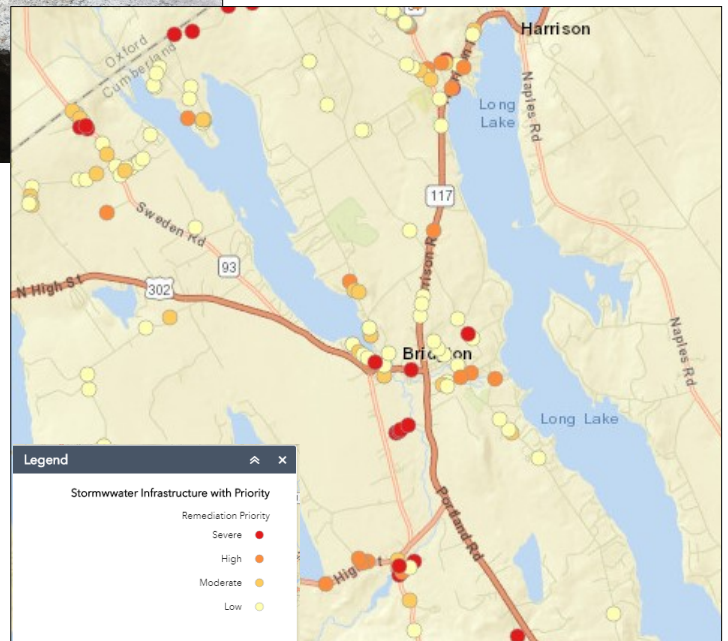
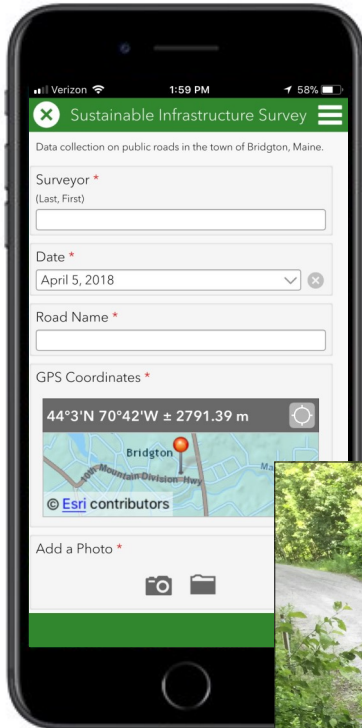


Smartphone Surveying Guide

With a Step-by-step Instruction for
Creating a Survey with Esri's Survey123



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Contents

Introduction	2
Background on Nonpoint Source Pollution	4
Project Purpose	5
Mobile Surveying	6
General Methodology	8
Applications	10
Safety	11
Choosing a Survey Product	11
Esri Products	12
Other Products	14
Bridgton Field Test	15
Survey123 Guide	
Step by Step Guide	20
Creating a Survey	20
Settings	38
Publishing your Survey	39
Sharing Your Survey	40
Collecting Data	42
Accessing Data	43
Data Through ArcGIS Online	44
Map Viewer	46
Editing Geographic Data	49
Creating Web Maps With Map Viewer	50
Editing Layer Styles	50
Sharing Your Web Map	52
Map Settings	53
Additional Resources	54

Introduction

Surveying is an essential part of many projects. Gathering current data allows managers to make informed decisions and direct resources appropriately. In contrast to the benefits, surveying is a time consuming and costly process. In our experience with watershed surveying, even a small pond could require hundreds of hours from dozens of volunteers to complete. Data then needs to be transcribed, corrected, and compiled in a usable format. We struggled to find the resources and time to do these surveys well. Fortunately, advancements in technology have allowed for a novel method of surveying with a mobile device.

The advent of cell phones and tablets has brought many advantages to mobile users. We can check email, send photos, and get GPS information from almost anywhere in the world. This same technology can be used to revolutionize the way we gather data. All the tools needed for surveying (camera, GPS device, paper forms, and maps) are conveniently available in smartphones. Software developers have taken advantage of these tools and have created applications that can perform complex surveys entirely through a mobile device. These new apps have pre-populated forms that can take GPS data and photos directly from the mobile device. Survey data can then be easily uploaded, and is immediately available to survey managers. No longer do managers have to collect paper forms and manually transcribe the information. This method saves hours of labor, and allows more resources to be spent on the project.

Traditional surveying techniques require paper forms, backpacks of gear, complicated methods, and transcription of data after collection in the field.



Mobile surveying is a powerful tool that can improve the efficacy and accuracy of nearly any project. However, the technology used can be complex, and be seen as a barrier to adopting these systems. This guide was created to help users learn about these new systems, walk them through the process of choosing a survey platform, and creating a survey. The first half of this guide talks about mobile surveying in broad terms: the benefits, different platforms, and our experience with them. The second part of this guide offers step-by-step instruction on creating your own mobile survey with Survey123. This section creates a survey specific to roadside erosion, however this guide can also be used as a learning tool. The detailed instructions teach you how to use Survey123 and simple maps. After completing this guide, you should be able to create your own survey specific to your goals.

This guide also chronicles the Lakes Environmental Association's (LEA) experience with mobile surveying. LEA is a environmental group focused on protecting water quality, and, like many other groups, had grappled with surveying strategies. Identifying erosion sites is crucial to preserving and protecting water quality, but traditional survey methods were time consuming. LEA took a bold step to field test mobile surveying in the summer of 2017, which ultimately culminated in the creation of this guide. The impetus, survey process, and the lessons learned are documented within.



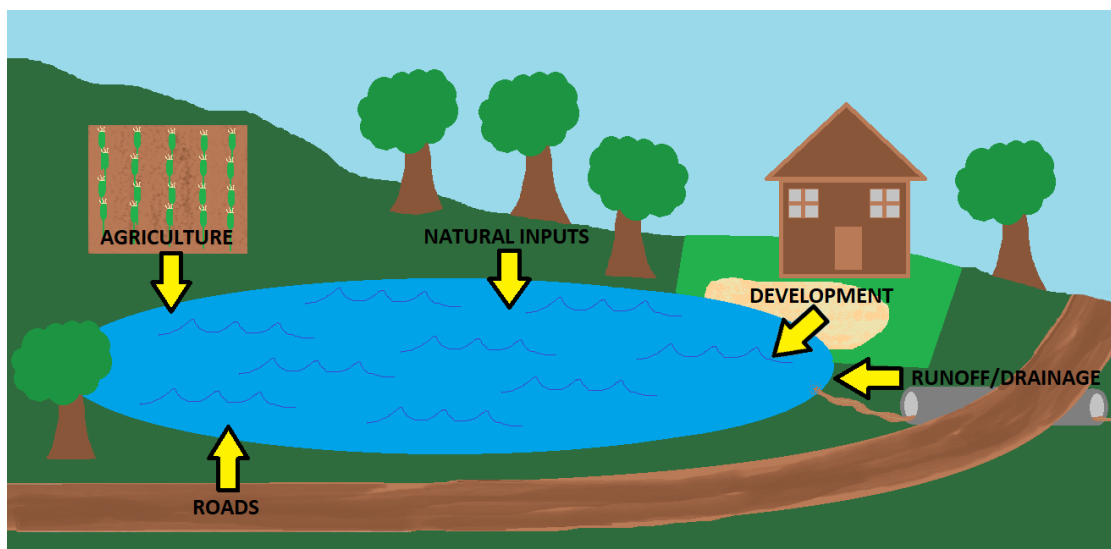
Mobile surveying is a modern approach to data collection. Fieldwork is simplified. All of the tools are available on your mobile device, and data is immediately stored electronically.

Background on Non-point Source Pollution

Across the country freshwater ecosystems are declining. Lakes, ponds, streams, and rivers are being negatively impacted by human-induced changes in land use. After the environmental movement of the 1970s, and the resulting legislation (e.g. Clean Water Act), the amount of industrial pollution reaching U.S. waters was reduced dramatically. However, non-point source (NPS) pollution, which includes pollutants that are diffuse but have a high cumulative impact, have not been nationally regulated. The major NPS pollutant is soil, and the nutrients contained within, like phosphorus and nitrogen. Phosphorus is the nutrient primarily responsible for algal growth in freshwater systems. Too much phosphorus, and algae grow so aggressively they turn the water the color and consistency of pea soup, a condition known as an algal bloom. This condition is all too common in the U.S., with hundreds of lakes blooming each year.

Preventing algal blooms and preserving water quality is usually done by preventing or correcting sources of non-point source pollution. NPS pollution is often soil loss from construction or excavation, farming practices, or improperly constructed roads. It also includes many residential sources such as turf erosion, erosion from driveways, or failing septic systems. Many other types of NPS pollution exist, this is merely a short list of commonly found problems.

Often, the first task when working on water quality projects is to identify NPS pollution sites within the watershed. The watershed is the geographic area which drains to the target waterbody. Depending on geography, watersheds can be very large. The more development within the watershed, the more NPS sites there are expected to be. Consequently, urban or suburban areas may have hundreds of NPS sites within a watershed. This exemplifies the idea of “death by a thousand cuts”. Each of these NPS sites, even if they only cause slight erosion and export of soil, end up affecting the waterbody, culminating in a large impact.



Project Purpose

Road systems and the ditches, culverts and water retention structures that comprise stormwater infrastructure are major contributors to nonpoint source pollution. The sheer size of road systems often make them a significant portion of land use within a watershed, and roads have a high potential to export phosphorus. When roads and stormwater infrastructure fail, the amount of sediment and nutrients exported to a waterway increases. Take a culvert for example, if the culvert becomes clogged, the stream may flood, causing the road to wash out and bring large volumes of soil into the waterway.

Maintaining proper stormwater systems is integral to water quality and safe driving conditions. However, roads are not always well maintained, as anyone who has driven through potholes knows. Unfortunately, this infrastructure is predicted to come under increased stress. Climate science shows that much of the U.S. will be experiencing increasingly intense precipitation events in the near future. Stormwater infrastructure can increase a community's resilience to a changing climate, but only if it is adequately sized and maintained.

Updating and maintaining infrastructure requires good data on current conditions, but surveys can be time and cost prohibitive. Current survey methods are cumbersome and require many tools. This project set out to create novel survey methods and decrease the cost of surveys using a smartphone

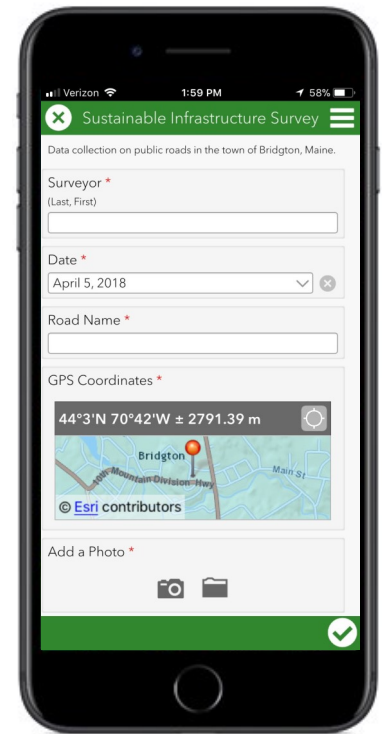


Stormwater infrastructure failures cause water quality problems: *Undersized culverts can lead to road washout, unsafe driving conditions, stream sedimentation, and phosphorus loading.*

Mobile Surveying

Traditional survey methods require a backpack of equipment and complicated field forms. This is a cumbersome, time consuming and costly way to get the vital data project managers need. Fortunately, advancements in the mobile phone industry have allowed detailed, technical surveys to be done with a mobile device. Surveying with a mobile device eliminates the need for additional equipment such as the form, GPS device, camera, calculator, etc., because they are already available right in the user's pocket. The surveys and tools are always available, giving them the ability to survey whenever necessary, without needing to pick up gear from the office.

The interactive nature of these survey forms is one of the great strengths of mobile surveying. The project manager has the ability to choose what information is shown to the user and when. You can explain the survey at the beginning, or display photos and/or diagrams critical to the survey. Additionally, managers can set parameters for questions, such as making questions mandatory, giving a certain number range, or defining a set of acceptable answers. This way, surveyors cannot forget to check a box or enter incompatible data.



“...nested questions reduce errors and speed data collection”

Many programs also have the ability to create ‘nested’ questions. These are questions that only appear when a certain answer is given to a previous question. In our survey, answering ‘culvert’ to the question “what are you surveying?” would result in follow-up questions only about culverts. However, if you answered ‘ditch’ then

a different, ditch-related set of questions appeared. Static survey forms can be long and complicated because they contain all possible questions, but digital surveys are able to direct the user only to pertinent questions. This ability to set parameters or create nested questions reduces errors and speeds data collection.

Compiling and editing data is incredibly simple with mobile surveys. Because the surveys are collected on mobile devices, the data is already transcribed into a digital format. There is no need to collect the paper forms and enter data into a computer. Data is also more secure. Forms can be lost or damaged, but the digital records are permanently stored in servers online. Survey data can be downloaded and viewed immediately, even in the midst of a survey. Viewing progress and initial results is easy with just a few

simple clicks. Data can be downloaded in standard formats, and manipulated in separate programs. With Esri's ArcOnline you can even view and edit data through a web browser.

Transitioning to surveying with a mobile device saves time and money by streamlining data collection and aggregation. Esri gives an example of a fire department's annual flammable brush survey. The process took three months, but was reduced to three weeks after implementing Collector*. Smartphones are designed to be portable, and most people already have a smartphone capable of running the apps used.

Advantages

- Simplicity
- Fewer errors
- Quicker
- Easily updated
- No data transcription
- Data immediately available
- Cost effective
- Mobile and always on hand
- Adaptable
- Great for volunteers
- Crowd-sourcing
- No other equipment necessary



Surveyors can quickly assess a site with the tool they always have available— their phone!

*Esri Training Seminar, ArcOnline: The Mapping Platform for Your Organization. <https://www.esri.com/training/catalog/57eb2d17ee85c0f5204be816/arcgis-online:-the-mapping-platform-for-your-organization/>

General Methodology

The methods of surveying will vary depending on the applications you use and the desired outcomes of the survey you are performing. Various survey products are reviewed in this guide, and detailed instructions for using Esri's Survey123 are described in the second half of this guide. Regardless, there are three main steps common to all mobile surveys: creating the survey, doing the fieldwork, and creating the output.

Creating a survey can vary from simple to complex. Many surveys can be administered through online platforms, but desktop programs offer additional features. This is the case with the Esri products where simple features are available through a user-friendly format online. Most users could create a survey through this process and accomplish their goals. More advanced features such as linking data, altering features, accessibility, default views, etc. are available through desktop programs. The features and options available give the user nearly endless ability to customize surveys.

Project managers should spend ample time creating their survey. An intuitive, well designed survey can take time to create, but reduces errors and time spent in the field. Testing the survey is also important. Work out the kinks in a survey before you give it to fieldworkers who may not have the same knowledge and insight you do. Changing a survey during a project may create incongruent data tables or leave data incomplete.

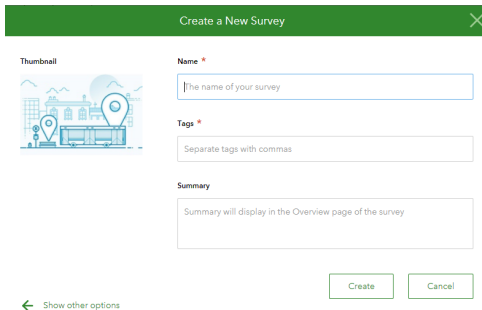
Before deploying, make sure the data collected is destined for the right location. Most products, such as Survey123 or Collector, will default to store the data online which can then be downloaded. Project managers can also choose who has access to the survey. Private access would only allow defined people with password protected accounts to access a survey. This would protect your data, ensure accuracy, and allow you to track productivity by user. Some programs such as Survey123 support public access which would allow anyone to submit data. This is great for volunteers, crowd sourcing, or citizen science initiatives.

