STREAM GAGING IN ALASKA:

FILLING THE STATE'S DATA GAP

THROUGH INTERAGENCY COOPERATION

by

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of

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ABSTRACT

Accurate streamflow data are essential for water resource management, infrastructure design, ecological protection, and public safety. In Alaska, a significant data gap exists due to limited coverage of the U.S. Geological Survey (USGS) stream gaging network. This gap limits decision-makers' ability to effectively monitor hydrologic conditions and respond to environmental and infrastructure challenges. To address this issue, my study focuses on improving and expanding the AKFlow database, which integrates stream gage data from USGS *and* non-USGS sources. My efforts centered on standardizing key data attributes across nine contributing agencies, implementing efficient data update workflows using ArcGIS Survey123 and Microsoft Excel, and enhancing user access through web-based mapping services and an interactive ArcGIS Dashboard. These approaches aim to balance data consistency, ease of maintenance, and usability for both technical and non-technical users. The addition of standardized attributes—such as measurement type, sensor type, data frequency, telemetry availability, and datum reference—improves the ability to compare and evaluate datasets across agencies. Streamlined data submission processes reduce administrative burden and support regular updates, while the Dashboard enables users to visualize gage distribution, spatially filter data, and identify gaps in coverage across Alaska. These improvements significantly enhance the accessibility, consistency, and practical value of stream gage data across the state. The AKFlow database provides a more comprehensive and user-friendly resource for understanding hydrologic conditions, supporting informed decision-making, and guiding future investments in stream gaging infrastructure.

CHAPTER ONE

INTRODUCTION

Background

Determining how much water flows through a river or stream is a critical piece of information for decision-makers at all levels. Accurate and timely streamflow measurements help predict future water supply, inform flood management decisions, and guide infrastructure design, such as buildings, roads, and utilities. They help answer questions about water quality and how to regulate pollutant loads in our waters. They provide a valuable tool for recreators to determine water levels for activities such as fishing and boating. Additionally, they play a critical role in keeping people safe by informing flood mapping and warning systems (NHWC, 2006). Many people rely on data from stream gages to determine discharge over time, as they provide a reliable, quality-assured resource for measuring discharge on a river or stream (USGS, 2019).

How does stream gaging work?

A stream gaging station is defined as a particular site on a stream or river where systematic observations of water stage and discharge are collected (Brabets, 1996). It is used to estimate streamflow- the amount of water flowing through a river or stream over time (Normand, 2021). There are many approaches to stream gaging, with various setups and devices that may be used, some much more sophisticated and complex than others. However, they all aim to collect water-stage height measurements, with some also collecting water discharge measurements.

Stage Height

In a traditional USGS stream gage installation (Figure 1), a pressure transducer or a bubble system is used to measure stage height at a specific location as water levels fluctuate over time. In many instances, this information can be transmitted via satellite or cellular networks to data servers, where it can be queried and viewed in real time (Normand, 2021). This stage height information is valuable as it shows how high the water level is at any given time, which can be an important indicator of a flood event or provide a warning of rising flood waters. Other typical deployments involve using radar water-level sensors (Figure 2). These deployments are typically less permanent and quicker to install, making them valuable for emergencies or temporary deployments (Turnispeed and Sauer, 2010).

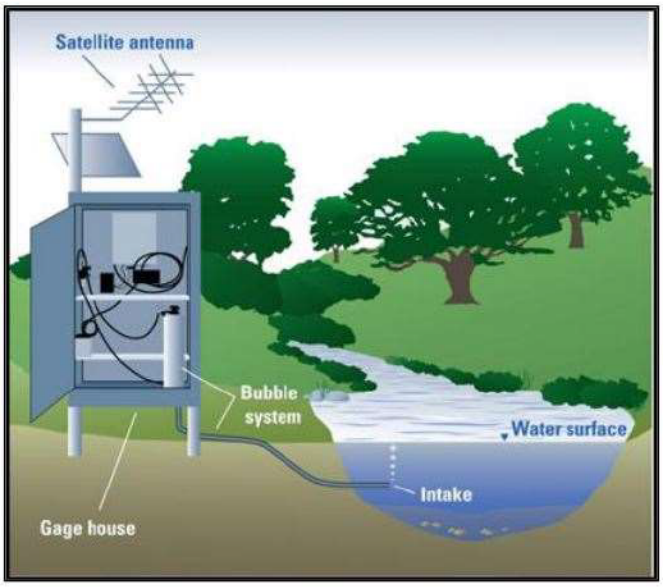


Figure 1: Typical stream gage installation employed by USGS (figure adapted from Normand 2021).

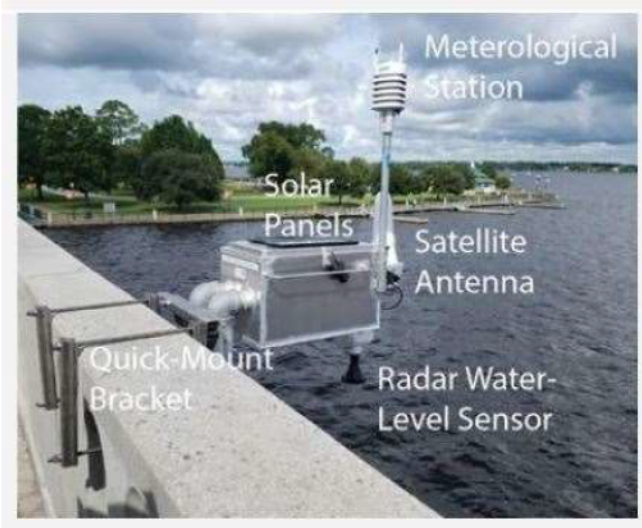


Figure 2: Typical radar water level sensor installation by USGS (figure adapted from Normand, 2021).

Discharge

Stage height itself does not answer the question of *how much* water is moving through a stream or river. This question is answered (or estimated) through periodic discharge measurements. Discharge measurements involve capturing a stream or river's cross-sectional geometry and how fast the water is flowing. As with measuring stage height, many different tools can be used to measure discharge. One common deployment is using an ADCP (Acoustic Doppler Current Profiler) (Figure 3). An ADCP uses the Doppler effect to transmit sound waves that ping off suspended particles throughout the water column (Mueller and Wagner, 2009). The frequency of these "pinged" sound waves indicates how fast the suspended particles are moving and thus provides an estimate of how fast the water is moving. Combining this water velocity measurement with the stream or river's cross-sectional area gives a final discharge measurement. By repeatedly measuring discharge at various flows (stage heights), one can establish a flow rating curve (Normand, 2021). The rating curve can then be used to estimate discharge based on stage height measurements coming from the installed stream gage (Figure 4).



Figure 3: An ADCP is used to map channel bathymetry (cross sectional area) and collect water velocity throughout the water column. Brighter colors in this example indicate areas with higher velocities. Source: Encyclopedia of the Environment.

