,MT
60.	6102050	Marias River near Loma MT
61.	6102500	Teton River bl South Fork nr Choteau MT
62.	6108000	Teton River near Dutton MT
63.	6108800	Teton River at Loma MT
64.	6109500	Missouri River at Virgelle MT
65.	6110020	Judith River above Carr Creek near Utica MT
66.	6114700	Judith River nr mouth, nr Winifred MT
67.	6115200	Missouri River near Landusky MT
68.	6120500	Musselshell River at Harlowton MT
69.	6123030	Musselshell River ab Mud Cr nr Shawmut MT
70.	6126500	Musselshell River near Roundup MT
71.	6127500	Musselshell River at Musselshell MT
72.	6130500	Musselshell River at Mosby MT
73.	6132000	Missouri River below Fort Peck Dam MT
74.	6140500	Milk River at Havre MT
75.	6154100	Milk River near Harlem MT
76.	6155500	Milk River at Malta MT
77.	6164510	Milk River at Juneberg Bridge nr Saco MT
78.	6166000	Beaver Cr bl Guston Coulee nr Saco MT
79.	6167500	Beaver Creek near Hinsdale MT
80.	6172310	Milk River at Tampico MT
81.	6174500	Milk River at Nashua MT
82.	6175100	Missouri R at W Frazer Pump Plant nr Frazer MT
83.	6175510	Missouri R at E Frazer Pump Plant nr Frazer MT
84.	6177000	Missouri River near Wolf Point MT
85.	6181000	Poplar River near Poplar MT

	Station No	Site Name
86.	6185110	Big Muddy Creek nr mouth nr Culbertson MT
87.	6185500	Missouri River near Culbertson MT
88.	6191500	Yellowstone River at Corwin Springs MT
89.	6192500	Yellowstone River near Livingston, MT
90.	6195600	Shields River nr Livingston MT
91.	6200000	Boulder River at Big Timber MT
92.	6205000	Stillwater River near Absarokee MT
93.	6207500	Clarks Fork Yellowstone River nr Belfry MT
94.	6208500	Clarks Fork Yellowstone River at Edgar MT
95.	6214500	Yellowstone River at Billings MT
96.	6286490	Big Horn Canal near St. Xavier MT
97.	6287000	Bighorn River near St. Xavier, MT
98.	6287800	Bighorn River at bridge, at St. Xavier, MT
99.	6288400	Bighorn River at Two Leggins Bridge, near Hardin
100.	6289000	Little Bighorn River at State Line nr Wyola MT
101.	6294000	Little Bighorn River near Hardin MT
102.	6294500	Bighorn River ab Tullock Cr nr Bighorn MT
103.	6295000	Yellowstone River at Forsyth MT
104.	6307616	Tongue R at Birney Day School Br nr Birney MT
105.	6308500	Tongue River at Miles City, MT
106.	6309000	Yellowstone River at Miles City, MT
107.	6324500	Powder River at Moorhead MT
108.	6326500	Powder River near Locate MT
109.	6327500	Yellowstone River at Glendive, MT
110.	6329500	Yellowstone River near Sidney MT

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

Either of the Beaverhead tribs above Dillon or a gage near the end of Boulder Creek could be helpful in flood operations at Clark Canyon or Canyon Ferry.

US Environmental Protection Agency

USGS Gages Funded by the US Environmental Protection Agency

	Station No	Site Name	Record
1	**12323600**	Silver Bow Creek at Opportunity MT	Discharge
2	**12323670**	Mill Creek nr Anaconda, MT	Discharge
3	**12323700**	Mill Creek at Opportunity, MT	Discharge
4	**12323710**	Willow Creek nr Anaconda, MT	Discharge
5	**12323720**	Willow Creek at Opportunity, MT	Discharge
6	**12323750**	Silver Bow Creek at Warm Springs MT	Discharge
7	**12323760**	Warm Springs Creek near Anaconda MT	Discharge
8	**12323770**	Warm Springs Creek at Warm Springs MT	Discharge / Water Temp
10	**12323800**	Clark Fork near Galen MT	Discharge
11	**12323840**	Lost Creek near Anaconda MT	Discharge
12	**12323850**	Lost Creek near Galen, MT	Discharge
13	**12324200**	Clark Fork at Deer Lodge MT	Discharge
14	**12324400**	Clark Fork ab Little Blackfoot R nr Garrison MT	Discharge
15	**12331800**	Clark Fork near Drummond MT	Discharge
16	**12334550**	Clark Fork at Turah Bridge nr Bonner MT	Discharge
17	**12340500**	Clark Fork above Missoula MT	Discharge