Once the survey is set up, data collection will be a breeze. Surveyors only have to download the app and the specific survey, and head out into the field. Some of the apps offer a map that will give directions and show survey progress. A simple map of the survey area that surveyors can cross off and reference as they go is very helpful. Most mobile surveys also allow offline data collection, so

data can be collected even in remote areas. Simply select the location on a map where you are surveying. Data can then be uploaded when Wi-Fi is available to reduce mobile data usage. The only additional items our surveyors used were a tape measure to measure accurate length and a reflective safety vest.

After collecting the data in the field, the data will be available to download and manipulate. Data is available to be downloaded in standardized formats (Shapefile, CSV, KML, Excel, etc.). This data can be used like data from any other GPS device. You can edit and manipulate the files to produce maps or do analyses. Some products can visualize and host data online. Esri products can be viewed, edited and shared online. Another online option is to upload the data to Google Maps, where a custom map can be hosted for free. These online maps are interactive, and a great way to show the public or survey participants your work.

Survey Creation → Field Work → Create Output

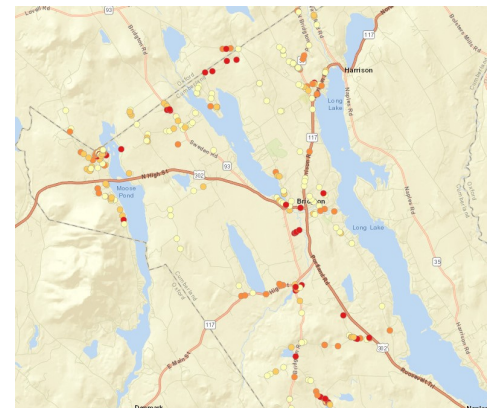


The screenshot shows a web form titled "Create a New Survey" with a green header bar. On the left is a "Thumbnail" icon of a surveyor. The form has three main sections: "Name" with a text input field and a red asterisk, "Tags" with a text input field and a red asterisk, and "Summary" with a text input field. Below the "Summary" field are "Create" and "Cancel" buttons. At the bottom left is a link that says "Show other options" with a left-pointing arrow.

1) Create a unique survey using the survey software.



2) Fieldworkers gather data from the interactive forms through their mobile device.

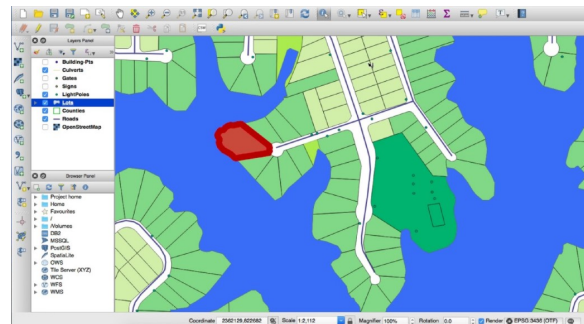


3) Compile data to create maps or graphs from the surveys.

Applications

Mobile surveying's potential applications are as vast as the imagination. Virtually any information gathering task can be replicated through a survey platform, and made faster and more efficient. This guide focuses on a survey of stormwater infrastructure sites, but this methodology could be expanded to a variety of applications. Surveys do not need to include location data to be used by these systems. Although, the ease of collecting GPS information through these products makes location data a useful augmentation to surveys that may have not used it before. Some potential applications are highlighted here:

Infrastructure Survey: Mapping and rating road infrastructure such as ditches and culverts based on their maintenance and efficacy.



Clean Water Act Section 319: Locating non-point source pollution sites within a watershed and rating sites for erosion severity.

Algae monitoring: Citizen science initiative to monitor algae blooms. GPS locate survey sites and rate level of algae growth.



Population/census: Population surveys can be aided by using built-in maps to locate houses or sites, and link to housing data.

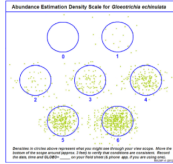
Time of Observation*

Gloeo Visual Aid Scale Rating*

Choose the number from the scale that best matches current conditions. You can use decimals if you must (e.g., 1.5)

It's an invalid answer

Abundance Estimation Density Scale for Gloeotricha aestivata



Abundance Estimation Density Scale for Gloeotricha aestivata

Did you use a view scope to help you determine Gloeo density?*

☐ Yes

☐ No

Safety

The importance of safety cannot be overstated. Surveys are inherently dangerous due to their often remote locations and proximity to roadways. Furthermore, using mobile devices can exacerbate the risk near roads. Surveyors have a tendency to look down or at their phone while surveying. Even more problematic, they may be looking at their mobile device while driving. Be sure to educate your surveyors to be aware of the risks involved, and develop safety standards for your survey.

Ensure your surveyors always stop their vehicles before working on their survey (it may also foul GPS data if they are moving quickly). Make sure they are wearing reflective or highly visible gear. Be aware of where surveyors are working and when to expect them back. For our infrastructure survey, we had surveyors work in teams of two. This alleviated some of the driving danger by allowing one person to look for survey sites while the other was focused on driving. Having two people also provided another level of safety if one were to get hurt. Overall, safety of volunteers and workers must be a priority when planning a survey.



Choosing a survey product

There are a vast array of products and programs available that are capable of creating surveys on a mobile device. They vary greatly in price and the features they offer. Some of the more widely used programs are discussed but many others are available. When choosing a program, think about the goals of your survey and whether the features of the survey product can accomplish those goals. Also important are the resources available and your organization's current GIS use. Our survey had great success with the Esri products, and we focus on these. Some platforms outside of the Esri suite of software are also discussed.

Esri Products: Survey123 and Collector

As the maker of ArcGIS, Esri is the market leader in professional GIS services. Their products are widely used, and the software is the standard across many industries. Many of the organizations looking to do surveys already use this software, so adopting these products would be practical and straightforward for most users. This guide focuses on the Esri software because of its ubiquitous usage and versatile design.

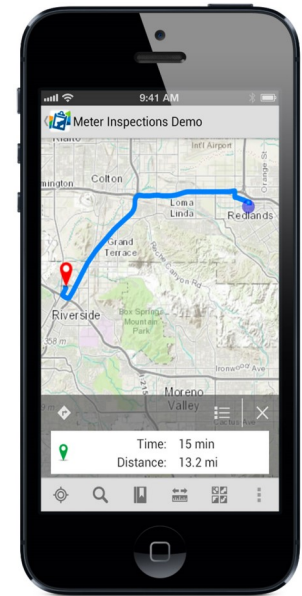
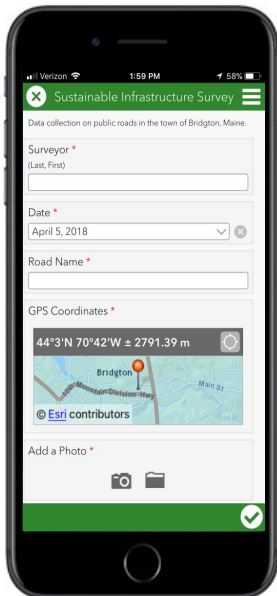
Esri offers two products that allow for data collection with a mobile device: Survey123 and Collector. Both of these products offer data collection with geolocation—where they differ is focus and accessibility. Survey123 is described by Esri as “form-centric”, meaning the form is the focus of the product. The survey is designed around the form, and a geolocation is one question among many types available in the form. Collector is “map-centric” in comparison. Opening a Collector survey brings you to a map view where users can add points, poly-lines, or edit existing features. The data for these products is stored on ArcGIS Online (or Arc Enterprise), and can be accessed through the online accounts.

Survey123’s form-centric design is great for projects with lots of questions or information. A wide variety of information can be entered through Survey123 including text, pictures, barcodes, and even signatures. Questions vary from a simple text answer to multiple choice, ranges, etc. Date, time, and geolocation are automatically generated when a survey is opened and submitted, but the user can input and manipulate these as well. Survey123 also has ‘nested’ questions that can be used to prompt additional questions after a specific answer to a previous question. This is great for shortening the survey, and leading the user directly to the questions that matter. Survey123 can also be accessed anonymously, so surveys can be distributed widely. This is perfect for crowd sourcing projects, or citizen science initiatives.

Collector, on the other hand, is focused around a map. The app automatically displays the user’s location on a customizable basemap. The map also displays features that the user can select to view data, edit, or create new features on the map. This is great for surveys where location is important and users are visiting defined sites. The app can give directions, and make field calculations about distance and area. Collector has a unique data structure that links multiple records together. This is great for field projects that go to the same location multiple times. A technician could visit a water quality monitoring site and click the site on the map. The site specific info would be pre-populated in the survey, and older data would be easily available. Survey123 does allow users to edit previous sites, but it does not link similar

locations the way Collector does. Collector does not support the wide variety of data input and question types that Survey123 offers. You can upload unlimited photos with Collector, as compared to just one with Survey123. Collector requires a named user for access, so volunteers or crowd sourcing is less possible with this product.

The subscription costs required to use Esri products can be quite expensive (multiple thousands of dollars). Users should also be aware that the online services these products rely on use “service credits” that the organization has to purchase. The more usage, the more credits consumed, and the higher the costs. However, there are also non-profit rates that are very affordable.



Survey 123

Form-centric

Point data only

Nested questions

Can edit past surveys

All responses stored uniformly

Allows public access

Collector

Map-centric

Points, lines and polygons

Edit map data in field

Easily edit past surveys

Links data at same site

Requires Esri account to upload

Other Products

Paid Products: Fulcrum, Mappt, among others

Both of these products are professionally made, reliable services. They are accessible and user friendly. Similar to the Esri products, they have online form building and hosting of data. These products generally have a monthly fee to use, but can be much cheaper than buying the organizational Esri accounts with licensed users. There are many other products online, with new ones coming out all the time. Folcrum and Mappt are good options, but try these or others before committing. They may not offer all of the services you want. Switching to a new product mid-survey may be difficult or impossible. The different services store data in formats that may not be compatible with one another.



Free Products: EpiCollect, QGIS, Open Data Kit (ODK)

There are a variety of open-source, free GIS products available online. All of these listed are reputable, and have mobile versions capable of doing surveys with a smartphone. These are great options for projects with limited resources. Given their open-source nature, the software of these products can be altered to tailor the specific needs of your project. However, this can also be a downside. Project managers need to be technically adept to use these products and set up a survey. Minor coding skills are required to add many features to a survey. After setting up the survey app, the data collection is relatively straightforward.



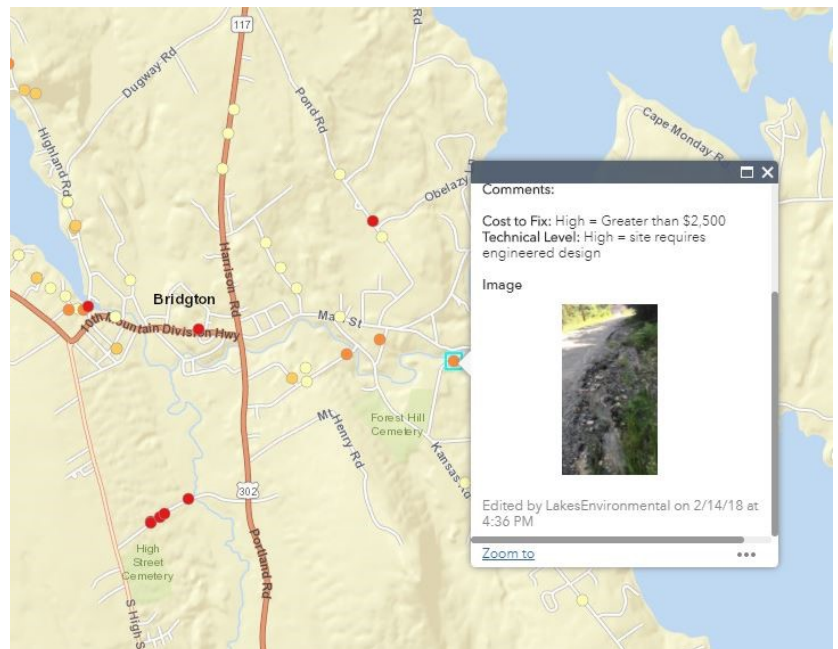
Bridgton, Maine Field Test

As part of this project, the Lakes Environmental Association implemented an intensive mobile survey pilot operation in order to test the methodology. For our survey, we used Survey123. We chose Survey123 because we had an Esri license and were already using their software to manage our GIS database. Adding Survey123 was a simple transition. Survey123 also seemed more user-friendly than Collector, which was attractive to us as novices to mobile surveying and GIS.

In accordance with the LEA's mission to protect water quality in Western Maine, we decided to survey public roads for erosion and failing stormwater infrastructure in the entire town of Bridgton. Stormwater infrastructure was defined as structures that transport or contain precipitation. The categories were culverts, ditches, road shoulders, bridges, and water detention structures. Improper installation or maintenance of these structures has serious consequences for water quality. Our goal was to identify problems along all of the public roads in the town, and then give that data to the Public Works Department in order to positively impact future road projects.



Field Test: Surveyors identified failing stormwater infrastructure such as this eroding roadside (left). These sites negatively effect water quality. The sites were then ranked based on severity and shown on a ArcGIS Online map through our website (below).



Survey123 offers two ways to create surveys: through their website, or through the Connect app. We used the website to create our survey. While initially this was quicker and easier, it caused problems when working with the data. The survey data is stored as text and responses were ‘choice 1’ or ‘choice 2’ instead of the answer selected in the survey which read ‘culvert’ or ‘ditch’. We were able to fix the data in Excel by using the ‘find and replace’ function for our survey. The web version is easier, but the simplicity comes with drawbacks. We recommend using the Connect app for surveys using more than a couple, simple questions. The second half of this guide demonstrates how to use the Connect app at length.

After setting up the survey, our interns and staff downloaded the Survey123 app to their phones. Then they signed in to the ArcGIS account to download the survey (you can also send a link to get access without an ArcGIS account). With the survey set up, fieldwork was relatively easy. Generally, teams of two would go out and either walk along the road or drive slowly to look for erosion sites. We used teams of two to ensure safety on and near the road, but only one person is required to survey. The only equipment we used in the field was an orange safety vest and a tape measure for accurate length measurements. Photos and GPS were taken on the phone through the survey. Surveyors did not need cellular network access to survey either. They could manually input GPS location (estimate based on general location), and then save the surveys to upload when Wi-Fi became available. We often did this to avoid overage charges for network data even if cell service was available.

Over the summer we tracked our progress by highlighting surveyed road sections on a large paper map. You can see survey sites by looking in the ‘sent’ or ‘outbox’ folders in the Survey123 app to track progress that way. However, we found the paper map to be more convenient and easier to understand than checking the map in the app.

After the field work was done we had collected 321 individual survey sites from over 70 roads. This effort took approximately 150 hours to find and survey all of these sites. The majority of that time was spent looking for sites. Each site could be surveyed in less than five minutes. Of the 321 sites, twenty-eight were removed due to errors in GPS data. If cellular data is poor or not available, GPS location could be wildly inaccurate. We learned this by reviewing the data early in the survey process, and instructed our surveyors to manually check the survey data for accuracy after. Because location



Our paper tracking method highlighting roads versus the Outbox in Survey123.

