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Getting Started with Digital Transformation Using ArcGIS

A Guide for Small and Rural Water Utilities

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Getting Started with Digital Transformation Using ArcGIS

Executive Summary

Maps have always been essential to understanding and improving the delivery of safe, clean drinking water and reliable sewer and stormwater services. An early example you may be familiar with is the 1854 cholera outbreak in London. Then, Dr. John Snow used maps to trace the cholera source to the Broad Street pump, which enabled authorities to take the contaminated well out of service and stop the outbreak. Today, water utilities continue to use maps to meet a wide variety of challenges related to issues such as regulatory compliance, water quality, aging infrastructure, and the loss of staff members' expertise upon retirement.

Today, with modern advances in technology such as improved internet connectivity and more powerful mobile devices, digital mapping can be readily deployed at a utility and improve the efficiency of workflows across an organization. Despite the availability of all this technology, some small and rural water utilities continue to rely on paper maps and/or long out-of-date digital maps. This reliance makes it more difficult to overcome common industry challenges and costlier to operate, thus the need for digital transformation. The benefits of digital transformation are well-known—such as reducing operations costs, achieving more with less, making smarter asset management decisions, attaining better regulatory compliance, and having more satisfied customers.

Through this document, you will learn the following:

- How digital transformation benefits water utilities
- How to set up an ArcGIS® Online mapping portal to store and share asset information
- How to quickly stage a water utilitycentric geographic information system (GIS) at your organization
- How to add staff as users and assign appropriate privileges so that they can contribute to asset data and collaborate through maps and applications
- How GIS can be effectively utilized to resolve common business challenges

The steps outlined in this document are intended to act as a guide to assist you in achieving a successful implementation of ArcGIS Online and various water-specific configurations. Because every utility is a little bit different and ArcGIS is flexible enough to meet your specific needs, we offer this document and related solutions as a foundational starting point. Additional configuration may be necessary to achieve your organization's goals.

Guide to Digital Transformation

With technology advancements and well-documented best practices, there has never been a better time for your water utility to get started with digital transformation. This transformation and associated mapping capabilities are driven by geographic information system technology. GIS combines the physical locations of your assets with information about them. Together they reconstruct your real-world water distribution system in simple and accessible digital maps. Common terms in industry, such as "digital twin" and "smart water," refer to this representation of our world through a digital format. Information about valves, mains, and other assets are never more than a tap or a click away on a mobile device or computer.

This guide will help you create the following through a GIS framework: a system of record for storing and managing assets; a system of engagement for enabling access to asset information on any device at any time; and a system of insight for analyzing information and making smarter, more informed decisions about asset management.

In particular, this document is directed toward small utilities looking to establish GIS for the first time or modernize their GIS footprint. By implementing the [Water Distribution Data Management for ArcGIS Online](#) solution, you will host and share your GIS through ArcGIS Online, a software-as-a-service technology, making it web accessible and rapidly deployable.

If your utility has already embraced this digital transformation or is looking to increase functionality—such as the integration of advanced work order management solutions, or [ArcGIS Utility Network](#) to support tracing capabilities—please take a look at the [Water Distribution Data Management for ArcGIS Enterprise](#) solution.

Components

With a subscription to [ArcGIS Online](#), utilities can manage digital mapping content in the secure, cloud-based Esri® technology environment. Members of your organization can publish data in ArcGIS Online and create [web maps](#) and apps that can be shared with whoever needs them. Existing ArcGIS Desktop customers who are current with their maintenance are entitled to ArcGIS Online.

[ArcGIS Solutions for Water](#) is a collection of preconfigured maps and apps that enable common water utility workflows. ArcGIS Solutions for Water maps and apps are designed to be configurable and extensible to meet the unique needs of individual water utilities. They are freely available for water utilities to deploy on their licensed Esri software, and they are fully supported and maintained by Esri. New map and app configurations are continually being developed, and the source code is generally available for download.

ArcGIS Apps

ArcGIS includes several out-of-the-box applications that are designed to utilize web maps and provide additional functionality. Several apps are discussed throughout this guide. Below is a list of these apps with links to each product's description and online help documentation:

- [ArcGIS Pro](#)
- [ArcGIS Field Maps](#)
- [ArcGIS Survey123](#)
- [ArcGIS QuickCapture](#)
- [ArcGIS Web AppBuilder](#)
- [ArcGIS Experience Builder](#)
- [ArcGIS Dashboards](#)
- [ArcGIS InsightsSM](#)

Most notably, ArcGIS Pro is a desktop GIS application that is typically used by water utilities to edit data, perform sophisticated analysis, and create professional-looking maps. The rest of these apps are accessible through web browsers or natively on mobile devices, allowing all staff members of a utility—regardless of role—to have up-to-date information anywhere and anytime.

Seven Steps to Get Started

We have outlined seven steps to help you get started with digital transformation of water data, using ArcGIS. For a more in-depth perspective on the [Water Distribution Data Management for ArcGIS Online](#) solution, how it works, and the possibilities that it introduces out of the box, we encourage you to first review the ArcGIS StoryMapsSM story [Getting to Know Water Data Management for ArcGIS Online](#).

Step 1 Activate and Configure ArcGIS Online

Once your organization has purchased a subscription to ArcGIS Online, you or someone else in the organization will receive an email from Esri containing a subscription ID and a link to activate your subscription. Click the link in the email and follow the instructions.