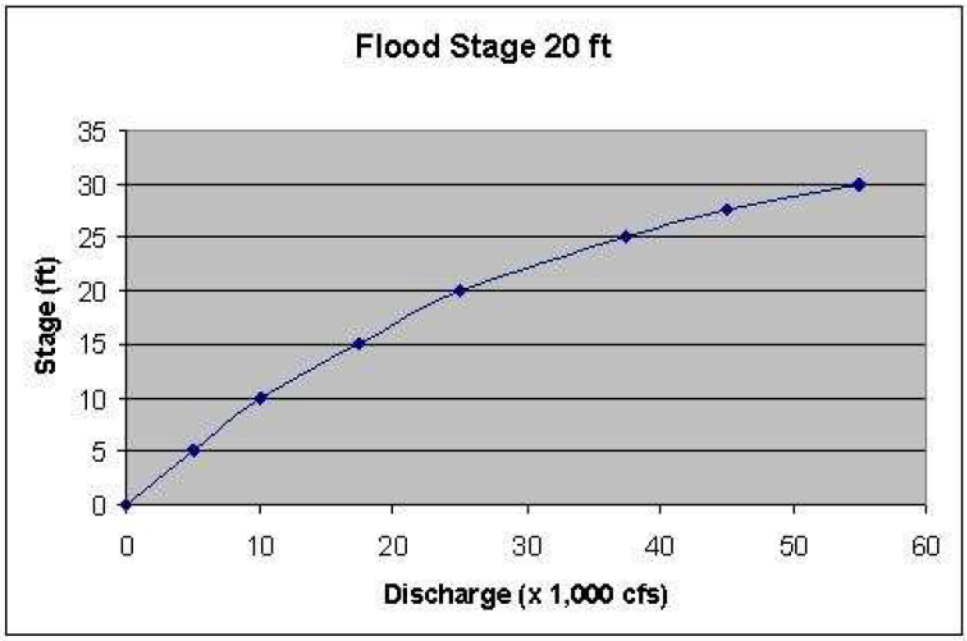


Figure 4: Example of a flow rating curve to relate stage height to estimated discharge. Source: National Weather Service Training Center, 2007.

Overview of Stream Gaging in the United States

The leading agency behind stream gaging in the United States is the United States Geological Survey (USGS). According to the USGS, as of 2023, there are approximately 11,885 USGS stream gages across the country (USGS, 2024). In 2023, there were almost 1.5 billion requests for streamflow data (USGS, 2024). This highlights the importance of streamflow data and access to the stream gaging network for all end users.

An overview of the number of active USGS gages in each U.S. State is shown in Figure 5. While the spatial coverage and the total number of USGS gaging stations appear impressive, it's important to note that the USGS gaging network has serious limitations. Due to spatial, logistical, and financial constraints, it is simply not feasible to collect water data across the entire country using a high-density network. As a result, the USGS National Streamflow Network

covers less than 1 percent of the Nation's streams and rivers (USGS, 2019). The USGS states that its goal for the stream gaging program is to provide data for a small number of medium-sized watersheds that are representative of larger regions (USGS, 2019). As others have pointed out, this has led to a bias towards large perennial rivers, leaving many smaller streams and rivers ungaged and unstudied by the USGS (Kaiser et al., 2023)

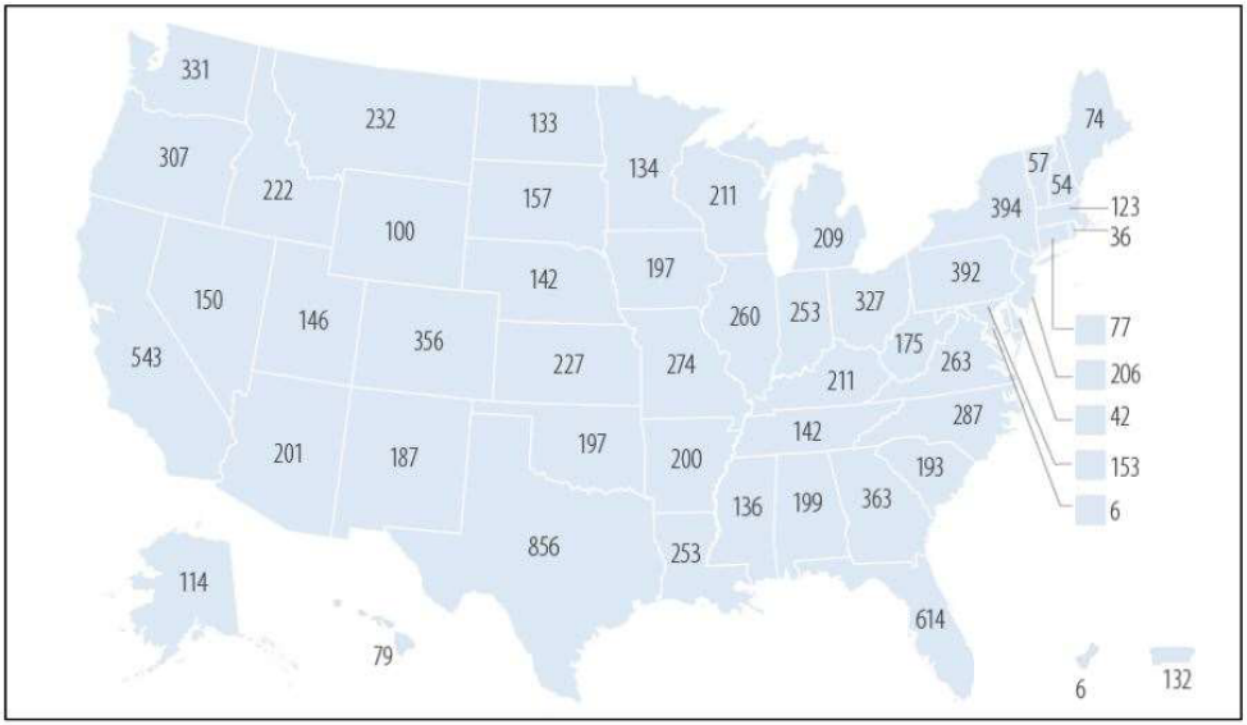


Figure 5: Number of active USGS stream gages by state as of 2021 (figure adapted from Normand 2021). Note: Alaska has retired additional gages and now only has 102 active USGS stream gages as of 2026.

Stream Gaging in Alaska

In Alaska, the USGS gaging network is even less robust. Of the almost 12,000 active USGS gages in the Nation, Alaska accounts for only 102 active USGS gages (Figure 6). This is fewer than 41 other states (Normand, 2021). To put it succinctly, Alaska has fewer than 1% of the total number of USGS gages despite accounting for more than 17% of the country's land area (US Census, 2025) and 40% of the United States' freshwater resources (ADNR, 2024).



Figure 6: Active USGS stream gage locations in Alaska as of 2026.

Alaska's stream gaging program began in 1906 with a primary purpose to "provide peak flow, average flow, and low-flow characteristics to a variety of users" (Brabets, 1996). While early stream gaging in Alaska primarily focused on determining water supplies for hydraulic placer mining, the network grew to almost 50 stations in 1950 and almost 120 in 1970 (Childers,

1970). However, that is when the growth of the Alaskan stream gaging network stalled. Despite a 1996 proposal for and identification of a stream gaging network of 308 stations, the current gage network is smaller than it was in 1970 (Brabets, 1996).