Response provided by: Melissa Schaar, Groundwater and Water Quality Studies Chief, USGS

1. What is the EPA's primary management objectives for funding USGS stream gages in Montana?

EPA primary Management objective is monitoring post-mining water quality in the Clark Fork Basin.
EPA is responsible for water quality monitoring.

2. Does EPA rely on information generated from USGS gages other than the ones you currently support? Please identify the station number and location of these other gages.

No

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

EPA could not identify any data gaps.

National Park Service - Yellowstone National Park

	Station No	Site Name	Record
1	**06037500**	Madison River near West Yellowstone, MT	Water Temp
2	**06187915**	Soda Butte Cr at Park Bndry at Silver Gate	Discharge
3	**06191000**	Gardner River near Mammoth, YNP	Discharge
4	**06191500**	Yellowstone River at Corwin Springs MT	Water Temp

1. What is the National Park Service – Yellowstone's primary management objectives for funding these four USGS stream gages?

2. Does the National Park Service - Yellowstone rely on information generated from USGS gages other than the four listed above? Please identify the station number and location of these other gages.

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

Bonneville Power Administration – Clark Fork Basin, MT

	Station No	Site Name	Record
1	**12354500**	Clark Fork at St. Regis MT	Discharge
2	**12355500**	North Fork Flathead River near Columbia Falls	Discharge
3	**12358500**	Middle Fork Flathead River near West Glacier	Discharge

1. What is Bonneville Power Administration's (BPA) primary management objectives for funding these three USGS stream gages?

2. Does BPA rely on information generated from USGS gages other than the three listed above? Please identify the station number and location of these other gages.

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

International Joint Commission

	Station No	Site Name	Record
1	**05017500**	St. Mary River near Babb MT	Discharge
2	**06133500**	N F Milk River ab St. Mary canal nr Browning MT	Discharge
3	**06135000**	Milk River at Eastern Crossing of Int Bndry	Discharge

1. What is International Joint Commission's (IJC) primary management objectives for funding these three USGS stream gages?

2. Does the IJC rely on information generated from USGS gages other than the three listed above? Please identify the station number and location of these other gages.

3. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

Survey of stat agencies contributing operation and maintenance funding to the USGS network in Montana

1. What is the source of funding that (state agency) uses to fund____ gage(s)?

   Montana Department of Environmental Quality (MDEQ): The Smith River Gage at Eden Bridge has been funded by a mix of state general fund match to federal EPA clean water act grant(s). 50/50 mix over the past few years. This general fund is matched to federal grant match requirements.

   Montana Bureau of Mines and Geology (MBMG): Pass-through funds from US EPA through the Superfund Program.

2. What are (state agency's) primary management objectives for funding USGS stream gages in Montana.

   MDEQ: DEQs management objectives are to protect and restore water quality. In particular, to support local water quality studies when gages are not currently present (ex. Smith River Algae and Nutrient Study). These are usually short-term projects needs that move from watershed to watershed. 2. DEQ permitting programs opportunistically use most or all existing and past gage data across the state to implement a statewide report on seasonal low or high flow conditions (example: 7Q10 flows) to ensure permit limits are protective. DEQ uses gage station data for many other daily functions (see next response).

   MBMG: Meet contract obligations with Superfund program and ensure Superfund remedies are meeting Consent Decree requirements.

3. Does the (state agency) rely on information generated from USGS gages other than the one you currently support? Please identify the station number and location of these other gages.

   MDEQ: DEQ relies on at least a majority of USGS sites and sometimes all available gage data for implementing programs. 1. Water quality monitoring depends on gages located on many medium and large rivers because instantaneous measures in these locations are dangerous and expensive to collect. We design studies to monitor water quality at USGS and DNRC discharge monitoring locations for codependent data. 2. Total Maximum Daily Loads must account for flow calculations. 3. Most water quality modeling requires discharge information. 4. Permitting must understand seasonal flow conditions for setting discharge limits. 5. Remediation of the Clark's Fork River and other stream channel restoration projects must understand baseflow and flood recurrence flows to design appropriate channel size. 6. Emergency Response 7. Staff safety 8. Implementing and tracking border pollutant loading agreements and disputes 9. There may be others as well.

