TEXAS STREAM TEAM DATAMAP AND SITE AUTOMATION

Final Report

Web Geo. Consulting Co.
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PRESENTED TO

THE MEADOWS CENTER FOR WATER AND THE ENVIRONMENT

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1. Abstract

This project reduced processing time and improved the accuracy of site requests and water quality monitoring submissions managed by the Meadows Center by developing a new datamap workflow and automating key components of the datamap. This work is intended to support the Meadows Center's staff productivity and enhance the reliability of monitoring data collected from sites across Texas. This data is essential for environmental monitoring, helping protect Texas rivers and enabling timely responses to potential water quality issues. We used GIS tools such as ArcGIS Online feature layers, Survey123, Survey123 Connect, and ArcGIS Dashboards to build a system that spans from the initial site request submission and internal review to water quality data reporting and public visualization. Integrating a related tables database with Survey123 with ArcGIS dashboards revitalized the datamap update process for community-based water monitoring. By automating, validating, and visualizing data, the new workflow provides a faster and more accurate process, fulfilling our intended outcome.

2. Introduction

The Texas Stream Team is a volunteer-based Core Environmental Monitoring program housed at The Meadows Center in San Marcos, Texas. The program collects surface water quality data used by resource managers, policymakers, and researchers to assess water health and guide conservation efforts. To help communicate this data to the public, the program developed the Texas Stream Team Datamap—an interactive ArcGIS application that visualizes information from over 350 monitoring sites. The datamap serves as a tool to increase public awareness and engagement in water monitoring.

Currently, the process for updating and verifying site data is mostly manual, resulting in inefficiencies and potential delays in data accessibility. This project aims to improve that process using ArcGIS tools such as Survey123, ArcGIS Online feature layers, and ArcGIS Dashboards. Through data automation, validation, and visualization, the project will enhance the reliability and accessibility of the public datamap for community scientists and the general public. It will also improve usability for internal Dashboard staff and administrative personnel.

3. Problem Statement

The Meadows Center for Water and the Environment has tasked Web Geo Consulting Co. (WGCC) with reducing the processing time of site requests and improving the accuracy of site information by automating aspects of the data map update process. The Meadows Center oversees the Texas Stream Team, a statewide volunteer-based Core Environmental Monitoring program that trains community scientists to collect and submit environmental data. This data, along with new site requests, is submitted through Esri Survey123 forms and managed internally by staff using additional forms.

Processing delays are potentially the result of manual data entry, human error, a volume of submissions that exceed staff capacity, or a combination of these factors. If left unaddressed, these challenges will lead to long-term inefficiencies, reduced data quality, and wasted staff effort. WGCC's response involves establishing a foundational data structure and implementing automation and validation tools to streamline the update process and improve data accuracy.

4. Data

4.1 ArcGIS Online Layers

The feature layers shown in table 1 were retrieved from ArcGIS Online and ESRI's Living Atlas. These layers serve two primary functions: to autopopulate the geographic attributes of monitoring sites requested using the New Monitoring Site Request Form, and to provide contextual reference in the Site Request Review Dashboard Web Map. Datasets published by state and federal sources have a high level of completeness and spatial accuracy. Although precision may vary by source, these datasets are regularly maintained and therefore suitable for autopopulation and spatial context. All these layers use the WGS 1984 Web Mercator (Auxiliary Sphere) coordinate system, which is compatible with Survey123 and ArcGIS Online. No projection transformation was necessary.