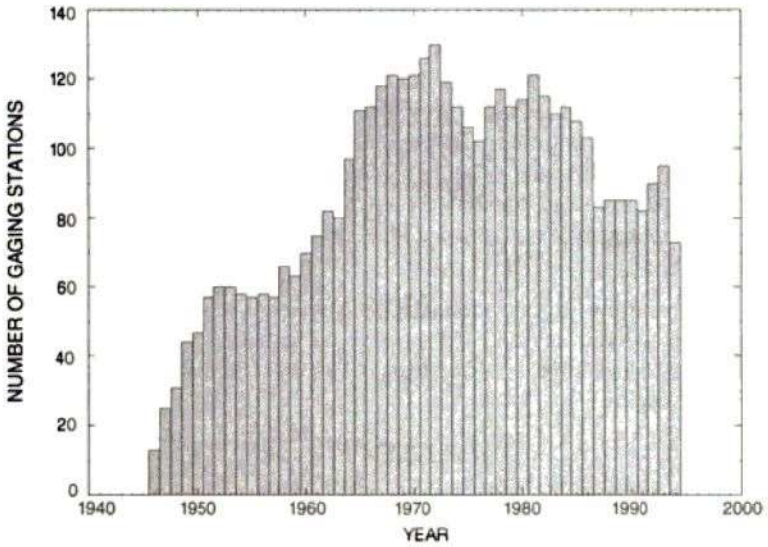


Figure 7: Number of USGS streamflow-gaging stations in Alaska 1946-1994 (Figure adapted from Brabets 1996).

Why does a lack of stream gaging matter?

Alaska's size and sparse human population mean decision-makers often rely on stream gage data to address critical problems. Stream gage data in Alaska is typically used to answer questions of "how high" or "how much" as they relate to flooding events, hydropower, or water supply. For example, during spring ice breakup, gage data is used to monitor river levels in Interior Alaska and to inform potential flooding in riverfront communities. Additionally, historic gage data is used to inform infrastructure design and ensure new buildings, roadways, and other engineered structures can withstand recurring storm and flood events. At the other end of the spectrum, gage data is important for delineating low-flow regimes (USFWS, 2026), which

inform decision-makers on baseline flows for specific waterbodies. For example, gage data is extremely valuable for monitoring and tracking fish habitat in Alaska's $400 million salmon industry (ADFG, 2023). Salmon that spawn in Alaska's waterways typically require a minimum flow to be able to swim upstream to spawning grounds. If flows drop below this minimum threshold due to natural causes or water diversions for human activities, it could have serious implications for the salmon run in that waterbody. Additionally, stream gage data is used in Alaska to determine instream flow reservations. Instream flow reservations stem from a 1980 amendment to Alaska's water law (Klein et al., 2020). The amendment allows reservations of instream flow (or lake water) for uses such as protection of fish and wildlife habitat, recreation and park use, navigation and transportation, and sanitation and water quality (ADNR, 2025). One major hurdle in the permitting process for inflow stream reservations, however, is the requirement for 5 years of continuous streamflow data. Establishing a stream gage and collecting 5 years of flow data is extremely time-intensive and expensive, underscoring the importance of using existing gage data wherever possible.

The Data Gap

It is evident that USGS stream gage coverage in Alaska is lacking. So how do we fill the data gap? The USGS isn't the only purveyor of stream gage data in Alaska. Numerous other federal, state, and private entities also install and manage gaging stations. While these may be designed for specific purposes, the data they collect can still be incredibly valuable to other users, especially if they are located in non-USGS gaged areas of the State. Once we start to look at the combined inventory of USGS and non-USGS gages in the State, the picture brightens

significantly, with approximately 416 total active gages (Geist, 2026) (Figure 8). This is where the Interagency Hydrology Committee for Alaska (IHCA) has stepped in.

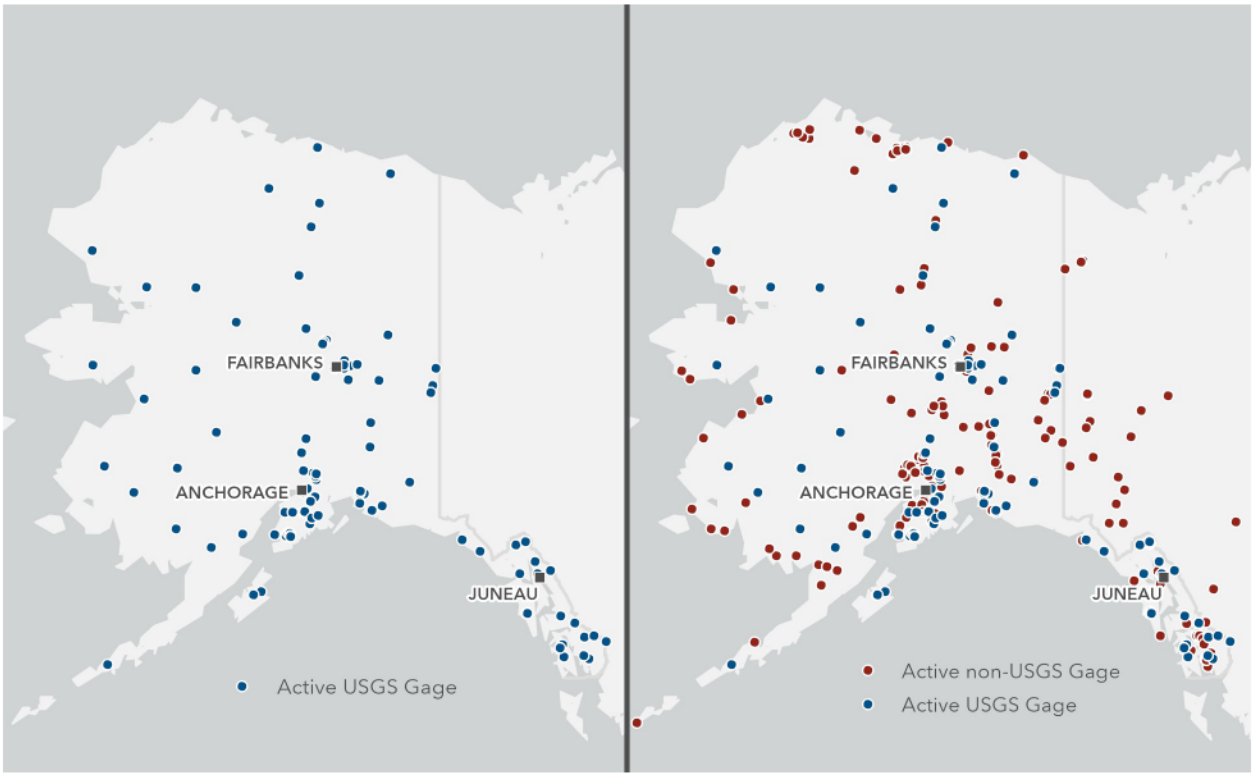


Figure 8: Comparison of all active USGS gages (left) and all active USGS and non-USGS gages (right) as of 2026.

IHCA and AKFlow

IHCA officially formed in 1977 and is made up of representatives from various state and federal stakeholders including the U.S. Geological Service, U.S. Fish and Wildlife Service, National Weather Service/Alaska Pacific River Forecast Center, U.S. Army Corps of Engineers, Alaska Department of Natural Resources, Alaska Department of Fish and Game, Bureau of Land Management, and the University of Alaska Anchorage (IHCA, 2025). Over the years, IHCA has filled various roles related to water resources within the State of Alaska, from acting as a

technical advisory committee to the Governor's Alaska Water Management Council to leading and coordinating efforts on the development of AKFlow (IHCA, 2025)

Before 2023, data for many active non-USGS gages was not publicly available due to either sharing constraints or poor metadata standards that prohibited valuable data transfer. IHCA saw the value in this data. Especially in areas of the State where USGS stream gage data is lacking, non-USGS gage data is of tremendous importance. However, one major hurdle is how to organize and standardize stream-gaging data from different organizations, collected with varying methods and standards. To tackle this, AKFlow was created as a partnership between IHCA and the University of Alaska Anchorage to fill the data gap by using a GIS to standardize stream gage data across the State, whether from USGS or other public or private sources (Figure 9). AKFlow has served as a tremendous resource within the State over the past few years and is a significant step towards building a publicly available, comprehensive stream-gaging dataset for the State. However, AKFlow has much room to grow, and questions remain to be addressed. How can we improve stream gage data standardization and make it accessible to all types of end-users, both technical