During the process, you will be asked to provide a short name that will be used in the URL for your ArcGIS Online organizational account. It is important to choose an appropriate short name because it should not be changed later. A fitting short name may be as simple as your utility or organization name. You will also be asked to create the initial user login. This name cannot be changed. Be sure to check the box to enable Esri access during the user login creation. This will allow the user access to unlimited, self-paced training through [Esri Academy](#) to aid with learning about the latest Esri products.

Your ArcGIS Online home page serves as the destination for users in your organization to access maps and applications. Some users in your organization may only need viewing capabilities, while others may need to edit data or access maps and collect information from the field. Before you assign users to the organization's portal, you will want to choose the correct user type for everyone. For information, please review the [ArcGIS user types](#).

As you introduce maps and applications to your organization, it will become increasingly important to ensure that the right individuals have access to the appropriate information. This is achieved by assigning [roles and privileges](#). As a result, individual users will only be able to perform actions that you permit, such as editing data. Adding members to [groups](#) within your ArcGIS Online organizational account is another way to manage access and organize content. When placed in groups, staff will only see the content shared with that group. Arranging these groups to reflect the structure of teams at your utility makes your GIS more accessible and secure.

Step 2 Deploy the Water Distribution Data Management for ArcGIS Online Solution

A system of record for storing asset information is one of the most important components to effectively managing and maintaining a utility's assets. At its core, the system of record allows your organization to have one authoritative dataset of assets that anyone can refer to for the most up-to-date information. The Water Distribution Data Management for ArcGIS Online solution is used to map assets, edit data, see water system maps in the field and office, view asset reports, and collaborate with map notes.

Now that you have successfully initialized and configured your mapping portal, it's time to create some content. The work involved in the next steps depends on how much data you have and how much needs to be collected and edited.

This step will guide you through the process of publishing the hosted feature layers that will serve as the containers for your GIS data. These layers are designed to be a starting point and can be changed or added to over time. They will be used as the foundation for the web maps and applications that serve the users in your organization.

1. Go to the [Introduction to Water Distribution Data Management for ArcGIS Online](#) page and click the hyperlink, Deploy now. You will be asked to log in to your ArcGIS Online organizational account.
2. Follow the instructions provided.

Once you have deployed the solution, you should take some time to examine and understand the data model in order to decide if you need additional configuration (additional fields, tables, and/or domains) to support your organization's needs. These layers can be found on your Contents tab in ArcGIS Online. The [data dictionary](#) for the Water Distribution Data Management for ArcGIS Online solution can be found in the Configure section of the documentation to help you explore the provided datasets.

Solution Contents

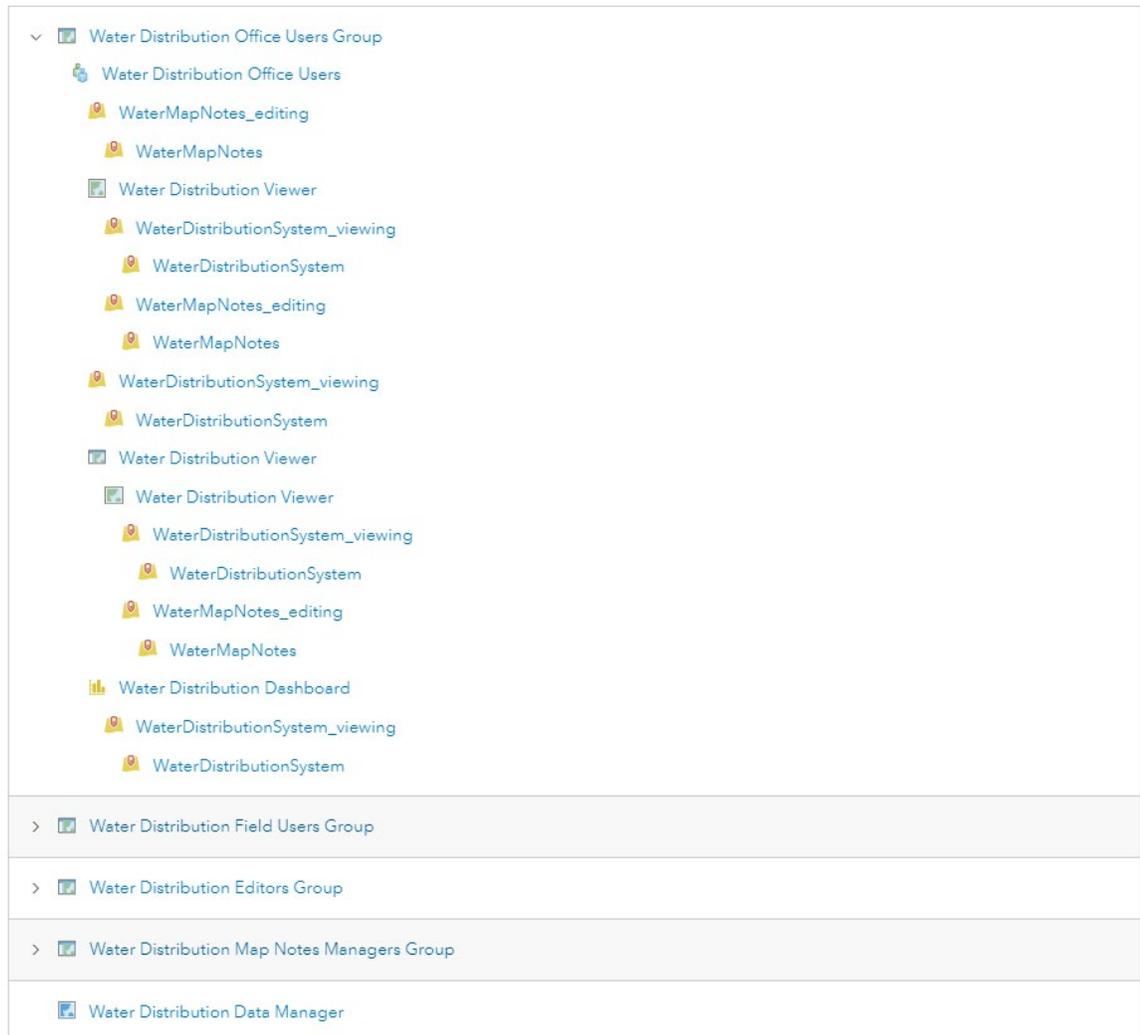


Figure 1. Once the solution has been deployed, take a look through the different apps provided under Solution Contents to understand how the layers provided are used and distributed.