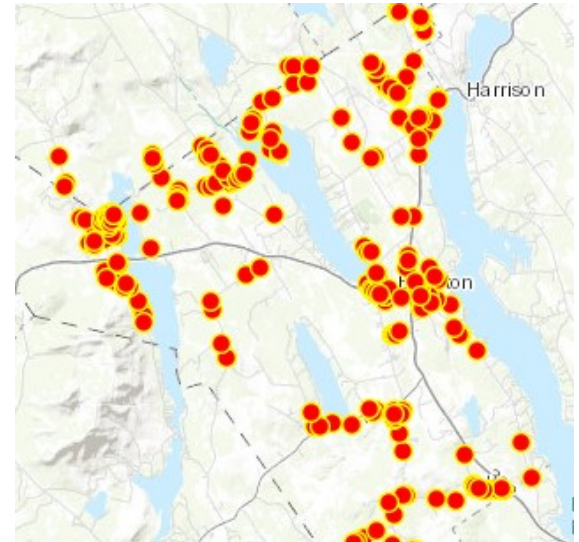
information is so important, these data points had to be removed. The whole road would need to be re-surveyed to find the specific culvert if not other location information is given. It is important to train your fieldworkers to be aware of these aspects of the survey, as well as how to do the survey itself.

With the fieldwork done, you can view the data on the Survey123 website (survey123.arcgis.com) in map or spreadsheet form. Often this data can be unwieldy or overwhelming in this form. Luckily, Survey123 offers some helpful ways to look at the data without doing any additional work. There are premade graphs and graphics under the 'Analyze' tab on the website to gain insights into your data. The data can also be downloaded to Excel, ArcGIS desktop or other GIS software. With access to Survey123 comes ArcGIS Online (www.arcgis.com), a web version of Esri's GIS desktop software.

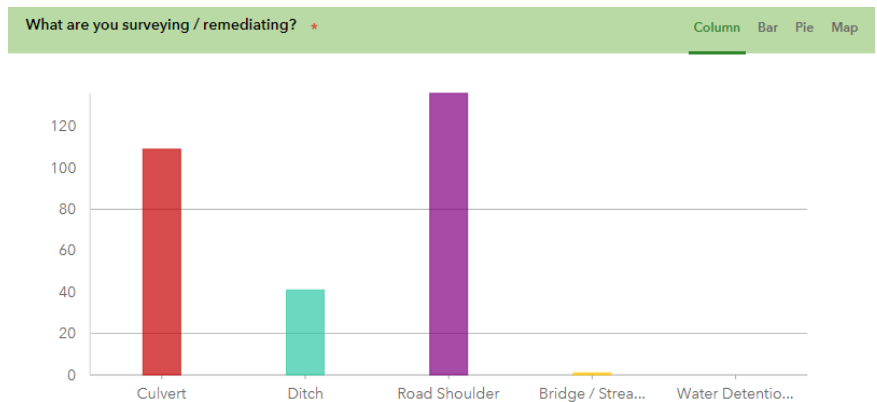
Most of the powerful tools available on the desktop version can be done directly though a web browser. Survey123 automatically stores survey data in ArcGIS Online to view, edit and create maps. We used ArcGIS Online to create a simple map that allows users to see pictures and information of the erosion sites when they click the site on a map.

Creating a map in ArcGIS Online is a relatively simple process. You need to open the 'Map Viewer' app from the website. Then you add the data layers you want to display. In our case we displayed the survey data layer that was already created by creating our survey with Survey123. We displayed this over a basic road basemap. You can then edit the layer settings to change the colors, size, image, etc., of the graphics in the layer. When changing layer settings be aware of how the data was stored. Data stored as text has fewer display options than data stored numerically. For more information and instruction on how to create a map with ArcGIS online, refer to the second half of this guide (ArcGIS Online instructions start on page 41).

ArcGIS Online also offers a program to create unique apps to display your map. We used the filter map app to create an app that displays our survey data with the ability to filter the data by infrastructure

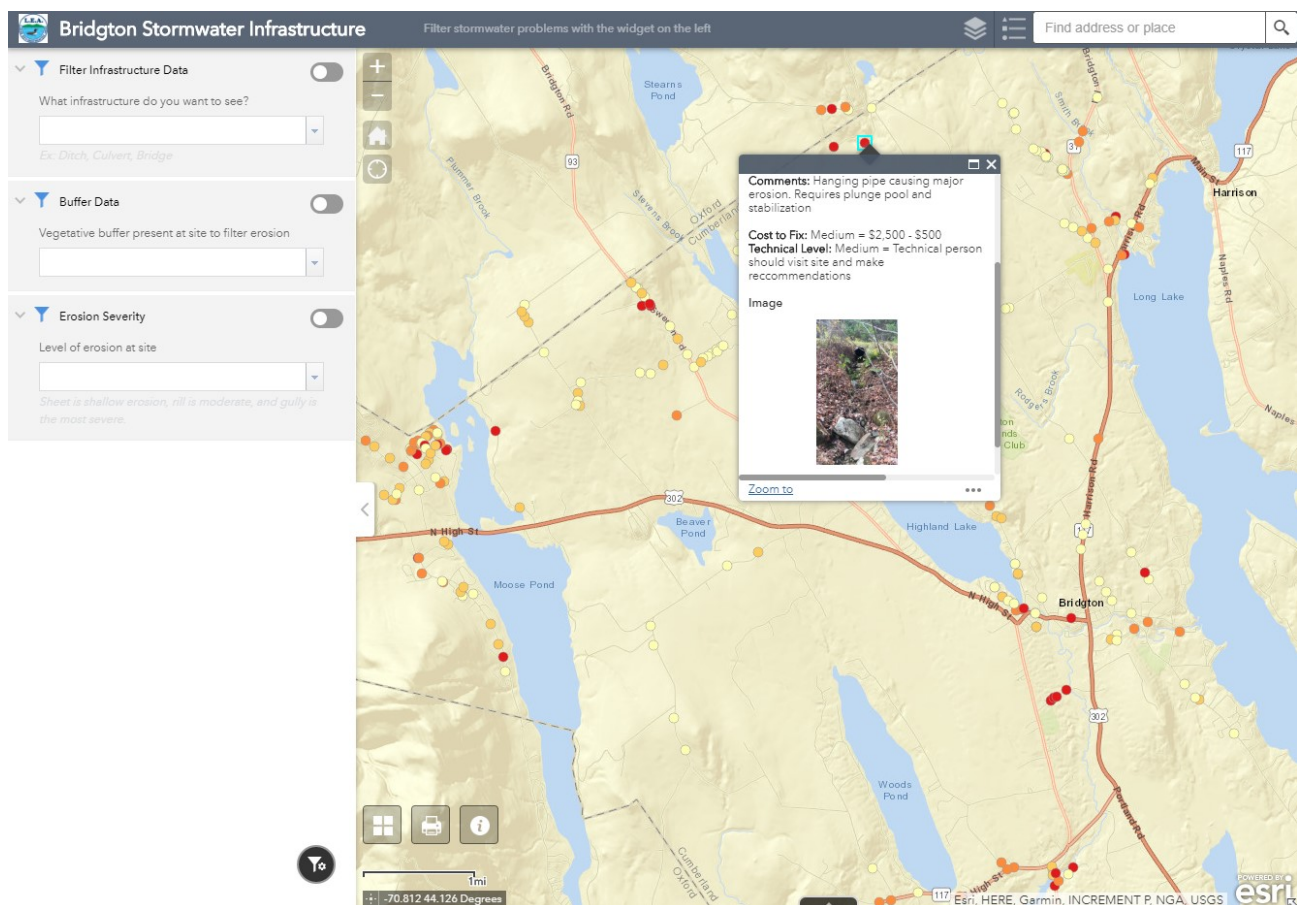


Data viewed by map or graphs in the Analyze tab



type, erosion severity, or buffer presence. With this app you can filter to look at the worst affected sites and focus only on those, and not be overwhelmed down by 300 other sites.

Once our map and app were complete we set the access to public to share this data with a broader audience. We put the data on our website to update our members, and we also shared the link with the Town of Bridgton. The goal of our project was to improve water quality by informing the Public Works Department to erosion problems around Bridgton. We met with the town to show them how to access and use this simple resource. The map was also designed with their use in mind. The public works department can sort by infrastructure type, which is helpful because they often coordinate similar work projects. For example, when they are doing ditch work they can select 'ditch' from the app to see all of the areas where ditches need to be maintained. Thinking about survey goals helped us design the survey and map at every level. This survey took a lot of time and work, but we could not have done it without mobile surveying. Transcribing paper forms and inputting all that data from different formats would take far too long. With this new technology we were able to learn a superior method of surveying, and create a powerful mapping tool to improve water quality and town roads simultaneously.



Final output: Online map app that filters stormwater sites based on severity or infrastructure.



Guide to using Survey 123 and online mapping tools

Step-by-step guide to surveying with Survey123

This section of this guide gives detailed instruction on creating a survey with Esri's Survey123 and creating a simple map through ArcGIS Online with data collected. Following this guide creates a survey to identify failing stormwater infrastructure (bridges, culverts, ditches, etc.). Included are step-by-step instructions and screenshots that walk the reader through creating this survey. The survey and map created by this guide are quite specific, but this guide may also be used as a lesson to familiarize yourself with Survey123 and ArcGIS online. Each step is explained in detail, with discussion about how to further use the features exemplified. After completing this guide, the reader will have a solid grasp of Survey123 and ArcGIS Online.

Nevertheless, this guide only represents one method of creating a survey with these products. Many other methods exist, and this guide exemplifies only a small portion of the functionality of the Esri products used. In addition to this guide, we recommend learning about these programs and experimenting with them on your own. Esri has created tutorial videos, and many are available free online through YouTube. These are powerful tools, but they are only as powerful as the knowledge of the user. Take a few hours to become acquainted with various survey and mapping programs.

Creating a Stormwater Survey

This process uses Excel and depends on precise formulas. If you would like a copy of LEA's template go to www.minelakes.org/stormwater_survey. You can download a completed excel form there. You can use that to replicate this survey, or use it follow along and correct your work.

To get started, go to the Survey123 website: <https://survey123.arcgis.com/>. Sign into your ArcGIS Online account and click create new survey. You will be given the option to do the survey online or through the Connect app. It is possible to create a survey entirely through the Survey123 website. This is simpler and may save some time initially, but the functionality is limited and data is stored in less optimal ways. To take full advantage of this survey product you need to use the Survey123 Connect application. Click 'Get Started' under the Connect app side, then download and install Survey123 Connect.

Open the Survey123 Connect program and sign into the Arc Online account. This gives you access to all of the online content available to your organization, and allows you to edit surveys, or publish a new one. click the “Create New Survey” button. On the next screen, choose a title for your survey, and then make sure the the “Advanced” template is selected. Click “Create Survey”. This will open a new survey in the program as well as an excel form like this:

	A	B	C	D	E	F	G
	type	name	label	hint	constraint	constraint_message	required
1	type	name	label	hint	constraint	constraint_message	required
2	text	example	Example				
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

- 1) The first, pre-populated line is example text, so delete that. In its place, the first item of information we want to collect is date and time. Modern versions of excel allow you to scroll through a list of question types to view and select. Older versions need to refer to the Types tab on the bottom of the page to see available question types, then write them instead of selecting from the dropdown. There are a couple ways to gather date and time with the types: *date*, *time*, *datetime*, *start* and *end*. Date will have the user enter the day, *time* has the user enter the time, and *datetime* selects both. For this survey we will use *start* to gather the start time and date of when the survey was opened directly from the mobile device, without user input. In the **type** column, select *start* from the dropdown, and then type “StartTime” in the **name** field. The **name** field will be the header for this data collected in the field. This field cannot use spaces or special characters. Other date selection tools are useful if users may be submitting or gathering data after the fact.

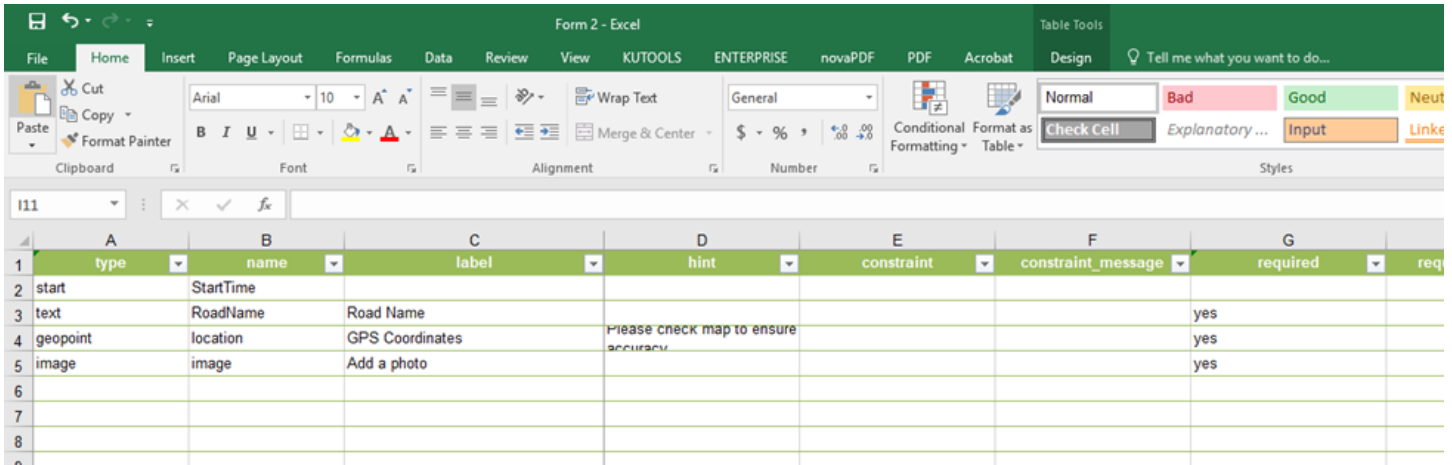
For this guide **bold** text indicates a column name in the smart form. *Italic* represents a question type, and text in quotations (“example”) is text to be entered verbatim.

- 2) The next question will be the road name. Select *text* from the dropdown, and write “RoadName” in the name field. The **label** field is what will be displayed on the survey. The previous question did not require this field because the question did not take user input. You can simply write “Road Name” to be direct, or write out a question such as, “Road name the site is located on?” This is critical information to the survey, so this question should be required. Scroll over to the **required** field and select ‘yes’. Now this survey cannot be submitted without being answered.

	A	B	C	D	E	F	G	H
1	type	name	label	hint	constraint	constraint_message	required	required_message
2	start	StartTime						
3	text	RoadName	Road Name				yes	
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

- 3) Next, we will collect the GPS location of the site. For this we will use the *geopoint type*. This creates a window in the survey with a map to collect the GPS coordinates of the mobile device. Enter “location” for the **name** field, and “GPS coordinates” for **label**. This question can be marked required, but keep in mind that the coordinates will automatically be set even if the user does not click the map. Mobile devices are not perfect GPS devices, and as such, the location may be inaccurate if the user does not verify the location automatically detected by the phone. Location can be corrected by opening the map and moving the point. This is only as accurate as the user’s sense of direction, however this can still an improvement in some areas with poor cell service. Therefore, we will use the **hint** field to display a message to remind the user to check the GPS point. Write a message on the lines of, “Please use map to ensure accuracy.” This will be displayed under the question text in the survey.