Table 1. ArcGIS Online layers

Feature Layer	Layer	Key Fields	Function	Source	Year
Texas County Boundaries	County	CNTY_NM	Autopopulation /Web Map	Texas Department of Transportation (TxDOT)	2024
TWDB_River_Basins	TWDB_River_Basins	Name	Autopopulation /Web Map	- Layer Source: Houston Advanced Research Center (HARC) - Data Source: Texas Water Development Board (TWDB)	2021
Watershed Boundary Dataset HUCs	HUC06, HUC08, HUC10, HUC12	name	Autopopulation /Web Map	- Layer Source: ESRI - Data Source: USGS	2023
Stream Segments_Current	TCEQ_Segment_Lines_Current (0) TCEQ_Segment_Polygons_Current (1)	SEG_ID, SEG_NAME	Autopopulation /Web Map	- Layer Source: Houston Advanced Research Center (HARC) - Data Source: Texas Commission of Environmental Quality (TCEQ)	2024
TCEQ_SWQM_Stations	TCEQ_SWQM_Stations	Station_ID	Web Map Only	- Layer Source: Houston Advanced Research Center (HARC) - Data Source: Texas Commission of Environmental Quality (TCEQ)	2024
Sampling Sites	–	–	Web Map Only	Laura Parchman	2024
Buffer of Sampling Sites	–	–	Web Map Only	Laura Parchman	2023

4.2 Custom Validation Table

To ensure submissions in the Core Environmental Monitoring Form are accurate, we created custom CSV from surface water quality standards regulated by the Texas Commission on Environmental Quality (TCEQ). This CSV includes segment-specific standards for five main core environmental measurements: total dissolved solids (TDS), dissolved oxygen (DO), pH range, indicator bacteria, and water temperature.

Because the original data comes from TCEQ, it is considered accurate for environmental monitoring purposes. The precision of the data varies by the measurement type but is appropriate for the purpose of community monitoring and data validation. This table is not a complete list as it only contains 382 stream segments, compared to the over 1500 streams and water bodies recorded in the Stream_Segments_Current feature layer. However, this table is complete enough to validate most of the monitoring data submissions likely to be encountered by the Texas Stream Team.

	A	B	C	D	E	F	G	H	I	J
1	river_basin	tceq_segment_no	segment_name	tds	do	ph_min	ph_max	indicator_bacteria	temp_f	temp_c
2	Canadian River Basin	0101	Canadian River Below Lake Meredith	5000	5	6.5	9	126	95	35
3	Canadian River Basin	0102	Lake Meredith	1300	6	6.5	9	126	85	29.4
4	Canadian River Basin	0103	Canadian River Above Lake Meredith	4500	5	6.5	9	126	95	35
5	Canadian River Basin	0104	Wolf Creek	1125	5	6.5	9	126	93	33.9
6	Canadian River Basin	0105	Rita Blanca Lake	1000	3	6.5	9	126	85	29.4
7	Red River Basin	0201	Lower Red River	1100	5	6.5	9	126	93	33.9
8	Red River Basin	0202	Red River Below Lake Texoma	1100	5	6.5	9	126	93	33.9
9	Red River Basin	0203	Lake Texoma	1500	5	6.5	9	126	92	33.3
10	Red River Basin	0204	Red River Above Lake Texoma	6000	5	6.5	9	33	93	33.9
11	Red River Basin	0205	Red River Below Pease River	10000	5	6.5	9	33	93	33.9
12	Red River Basin	0206	Red River Above Pease River	25000	5	6.5	9	33	93	33.9
13	Red River Basin	0207	Lower Prairie Dog Town Fork Red River	46200	5	6.5	9	33	93	33.9
14	Red River Basin	0208	Lake Crook	350	5	6.5	9	126	90	32.2
15	Red River Basin	0209	Pat Mayse Lake	350	5	6.5	9	126	90	32.2
16	Red River Basin	0210	Farmers Creek Reservoir	550	5	6.5	9	126	93	33.9

Figure 1. Custom TCEQ water quality standard CSV used for data validation

4.3 Sample Data Records

To verify that each component of the updated datamap workflow functioned correctly, we submitted sample records throughout the development process. These records were created for internal validation processes only and were not based on accurate site or monitoring data. These records were created in structured phases, with each phase focusing on testing specific set of functionalities such as relationship integrity, data storage, autopopulation, and form behavior. A summary of record creation phases is provided in table 2 below.