If you would like to make changes to any of the layers within the data model, the most efficient way to do this is through ArcGIS Online:

1. Browse to find the layer you wish to change.
2. Click the Data tab and choose the layer you wish to examine.
3. Toggle the fields to display field names.
4. Click a field name to view the settings and the list of domain values. Here you can also edit the settings and list of values. (Note—it is strongly recommended that you do not delete fields or domain values.)

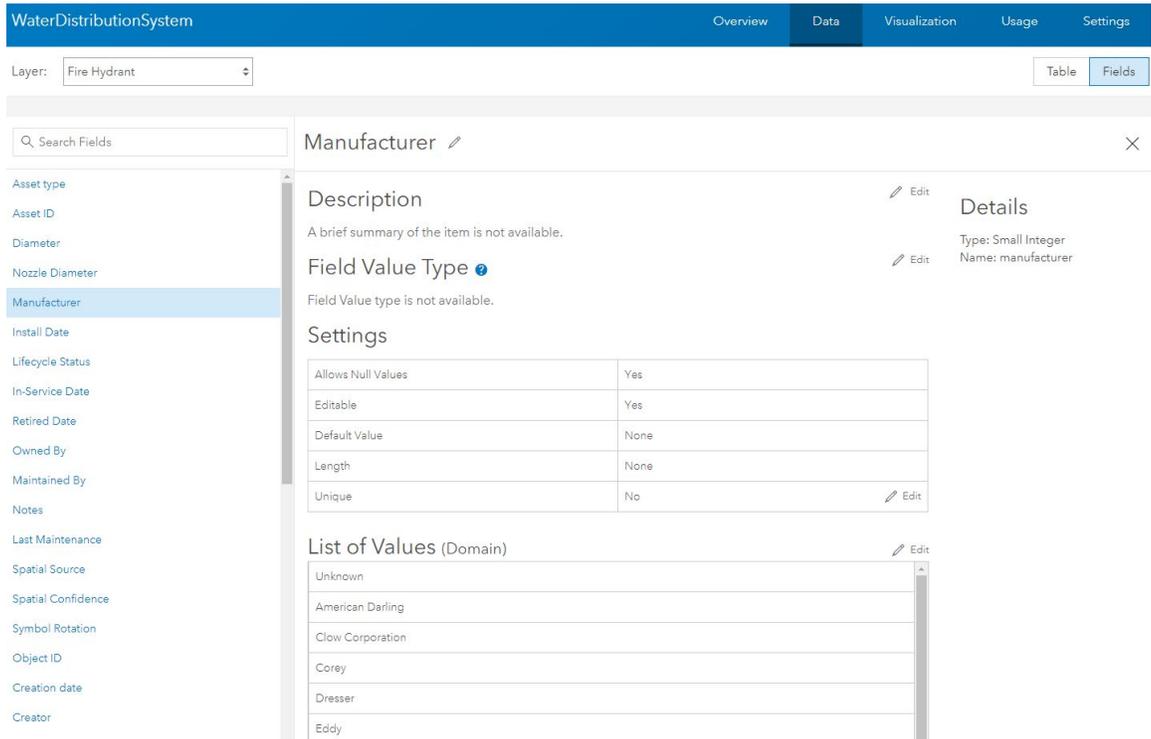


Figure 2. Use ArcGIS Online to add and configure attribute fields and domains.

Another way to make changes to the provided data model is to download hosted feature layer items from the Water Distribution Data Management solution from your ArcGIS Online organizational account. Changes can be made to the schema and layers can be republished using ArcGIS Pro. Please note that you should avoid making changes to layer names and attribute fields or deleting fields, as maps included in the solution may no longer work as a result. Adding fields and relationship classes to support additional workflows such as inspections is generally okay. Depending on your experience level and the extent to which you wish to alter the schema, it may be faster and easier for Esri Professional Services or a qualified Esri partner to assist with your specific configuration changes.

Once you are familiar with the data model structure and have made any changes or additions, you should load data into the corresponding layers. Your organization may have several types of data that contain information about the assets you can load into ArcGIS. Here are some common data types:

- Geodatabases
- Shapefiles
- CAD files
- CSV files or spreadsheets

Your choice of process may depend on the type of data you wish to load into ArcGIS. The preferred method for loading data from a geodatabase or shapefile

is to use the [Append](#) tool. Alternatively, you can use the [data loading tools](#). The data loading tools help you map sources and target datasets to pull data from your existing geodatabases into the Water Distribution Data Management solution's datasets. If your data currently resides in spreadsheets, CSV or CAD files, or another format, other tools such as the [ArcGIS Data Interoperability extension](#) may be better suited. In that case, you should consult with Esri or a qualified Esri partner for assistance with loading data.