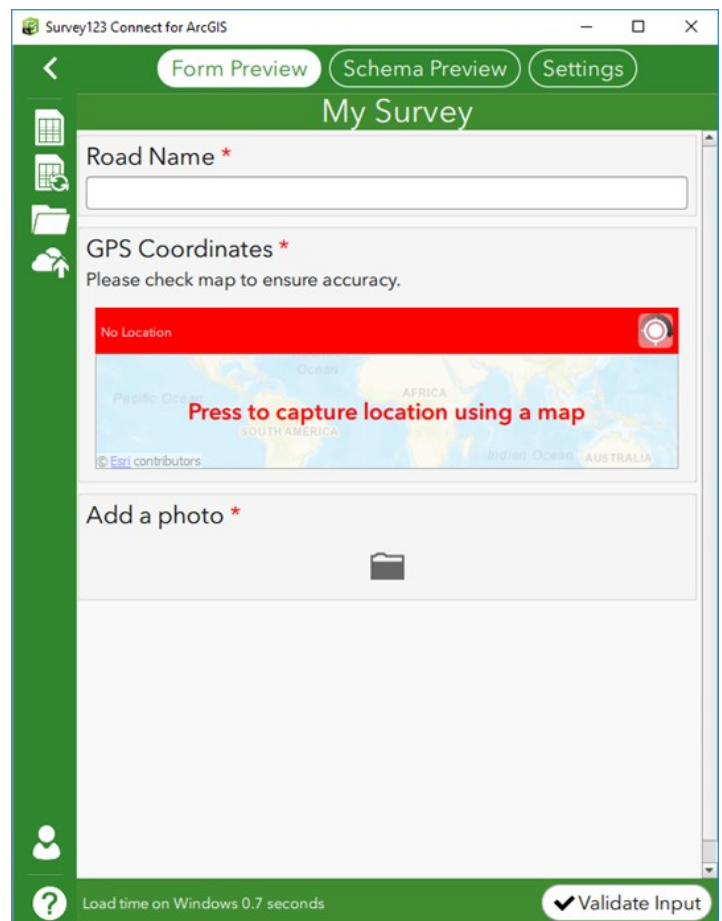
- 4) Now we will attach a photo to the survey. For **type**, choose *image*. Under **name**, type “image” and **label** it “Add a photo.” This field allows the user to input a photo from the mobile devices memory, or take a photo using the camera. This field should be marked as required.



The screenshot shows an Excel spreadsheet titled 'Form 2 - Excel' with the following data:

	A	B	C	D	E	F	G	
	type	name	label	hint	constraint	constraint_message	required	req
1	start	StartTime						
2	text	RoadName	Road Name				yes	
3	geopoint	location	GPS Coordinates	Please check map to ensure accuracy.			yes	
4	image	image	Add a photo				yes	
5								
6								
7								
8								

The excel file should now match the one above. Save the form and then go back to the Survey123 Connect program, which should still be open. Saving the spreadsheet will automatically update your survey and show you what it currently looks like in the connect app. The survey should match the picture to the right. Check your work, and then continue on to the site information.



The screenshot shows the Survey123 Connect app interface. The top bar has buttons for 'Form Preview', 'Schema Preview', and 'Settings'. The main title is 'My Survey'. The form fields are:

- Road Name ***: A text input field.
- GPS Coordinates ***: A section with the text 'Please check map to ensure accuracy.' and a map interface. The map shows a red location pin and the text 'Press to capture location using a map'.
- Add a photo ***: A section with a camera icon and a text input field.

The bottom bar shows a user profile icon, a question mark icon, and the text 'Load time on Windows 0.7 seconds'. A 'Validate Input' button is in the bottom right corner.

- 5) Create a new question with the **type** *select_one [list name]*. This type is a multiple choice question, with only one allowable answer. The list of multiple choice answers is stored in the next tab labeled choices. This question will ask what type of infrastructure is being surveyed, so we need to create a list of the possible storm-water infrastructure features. Write “infra_type” in the **name** column and “What are you surveying?” in the **label** column. Go to the choices tab. The choices the user will see will be listed under the **label** column, and the data captured by the survey will be in the **name** column the same way other answers are saved. The lists “yes_no” and “rating” are already populated as examples. You are going to add several additional choices. In the **label** column, add the choices “Culvert”, “Ditch”, “Road Shoulder”, “Bridge/Stream Crossing”, and “Water Detention Structure”. Copy these into the **name** column, making sure to delete or replace any spaces with underscores. Write the name of the list in the **list_name** column. I used *infra* to refer to infrastructure. Use that same name to replace *[list name]* in the question type on the first tab with no brackets (i.e., “select_one infra”).

	A	B	C
1	list_name	name	label
2	yes_no	yes	Yes
3	yes_no	no	No
4			
5	rating		1 1 Star
6	rating		2 2 Stars
7	rating		3 3 Stars
8	rating		4 4 Stars
9	rating		5 5 Stars
10			
11	infra	Culvert	Culvert
12	infra	Ditch	Ditch
13	infra	RoadShoulder	Road Shoulder
14	infra	Bridge/Crossing	Bridge/Stream Cros:
15	infra	WaterDetention	Water Detention Str

The choices tab should now look like this.

	A	B	C	D	E	F
1	list_name	name	label	infra	image	label::lan
11	infra	Culvert	Culvert			
12	infra	Ditch	Ditch			
13	infra	RoadShoulder	Road Shoulder			
14	infra	Bridge/Crossing	Bridge/Stream Crossing			
15	infra	WaterDetention	Water Detention Structure			
16						
17	condition	Broken	Broken	Culvert		
18	condition	Clogged	Clogged	Culvert		
19	condition	Crushed	Crushed	Culvert		
20	condition	Exposed	Exposed	Culvert		
21	condition	Oversized	Oversized	Culvert		
22	condition	Undersized	Undersized	Culvert		
23	condition	Perched	Perched	Culvert		
24	condition	Piping	Piping	Culvert		
25	condition	Rusted	Rusted	Culvert		
26	condition	Obscured	Obscured	Culvert		
27	condition	Unstable_Inlet	Unstable Inlet	Culvert		
28	condition	Unstable_Outlet	Unstable Outlet	Culvert		
29	condition	Bank_Failure	Bank Failure	Ditch		
30	condition	Erosion	Erosion	Ditch		
31	condition	Excess_Sand	Excess Sand	Ditch		
32	condition	Lack_Vegetation	Lack of Vegetation	Ditch		
33	condition	Undersized	Undersized	Ditch		
34	condition	Erosion	Erosion	RoadShoulder		
35	condition	Undercutting_Pavem	Undercutting Paven	RoadShoulder		
36	condition	Narrow_Width	Narrow Width	Bridge/Crossing		
37	condition	Unstable_Bank	Unstable Bank	Bridge/Crossing		
38	condition	Unstable_Inlet	Unstable Inlet	Bridge/Crossing		
39	condition	Unstable_Outlet	Unstable Outlet	Bridge/Crossing		
40	condition	Physical_Barrier	Physical Barrier	Bridge/Crossing		
41	condition	less.25	Less than 1/4 full	WaterDetention		
42	condition	.25to.5	1/4 - 1/2 full	WaterDetention		
43	condition	more.5	More than 1/2 full	WaterDetention		
44	condition	Full	Full	WaterDetention		
45						

The list name is *condition*, as shown connecting all of the options. Each option is then listed by its survey output and visible label. The fourth column is a new row you must add, called **infra**, to match the choices from the previous question to this new one. This allows you to create a subset within the condition list that only displays those choices based on the matching answer from the previous question. Copy the list as shown.

*Note: *select_multiple* does not currently work with the **choice_filter** option. The Survey123 team is working on a solution. This survey question was built with that eventual fix in mind. Until then, the next question can be used to supplement this data.*

7)

Now we will give the user the option to add additional conditions, since the previous question could only have one answer. Choose the **type** *select-_multiple* [list name], and change [list name] to *condition* to use the same list as before.

Name this field “additional_condition” and ask, “Any additional conditions from above?” in the **label** column. Unlike other questions, this question will not be ‘required’ in the survey (all others should be required up to this point). This question will also take advantage of the **appearance** column. Choose “minimal” from the dropdown menu in the correct row under the **appearance** column to make the list a drop-down tab. This way the survey conserves space, and the user can go into this tab only if they need to .

	A	B	C	D	E	F	G	H	I	J
	type	name	label	hint	constraint	constraint_message	required	required_message	appearance	det
1	start	StartTime								
2	text	RoadName	Road Name				yes			
3	geopoint	location	GPS Coordinates	Please check map to ensure accuracy.			yes			
4	image	image	Add a photo				yes			
5	select_one infra	Infra_Type	What are you surveying?				yes			
6	select_one condition	Infra_Condition	What is the current condition?				yes			
7	select_multiple condit	additional_condition	Any additional conditions from above?						minimal	
8	select_one volume	Stormwater_Volume	Stormwater volume?				yes			
9										
10										
11										
12										
13										
14										

Appearance
Select the appearance of this field in your survey. See 'types' for more information.

- 8) Now we will create dependent questions using the **relevant** column. This column creates additional questions based on previous answers. First we will ask about culvert size. Create a *select_one* question, and replace *[list name]* with *diameter* to name the list. Culverts come in standard sizes, so we can create a list of these sizes to choose from. **Name** this question “Culvert_Diameter” and **Label** it “Culvert Diameter” for the survey.

Tab over to choices and create this list of diameter choices. Standard sizes start at 12”, and went up in 3” increments to 30”, then 6” increments to 48”. I included a >12” and a greater than 48” option as well to include non-standard culverts. My list had <12, 12, 15, 18, 21, 24, 27, 30, 36, 42, 48 and >48. Be sure to have *diameter* as the **list_name** for each row, and to have the numbers in both the **name** and **label** category. I put quotation marks after each number to indicate inches.

Go back to the survey tab. Scroll over to the **relevant** column and enter `#{Infra_Type}='Culvert'` to indicate that we only want to display this question when “culvert” has been selected. Again, we want to use the “minimal” feature under **appearance** to make the question a drop down menu. The excel sheet should now look like this:

	A	B	C	H	I	J	K	L	M	N
1	type	name	label	required_message	appearance	default	readonly	relevant	calculation	choice_filter
2	start	StartTime								
3	text	RoadName	Road Name							
4	geopoint	location	GPS Coordinates							
5	image	image	Add a photo							
6	select_one infra	Infra_Type	What are you surveying?							
7	select_one condition	Infra_Condition	What is the current condition?							infra=#{Infra_Type}
8	select_multiple condition	additional_condition	Any additional conditions from above?		minimal					
9	select_one diameter	Culvert_Diameter	Culvert Diameter		minimal			#{Infra_Type}='Culvert'		

- 9) We also want to know the culvert length, so we will create a new question with the **name** “Culvert_Length” and use the **label** “Culvert Length”. We want this value to be entered in whole measurements to the whole foot, so we will choose the question **type** *integer*. This **type** only allows whole number responses. Use the **appearance** column to select “numbers” to have the user’s keyboard only display numbers when this question is selected. Again, we only want this question to display when “culvert” is selected. Copy $\{\text{Infra_Type}\} = \text{'Culvert'}$ from the last row, and paste it into this questions row. Optionally, you can create a **hint** to show “Answers to the whole foot” to help users.
- 10) For ditches, we want to know if they are U-shaped, V-shaped, or other. Ditches should generally be a U-shape to discourage erosion while allowing proper drainage. Create another *select_one* question, and replace $[list_name]$ with *shape*. **Name** the row “Ditch_Shape” and **label** it “Ditch Shape”. Again, use the **relevant** column, but this time use “Ditch” instead of “Culvert” from the last question. The function should read $\{\text{Infra_Type}\} = \text{'Ditch'}$. Tab over to choices and create 3 choices: U-shaped, V-Shaped, or other.

type ▼	name ▼	label ▼	relevant ▼
start	StartTime		
text	RoadName	Road Name	
geopoint	location	GPS Coordinates	
image	image	Add a photo	
select_one infra	Infra_Type	What are you surveying?	
select_one condition	Infra_Condition	What is the current condition?	
select_multiple condition	additional_condition	Any additional conditions from above?	
select_one diameter	Culvert_Diameter	Culvert Diameter	$\{\text{Infra_Type}\} = \text{'Culvert'}$
integer	Culvert_Length	Culvert Length	$\{\text{Infra_Type}\} = \text{'Culvert'}$
select_one shape	Ditch_Shape	Ditch Shape	$\{\text{Infra_Type}\} = \text{'Ditch'}$

The screenshot shows the Survey123 Connect for ArcGIS application window. The title bar reads 'Survey123 Connect for ArcGIS'. The interface has a green header with three tabs: 'Form Preview' (selected), 'Schema Preview', and 'Settings'. Below the header is a green bar with the title 'My Survey'. On the left is a green sidebar with icons for a spreadsheet, a map, a folder, a home icon, and a user icon. The main content area displays a survey form with the following sections:

- What are you surveying? ***
 - ☐ Culvert
 - ☒ Ditch
 - ☐ Road Shoulder
 - ☐ Bridge/Stream Crossing
 - ☐ Water Detention Structure
- What is the current condition? ***
 - ☐ Bank Failure
 - ☐ Erosion
 - ☐ Excess Sand
 - ☐ Lack of Vegetation
 - ☐ Undersized
- Any additional conditions from above?**
- Ditch Shape**
 - ☐ U-shaped
 - ☐ V-shaped
 - ☐ Other

At the bottom of the form, there is a green bar containing a question mark icon, the text 'Load time on Windows 1.3 seconds', and a 'Validate Input' button with a checkmark icon.

Save the excel form to check your work in the Connect program.
The survey should now look like this if Ditch is selected.

- 11) Next, create a question to gauge if this infrastructure is the correct size for the drainage. Create another *select_one [list name]* question, and change *[list name]* to *volume*. **Name** the field “Stormwater_Volume” and have the **label** read “Stormwater Volume” as well. Create a new **list_name**, *volume*, in the choices tab, with the options “Undersized”, “Adequate”, and “Oversized” in the **name** and **label** columns. Mark this field as required.

- 12) Now we are going to assess the impact of the erosion. Create a *select one* question where *[list name] = impact*. **Name** and **label** the field “impact”. Again this question should be required. Tab over to the choices tab to create the list. This list is titled *impact* to match the question. We will have the choices “sheet”, “rill” and “gully” for **labels**. However, under **name**, enter 1 for sheet, 2 for rill and 3 for gully. We want the survey to display these choices, but we will be using the numbers to create a priority index to rate the severity of the erosion problem. I placed the corresponding number in parenthesis in the label to give the user better understanding of the priority index. The question then would look like this in the survey:



Impact *

☐ Sheet (1)

☐ Rill (2)

☐ Gully (3)

- 13) Continuing with assessing the impact, now create a question to gauge the size of the erosion. Make another *select one* question with the list titled *area*. **Name** and **label** should both be “Area” and we want this question to be required again. For the choices, create “small”, “medium” and “large” **labels** that correspond with ‘1’, ‘2’ and ‘3’ in the **name** column. Again, you can place parenthesis in the label to give the numerical value.
- 14) Then we will get information on buffers present at the site. Create another *select one* question with the list name *buffer* and “Buffer” as the **name** and **label** of the question. In the choices tab create the list of *buffer* options. We will use the **labels** ‘No filter’, ‘Some filtering’ and ‘Significant buffer present’. These will correspond to the numbers 2, 1 and 0.5 in the **name** column.