Table 2. Functional testing of datamap components by phase

Component	Phase 1	Phase 2	Phase 3	Phase 4
SiteAttributes monitoringData layers	Manually added site and monitoring records in ArcGIS Pro to confirm one-to-many relationship	–	–	–
New Monitoring Site Request Form	Confirmed form data stored in siteAttributes and autopopulates geographic attributes	Confirmed submitted records appeared in internal editable version of the form	Confirmed dynamic visibility of form questions	Confirmed that internal form edits updated the feature layer
Core Environmental Monitoring Form	Confirmed form data stored in monitoringData and TDS/DO average calculations worked	Confirmed site list showed only approved, active, inactive sites; link between monitoring data and site is accurate	Confirmed data validation messages triggered for key parameters	–

5. Methods

The flow chart in figure 2 shows the new datamap workflow, starting with a site request submission, moving on to site review and approval, then towards monitoring data submission, and finally to data visualization on the public Texas Stream Team Datamap. It also shows how each survey, feature layer, view layer, and dashboard is involved in this process. These steps are explained further in the following subsections.

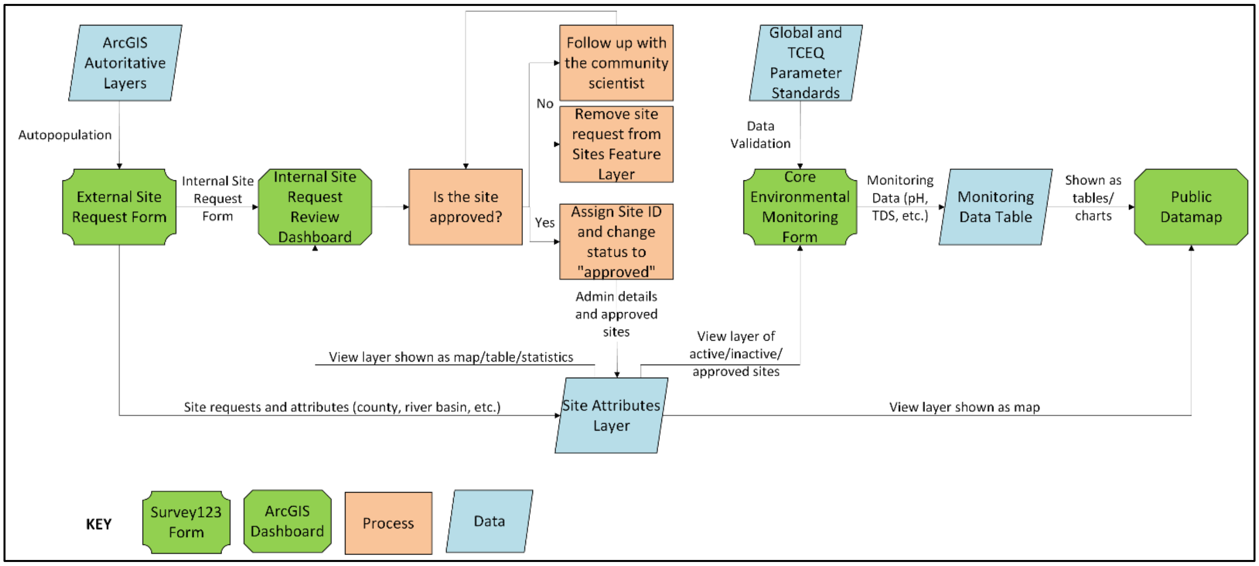


Figure 2. Data flow chart

In addition to the new components of the datamap workflow, we have automated geographic attribute population, created a dynamic list of sites for selection, and implemented data validation for core environmental measurements. These improvements have streamlined the flow of data from site request to site monitoring, minimizing administrative workload.

5.1 SiteAttributes and monitoringData Related Tables

Before developing any Survey123 forms or the ArcGIS dashboard, we created the foundational feature layer and standalone table required for the updated datamap workflow. As outlined in our proposal and progress report, we implemented a one-to-many relationship between a point feature class and a standalone table: one storing sites and their attributes (siteAttributes) and another storing monitoring records (monitoringData) (Esri Ireland, 2016).