Below are some additional methodologies and tools for loading data into ArcGIS:

- [Copy and paste](#)
- [Update data \(ArcGIS Online\)](#)
- [Publish from a spreadsheet using ArcGIS Maps for Office](#)

It is likely that you will not have data for all layers and all fields that were published as part of the Water Distribution Data Management solution. In that case, it may be necessary to manually edit or collect features to populate the layers. You may not require all the layers, depending on your organization's needs. Field data collection will be covered in the next step. As you begin editing and enabling others in your organization to edit data, it will be important to ensure that you have assigned the appropriate user type and permissions. For information about editing and permissions, please visit the ArcGIS Online help sections on the topics listed below:

- [Adding members to groups](#)
- [Managing hosted feature layers](#)
- [Disabling editing](#)
- [Creating hosted feature layer views](#)

It is also possible that the data you have loaded or that has been edited contains errors. Errors can include assets that are misidentified or missing, are placed in the incorrect location, or contain only partial attribution information. The Water Distribution Data Management solution includes the Water Map Notes layer for capturing information errors. This layer is included in Water Distribution Viewer, Water Distribution Editor, and Water Distribution Map Notes Manager maps and applications.

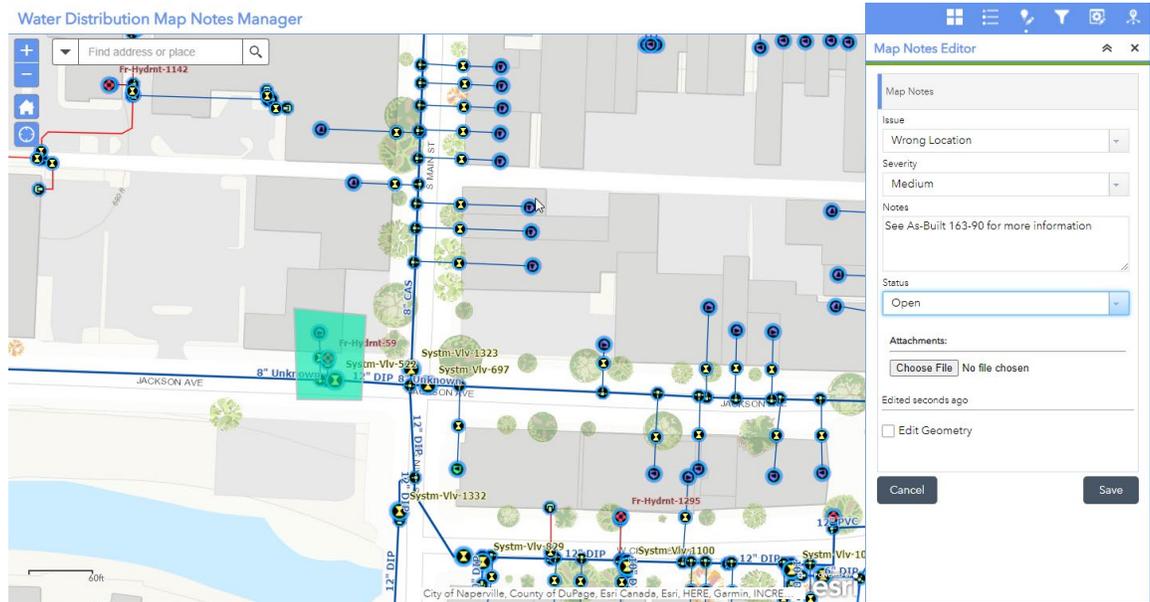


Figure 3. Water map notes allow field and office users to flag errors in your GIS data to ensure that your distribution system is accurately mapped.

The Water Distribution Map Notes Manager application also contains the Map Notes Editor widget for adding and editing issues in addition to viewing and querying assets. The Water Map Notes layer can easily be added to other maps and apps so that anyone using a map or accessing the data can report issues.

Step 3 Perform Data Collection Using ArcGIS Field Maps and ArcGIS Pro

If your asset inventory is not complete, it may be necessary to collect or manually digitize additional assets and information either by using a mobile device in the field or with desktop software.

The ArcGIS Field Maps application was designed with field data capture in mind. Mobile devices can be connected to high-accuracy GPS receivers to improve the positional accuracy of asset data. The Water Distribution Data Management solution includes GPS metadata and z-values. If you create layers outside the Water Distribution Data Management solution, it is recommended that you add GPS metadata fields and z-values to these layers.