   MBMG: Our staff scientists make use of gage data at many locations, depending on our current project list. MBMG monitors surface water at many additional locations, collecting stream flow measurements and establishing gage sites to meet specific project objectives. These records are available to the public here:
   http://www.mbmg.mtech.edu/WaterEnvironment/SWAMP/main.asp [mbmg.mtech.edu]

4. Do you know of any stream flow data gaps that could be filled if additional USGS gages were installed? If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial.

   MDEQ: If possible, please identify the waterbody and approximate geographic location where an additional USGS gage would be beneficial. Many of the recent gages that have been lost due to lack of funding or inflationary conditions. Not that this was lost, but Clarks Fork of Yellowstone just above confluence with Yellowstone River.

   MBMG: This list is subjectively random, focusing on locations where we have recently worked or expect to work: an additional station on the Yellowstone River near Columbus, MT would help with monitoring and sampling decisions at the Mouat Chromium site in Columbus; the Gallatin River above the Spanish Peaks Fault area, here the Madison FM discharges via springflow to the river. The USGS gage at Deer Creek is below the springs; reestablishing a USGS site on Skalkaho Creek near Hamilton might be useful to stakeholders. The discontinued gage on Otter Creek at Ashland would be useful if Otter Creek Coal Tracts, or coalbed methane development returns to that area; a gage on Ashley Creek (probably near the bypass) in the Flathead Valley.

5. What are MDEQ's expectations with regard to maintaining or enhancing the USGS Stream Gage Network in Montana?

   MDEQ: DEQ hopes that no more gages are lost due to inflation or lack of funding and that a subset of the recently discontinued gages could be reinstated.

   MBMG: We will continue to support the three stations listed above until the monitoring requirements for Superfund change.

Appendix F

Montana Streamgage User's Survey Report

Draft

The Streamgage User's Survey (Survey) was the result of meetings held in Helena and organized by the U.S. Geological Survey (USGS) in 2019 and 2020. Streamgage stakeholders including watershed groups, agricultural organizations, and federal, state, local and tribal agencies met discussing streamgage funding issues.

As discussions progressed it became clear that these committed professionals didn't know specifically who was accessing and using streamgage data. Funding agencies tend to hear more specifically who views gage data when a gage goes unexpectedly offline from technology issues or when funding has expired. Then, people call or email inquiring about the missing data on the website. While webpage analytics can be used to understand the number of clicks for a specific gage, or which gage site received the most clicks; the origination of the click can be from agency websites that host links to the gage sites, fishing shop websites, and apps developed for recreationists such as Rivercast, RiverApp, and FlyWise.

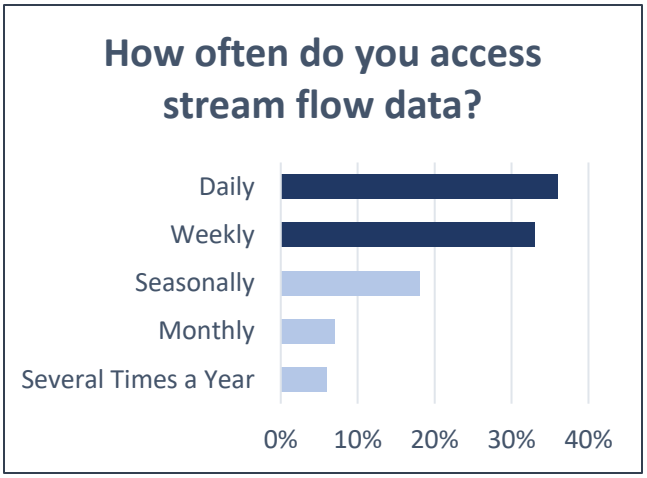
A small group designed the Survey to increase understanding about who uses the gage data, how often, during what times of year, and also get a snapshot of the gages that people look at. The Survey was promoted and distributed via newsletters, emails, meetings, social media, listservs and flyers posted in communities. Organizations that assisted in publicizing the survey included federal, state, city, and county agencies; watershed groups; conservation districts; and water related nonprofits. Printed fliers were developed including the survey link address, and QR code. These were distributed to watershed groups, conservation districts, county, state, and federal agencies. The contact person was asked to post on local bulletin boards, and to place copies in local businesses and community organizations. In addition, 31 organizations distributed the Survey information via newsletter, social media accounts, list-serv's and emails.