Using ArcGIS Pro, the point feature class and table were created with all the necessary fields and domains. We configured the GlobalID-GUID relationship class using the GlobalID field in siteAttributes as the primary key and the siteGlobalID field in monitoringData as the foreign key. We then added a test record to the siteAttributes feature class and two related records to the monitoringData table to confirm the relationship class functioned correctly. Both datasets were uploaded to ArcGIS Online as a single hosted feature layer, and we confirmed that they maintained their relationship. (Figure 3).

siteAttributes

Site ID	
testSite001	(2)
testSite002	(0)
testSite003	(1)
testSite004	(0)
testSite005	(0)
testSite006	(0)
testSite007	(0)
testsite008	(0)
testSite009	(2)

monitoringData (Features: 2, Selected: 0)

Site Global ID	Sample Date	Sample Time...	Sample Dept...	Group or Affi...
3aaddd26-4e68-473b-865b-e785f3c55417	2025-04-22	0930	10	WGCC
3aaddd26-4e68-473b-865b-e785f3c55417	2025-04-23	1500	10	WGCC

Figure 3. Related tables in ArcGIS Online

5.2 New Monitoring Site Request Form

5.2.1 Form Creation and Design

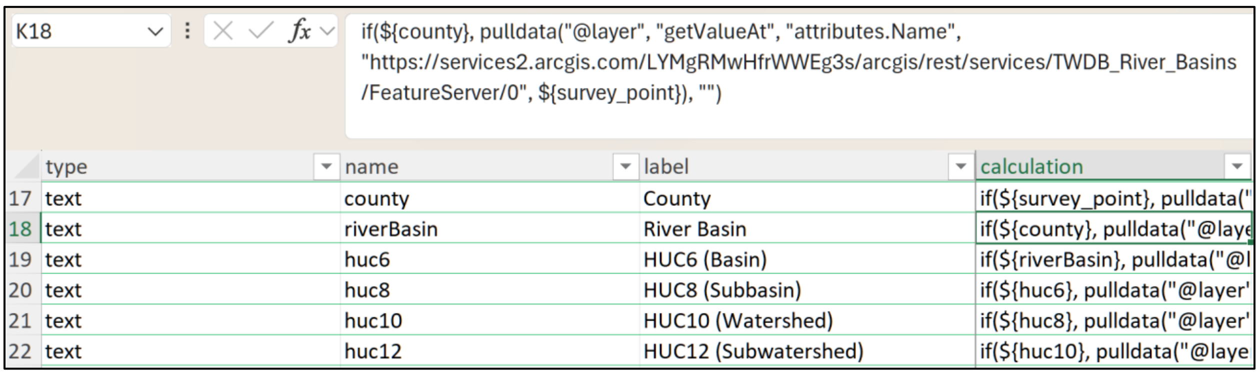
Once the feature layer and table were uploaded to ArcGIS Online, we created the New Monitoring Site Request Form in Survey123 Connect using the siteAttributes feature layer. Because the form was generated directly from the feature layer, all question types, names, and labels were pre-populated in the XLSForm.

We refined the design of the form by adding a customized title, introductory text at the top of the form, and subtext beneath certain questions to add context. For a cleaner interface, we also customized the font sizes, added a color scheme, and formatted hyperlinks. We also rearranged the question order to improve the logical flow of the form.

5.2.2 Autopopulation of Geographic Attributes

To improve efficiency and data accuracy, we configured the form to autopopulate geographic attributes of a requested site based on a location selected by the user. These attributes included county, river basin, and hydrologic unit codes (HUCs). Each field used a conditional pulldata(“@layer”) calculation (Esri, n.d.-c) to query ArcGIS Online feature layers from authoritative sources, including TxDOT, the Houston Advanced Research Center, and ESRI’s Living Atlas.

To avoid timeouts caused by querying seven layers at the same time, we sequenced the pulldata calculations so that each field only populates if the previous field has a value. For example, the river basin field will only autopopulate after the county field has been filled (Figure 4).