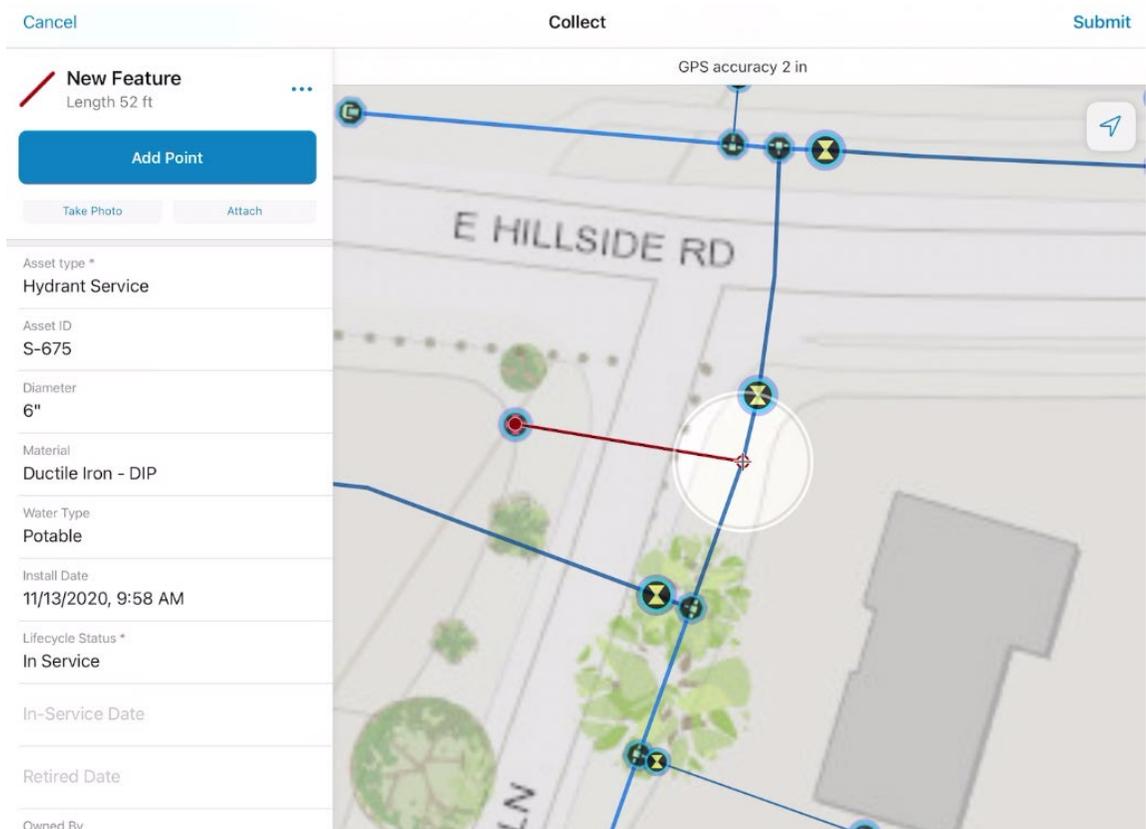


Figure 4. ArcGIS Field Maps lets users collect field assets in just a few taps and with high accuracy.

The Water Distribution Data Management solution includes web maps that can be used with the Field Maps app for [data collection](#). Depending on your organization's needs, you may want to create additional maps. Some utilities prefer maps that are used to collect every asset, and some prefer to have maps representing only individual asset types (valve map, hydrant map, etc.). The choice is yours, based on your operational needs.

Some considerations for field data collection include the following:

- Configuring which layers and fields should be editable (This can be accomplished by setting properties within the web map or, alternatively, by creating a hosted layer view. The Water Distribution Data Management template contains noneditable views for all layers.)
- Learning how to take web maps offline
- Preparing maps for [download](#)

The process for connecting a high-accuracy device to Field Maps may depend on your device's OS and the Global Navigation Satellite System (GNSS) receiver. Resources for learning about high-accuracy data collection can be found in the ArcGIS Field Maps help sections on the topics listed below:

- [High-accuracy receivers](#)

- [High-accuracy GPS](#)

ArcGIS Pro connects to your data stored in ArcGIS Online. As data is collected in the field, it can be seen on your computer, and as edits are made in the office, they are visible to those out in the field. The Water Distribution Data Management solution comes with a preconfigured [ArcGIS Pro project](#) template that is ready to be used to expedite data entry.

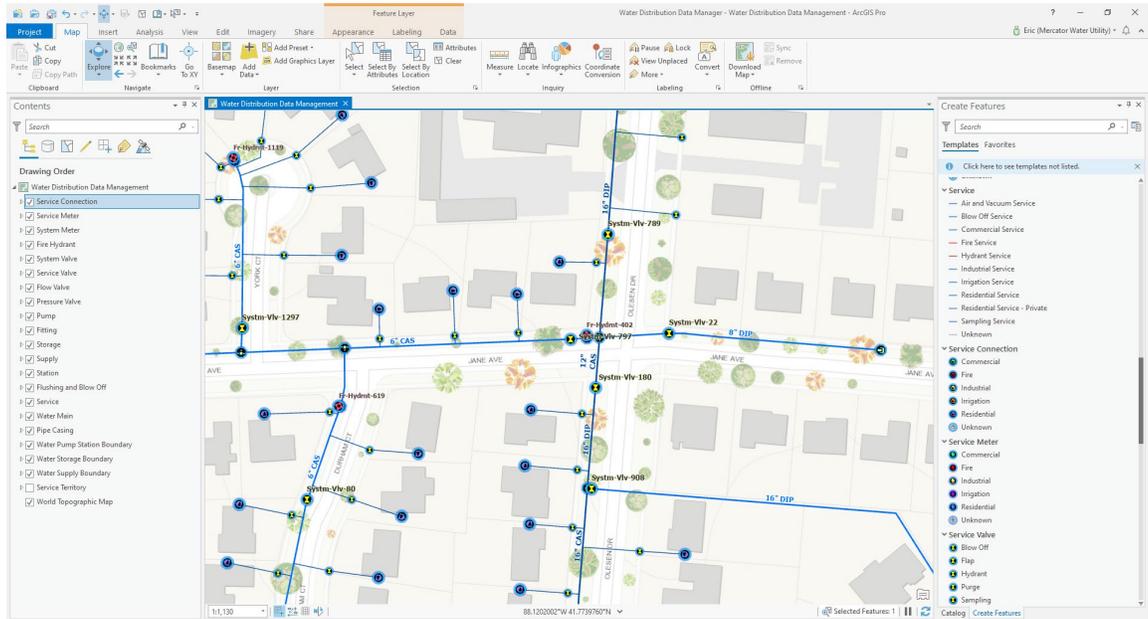


Figure 5. The ArcGIS Pro editing template, included with the Water Distribution Data Management solution, allows for precision editing to ensure that your utility's data is accurate.