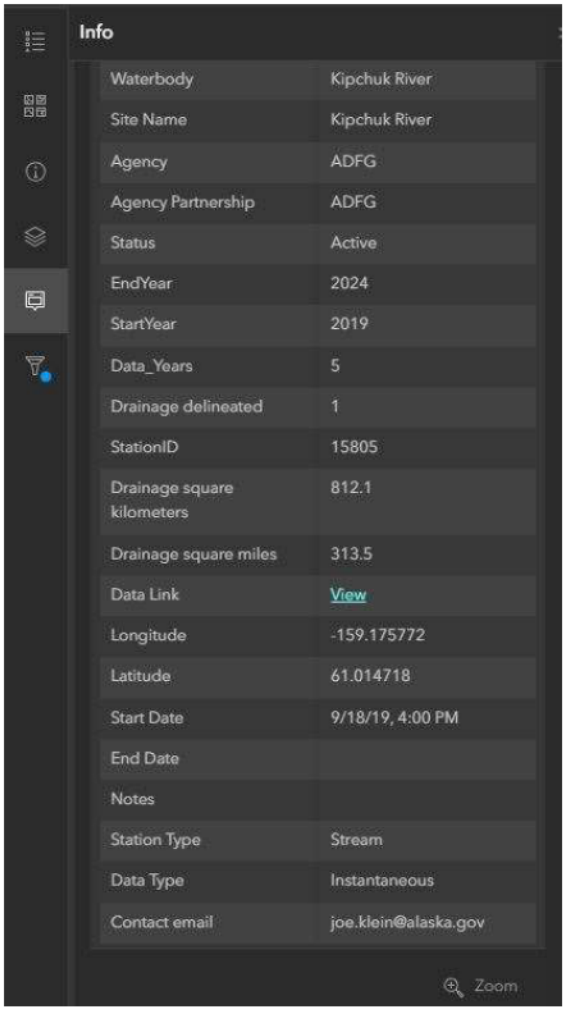


Figure 9: Example of tabular data from AKFlow web interface showing data for a non-USGS stream gage in northern Alaska.

and non-technical? Which gage data attributes are most critical? What areas of the State lack gage data? How can AKFlow tie into a mostly automated system that streamlines data population and attribution as new gages come online (or old gages become inactive)? The goal of my study is to help answer these questions and to provide an update on current efforts and the future direction of AKFlow.

CHAPTER TWO

METHODS

Overview

The goals of my project can be structured into three tiers (Figure 10). The first tier, data standardization, addresses the challenge of organizing the wide variety of data sources and formats into a single, easily digestible endpoint. Specifically, which attributes are worth carrying over from data shared by all participating agencies? The goal is to find a balance between providing enough information for end users to make informed decisions about the utility of the

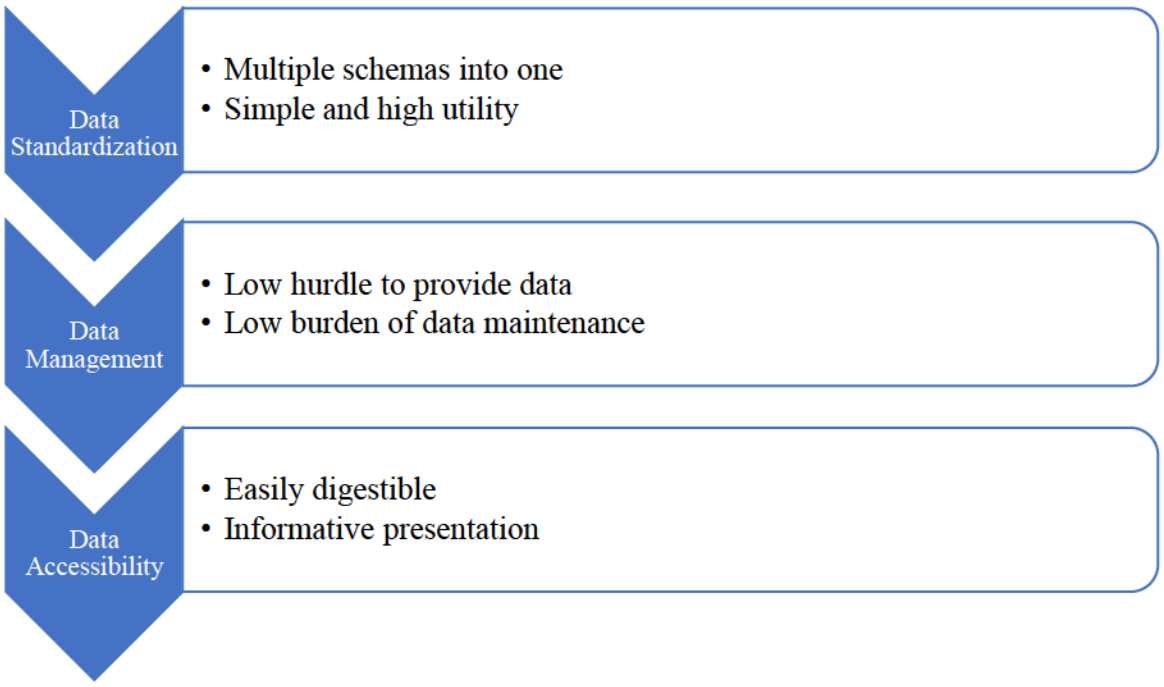


Figure 10: Three-tiered process for updating AKFlow.

data without overwhelming them with an excessive amount of attribute data or metadata. The second tier, data management, deals with the behind-the-scenes maintenance of the database and the management of updates as new data becomes available from both new and existing agency sources. This step is just as critical as the first; what good is a well-attributed dataset if it is not up to date? Lastly, the third tier, data accessibility, aims to improve the end-user experience with the dataset. How can we make the data accessible and usable across a wide range of users and end goals?

Data Standardization

Including the USGS, nine agencies currently contribute to the AKFlow Stream Gage Database (Table 1).

Table 1: Agencies actively contributing to AKFlow stream gage database as of May 2026.

Agency	Alaska Department of Fish and Game (ADFG)
	Alaska Department of Natural Resources (ADNR)
	Alaska Pacific River Forecast Center (APRFC)
	Bureau of Land Management (BLM)
	National Park Service (NPS)
	University of Alaska Fairbanks (UAF)
	United States Army Corps of Engineers (USACE)
	United States Fish & Wildlife Service (USFWS)
	United States Geological Service (USGS)

With a future goal of adding additional contributors, this stresses the need for a standardized list of attributes common to all agencies and gage types. Currently, each contributing agency has a wide array of stream gage attributes that fit their specific use cases. As the authoritative provider

of stream gage data for the country, the USGS strives to provide standardization across all their gage data. However, the level of detail and standardization required by the USGS is likely not economical nor feasible for many other stream gage purveyors. ADFG, for example, may have a stream gage installed for studying stream flows related to fish passage, while UAF may have a stream gage installed for a very specific research topic or use case. This is not to say that data from stream gages installed for a very specific use case is not useful for a wider array of applications. No matter the stream gage source or use intent, data related to stage height can be immensely useful to many practitioners. However, providing this data in a standardized format that allows key features to be compared is of utmost importance. Attributes such as stream gage type, the temporal scale of the data, and data quality are essential when determining whether the data is appropriate for a specific application.