67	impact	1	Sheet (1)	
68	impact	2	Rill (2)	
69	impact	3	Gully (3)	
70				
71	area	1	Small (1)	
72	area	2	Medium (2)	
73	area	3	Large (3)	
74				
75	buffer	2	No filter (x2)	
76	buffer	1	Some filtering (x1)	
77	buffer	0.5	Significant buffer present (x.5)	

Choices tab entries of the past three questions.

- 15) Using the three previous questions, we will create a field for a priority number. We will add the Impact and Area fields, and then multiply by the buffer field to weight the erosion site appropriately. Soil eroding directly into a waterbody is more detrimental than a large erosion site in a dense forest, far from any lakes or streams. Multiplying will effectively weight the priority number to draw attention to sites with no buffers. You can change these numbers to suit your needs, or if you think this too heavily prioritizes sites near water.

For this, create a question where **type** = *decimal*, **name** it “Priority” and **label** it “Priority Level”. The decimal question allows non-whole number inputs. This question is going to automatically calculate the priority level by using the **calculation** column. Copy this formula into the **calculation** column to add the impact and area scores, and then multiply by the buffer:

$$(\text{int}(\${\text{Impact}}) + \text{int}(\${\text{Area}})) * \text{max}(\${\text{Buffer}})$$

This formula requires the *int* and *max* functions to convert the previous answers from text strings into number formats. Survey123 stores data from most questions as text, which cannot be used in calculations. The *int* function converts text into integers (only whole numbers). The *max* function chooses the larger of two numbers, including non-whole numbers. We need the *max* function for the buffer because it returns non whole numbers that would be rounded or converted to 0 in the *int* function. Notice the *max* function does not need a second value to choose from in the function, and will always return the buffer value here. Because this question automatically calculates the answer, we will use the **read only** column to prevent the user from editing this entry. Select ‘yes’ in this column to finish this question.

Impact *

- ☐ Sheet (1)
- ☒ Rill (2)
- ☐ Gully (3)

Area *

- ☐ Small (1)
- ☒ Medium (2)
- ☐ Large (3)

Buffer *

- ☒ No filter (x2)
- ☐ Some filtering (x1)
- ☐ Significant buffer present (x.5)

Priority Level

Open the survey in Survey123 Connect window to experiment with these questions. The Priority level should automatically update as you select different erosion options. If your survey is not functioning, compare your smart excel form to the one below

type	name	label	readonly	relevant	calculation	choice_filter
start	StartTime					
text	RoadName	Road Name				
geopoint	location	GPS Coordinates				
image	image	Add a photo				
select_one infra	Infra_Type	What are you surveying?				
select_one condition	Infra_Condition	What is the current condition?				infra=\${Infra_Type}
select_multiple condition	additional_condition	Any additional conditions from above?				
select_one diameter	Culvert_Diameter	Culvert Diameter		`\${Infra_Type}` = 'Culvert'		
integer	Culvert_Length	Culvert Length		`\${Infra_Type}` = 'Culvert'		
select_one shape	Ditch_Shape	Ditch Shape		`\${Infra_Type}` = 'Ditch'		
select_one volume	Stormwater_Volume	Stormwater volume?				
select_one impact	Impact	Impact				
select_one area	Area	Area				
select_one buffer	Buffer	Buffer				
decimal	Priority	Priority Level	yes		(int(`\${Impact}`) + int(`\${Area}`)) * max(`\${Buffer}`)	

- 16) Next, we are going to ask a question about how to remediate the infrastructure being surveyed. This question will be similar to the 5th question in that we will use the infrastructure type to narrow the list of responses. Create another *Select one* question and title the list *remediation*. Enter “Remediation” in the **name** and **label** columns as well. Fortunately, we can use the same **choice filter** for this question as in question 5. Copy the formula from question 5 and paste it into this question’s **choice filter** column (form should read `infra=${Infra_Type}`).

Tab over to choices to create the choice list for this question. This will be a list of common options to remediate infrastructure problems. Similar to question 5, this is a long list. The list is shown below. Copy the options into your excel form as shown. Be sure to avoid spaces in the **name** column and include the correct infrastructure type in the **infra** column (case does matter).

remediation	Armor_Inlet	Armor Inlet	Culvert
remediation	Armor_Outlet	Armor Outlet	Culvert
remediation	Clean_Out	Clean Out	Culvert
remediation	Enlarge	Enlarge	Culvert
remediation	Install_Culvert	Install Culvert	Culvert
remediation	Install_Plunge_Pool	Install Plunge Pool	Culvert
remediation	Install_Rock_Apron	Install Rock Apron	Culvert
remediation	Lengthen	Lengthen	Culvert
remediation	Remove_Clog	Remove Clog	Culvert
remediation	Replace	Replace	Culvert
remediation	Armor_With_Stone	Armor with stone	Ditch
remediation	Install_Check_Dams	Install Check Dams	Ditch
remediation	Install_Ditch	Install Ditch	Ditch
remediation	Install_Sediment_Po	Install Sediment Po	Ditch
remediation	Install_Turnout	Install Turnout	Ditch
remediation	Remove_Debris	Remove Debris/Sec	Ditch
remediation	Reshape_Ditch	Reshape Ditch	Ditch
remediation	Vegetate	Vegetate	Ditch
remediation	Add_Surface_Materi	Add Surface Materi	Road
remediation	Pave	Pave	RoadShoulder
remediation	Reshape	Reshape	RoadShoulder
remediation	Stabilize	Stabilize	RoadShoulder
remediation	Armor_Inlet	Armor Inlet	Bridge/Crossing
remediation	Armor_Outlet	Armor Outlet	Bridge/Crossing
remediation	Armor_Banks	Armor Banks	Bridge/Crossing
remediation	Clean_Out	Clean Out	WaterDetention
remediation	Enlarge	Enlarge	WaterDetention
remediation	Stabilize_Banks	Stabilize Banks	WaterDetention

- 17) Similarly to question 5, we will have an additional question to ask for any additional remediation methods. More often than not the infrastructure requires multiple fixes. Create a *select multiple* question using the same *remediation* list shown on the previous page. **Name** the question ‘additional_remediation’ and **label** the question, “Any additional remediation methods from above?” This question has a long list of answers, so we can use the “minimal” option in the **appearance** column to save space in the survey.
- 18) The next two questions are about the cost and technical level to remediate the infrastructure. First we will get information on the cost. Create another *select one* question with the list name *cost*. **Name** the question “cost” and write, “Cost to Fix?” in the **label** column. Create the list for *cost* in the choices tab. The choices for this question and the next question are shown in the box below.

cost	high	High = Greater than \$2,500		
cost	medium	Medium = \$500 - \$2,500		
cost	low	Low = Less than \$500		
tech	high	High = Site requires engineered design		
tech	medium	Medium = Technical person should visit site and make recommendations		
tech	low	Low = Property owner able to accomplish with reference materials		

- 19) For the technical question, we are going to use another *select one* with the list name *tech*. Write “Technical_level” in the **name** column, and “Technical level to install?” in the **label** column. Then go to the choices tab and create the choice list. The list options are shown above starting with the *tech* list name.
- 20) Lastly, we will give the user the chance to add additional comments. Create a question with the **type** being *text* and **name** it “additional_comments”. Write “Any additional comments?” in the **label** section. Then you want to select “multiline” in the **appearance** column to show that the user has ample room to write comments on the survey. Save the form and check your work!

A	B	C	D	E	F	G	H	I
type	name	label	hint	constraint	constraint_message	required	required_message	appearance
1 start	StartTime							
2 text	RoadName	Road Name				yes		
3 geopoint	location	GPS Coordinates				yes		
4 image	image	Add a photo				yes		
5 select_one infra	Infra_Type	What are you surveying?				yes		
6 select_one condition	Infra_Condition	What is the current condition?				yes		
7 select_multiple condition:additional_condition		Any additional conditions from above?						minimal
8 select_one diameter	Culvert_Diameter	Culvert Diameter						minimal
9 integer	Culvert_Length	Culvert Length	Answer to the whole foot.					minimal numbers
10 select_one shape	Ditch_Shape	Ditch Shape						
11 select_one volume	Stormwater_Volume	Stormwater volume?				yes		
12 select_one impact	Impact	Impact				yes		
13 select_one area	Area	Area				yes		
14 select_one buffer	Buffer	Buffer				yes		
15 decimal	Priority	Priority Level						
16 select_one remediation	Remediation	Remediation						
17 select_multiple remediation:Additional_Remediation		Any additional remediation methods from above?						minimal
18 select_one cost	Cost	Cost to fix?						
19 select_one tech	Technical_Level	Technical level to install?						
A	B	C	I	J	K	L	M	N
type	name	label	appearance	default	readonly	relevant	calculation	choice_filter
1 start	StartTime							
2 text	RoadName	Road Name						
3 geopoint	location	GPS Coordinates						
4 image	image	Add a photo						
5 select_one infra	Infra_Type	What are you surveying?						infra=\${Infra_Type}
6 select_one condition	Infra_Condition	What is the current condition?						
7 select_multiple condition:additional_condition		Any additional conditions from above?	minimal					
8 select_one diameter	Culvert_Diameter	Culvert Diameter	minimal					
9 integer	Culvert_Length	Culvert Length	numbers					
10 select_one shape	Ditch_Shape	Ditch Shape						
11 select_one volume	Stormwater_Volume	Stormwater volume?						
12 select_one impact	Impact	Impact						
13 select_one area	Area	Area						
14 select_one buffer	Buffer	Buffer						
15 decimal	Priority	Priority Level						
16 select_one remediation	Remediation	Remediation						
17 select_multiple remediation:Additional_Remediation		Any additional remediation methods from above?	minimal					
18 select_one cost	Cost	Cost to fix?						
19 select_one tech	Technical_Level	Technical level to install?						
20 text	Additional_comments	Any additional comments?	multiline					
21								
22								

Settings

You can change certain settings of your survey through the Survey123 Connect program. Click on the survey, and select the 'Settings' button on the top right. This will show you more tabs to click through to access different settings. 'General' is where you can name the survey and give a summary that users will see when they go to download the survey. The 'Style' tab can change colors and add images to the background of the survey. The 'Map' tab can change the default map settings. 'Images' changes the uploaded image size settings. 'Inbox' and 'Sent Surveys' are important tools. 'Sent Surveys' keeps completed surveys on the user's phone that can be uploaded after the fact. This is necessary for doing surveys offline. The 'Inbox' tab allows you to enable the inbox. This is a useful feature that will pull completed survey data onto the user's phone. They can view a list or a map of completed surveys and then edit their data.

Survey123 Connect for ArcGIS

Form Preview Schema Preview **Settings**

General Style Map Images Inbox Sent Surveys

Thumbnail

Title

Stormwater Survey Template

Summary

Stormwater Infrastructure Survey Template created by the Lakes Environmental Association

Description

This template includes all XLSForm features supported in Survey123 for ArcGIS.

Publishing your Survey

Publishing a survey is easy with the Survey123 connect program. Simply click the button with an arrow pointing to a cloud on the left hand side. You will be prompted to be sure that your survey is ready. If you are ready then click through the prompts and the survey will be uploaded to your organization's ArcGIS Online portal. Publishing the survey creates a Feature Layer on your ArcGIS portal, as well as the Survey Form. The Feature Layer is a way of storing data through ArcGIS Online. The Feature Layer links spatial data to the feature service used to gain the data (Survey123 in the case of this survey). The Feature Layer can be accessed through the portal to view the data. The Survey Form will direct the user to the Survey123 web app, <https://survey123.arcgis.com/>. Instructions on how to share and access the published survey are discussed next.

Survey123 Connect for ArcGIS

Form Preview Schema Preview Settings

Stormwater Infrastructure Survey

Road Name *

GPS Coordinates *

Please check map to ensure accuracy.

No Location
Position source closed error

Press to capture location using a map

Add a photo *

What are you surveying? *

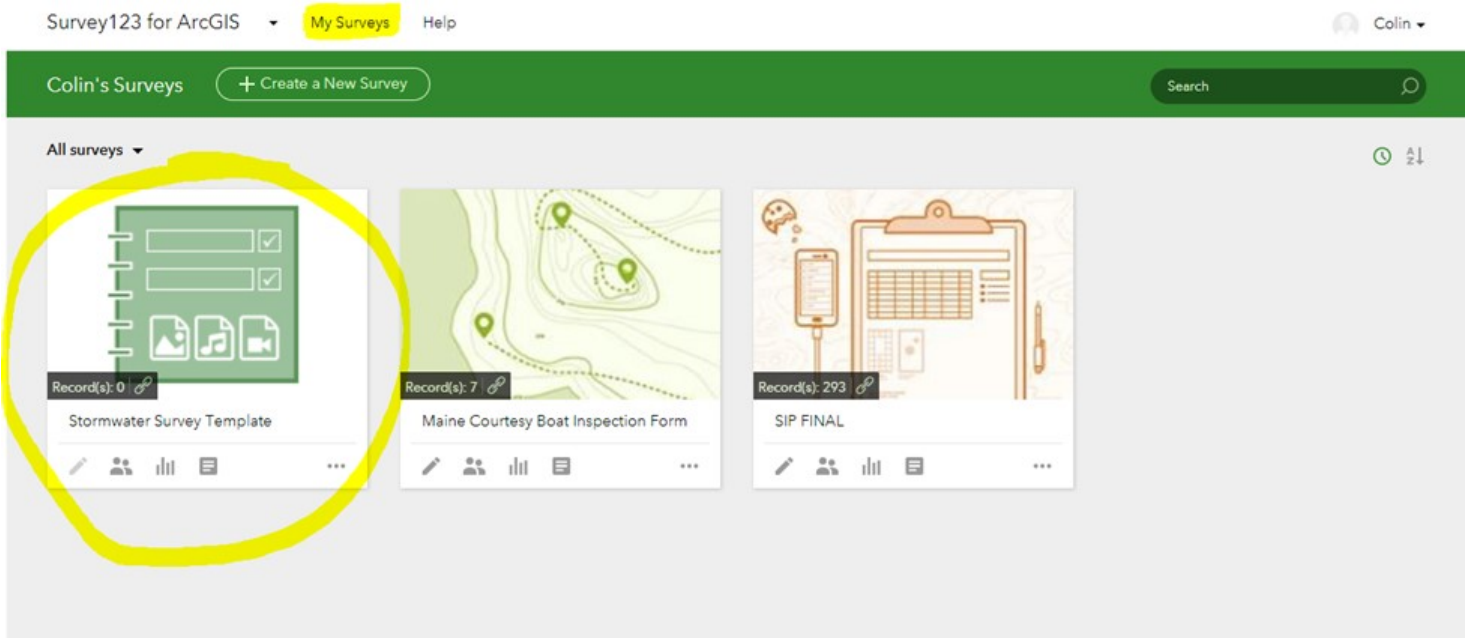
- ☐ Culvert
- ☐ Ditch
- ☐ Road Shoulder
- ☐ Bridge/Stream Crossing
- ☐ Water Detection Structure

Load time on Windows 1.7 seconds

Validate Input

Sharing your Survey

To share your survey, first you need to publish a survey. If you have not done so, read the previous paragraph. After publishing the survey, the survey is online, but the username you used to publish the survey is the only one that can access this survey. Go to the Survey123 website to edit the sharing settings. You can access this online at <https://survey123.arcgis.com/> or simply by clicking the globe icon through the Survey123 Connect program. Make sure you are signed in under the same username you used to publish the survey.