Whether you are [digitizing new assets](#), tracing features from an [as-built drawing](#), or [editing map notes](#), ArcGIS Pro provides the precise tools needed to build and refine your system of record.

Creating and maintaining a system of record is only the start of the GIS journey, but many utilities, unfortunately, stop at this point. They set out to create a digital map and end there. However, ArcGIS software offers much more value than just the creation of digital maps. It enables everyone in an organization to access the information they need, from any device. ArcGIS Online is critical to the dissemination of information coming from the system of record. In the next steps, we will look at some ways to enable all staff at your utility to use apps and maps to help with daily operations.

Step 4 Empower the Utility through the System of Engagement

Creating the system of record is not the finish line but rather the beginning. It is critical that information finds its way into the hands of those who need it most, whether they work in the field or the office. This is what it means to have a system of engagement. Earlier, you saw how ArcGIS Field Maps and ArcGIS Pro can be used to collect and create data. The Water Distribution Data Management

solution comes with a number of viewing apps and maps that help users access, view, and explore this data.

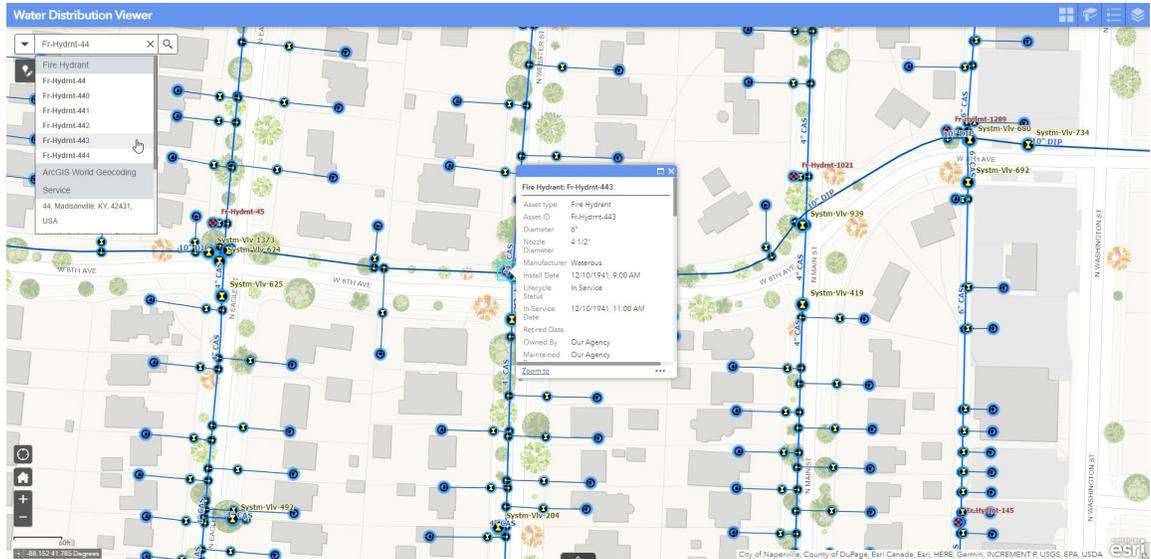


Figure 6. The Water Distribution Viewer app provides an interactive map of your system. As shown, it also comes with built-in locators to help you look up assets by their unique IDs.

For office workers, the web-based Water Distribution Viewer app allows access to your system of record in a nonediting environment. As data is created or collected by others, office staff—such as customer service representatives—can see assets of interest on a map. Additionally, this app comes with the ability to look up specific addresses or assets by their unique IDs.

For field crews or others using mobile devices, the same map is available in ArcGIS Field Maps. Water Distribution Mobile Viewer provides the same nonediting and asset search capabilities everywhere you go, whether you have an internet connection or not.

However, the system of engagement can be expanded upon to include more than these viewer maps. As you will see in the next section, engagement can take place through the use of dashboards to help users better understand key aspects of your utility at a glance.

Step 5 Monitor Progress

A key step in maintaining a system of record and engaging with others is to monitor progress. ArcGIS Dashboards is useful for bringing together information to ensure the success of projects. ArcGIS Dashboards is a web-based application that turns data into information that is easily understood and shared.

More information about creating dashboards can be found via the hyperlink below:

[ArcGIS Dashboards Help Documentation](#)