K18 | if(${county}, pulldata("@layer", "getValueAt", "attributes.Name", "https://services2.arcgis.com/LYMgRMwHfrWWEg3s/arcgis/rest/services/TWDB_River_Basins/FeatureServer/0", ${survey_point}), "")

	type	name	label	calculation
17	text	county	County	if(${survey_point}, pulldata("
18	text	riverBasin	River Basin	if(${county}, pulldata("@laye
19	text	huc6	HUC6 (Basin)	if(${riverBasin}, pulldata("@l
20	text	huc8	HUC8 (Subbasin)	if(${huc6}, pulldata("@layer"
21	text	huc10	HUC10 (Watershed)	if(${huc8}, pulldata("@layer"
22	text	huc12	HUC12 (Subwatershed)	if(${huc10}, pulldata("@laye

Figure 4. Pulldata(“@layer”) function for retrieving river basin value

Additionally, we used the selected geopoint (survey_point) to autopopulate latitude and longitude fields. This was achieved using the pulldata(“@geopoint”) function, which extracts the x- and y-coordinates from the map location selected by the user (Esri, 2016b). We rounded both coordinates to five decimal places, which provides a precision of about ± 1.1 meters.

Table 3. Pulldata("@geopoint") function for retrieving latitude and longitude

type	name	label	calculation
decimal	latitude	Latitude	round(pulldata("@geopoint", ${survey_point}, "y"), 5)
decimal	longitude	Longitude	round(pulldata("@geopoint", ${survey_point}, "x"), 5)

5.2.3 Conditional Field Visibility Based on Form Mode

For this form, we wanted these geographic attribute fields and certain administrative fields to be hidden from the public during new form submissions and visible to internal staff during the site request review process. To implement this, we used the pulldata("@property", 'mode') function in Survey123 Connect (Esri, 2021a).

This function retrieves the current mode of the form, whether it's being used to create a new record ("new"), edit an existing record ("edit"), or view a record in read-only mode ("view"). We created a hidden field at the top of the XLSForm to store this value (Table 4), then used the body::esri:visible column to control when certain fields should be displayed (See Table 5; Esri, 2022a).

Table 4. Field configuration to capture current form mode

type	name	label	calculation
Hidden	survey_mode	Survey Mode	pulldata("@property", 'mode')

Table 5. Conditional visibility logic for fields shown only in edit mode

type	name	label	calculation	body::esri:visible
Text	county	County	Pulldata("@layer"...)	${survey_mode}='edit'

siteStatus is a specific field that that not only has conditional visibility but also has a default value of "New." However, Survey123 Connect doesn't fill in default values to fields that are hidden during the initial form load, even if the field becomes visible later in edit mode. To resolve this, we added a calculate field that always outputs "New" and then set the siteStatus field to reference this value (Table 6).

Table 6. Logic to assign default value and show siteStatus only in edit mode

type	name	label	calculation	appearance	body::esri:visible
calculate	calc_siteStatus	Site Status Logic	"New"		
select_one	siteStatus	Status	${calc_siteStatus}	minimal	${survey_mode}='edit'

Setting up conditional field visibility accomplishes several things: it ensures the public only see fields relevant to their submission, allows staff to access all necessary fields during site request review process, and allows all hidden fields to be stored within the single siteAttributes feature layer.

5.3 Core Environmental Monitoring Form

5.3.1 Form Creation and Design

With the related tables completed, we created the Core Environmental Monitoring Form in Survey123 Connect using the monitoringData table. As with the New Monitoring Site Request Form, creating the form using the table automatically populated the question type, names, and labels in the XLSForm. We applied the same overall design elements used in the New Monitoring Site Request Form, which included a customized title, font styling, color scheme, and question reordering.

5.3.2 Creating a Time Constraint for Sample Time

To enforce a valid military time format for the sampleTime field, we applied a constraint that used a regular expression and substring logic (see Table 7; Esri, 2022b; Microsoft, 2022).

Table 7. Constraint logic for sampleTime field

type	name	label	constraint	constraint_message
text	sampleTime	Sample Time (military)	regex(., '^[0-9]{4}$') and number(substr(., 0, 2)) < 24 and number(substr(., 2, 4)) < 60	Must be HHMM in 24-hour format (ex. 0930)

The regular expression (regex) checks that the input is exactly 4 digits with no spaces or symbols. The substring (substr) logic checks to see if the first two digits (hours) are less than 24 and the last two digits (minutes) are less than 60. This constraint helps standardize the time format for all form submissions and prevent errors from invalid formats like “1:30” or “1166”.