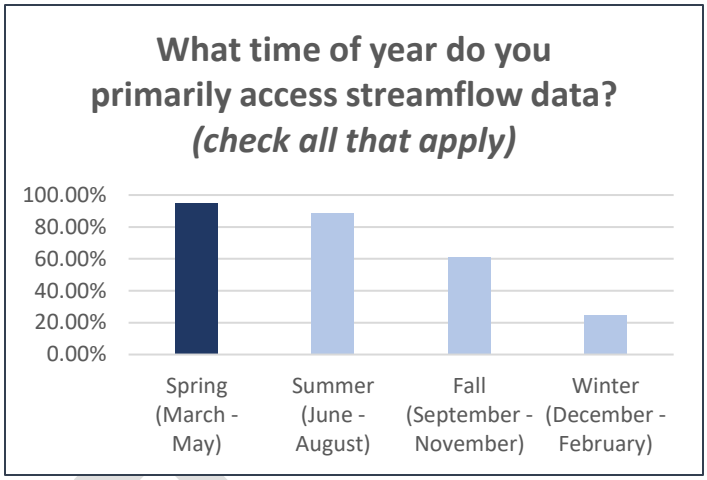
Streamgage User's Survey Flier

The Survey had 15 questions and took five minutes to complete. It was open April 23 through October 8, 2020. There were 576 respondents from 92 different zip code areas in Montana and 25 zip codes areas from other states.

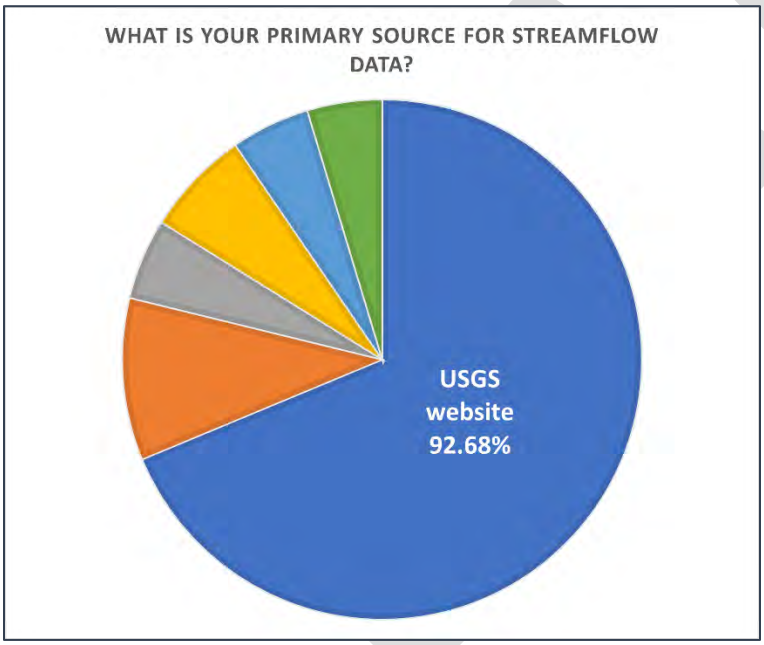
Survey Results

A majority of the Survey participants accessed streamgage data either daily or weekly and 79% of the participants have been doing this for over seven years. The data was accessed the most between March and August.