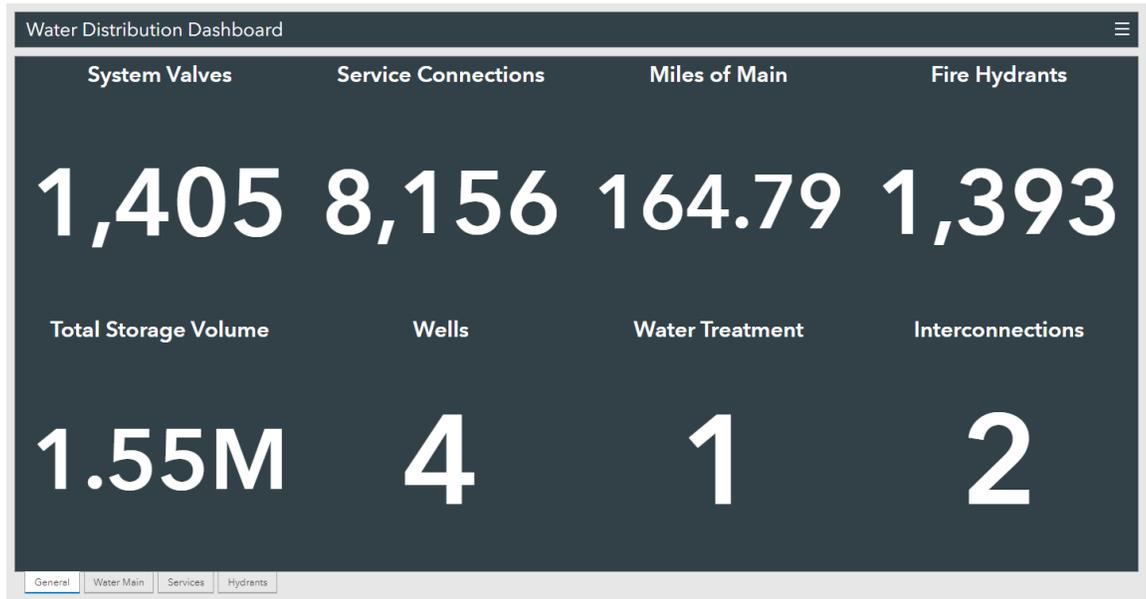


Figure 7. Water Distribution Dashboard comes with the Water Distribution Data Management solution and provides a quick snapshot of the entire system's assets. ArcGIS Dashboards can also be used to track work orders, inspection progress, and more.

Aside from collecting data and sharing it through apps such as a dashboard, ArcGIS can be used as an analytics technology. We commonly refer to this as the system of insight. A system of insight is perhaps the most powerful aspect of digital transformation. By creating a system of insight, you will be able to augment decision-making with rich analytics based on location intelligence and powerful visualizations. While the next section will focus on ArcGIS Insights, an excellent geospatial tool for GIS and non-GIS professionals alike, it is important to know that ArcGIS Pro supports advanced analytics as well.

Getting Started with Digital Transformation Using ArcGIS

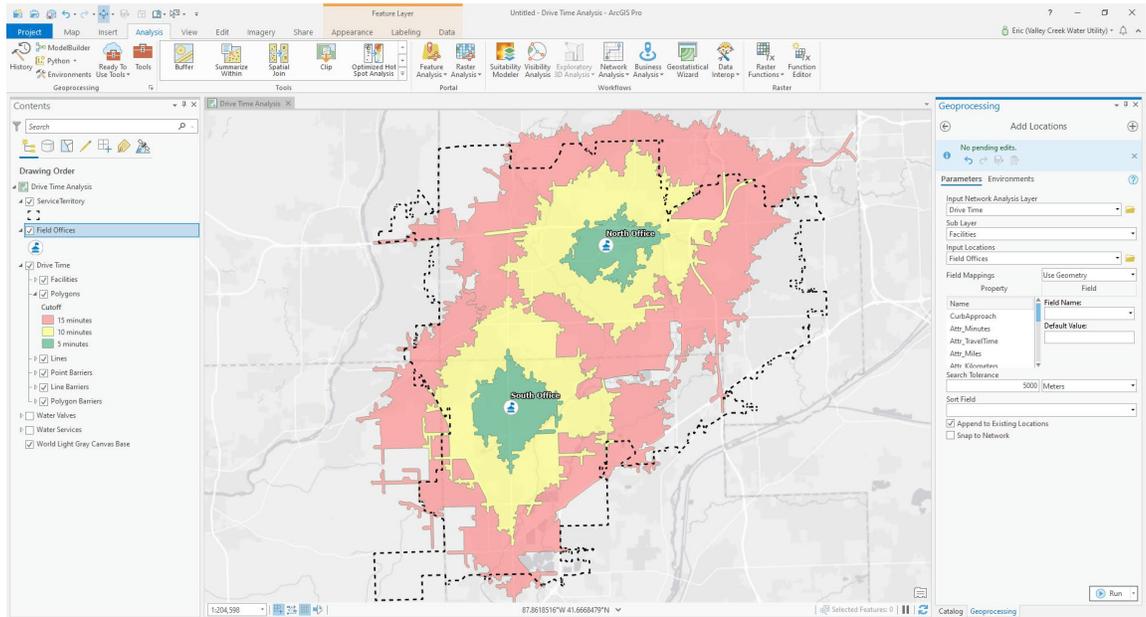


Figure 8. ArcGIS Pro does more than help you create and manage data. It is a full analytical technology to help you better understand your utility's data through a spatial lens.

Drive-time analyses, driving route optimization, spatial density, and time-based analyses are all possible and ready to be used out of the box with ArcGIS Pro. This helps you utilize your compiled data to make informed decisions around capital improvement projects, emergency response, and daily operations.

Step 6 Analyze Data Using ArcGIS Insights

ArcGIS Insights is a powerful application that enables you to visualize, explore, and analyze data. With Insights, you can connect to spatial data layers from your ArcGIS Online organizational account; spreadsheets containing asset information such as condition assessment or previous work history; or the thousands of data layers, like demographics and soils, from Esri's [ArcGIS Living Atlas of the World](#). Insights enables you to assemble information through workbooks, pages, and cards and is a powerful tool for identifying patterns and trends in your data. With Insights, you can begin to understand complex problems such as asset failure, water loss, billing inconsistencies, or conservation challenges. As you perform your analyses with Insights, the steps and tools you utilize are automatically recorded to help document your work and make it repeatable. Your final results can be shared via the web with internal stakeholders or sent out to the public if necessary. There are many [resources](#) to help you get started.