5.3.3 Automatic Calculations for TDS and DO Average

Some measurements, such as total dissolved solids (TDS) and dissolved oxygen (DO) average, require calculations. TDS is calculated by multiplying conductivity by 0.65. The DO average is calculated by finding the mean of the two DO titration values (DO1stTitration and DO2ndTitration), but only if the absolute difference between them is less than 5 mg/L. Both calculations were implemented using expressions in the calculation column of the XLSForm, as shown in table 8 below.

Table 8. TDS and DO average calculation expressions

type	name	label	calculation
decimal	totalDissolvedSolids	Total Dissolved Solids (mg/L)	number(${conductivity}) * 0.65
decimal	DOAverage	Dissolved Oxygen Average (mg/L)	if((number(${DO1stTitration}) - number(${DO2ndTitration}) <= 5 and number(${DO2ndTitration}) - number(${DO1stTitration}) <= 5), (number(${DO1stTitration}) + number(${DO2ndTitration})) div 2, '')

Survey123 doesn’t support constraints and constraint messages on calculated fields, so to alert community scientists when their titration values are too far apart, we added a warning note (See Table 9; Esri, 2023) that only appears when the mean difference between the two titration values exceeds 5 mg/L. This message provides real-time feedback while still allowing users to submit the form.

Table 9. Field configuration for DO warning message

type	name	label	relevant
note	DOwarningNote	Cannot calculate DO average — values differ by more than 5 mg/L	(${DO1stTitration} - ${DO2ndTitration} > 5 or ${DO2ndTitration} - ${DO1stTitration} > 5)

5.3.4 Creating a Dynamic List of Sites

To ensure each new monitoring record is automatically linked to its corresponding site record, we created a dynamic list of sites for community scientists to select from when submitting monitoring data. This list was sourced from a view layer called siteAttributes_status_viewLayer, which is a filtered subset of the original siteAttributes feature layer. The view layer only includes site records that have a status of “approved,” “active,” or “inactive,” ensuring that the site list is always up to date while excluding unapproved or incomplete site records.

To create this list, we configured a "select_one" question that uses the search() function to retrieve records from the view layer (Esri, 2021b). The question allows users to type their site's ID or description to help them narrow down the list (Table 10).

Table 10. Field configuration to set up the dynamic list

type	name	label	appearance
select_one site_list	selectedSite	Site ID and Description	autocomplete search("site_list?url= https://services1.arcgis.com/M68M8H7oABBFs1Pf/arcgis/rest/services/siteAttributes_status_viewLayer/FeatureServer/0 ")

In the choices sheet, we defined the structure of the list so that the site's GlobalID is stored as the value and the site's ID and description are displayed as the label, making it easier for users to find the correct site (Table 11).

Table 11. Configuration of site list structure in the choices sheet of the XLSForm

list_name	name	label
site_list	GlobalID	siteIdAndDescription

Once a site has been selected by the user, the site's GlobalID is stored in the siteGlobalID field of the monitoring record. This value establishes the one-to-many relationship between the selected site and submitted monitoring data, allowing all submissions to be linked to their site record without any manual intervention, improving data organization and workflow efficiency.

Table 12. Field configuration to store the selected site's GlobalID

type	name	label	calculation
text	siteGlobalID	Site Global ID	${selectedSite}

5.3.5 Data Validation of Core Environmental Measurements

To ensure that values submitted in the Core Environmental Monitoring Form align with surface water quality standards, we implemented a data validation system referencing standards from TCEQ. This system dynamically warns users when their measurement values are outside the expected range for their selected site.

We started with the TCEQ_Basin_WQS Excel spreadsheet provided by our client and reformatted it into a CSV so that the data is compatible with Survey123 Connect's pulldata() function. We standardized the column names, added a Celsius column, and split the pH column into separate minimum and maximum columns. We removed commas, exponents, extra symbols, and padded segment numbers between 100 and 999 with a leading 0. For tidal and marine segments where the indicator bacteria values were listed as 34/14 (geometric mean/single sample max), we retained only the geometric mean since we only have one field recording indicator bacteria. After finalizing these changes, the CSV was saved in the form's media folder (Figure 1).