The current list of data attributes included in the AKFlow database is shown in Table 2. While this data provides a strong foundation for comparing stream gage data across the State, there are a few areas that this project aims to improve.

Table 2: List of attributes currently used in AKFlow database.

Attribute
Waterbody
Site Name
Station ID
Latitude
Longitude
Agency
Agency Partner
Status
Start Year
End Year
Data Years
Data Link
Contact Email
Drainage
Drainage ID
Drainage Class
Drainage (sq kms)
Drainage (sq miles)
Notes

To identify and compile the list of additional attributes to include in the AKFlow database, initial coordination was conducted with agency members at IHCA meetings. These meetings resulted in a short list of key attributes to be included in the AKFlow database. I further refined these attributes by identifying associated domains (permissible values that can be entered into a field). This was primarily accomplished through follow-up coordination via email with key IHCA members. I drew additional input for these attributes from a similar collaborative project that aimed to collect information on active stream gages from non-USGS agencies in the Pacific Northwest (Kaiser et al., 2023).

Data Management

Once I finalized the standardized list of stream gage attributes, the next step was to determine how to provide efficient, effective access to the AKFlow database for seasonal updates. Each year, agencies install new gages, retire old ones, and make changes to existing ones. How can we efficiently track these changes when the agency data is collected and stored in different formats? Ultimately, my goal was to find a balance between providing the lowest 'hurdle' for data submittal by participating agencies while also reducing overhead burden on database managers. Through consultation with the IHCA Committee, I determined that two main routes would be appropriate. One route would aim to streamline the data update process by using existing technical tools familiar to most agency participants (ArcGIS Survey123). The second route would provide a simplified yet standardized data submittal process for non-technical collaborators using Microsoft Excel.

Data Accessibility

The final, and perhaps most critical project component, is ensuring the database is accessible and usable. AKFlow currently provides access to the database via a Web Mapping Service (WMS) and an ArcGIS Online Web Application. The WMS allows data users to view, query, and export the data in all commonly used online and desktop GIS software applications. The web application allows viewing data in both spatial and tabular formats while applying filters to narrow the data focus to a particular need. While these two basic data functionalities cover the majority of end users' data needs, the IHCA Committee requested a third option. Specifically, committee members wanted an interactive map that allows filtering by relevant spatial criteria, providing quick snapshots of what stream gaging looks like across the State within both natural and geopolitical boundaries. This could serve as a strong illustration of current data gaps in the State's stream gaging coverage and offer talking points for future gaging and funding opportunities. After discussion of various options, I selected an ArcGIS Dashboard as the most appropriate tool.

CHAPTER THREE

RESULTS

Data Standardization

A table of attributes I added to the AKFlow database as a result of this project is shown in Table 3. I distilled this list down from a greater pool of potential choices and ultimately chose this selection for its simplicity and utility. One attribute that did not make the list, but I seriously considered was whether the data had undergone Quality Control (QC). While the committee deemed it a very valuable metric, the gradations involved in determining whether something has been "QC'd" make it quite difficult to simplify this field to a simple yes-or-no. Most agencies discussed their QC processes and the differences between their processes and those of other agencies. Ultimately, it was decided to omit this metric. Combined with the original 19 dataset attributes, these five additions provide greater utility to the dataset, especially for discerning the nature of the collected data and whether it is appropriate for other uses.

Table 3: Attributes added to the AKFlow database.

Attribute	***Domain***
Measurement Type	Continuous
	Staff
	Crest Stage
	Other
Sensor Type	Pressure Transducer
	Bubbler
	Radar
	Ultrasonic
	Float
	Other
	N/A
Data Type	Unit (5-60 mins)
	Daily
	Monthly
	Annual
	Peak Only
	Discrete
	Other
Remote telemetry?	Yes
	No
Surveyed to datum?	Yes
	No

Measurement Type

Measurement Type refers simply to the type of stream gage in operation. While there are many more types of stream gages in operation across the State, the domain associated with this field covers most stream gage types, as indicated by IHCA partners. The goal with this field is to generally categorize the stream gage database without getting too detailed with the intricacies of different stream gage types. The chosen defined types: *continuous, staff, and crest stage,* are most pertinent to outside uses of the collected data. In other words, stream gages classified as *other* likely will not be as valuable to uses outside the intended use of the stream gage.

Sensor Type

Sensor Type is a conditional field applicable only to data classified as continuous measurements. As with the *measurement type* field, the domain options for *sensor type* are not all-inclusive. However, according to IHCA feedback, they cover the vast majority of sensor types currently in operation across Alaska. This field allows for a critical descriptor that explains how the gaging data is collected and can help inform data quality and potential additional uses for collected data.

Data Type

The *Data Type* field helps categorize the data by collection interval. These intervals range from time-unit measurements for continuously operating sites to discrete measurements for sites where data are collected intermittently. The time interval of collected stream gage data is critical to determining whether a dataset is useful for a given use case. This field allows users to determine whether the data collection granularity is adequate for a specific use. Data collected

intermittently in the summer months, for example, is unlikely to apply to a use case that requires a more complete hydrograph with data covering an entire water year.

Remote Telemetry

This field has a Boolean domain and indicates whether the stream gage site uses remote telemetry to push stream gage data to an online portal. Remote telemetry is often associated with stream gage sites that provide real-time data that is accessible via an online portal. This field, in combination with the Data Link field, allows end-users to quickly filter data to find sites that provide real-time data and share it on a public-facing portal.

Surveyed to Datum?

This field, with a Boolean domain, indicates whether the stream gage site has been associated with a known vertical datum. Stream gage stage height measurements alone are informative to an end user, particularly for comparing water surface elevations and/or discharge over time. However, to associate these measurements with other elevation data (e.g., ground-surface elevation), they must be tied to a known vertical datum. This is particularly relevant for uses such as surface water and/or flood studies, where the dataset must be adjusted to a relevant vertical datum that ties the water-surface elevation dataset from the stream gage data to the ground-elevation dataset used in the study. This field will allow water data users to filter the dataset based on whether the data can be associated with a known vertical datum.

Data Management

As discussed previously, the result of IHCA discussions on data management and upkeep was a two-tiered data input process that aims to reduce the burden on database managers while keeping the barrier to agency data contributions as low as possible. Input option one uses ArcGIS Survey123 to allow agencies to directly access and edit their gage database as it exists in AKFlow (Figure 11). With a provided ArcGIS login, agencies can view their existing stream gage records, edit previous records, and add new stream gage locations and associated tabular information. Users can submit a new record by entering data for all available fields and identifying a spatial location by either providing coordinates (latitude and longitude in decimal degrees) or clicking the provided map to locate the stream gage site. All fields in the database with domains are honored in Survey123, meaning users are limited to the domain options when editing that field. Conditional visibility is also used for the *sensor type* field, so it appears on the survey only when the "Continuous" measurement type is selected in the previous