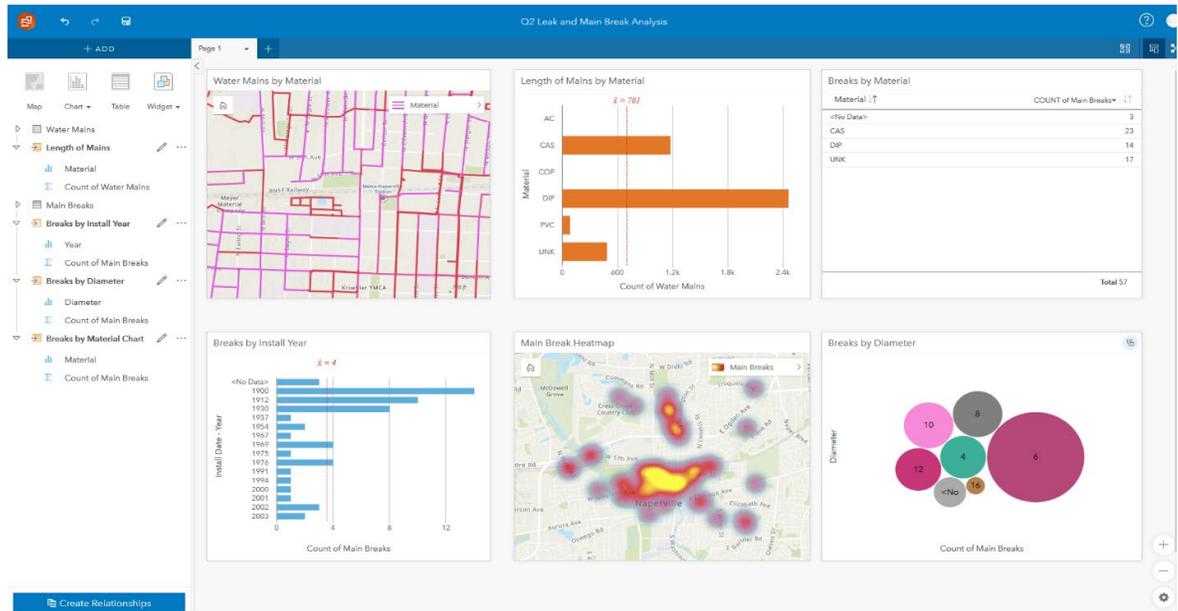


Figure 9. This sample ArcGIS Insights workbook displays water mains and breaks to highlight where leaks are occurring as well as the rate of occurrence by material, diameter, and age of pipe.

Step 7 Learn about Other Workflows

ArcGIS apps and [ArcGIS Solutions for Water](#) can be used in combination to satisfy a wide variety of workflows and business challenges. For example, the [ArcGIS Survey123](#) app can be used to replace paper forms with digital workflows and to send automated emails to employees or managers via [webhooks](#). The [Water Outage](#) solution can be deployed for capturing leak information and creating water main break and service outage information and sharing it within an organization as well as with the public. Also, the [Lead Service Management](#) solution can be used to capture operational issues, such as lead service line replacement, to assist with safety concerns or government regulations. These are just a few examples of what is possible using ArcGIS apps and ArcGIS Solutions for Water.

HYDRANT FLUSHING

2.5 Inch
 4.5 Inch
 6 Inch

Outlet Smooth and Rounded
 Outlet Square and Sharp
 Outlet Square and Projecting into Barrel

Pitot Pressure (Hydrant "A"): * 26
Static Pressure (Hydrant "B"): * 59

Residual Pressure (Hydrant "B"): * 44
Length of Flow Test (Minutes): * 1

Flow Rate (GPM): * 1433.8166771019983
Total Gallons Flushed: * 1433.8166771019983

ADDITIONAL COMMENTS:

Notes:

Photo:

Figure 10. Use ArcGIS Survey123 to create smart forms. This example of a hydrant flushing form automatically calculates the amount of water flushed, based on user inputs.

Summary

As utilities are asked to do more with less, advanced technologies can help soften the shortfall in resources by increasing the efficiency of field and office workflows. As shown in this document, ArcGIS software addresses these challenges through the systems of record, engagement, and insight. It enables you to manage, share, and analyze your assets from a geographic perspective. The seven steps provided in this document offer a path to quickly get started with GIS as the launchpad for digital transformation. Through these steps, you can see how out-of-the-box solutions broadly establish your GIS foundation but also can be adjusted to meet your specific needs and requirements. With ArcGIS, even the smallest or most rural water systems can benefit from embracing modern technologies and digital transformation.

Additional Resources

While this guide is intended to act as a starting point for your utility's digital transformation journey using GIS, there remain a wealth of additional resources beyond this document that can help you find success. [Esri Academy](#) provides

access to self-led and instructor-led courses to help you expand and refine your GIS skill set. [Esri Professional Services](#) offers consulting services, enabling you to get your GIS implemented quickly while providing knowledge transfer so that you can feel confident running and maintaining your own system. [Esri technical support](#) experts are ready to address any question or issue related to ArcGIS software. Finally, as an ArcGIS subscriber, you are part of Esri's global user community, [GeoNet](#). As a member of this community, you are able to ask questions and learn from your peers. These resources offer multiple avenues for GIS advancement at your utility.

If your work also entails the management of sewer assets, please look into the [Sewer Data Management for ArcGIS Online solution](#). It contains maps, apps, and datasets focused on the wastewater industry. To learn more, please see the StoryMaps story [Getting to Know Sewer Data Management for ArcGIS Online](#).



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