In Survey123 Connect, we used the user's selected site to retrieve its corresponding segment number. The segment number is needed to look up applicable water quality standards from the CSV. We accomplished this by using the pulldata("@layer") to query the siteAttributes_status_viewLayer (See Table 13; Esri, 2022c).

Table 13. Field configuration for retrieving the site's segment number

type	name	label	calculation
calculate	segmentNoFromLayer	Segment ID Lookup from Layer	pulldata("@layer", "getValue", "attributes.tceqSegmentNo", "https://services1.arcgis.com/M68M8H7oABBFs1Pf/arcgis/rest/services/siteAttributes_status_viewLayer/FeatureServer/0", concat("GlobalID='", ${siteGlobalID}, "'"))

Using the segment number, we retrieved the appropriate standards from the CSV using the pulldata() function. (See Table 14; Esri, 2016a)

Table 14. Pulldata() function for retrieving surface water quality standards

type	name	label	calculation
calculate	temp_param	Water Temp Parameter	pulldata("TCEQ_WQS_data_validation", "temp_c", "tceq_segment_no", ${segmentNoFromLayer})

To provide feedback without blocking submission, we used notes to display warning messages when a user's input exceeds the TCEQ standard (See Table 15; Esri, 2023).

Table 15. Field configuration for standard warning message

type	name	label	relevant
note	TempParamWarningNote	Alert: The water temperature value entered exceeds the typical range for this stream segment, and may indicate a potential concern. Please verify your entry and check site conditions before submitting. TCEQ parameter maximum: ${temp_param} °C	${waterTemp} > ${temp_param}

While each parameter needed their own pulldata() calculation and warning note, the structure of the logic was the same. Below is a summary describing the logic applied to each parameter (See Table 16; Texas Commission on Environmental Quality, 2022).

Table 16. Threshold type for each surface water quality standard

Parameter	Validation Logic	Threshold Type
Water Temperature	${waterTemp} > ${temp_param}	Maximum
Total Dissolved Solids	${totalDissolvedSolids} > ${tds_param}	Maximum
Indicator Bacteria	${indicatorBacteria} > ${bacteria_param}	Maximum
Dissolved Oxygen	${DO1stTitration} < ${do_param}	Minimum
pH	${pH} < ${ph_min_param} or ${pH} > ${ph_max_param}	Range

5.4 Web Map Configuration

The central component of the Site Request Review Dashboard is a web map created in ArcGIS Online. This map provides spatial visualization for monitoring sites and the surrounding hydrologic and administrative features. The following subsections describe the map's view layer, styling, and pop ups.

5.4.1 View Layer Configuration

All embedded elements of the dashboard, including the web map, rely on the siteAttributes_viewLayer as the primary data source. This view layer is a subset of the original siteAttributes layer that retains all original fields and records. Because embedding feature layers with an existing relationship class can cause compatibility issues in the dashboard, we created the view layer to isolate the data from its related table (monitoringData). This approach provides stable access to the data while also preserving the relationship between the original feature layers.

5.4.2 Symbology and Pop-Up Configuration

All layers included in the web map were renamed for clarity and symbolized to enhance visibility. Monitoring sites were symbolized based on the same color scheme as the status indicators in the Site Request Review Dashboard, helping staff quickly associate the point features with summary statistics. To reduce visual clutter, HUCs, stream segments, and Texas county lines were displayed with thinner lines and increased transparency.

We also reconfigured the popup for the siteAttributes view layer (Esri, n.d.-b). We selectively included and reordered the fields to mirror the structure of the New Monitoring Site Request Form, while also including the river basin, HUCs, and segment fields to provide a more detailed overview. This configuration was done in preparation for the dashboard's Detail element, which appears in the left panel and displays site information when a feature is selected (Figure 5).

5.4.3 Attribute Expressions for Stream Segment and TCEQ Station Information

In the New Monitoring Site Request Form, we were able to autopopulate several geographic attributes, such as county, river basin, and HUCs using pulldata("@layer") functions. However, this method doesn't support retrieving values from point or line feature layers, which means that we couldn't autopopulate fields such as tceqStation, tceqSegmentNo, and segmentName in Survey123 Connect.