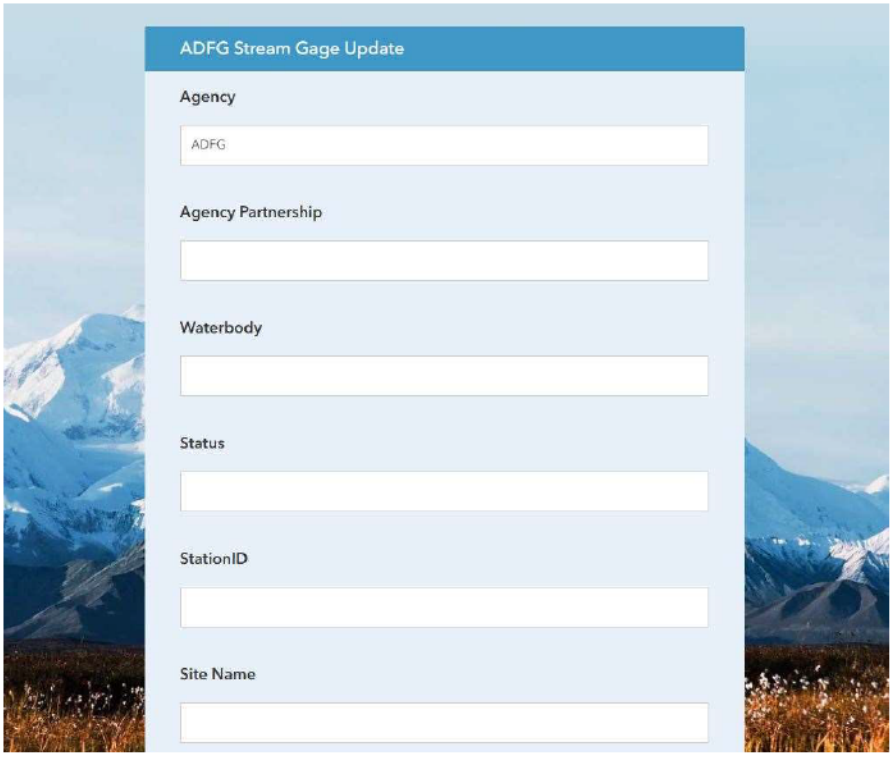


Figure 11: Snapshot of the Survey123 Stream gage update form.

question. If "Continuous" is not selected on the *measurement type* question, the *sensor type* field is automatically populated with "N/A," and the question stays hidden on the survey form.

The Survey123 interface also allows agencies to view their stream gage database on a map and query/filter the data based on *Station ID* to more efficiently identify stream gages that need to be updated. After agency updates are submitted, the database is automatically updated, and all referenced web maps and applications will automatically reflect any changes to the stream gage database.

Input option number two utilizes a Microsoft Excel template that organizes the AKFlow database schema in a tabular format. The Excel template has two tabs: a Gage Updates tab that agencies have edit access to, and an Attribute Overview tab that is sheet-protected in Excel to prevent any incidental editing. The attribute overview tab provides the entire database schema, including field names, field aliases, and domains. The Gage Updates tab is directly editable by agencies and allows editing existing stream gages and adding new gages. Critically, column titles are identical to the corresponding field names in the underlying feature layer, allowing for a streamlined data update process in later steps. Additionally, the data validation feature in Microsoft Excel is used for all fields that require domains. This means that cell values for those fields are restricted to the options in the associated domain, and a dropdown is shown when users click a cell in the column associated with that field. A GlobalIDs field is hidden in the spreadsheet and uneditable by agency viewers. This field provides a unique ID for all existing fields, enabling the updated Excel file to be related to the existing feature layer in ArcGIS Online. This is easily done using the Update Data function in ArcGIS Online or the Append tool in ArcGIS Pro desktop software. Using either of these tools, AKFlow database managers can

update the existing feature layer from the associated Excel template, enabling the creation of new features and edits to existing ones. Once the *Update Data* function completes (or the Append tool if using ArcGIS Pro), gage data is automatically updated in the AKFlow database and in all associated web maps and applications.

Additionally, I developed a Python script for AKFlow database managers as part of this update effort. The "Data Link" field is perhaps the most valuable in the AKFlow database, as it provides the link between AKFlow and the actual stream gaging data record. However, agencies often update their web services or change where data is stored, breaking the URL link within the AKFlow database. Finding and updating broken data links can be a tedious process for both agencies and database managers. To streamline this process, I designed the Python script to flag records in the AKFlow database with broken data links. These flagged links can then be highlighted during the agency update process so agency managers can easily identify which links need to be refreshed.

Data Accessibility

As a result of this project, I created an ArcGIS Dashboard (AKFlow Dashboard) to provide a clean end user interface for interacting with the stream gage database and to allow easy viewing of stream gage data across Alaska using custom spatial data filters. The Dashboard comprises a map, multiple filters, multiple indicators, and multiple graphs. The Dashboard allows users to filter stream gage data by both Borough/Census Area, HUC-4 watershed, and Active status (Figure 12). As filters are applied, the indicators, graphs, and map automatically

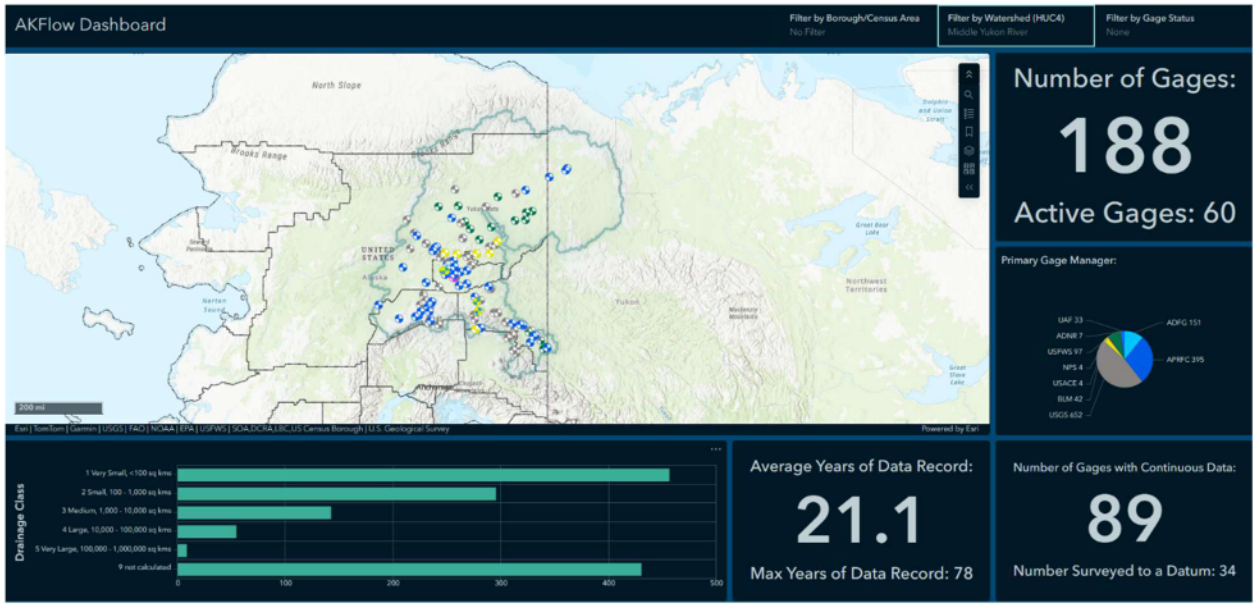


Figure 12a: ArcGIS Dashboard showing stream gage database filtered to the North Slope Borough in northern Alaska.