<https://survey123.arcgis.com/surveys/cdf9433b969d47ed8a6bfe587f71697a/collaborate>

Survey123 for ArcGIS
My Surveys
Help
Colin

Stormwater Survey Template
Overview
Design
Collaborate
Analyze
Data

Submitter
Viewer
Group Settings

Choose who can submit data to this survey:

☐ Everyone (Public)
☐ Members of my organization (Lakes Environmental Association)
☐ Following Groups:

☐ Lakes Environmental Association Open Data
Details

Currently, no one except you can submit data to the survey.
Save

Survey link:

<https://survey123.arcgis.com/share/cdf9433b969d47ed8a6bfe587f71697a>

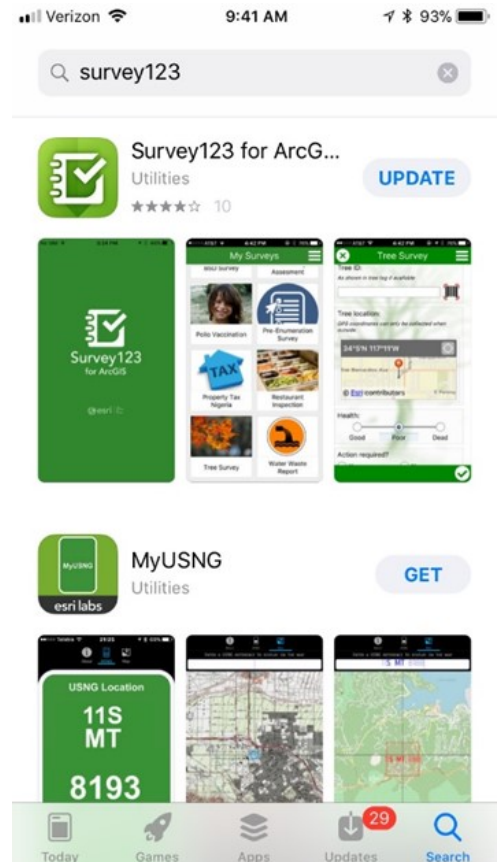
☒ Open the survey in browser directly
☐ Ask the user how to open the survey, in browser or in the Survey123 field app
☐ Open the survey in the Survey123 field app directly. (Learn more about this option)

After selecting the survey you will see the overview tab. This will give you general information on the survey, and tell you the current sharing settings of the survey. Most likely your survey is set to 'private' currently. Click the 'Collaborate' tab to edit the sharing settings. In the collaborate tab you will see the settings for the 'submitter' and the 'viewer'. The 'submitter' is the person filling out the survey and the 'viewer' is the person who is allowed to access the survey data. You can set the access to 'viewing' or 'submitting' independently of each other. Sharing options in Survey123 are public (everyone), your organization (anyone with an ArcGIS login through your organization) or specific groups you can create through your ArcGIS Online portal. Choose the sharing options that work best for your survey. This page also gives you a link to share the survey and a separate link to share the survey data. Use these links wisely to obtain survey responses and disseminate information.

Collecting Data

Now that you have created and shared the survey, you are ready to start collecting responses. Share the link from the collaborate tab in the Survey123 web app to direct users to the survey. Users can fill out the survey through a web browser or through the Survey123 mobile app. The web browser is useable, but the mobile app offers more functionality such as offline data collection.

To collect data with the Survey123 app, first the user must download the app. The app is available on Apple (IOS) and Android devices through their respective app stores. Search for Survey123 and download the app with the Survey123 logo as shown on the right.

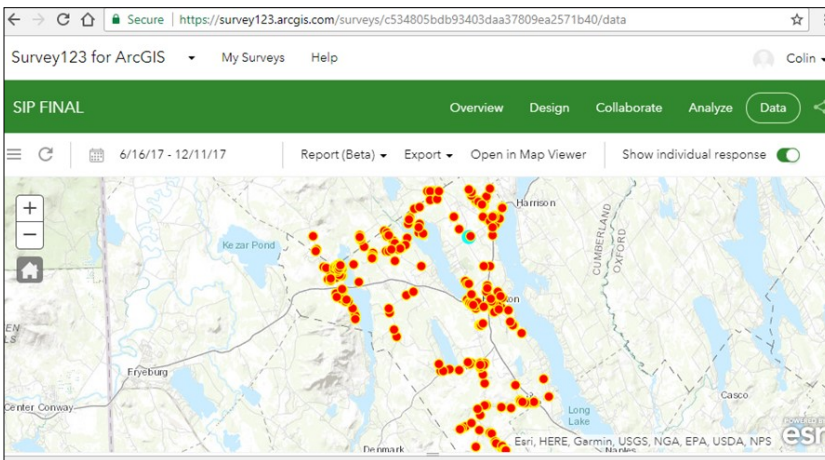


After downloading the Survey123 app, open the app and sign in with your ArcGIS Online account. Click the icon at the top right to open the menu and click download surveys. As long as the user account has access to the survey, the survey should appear in a list here. Click on the survey to download it. Once downloaded the survey will appear on the main screen. Tap on the survey to open the survey. In the survey you have the option to collect data or view completed records as long as this feature is enabled on the Survey123 web app. Click 'collect' to start gathering data. If you want to work offline, collect data as normal, but when submitting each record choose to submit data later. Then when you have service, or are on Wi-Fi, open the survey and click the outbox to send those records.

Accessing Survey Data

Survey data is readily available on the Survey123 website. Go to survey123.arcgis.com, click on the survey, and then go to the 'Data' tab on the top right. This page will bring up a map with the GPS location of each survey pinpointed. Selecting a point will display the data related to that location. A table with the raw data from each survey is also shown below the map.

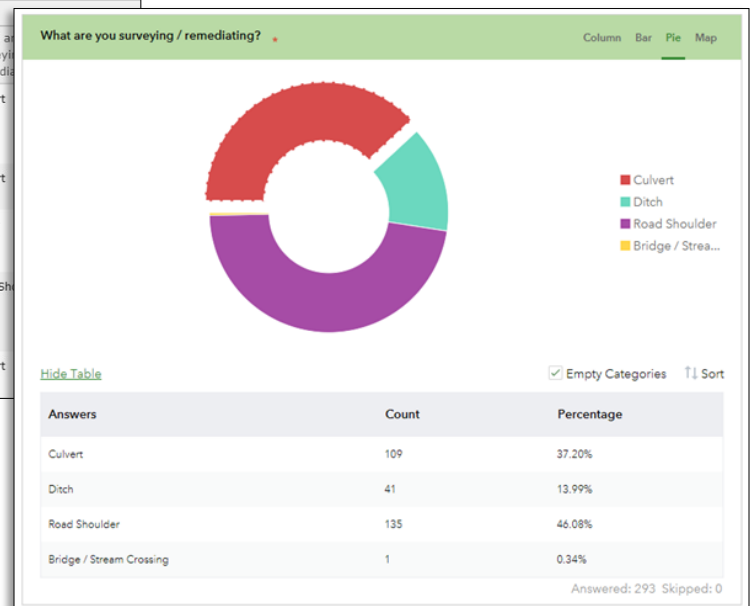
Selecting an entry from the table will also select the entry in the map, and will center the map view on the selected entry. The table can be sorted by any of the headers, and you can use the small plus sign to add or remove columns in the table. Notice photos are not available through this feature. Photos can be accessed through the map viewer on the main ArcGIS Online page. Data can be exported from this page as well. Select the 'Export' tab to select from a list of file options. Be aware that file geodatabase must be selected to retain photos.



The screenshot shows the Survey123 interface for a survey titled 'SIP FINAL'. The 'Data' tab is selected, displaying a map with numerous orange survey points. Below the map is a table with the following data:

Surveyor	Date	Road Name	Are you surveying or remediating?	Other - Are you surveying or remediating?	What are you surveying / remediating?
Gray, kayla	Jun 16, 2017	93	Surveying		Culvert
Gray, kayla	Jun 16, 2017	93	Surveying		Culvert
Gray, kayla	Jun 16, 2017	Isaa stevens road	Surveying		Ditch
Gray, kayla	Jun 16, 2017	93	Surveying		Road Shoulder
Gray, kayla	Jun 16, 2017	93	Surveying		Culvert

The 'Data' tab displays raw survey data in map and table form. Survey123 also offers the 'Analyze' tab which automatically creates graphs and maps of your data. This feature analyzes each question based on the current data, so you can get quick insights on your survey while data is being collected. Use these premade graphs to add to reports or share them with participants without any additional work required.



Home Gallery Map Scene Groups Content Organization

Colin

Content

My Content My Favorites My Groups My Organization

+ Add Item Create

Folders New

Filter folders

- All My Content
- LakesEnvironmental
- Public
- Survey-Maine Courtesy Boat Inspection Form
- Survey-SIP FINAL
- Survey-Stormwater Survey Template

Item Type

- Maps
- Layers
- Scenes
- Apps
- Tools
- Files

> Date Modified

> Date Created

Search All My Content

1 - 14 of 14 in All My Content

Sort by: Date Modified

Title	Modified
Stormwater Survey Template_stakeholder	Mar 21, 2018
Stormwater Survey Template	Mar 21, 2018
Stormwater Survey Template	Mar 21, 2018
Stormwater filter app map	Feb 20, 2018
Stormwater filter app map	Feb 15, 2018
Stormwater Infrastructure with Priority	Feb 15, 2018
SIP FINAL	Feb 15, 2018
SIP FINAL_stakeholder	Feb 1, 2018
S123_c534805bdb93403daa37809ea2571b40_CSV	Jan 12, 2018
Maine Courtesy Boat Inspection Form	Sep 28, 2017
Maine Courtesy Boat Inspection Form_fieldworker	Sep 22, 2017
Maine Courtesy Boat Inspection Form	Sep 22, 2017
SIP FINAL	Sep 1, 2017
SIP FINAL_fieldworker	Jun 16, 2017

Data through ArcGIS Online

Many additional functions are available through the ArcGIS Online portal such as editing data as well as creating maps and apps. The Survey123 web app allows the user to view data and edit settings. However, editing data and creating more advanced maps requires going to the main portal.

To access this content, go to your portal and log in. The web address for this site varies based on your organizational name, regardless you should be able to log in from www.arcgis.com. Once you are logged in, click on the 'content' tab near the top left. This will bring you to a list of the online content that you have access to across your organization. Use the filters on the left hand side to sort by items you own, folders, organizational ownership, or type of content. In your content, there should be two items with your survey name. One will be the survey form; denoted by 'form' in the type column. The other will be the hosted feature layer where all of the data from survey responses is stored. There may also be a 'stakeholder' or 'fieldworker' feature layer which was created based on the sharing settings for the survey.

Clicking a content item will bring you to a page with more information on the item. Here you can edit settings, sharing, and descriptions of the item. This is also where you will be able to edit the survey data. In the content page, click on the 'settings' tab to change the editing settings. Here you can enable or disable editing, as well as control who and what kind of edits can be made to the data.

In the data tab, the raw data is displayed as a table similar to the table seen in the Survey123 web app. However, unlike in the Survey123 app, this data can be changed and manipulated. Double click any value to change it. The data tab also allows you to add or remove fields. You can use this to add a data field to all current and new surveys. Another powerful feature is the ability to calculate fields. Calculate can pull data from other fields and takes advantage of Excel functions to manipulate that data. This is a valuable tool because you can bulk edit the whole survey by creating a new field and using the calculate field. For example, if you want to combine the answers to two questions you could create a new field, and use the concatenate function to pull the responses for those questions into the new field. Clicking the header of a field will bring up a tab of options where you can find the calculate feature. To edit the location data, the layer must be opened through the map viewer app, which will be discussed on page 45.

Home Gallery Map Scene Groups Content Organization Colin

SIP FINAL

Overview **Data** Visualization Usage Settings

Layer:

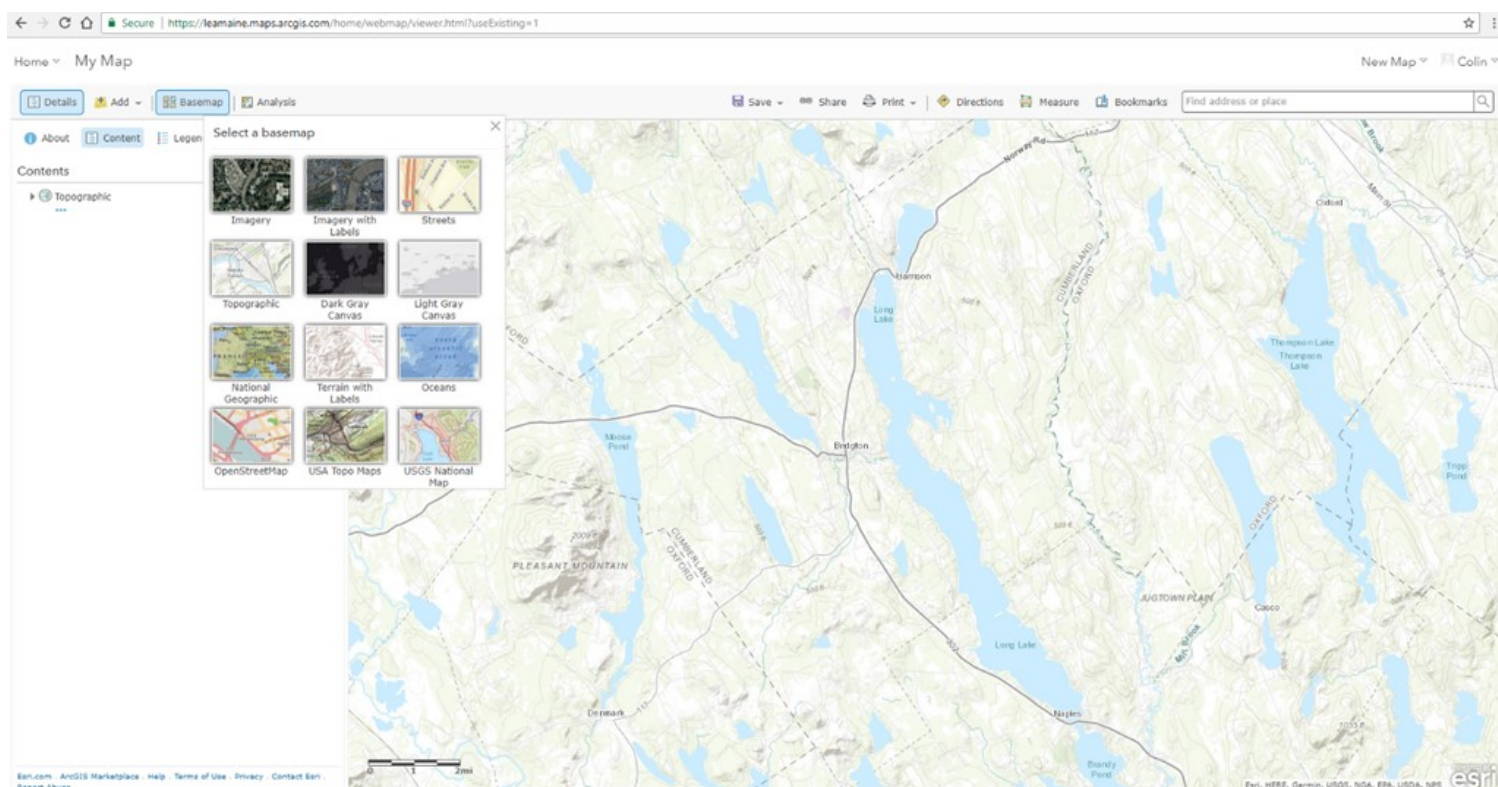
Double-click a value in the table to change it. Data Last Updated: Mar 5, 2018, 1:11:28 PM

surveyPoint (Features: 293, Selected: 0)