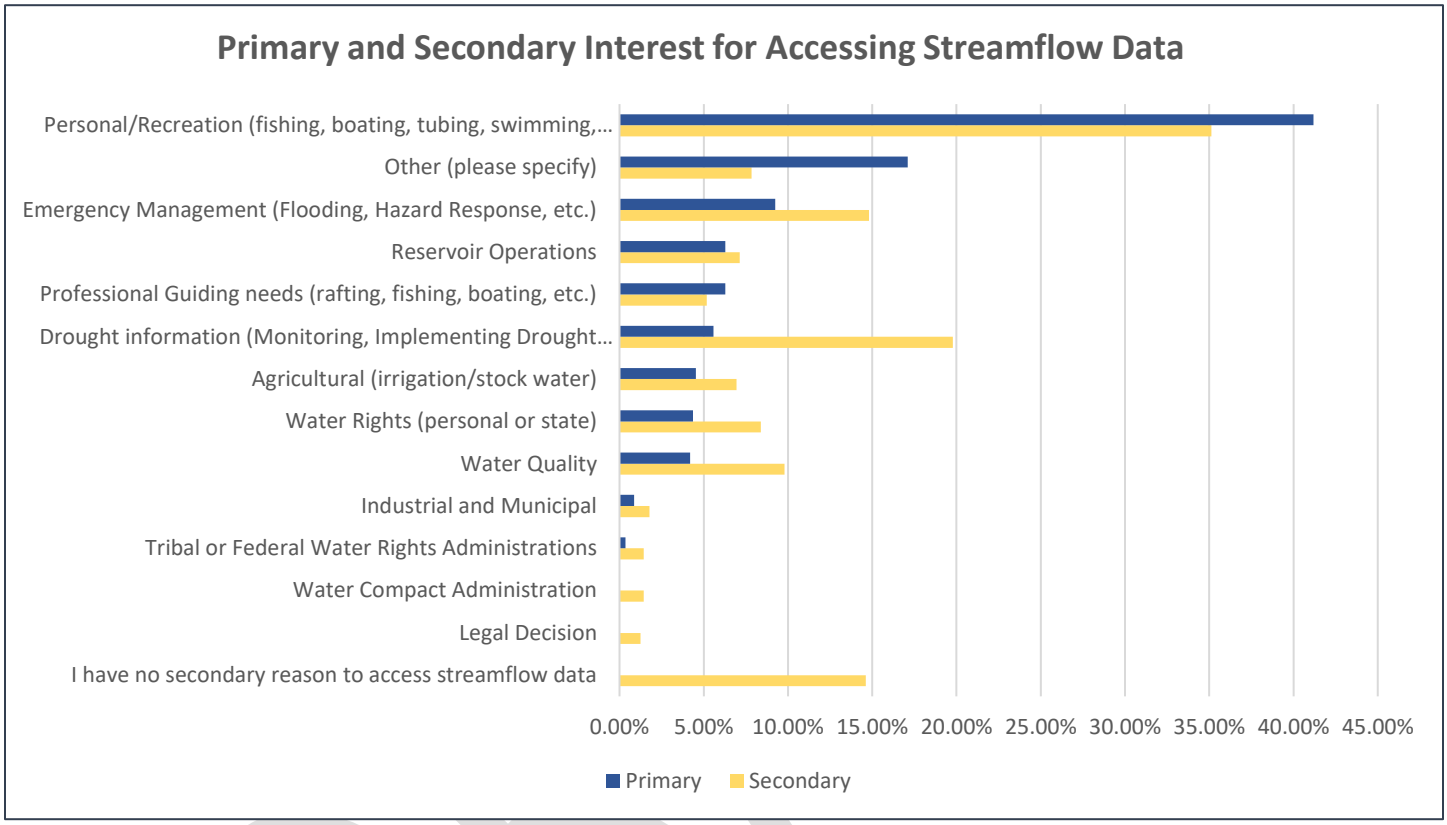


Participants reported that their primary source for accessing streamgage data was the USGS website.



	USGS website – waterdata.usgs.gov
	MBMG/DNRC's Surface Water Assessment and Monitoring Program (SWAMP)
	Third-party Mobile App - such as Rivercast, RiverApp, FlyWise, etc.
	National Weather Service AHPS Page - waterweather.gov
	A Watershed Group or other third-party website.
	Other (please specify)

A key for the Survey was to understand who was accessing the gage data and for what reasons. The table below shows the primary and secondary interests that participants reported. Some of the "Other" responses aligned directly with options that were provided. A surprising result for the Interests was that personal/recreation was the top interest in accessing streamflow data.