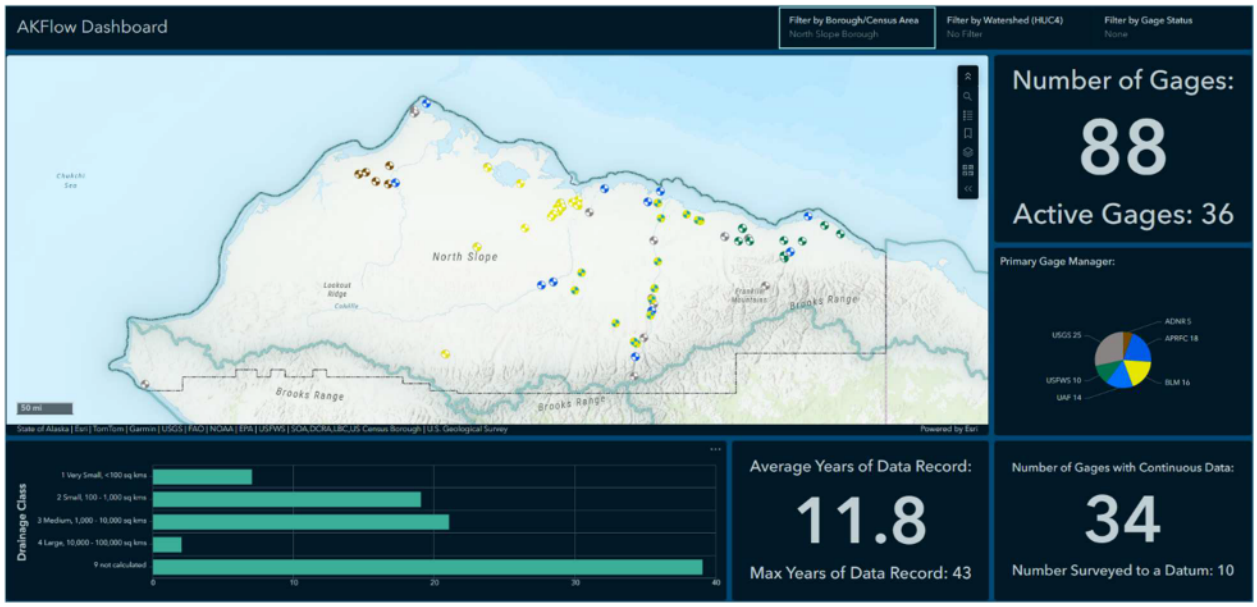
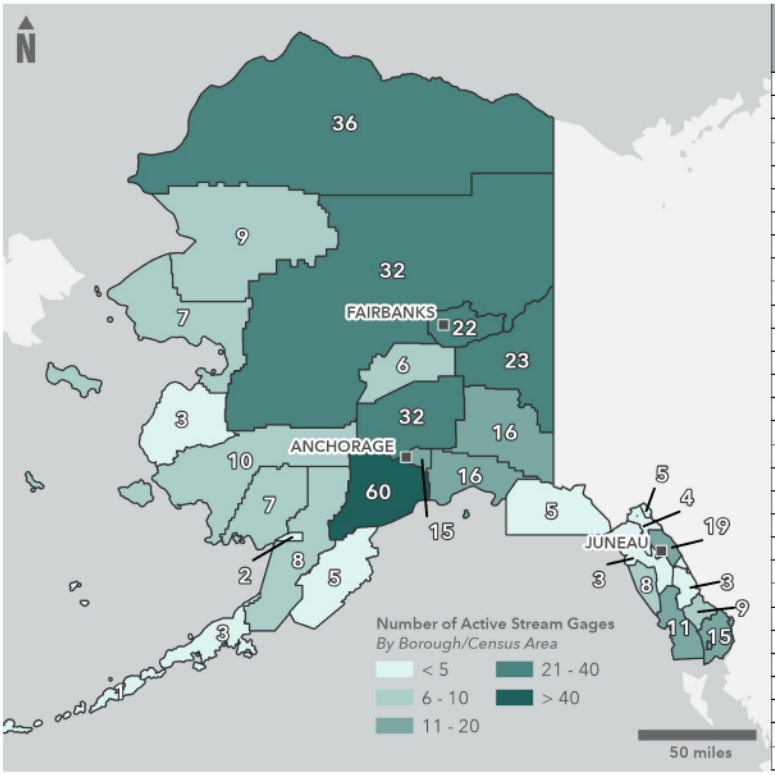


Figure 12b: ArcGIS Dashboard showing stream gage database filtered to the Middle Yukon HUC4 Watershed.

filter to provide snapshots of gage classification by agency, drainage class, measurement type, length of record, and the number of active and inactive gages within that geographical boundary and/or measurement type. Additionally, the map extent will zoom to show the extent of the

filtered geometry. Users can export the source data to CSV format, preserving all filters that were applied to the dataset. Critically, the Dashboard is fed directly from the AKFlow database (hosted feature layer), so any updates to the database via Excel and/or Survey123 will be immediately reflected in the Dashboard map and indicators. Additionally, the Dashboard integrates with the existing web application interface, enabling additional filtering and database querying. As previously mentioned, the updated database is also available as a web mapping service that can be accessed in both online and desktop GIS software or exported to other data formats.



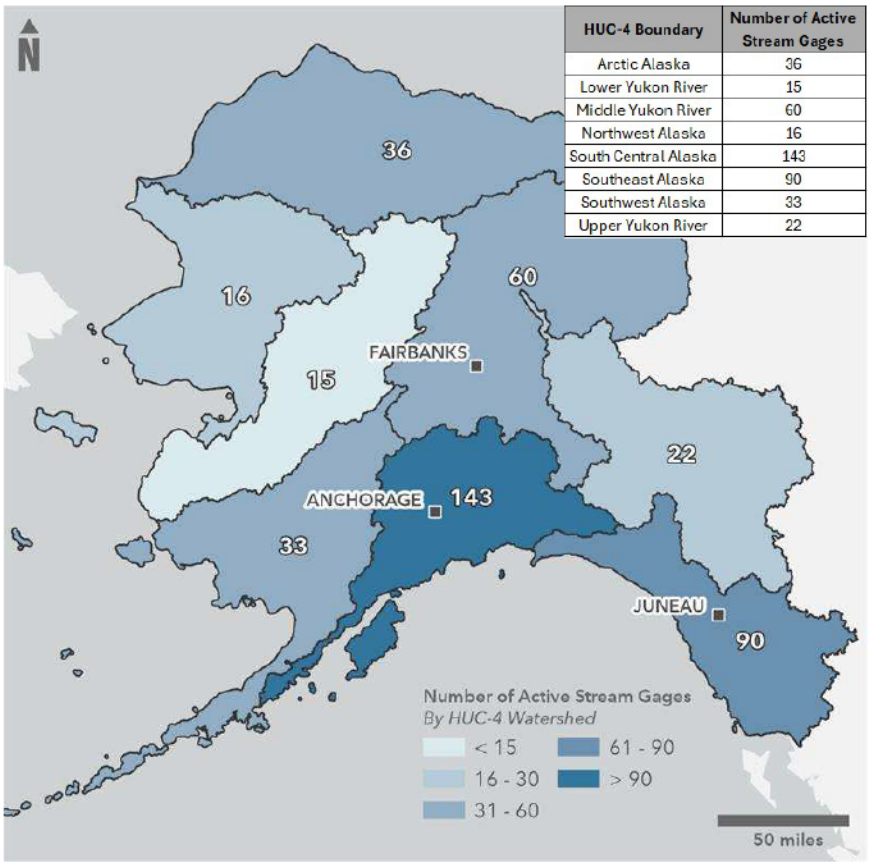
Borough/Census Area	Number of Active Stream Gages
Aleutians East Borough	3
Aleutians West Census Area	1
Bethel Census Area	10
Bristol Bay Borough	2
Chugach Census Area	16
City and Borough of Juneau	19
City and Borough of Sitka	8
City and Borough of Wrangell	9
City and Borough of Yakutat	5
Copper River Census Area	16
Denali Borough	6
Dillingham Census Area	7
Fairbanks North Star Borough	22
Haines Borough	4
Hoonah-Angoon Census Area	3
Kenai Peninsula Borough	60
Ketchikan Gateway Borough	15
Kodiak Island Borough	5
Kusilvak Census Area	3
Lake and Peninsula Borough	8
Matanuska-Susitna Borough	32
Municipality of Anchorage	15
Municipality of Skagway	5
Nome Census Area	7
North Slope Borough	36
Northwest Arctic Borough	9
Petersburg Borough	3
Prince of Wales-Hyder Census Area	11
Southeast Fairbanks Census Area	23
Yukon-Koyukuk Census Area	32

Figure 13: Number of active stream gages by Borough/Census Area.