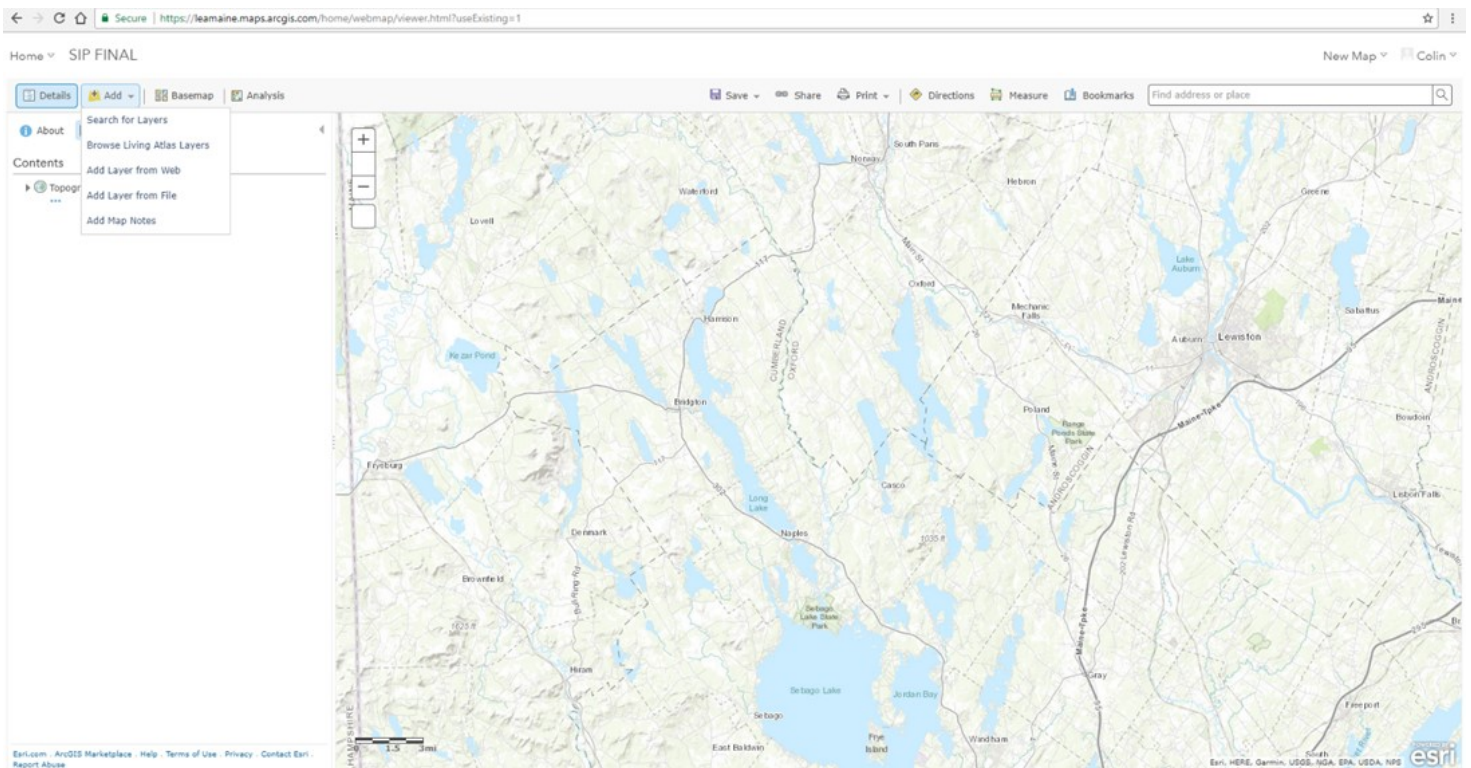
Surveyor	Date	Road Name	Are you surveyin...	Other - Are you s...	What are you sur...	Diameter	Other - Diameter	Length	Capacity
Gray, kayla	6/16/2017, 12:00 AM	93	Surveying		Culvert	12"		30ft	Undersized
Gray, kayla	6/16/2017, 12:00 AM	93	Surveying		Culvert	15"		50	Adequate
Gray kayla	6/16/2017, 12:00 AM	Isaa stevens road	Surveying		Ditch				
Gray, kayla	6/16/2017, 12:00 AM	93	Surveying		Road Shoulder				
Gray, kayla	6/16/2017, 12:00 AM	93	Surveying		Culvert	12"		60 ft	Oversized
Gray kayla	6/16/2017, 12:00	93	Surveying		Culvert	Less than 12"		30 ft	Undersized

Map Viewer

Map viewer is a unique web app developed by Esri that offers many of the powerful tools available on the desktop ArcMap application through a web browser. This is a multifaceted tool that has a wide array of applications. Users can view data, create and save maps, and perform data analysis through their web browser. These maps can be shared and explored by people without Esri organizational accounts, making this a great tool for public outreach. This guide will only cover a small section of the features of this product. Many tutorials exist online and Esri has a series of educational material focused on the online capabilities. I encourage people to explore these materials if they are interested in creating maps online.

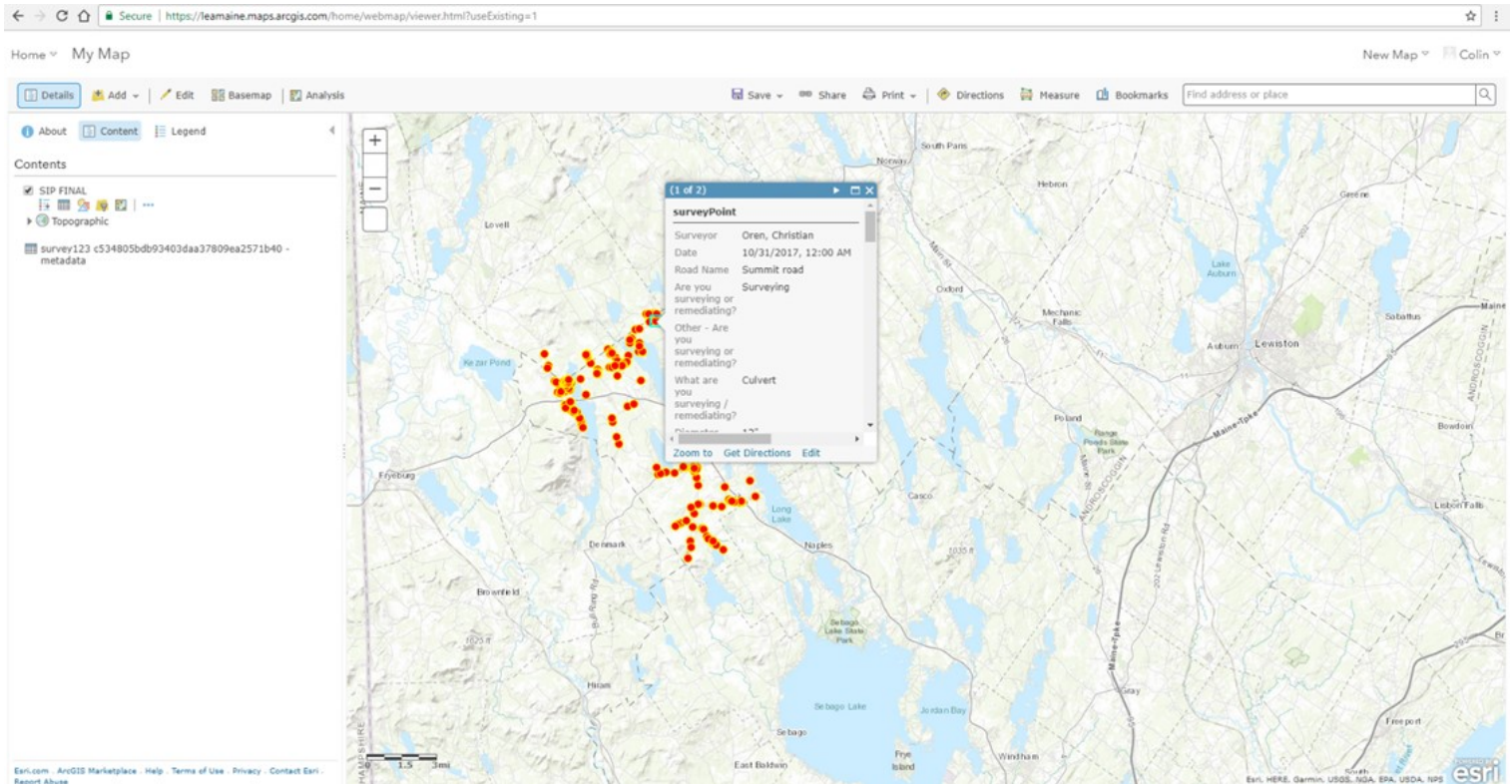


To access the map viewer, go to www.arcgis.com and sign into your organization account. Click the Map tab on the top left to open the Map Viewer app. This will open a web page that displays a map surrounded by an interface similar to the ArcGIS desktop program. In fact, this web app is designed with the desktop program in mind. Users familiar with the desktop program will easily make a switch to this web version. These applications are compatible in that maps and layers can be opened, downloaded or exported to either platform.



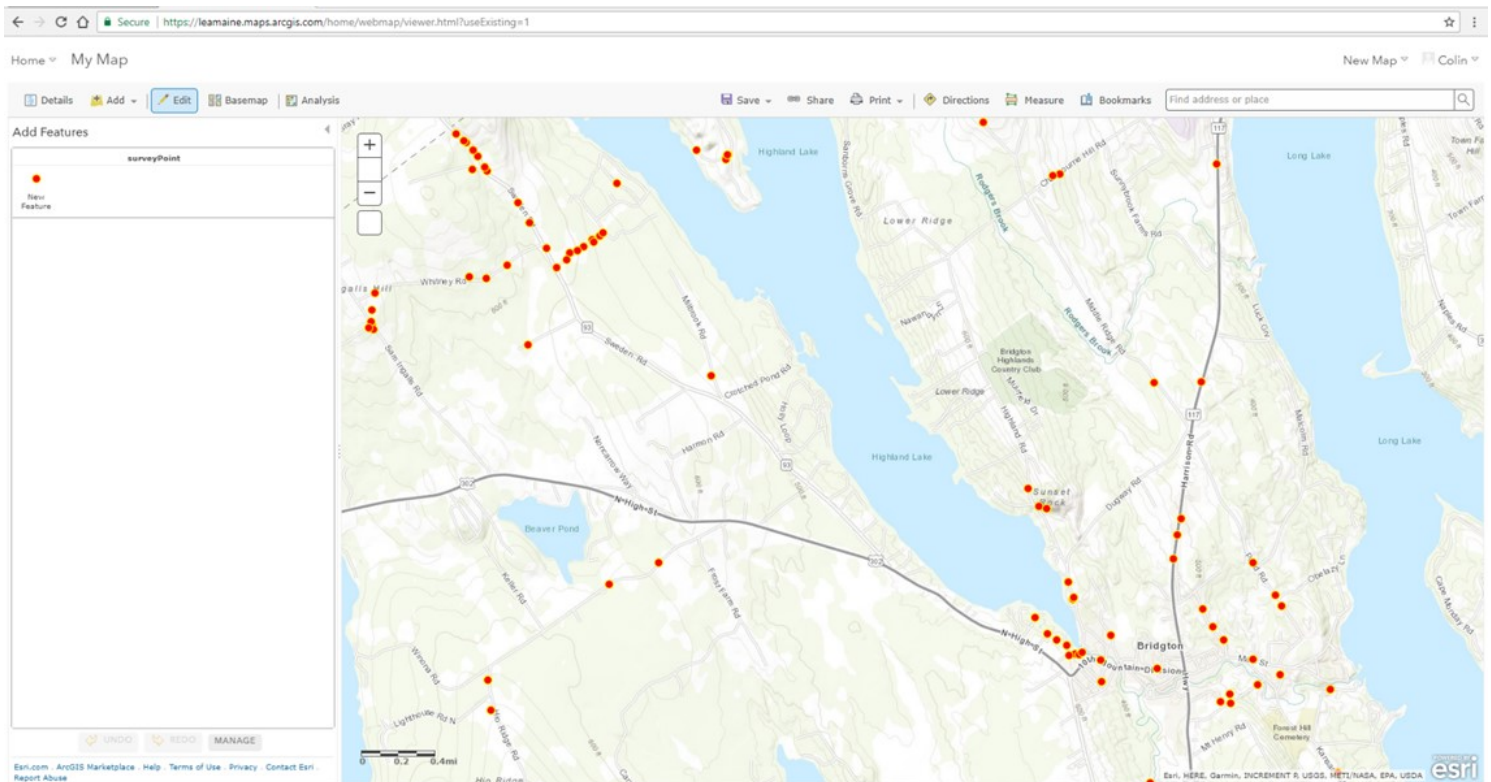
With the Map Viewer open the default view only displays a basemap (you can change the basemap with the Basemap button on the top left). You need to add the survey layer to view and edit data. As mentioned previously, publishing a survey automatically creates a data layer that is hosted on the ArcGIS website. This is where survey data is stored. Add a layer by clicking the Add button on the top left. Click search for layers and your survey layer should pop up. If the layer does not appear, confirm you have access to the layer and that you have selected 'My Organization' from the dropdown. You can add other layers to the map as well. Esri and the GIS community have many layers of demographic, geographic, or environmental information. You can add these layers to supplement or expand your own data and maps.

Once the survey layer has been added, data points will be visible in the map. Go to the Details tab on the top left to see the layer that has been added, and ensure you are in the Contents sub-category as shown below. On the contents tab you have many options to change the expression of the data, view the data table, and perform analysis, among many others. Clicking a data point on the map will display survey questions and answers in a pop-up. This pop-up can be enabled or disabled by in the additional layer options under the content tab (click the ellipsis to show additional options).



Editing Geographic Data

To edit the data, open the data in the map viewer (page 46) and click the Edit button with the pencil graphic on the top left. This will bring up a box on the left with a point that is labeled 'New Feature'. Clicking that box will allow you to create new points on the map that will be part of the survey. You can click on the point to fill out survey information. You can also click any point to edit the responses for that data. Clicking and dragging allows you to change the GPS location of the point. You can use this feature to correct a GPS point a surveyor may have entered incorrectly, or had poor cell service and did not check the map. Any edit you make will be automatically saved to the layer. You do not need to click the save button. The save button actually saves the current settings of the map viewer, not the data layers included. These features, and the ability to correct them, is important in ensuring the quality and accuracy of your data.