Members of the committee:

Nikki Sandve – MT DNRC

Arin Peters – NOAA

Bill Milton – Musselshell Watershed Organization

Kirk Miller – USGS

Morgan Lee Case – Trout Unlimited

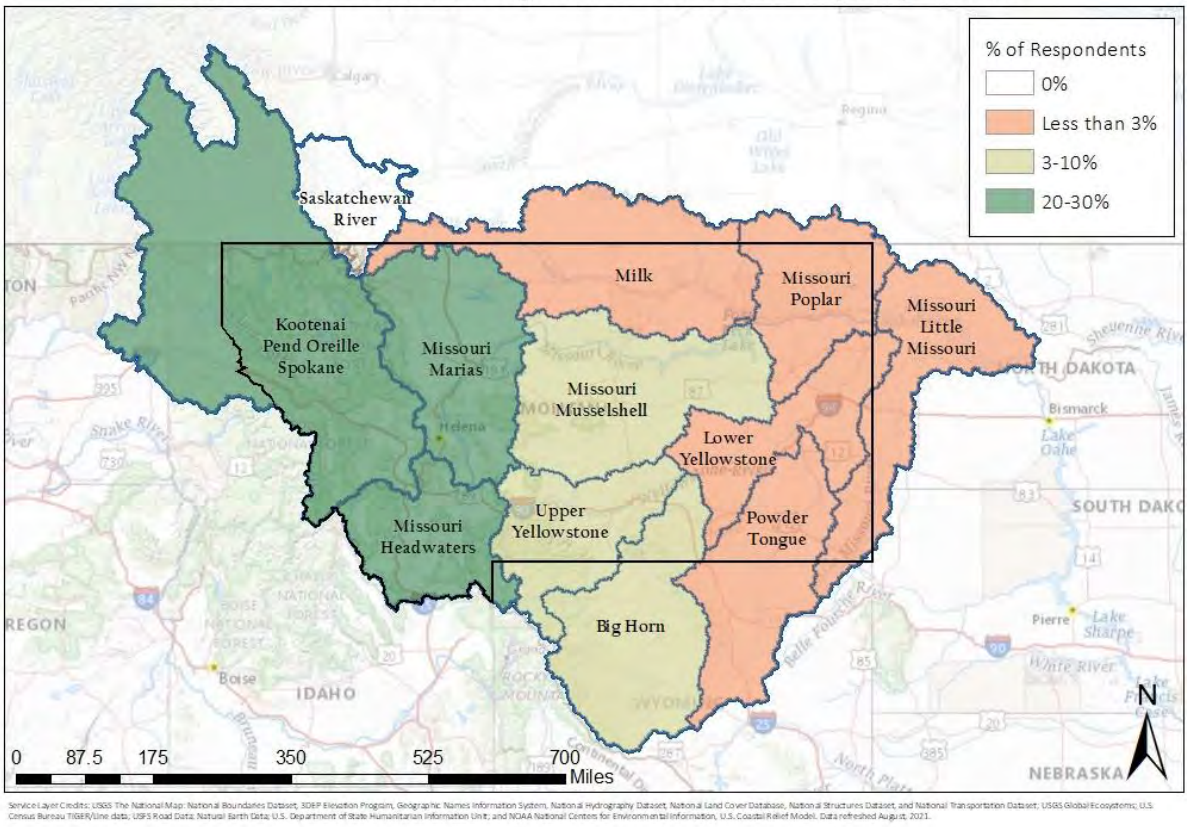
Pedro Marques – Big Hole Watershed Committee