Data Gap

The Dashboard allows quick, easy filtering of the database to show coverage across the State and help identify current data gaps. A breakdown of the current data picture across the State can be viewed by both geopolitical boundaries (Figure 13) and watershed boundaries (Figure

14). Notably, there appear to be fewer active stream gaging sites in Western Alaska and the Alaska Peninsula (Southwest Alaska) than in the rest of the State. This is in line with previous observations that stream gaging was particularly absent in the Arctic, Northwest, and Southwest regions of Alaska (Brabits, 1996). Areas near major population centers (Anchorage, Fairbanks, Southeast Alaska) appear to have a more robust stream gaging network. Ultimately, the Dashboard aims to enable agencies to provide quick snapshots of stream gage coverage across the State to support funding and additional stream gaging requests. Hopefully, this tool can be further refined as additional data from the new database attributes becomes available and will allow for showing the overall stream gage picture with a bit more detail.



HUC-4 Boundary	Number of Active Stream Gages
Arctic Alaska	36
Lower Yukon River	15
Middle Yukon River	60
Northwest Alaska	16
South Central Alaska	143
Southeast Alaska	90
Southwest Alaska	33
Upper Yukon River	22

Figure 14: Number of active stream gages by HUC-4 Watershed.

CHAPTER FOUR

DISCUSSION

AKFlow Update

This current update to AKFlow provides a critical enhancement that increases utility for Alaska's stream gaging network and highlights its overall deficiencies. This update allows for better data standardization across all gages with improved attribution to more clearly compare gage sites and data from different agencies and locations. Additionally, the streamlined data management functions will make it easier for agency partners to update their gage databases and reduce overall data processing for AKFlow data stewards in the future. Finally, the addition of the ArcGIS Dashboard, paired with the existing web application, provides a simple, clean interface for quickly visualizing and analyzing stream gage data across the state.

This update aligns with similar efforts across the country. In particular, a partnership between Boise State and the USGS recently surveyed 300 individuals and organizations involved with collecting streamflow data across the Pacific Northwest (Kaiser et al., 2023). They received responses from 29 organizations and identified 2,000 streamflow monitoring locations beyond the USGS monitoring network (723 streamflow gages as of 2023). As with AKFlow, this is a significant improvement over purely relying on USGS gages and shows the power of collaboration and accessibility of non-USGS gaging data. However, the authors of this project note the difficulties of compiling data from so many agencies in a consistent way. In this regard, AKFlow provides an improved framework for standardized data attribution, ensuring inter-agency consistency in water data across the State.

This update to AKFlow also mirrors broader national efforts to standardize water data. The Water Geoconnex Project is a national effort aiming to establish common metadata to link disparate water datasets and enable users to search data across data systems (Marston et al. 2022). This is essentially the same framework as AKFlow, but on a much broader scale, entailing numerous partners such as the USGS, Water Data Exchange (WaDE), Internet of Water (IoW), Consortium of Universities for the Advancement of Hydrologic Science, and the U.S. Environmental Protection Agency. The Water Geoconnex Project follows the Findable, Accessible, Interoperable, and Reusable (FAIR) principles to provide national-level water data integration (Wilkinson et al., 2016). FAIR provides a perfect framework for moving forward with AKFlow.

Limitations

While this effort presents a significant improvement to the AKFlow database, certain limitations do persist. For one, AKFlow is critically dependent on active agency participation. In its current state, AKFlow has benefited immensely from having active agency participants willing and able to update the database with their respective gages. However, the future success of AKFlow depends on these agencies continuing to do so and, hopefully, recruiting additional partners to contribute. Tools, such as the Excel template introduced in the current revisions to AKFlow, are an important step in maintaining a low hurdle for future data contributions, especially from less technical users.

It is also important to note that while AKFlow provides access to a wealth of stream gaging data across the State, this data comes with its own limitations. USGS stream gaging data

is held to a high standard and undergoes rigorous QC. The same likely cannot be said for water data from non-USGS sites, and in some cases, information about data quality and accuracy may be sparse. While AKFlow provides a valuable resource for accessing this data, further consideration and caution should be exercised when using it, depending on the intended use.

Future Direction

AKFlow is well-positioned to continue growing, enabling access to new gage sites as they come online. Continued outreach to non-IHCA individuals and agencies will hopefully help grow this resource in the future. With this goal in mind, a few potential efforts were considered for this update but were determined to be employed at a future date. These efforts include conducting a survey effort like the one conducted in the Pacific Northwest (Kaiser et al., 2023). This survey could cast a wider net to include other potential water data users and providers across the State and gather information not only on who is collecting water data within the State, but also on how that water data is being used. Additionally, it is intended for AKFlow to move to a more visible location with higher web traffic, the Alaska State Geoportal. The Geoportal, run by the Alaska DNR, is an authoritative source of GIS data across the State and provides a clean, accessible Hub for data hosting and access. It receives much more web traffic than where AKFlow is currently hosted (the University of Alaska Anchorage Conservation Science Portal). To support this move to the Alaska Geoportal, AKFlow could benefit from an ArcGIS StoryMap landing page. StoryMaps have become commonplace across both scientific and non-scientific communities and are a great tool for presenting data and information in an easily digestible format. The current Dashboard and web application can be embedded in the StoryMap, and critical information about the data sources and agency contacts can be provided. This would help

bridge the gap between data access and data quality, so end users can make informed decisions about where a particular dataset originated and how it was created. Additionally, a tailored Survey123 can be embedded within the StoryMap to gather feedback on how people are using AKFlow and what their water data needs are. This could provide valuable feedback on areas where AKFlow can continue to grow and serve as a valuable resource in the future.

CHAPTER FIVE

CONCLUSION

AKFlow continues to provide a valuable resource to users of water data across Alaska. It serves as a single gateway to all currently publicly available stream-gaging data in the State. The most recent updates make significant steps in increasing the utility of the data and aligning it with FAIR data principles. The next steps for AKFlow entail identifying ways to grow and expand the stream gage network through increased partner outreach and continuing to lower the hurdle to data sharing. Migrating the database to the Alaska State Geoportal will be an important first step in increasing exposure and access to the data. Additionally, national efforts like the Water Geoconnex Project and the Internet of Water continue to gain momentum, and IHCA and AKFlow should continue to explore ways to maintain data standards and structures that align with these efforts. With areas like the Pacific Northwest undertaking similar efforts to AKFlow, it would be wise to consider aligning non-USGS water data standards not just regionally but also nationally.

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