Creating Maps with Map Viewer

This online platform allows you to create professional looking maps relatively quickly and easily. Moreover, maps created online are dynamic and intractable unlike static images created through ArcGIS for desktop. Users can zoom, scroll and click on map features. To create a

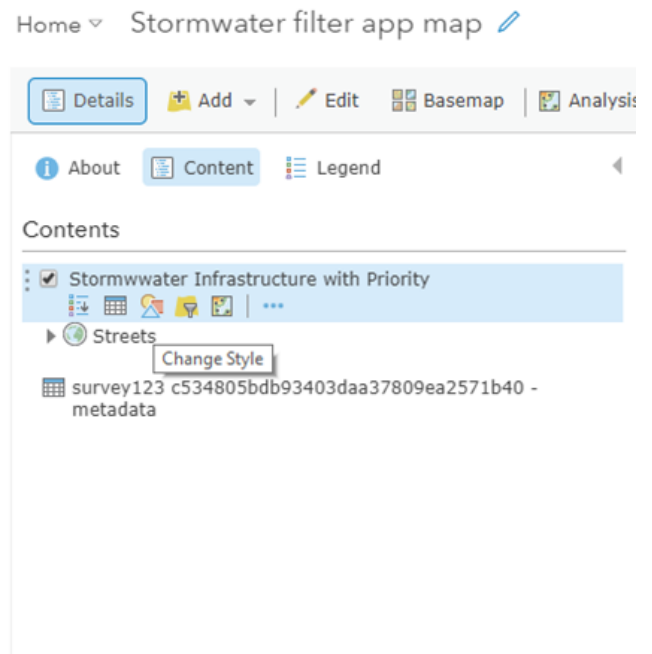
map, follow the previous instructions to open the viewer, edit the basemap, and add layers. Once you have the data you want in your map click on the Save button near the top of the page. Clicking Save will prompt you to name the map, give it searchable tags, a summary, and place it in a folder. Fill out these prompts and the map will be saved in your Content. The current layers and settings of the map are now saved. When you share this map, viewers will see the same layout.

Saving your map in Map Viewer allows others to access the map and data in a usable format.

Editing Layer Styles

To change the way a layer's data is displayed you need to change the layer Style. This feature is accessed under the Details tab on the top left, selecting content, and then clicking Change Style on the specific layer (hover over the layer to display this button). Clicking on the change style button will bring up different drawing options available for that feature in the map. The default option has "Show location only" selected and gives you a choice between a single location point or heat map. Clicking either option will allow you to change color, size, or symbol settings for these types. However, changing the attribute to show allows different style

options. Choosing to show separate attributes will group types for easier viewing. Choosing a number field will bring up counts and amounts that can have gradients of color or size based on the value of the attribute. This is a valuable tool for displaying large groups of data and bringing attention to certain values or points. Experiment with the style options to find ones that are visually appealing and relay your map's message.



Change Style
Stormwater Infrastructure with Priority - surveyPoint

1 Choose an attribute to show
Show location only

2 Select a drawing style
Location (Single symbol) ☒

Options

Heat Map ☐

Select

DONE CANCEL

Default style options on the left and additional options on the right after choosing an attribute stored as a number.

Change Style
Stormwater Infrastructure with Priority - surveyPoint

1 Choose an attribute to show
Remediation Priority

+ Add attribute

2 Select a drawing style
Counts and Amounts (Size) ☒

Options

Counts and Amounts (Color) ☐

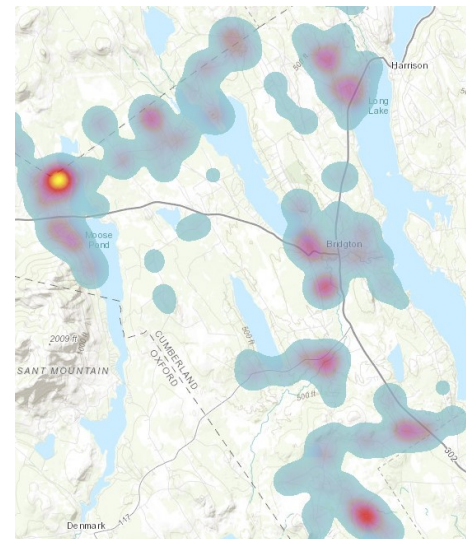
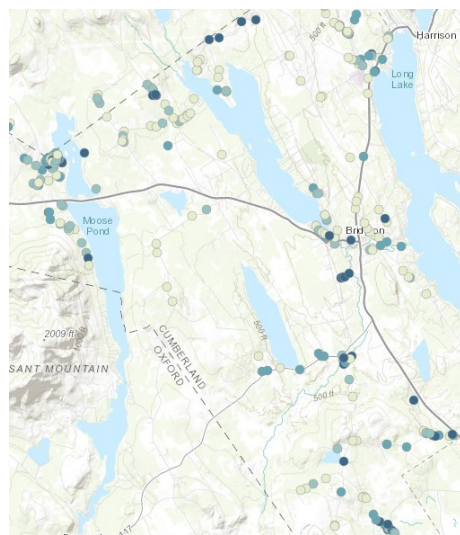
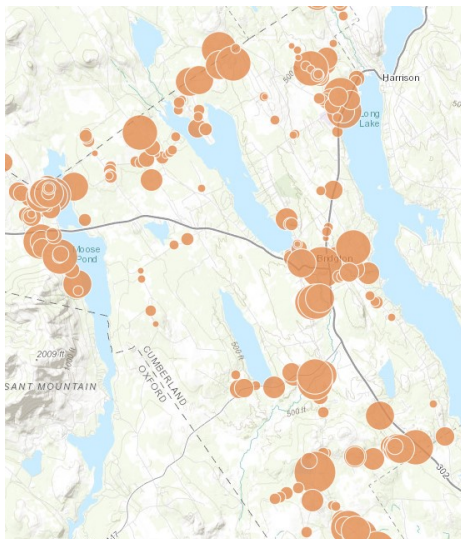
Select

Heat Map ☐

Select

Location (Single symbol) ☐


DONE CANCEL



The variety of layer styles produces very different maps. Left: Counts and Amounts (Size), Center: Counts and Amounts (Color), Right: Heat Map

Sharing your Web Map

After you create a map and customize the layers to your liking, you can share the map for others to see. If you have not already, save the map with the same button. This will save all of the current settings for the map and layers and create a *Web Map* item on the Content page of your online account. Go to that Content page and click on the *Web Map* you would like to share. Clicking on the map from the Content page will bring you to map item where you can edit the map's settings. The Share button on the right side will allow you to set which people you would like to have access to this map. You can share with specific groups, your organization, or the public. Be aware that all of the layers within the map need to have the same sharing settings as your map. You may have to go to those layers from the Content page and set their sharing settings in the same manner.

Once you have the sharing settings administered, click the share button () to get a shareable link to the map. Clicking that link will bring people directly to your map. If sharing settings are set to public, they do not even need ArcGIS access to view the map. You can also open this map through ArcGIS desktop to view and edit the data with that program.

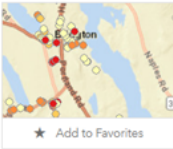
<https://leamaine.maps.arcgis.com/home/item.html?id=fbe7681b6924435295c7ff94732738d1>

Home Gallery Map Scene Groups Content Organization


Colin

Stormwater filter app map

Overview Usage Settings

 Edit Thumbnail

Add a brief summary about the item.

 Web Map by LakesEnvironmental

Created: Feb 15, 2018 Updated: Feb 20, 2018 View Count: 88

★ Add to Favorites

Description

Add an in-depth description of the item.

Layers


Stormwater Infrastructure with Priority


World Street Map


World Street Map


Tables

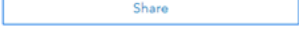
survey123_c534805bdb93403daa37809ea2571b40 - metadata


 Open in Map Viewer

 Open in ArcGIS Desktop


 Create Presentation

 Create Web App

 Share

Item Information  Learn more

Low High




 Top Improvement: [Add a summary](#)


Details

Size: 2 KB

Shared with: Everyone (public)

★★★★★

Owner  Change Owner

LakesEnvironmental

Map Settings

Clicking on the Web Map item from the Content page will bring you to that item's settings page. From this map page you can edit many settings for the map such as the description, thumbnail image, terms of use, among others. Click on the settings tab to have access to more settings. One great feature on this page is the Extent setting. The Extent is the default map view extent when the user opens the map. You can set this by clicking the set extent and zooming in and out of the map pop-up to your desired magnification.

The screenshot shows the 'Map Settings' interface. At the top, there are tabs for 'Overview', 'Usage', and 'Settings'. Below these, there are sub-tabs for 'General Settings' and 'Web Map Settings'. The 'Settings' tab is active, and the 'General Settings' section is visible on the left. The 'Content Status' section includes options to 'Mark as Authoritative' or 'Mark as Deprecated'. The 'Delete Protection' section has a checkbox for 'Prevent this item from being accidentally deleted'. The 'Extent' section shows the current map extent with coordinates: Left: -70.74, Top: 44.07, and Bottom: 44.02. A 'Set Extent' dialog box is open, showing a map of Bridgton, Maine, with a red rectangle indicating the selected extent. The dialog includes a search bar, a 'Draw Extent' button, and input fields for the extent coordinates: Left: -70.745, Right: -70.618, Top: 44.072, and Bottom: 44.018. The dialog also has 'OK' and 'Cancel' buttons.

Additional Resources

Thank you for reading this guide. We hope this guide helps you utilize the powerful tools that mobile surveying offers. It may seem very complicated, but the process is not nearly as confusing as it seems. The software is quite intuitive, and the methods become easier as you gain practice.

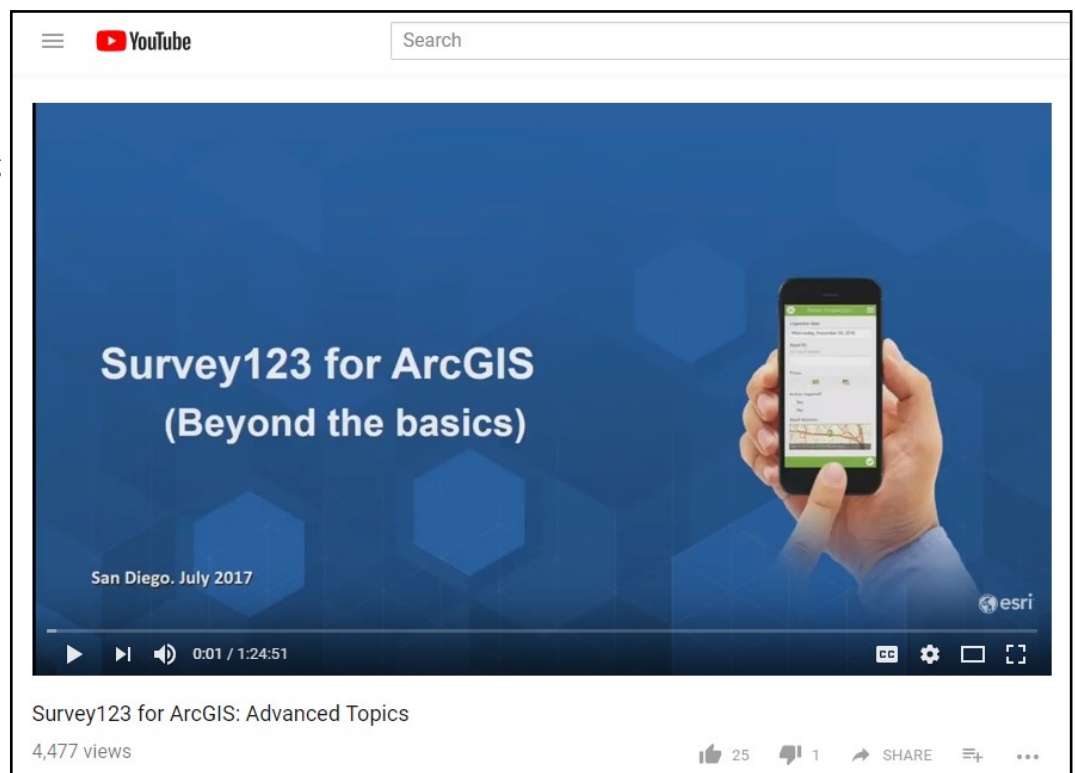
The methods described in this guide offer only a small portion of the functionality of mobile surveying. These are powerful tools, and an exhaustive list would fill up many more pages.

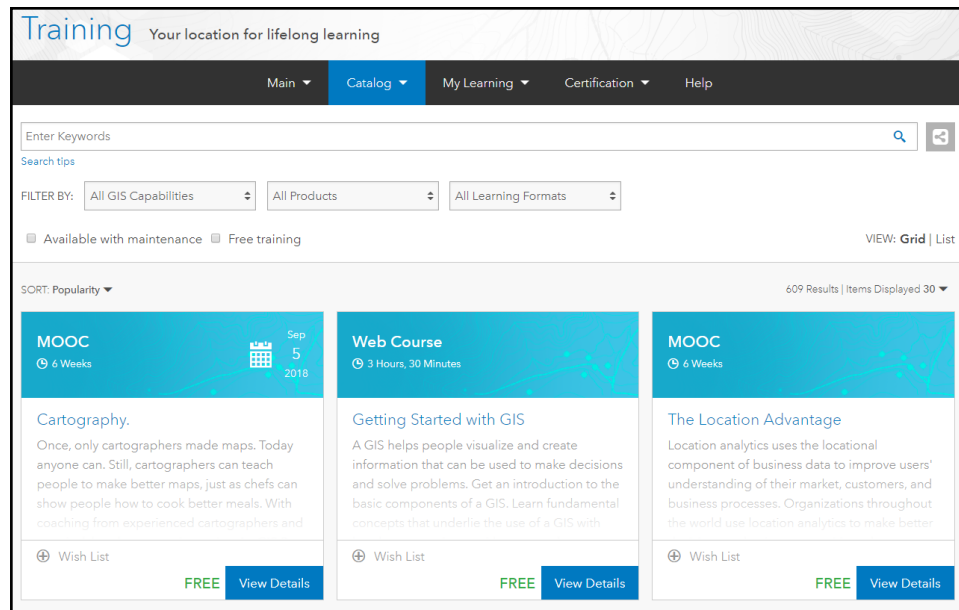
Fortunately, there are many other resources available to help you. These pages direct you to some of the resources I used to write this guide. Best of luck!

Survey123

There is a host of resources to learn more about survey123. The Survey123's help website (<https://survey123.arcgis.com/help>) has quite an array of learning videos, FAQs, blogs, forums, and contact info for Esri support staff. The instructional videos and the Geonet forum were both extremely helpful in learning to use this product. There are also YouTube videos published by Esri

from training seminars or events that cover more in depth topics. One such video we found enlightening was Survey123 for ARcGIS: Advanced Topics (<https://www.youtube.com/watch?v=vECznnoJHGk>).





ArcGIS

ArcGIS software can be quite complicated for new users. The many features can be confusing and even doing simple tasks can be counterintuitive. Fortunately, Esri offers many lessons and tutorials for free (or with an ArcGIS organizational account). These can be accessed at <https://www.esri.com/training/>. Again, free YouTube videos are available for many topics if Esri classes are not an option for your organization.

Environmental Protection Agency



To learn more about Non-Point Source Pollution or the environmental impact of failing stormwater infrastructure, visit the EPA's nonpoint source webpage: <https://www.epa.gov/nps>. This site has learning material on remediating nonpoint source pollution problems such as erosion. There is also information about applying for Clean Water Act Section 319 grant funding that can be used to do watershed improvement projects similar to the project we did in Bridgton.

Lakes Environmental Association

This guide was created to help other small organizations adopt mobile surveying. As the creators of this guide, we are happy to offer additional information on this topic. Contact Christian at 647-8580 or Christian@leamaine.org.



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