Stephen Begley – FWP

Tracy Wendt – Sun River Watershed Group

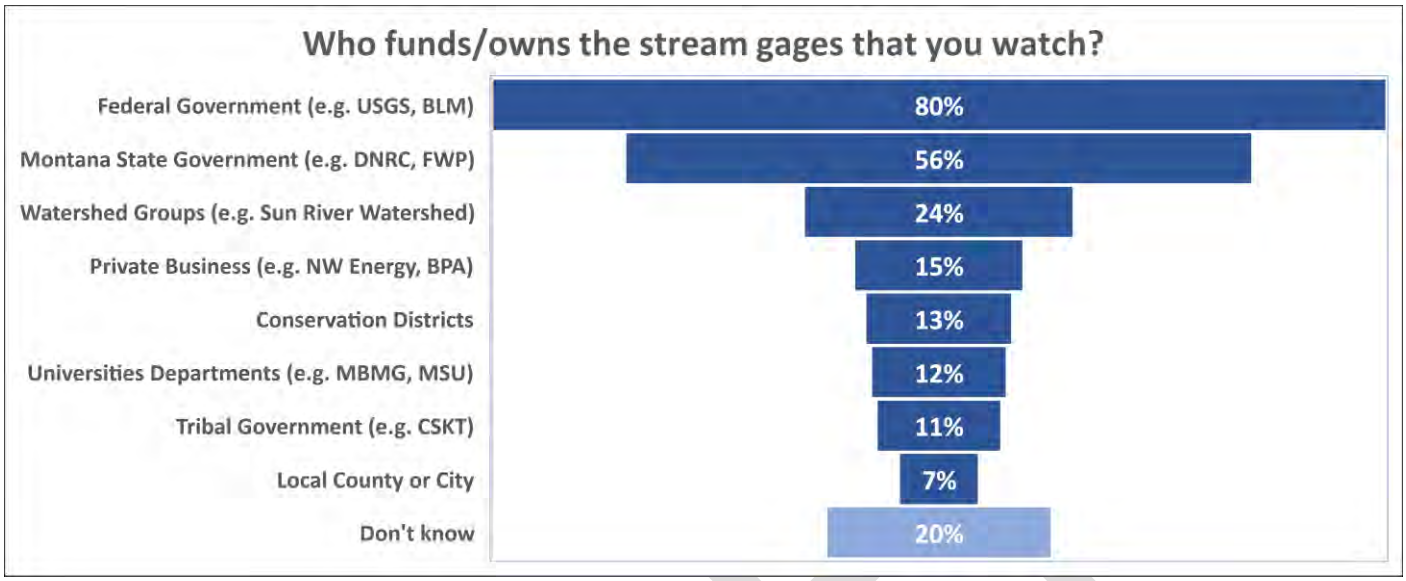
The three major western watersheds were accessed the most by the participants.

Montana Stream Gage Survey
Watershed with Stream Gages Accessed the Most by Respondents



In addition to which watershed gages were located in that were accessed by the participants, the survey also asked, “Which gages do you check most often?” Participants were to specify the gage by the river system, gage name, and/or USGS gage number. The wide variety of ways that gages were named and listed, makes data for this question challenging to parse out.

The Survey asked if participants knew who funds/owns the streamgages. While participants could check all that apply, almost 20% didn't know what agencies and organizations ensured they had accurate and free data.



As the Survey was being designed the team discussed providing gage funding information to determine what participants understood about the costs to install and maintain these vital networks.

Installation of a gage that measures streamflow and is installed where there is existing infrastructure costs an average of **$5,000**. Is this amount -

More than you thought it costs.	24%
About what you thought it costs.	**62%**
Less than you thought it costs.	14%

The average yearly costs of **operation, maintenance, and calibration** of a streamflow gage is **$11,840** (for a 6-month streamflow gage) to **$18,360** (for a year-round streamflow gage). Is this amount -

More than you thought it costs.	**63%**
About what you thought it costs.	35%
Less than you thought it costs.	2%

Participants primary residence were located in 122 zip codes areas from 39 counties in Montana and nine other states. Each county/state reported is shown in the graphic below. The size of the font is determined by the number of responses for that county. As a size reference, Lewis and Clark had 93 responses and Jefferson County had 14 responses.

Almost 60% of the participants wanted to be notified if a gage might be shut down because of lack of funding. Forty percent were affiliated with organization that have funded streamgages, but 32% of the participant either didn't know or the question wasn't applicable for them.

For potential future follow-up, the participants were asked if they would be willing to be contacted with additional questions to provide their email address. Two hundred and forty-seven emails addresses were submitted. At this time the survey design team has not conducted any follow-up questioning.

SUMMARY

There is a strong interest in using gage data to support multiple water needs across the state. While most survey participants have been accessing gage data frequently for over seven years, there was not a clear understanding of the costs involved in maintaining streamgages. There appears to be a concentrated interest in the gages located in the western Montana watersheds, this could be because of the population and number of gages in those areas. Additional outreach and education may be needed about the needs of ongoing O&M and the associated costs for gages.