To address this limitation and further reduce manual lookup for staff, we used Arcade attribute expressions in the siteAttribute View Layer's pop-up configuration (Esri, n.d.-a). Attribute expressions allow us to display information that is not originally stored in the feature layer (Esri, n.d.-b). The Arcade logic works by retrieving the segment number, segment name, and TCEQ station fields from their respective layers. When a monitoring site is selected, a 400-meter buffer is generated around the point. The expression identifies the features that intersect with the buffer, then iterates through all the features and selects the closest one to display in the pop-up. This can be seen in the Detail element in figure 5.

These dynamically generated values are not saved in the siteAttributes view layer, but staff can use them to fill out the fields using the embedded form so that they can be stored permanently. This method will ultimately save staff time during the site request review process by eliminating the need to cross-reference other datasets.

5.5 Site Request Review Dashboard

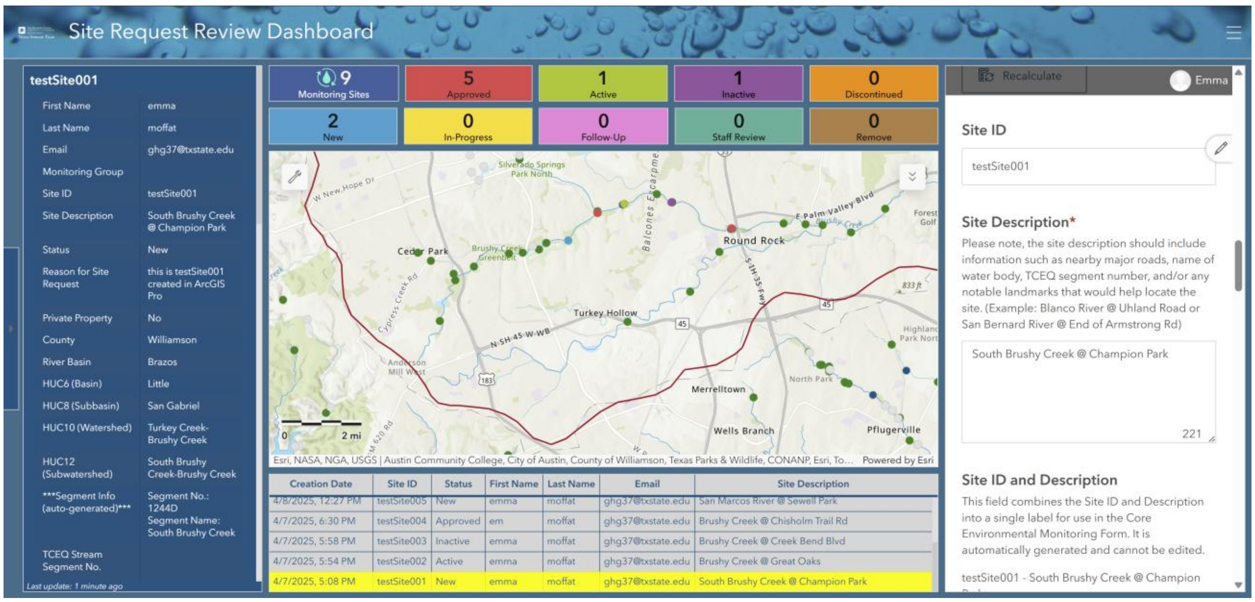


Figure 5. Site Request Review Dashboard

The Site Request Review Dashboard was created to support the internal review of monitoring site requests submitted using the New Monitoring Site Request Form. This dashboard streamlines the review process by combining real-time status tracking, record editing, and spatial visualization.

The top row includes two rows of status indicators that display the number of sites currently in each review stage. The top row includes All sites, Approved, Active, Inactive, and Discontinued. These represent post-review statuses, used to track sites after they have gone through the review process and reflect their current operational state. The bottom row includes New, In progress, Needs follow up, Staff review, and Remove. These represent site review statuses used to monitor submissions during the request review process. These indicators are updated automatically based on the siteStatus field of the site request record, giving staff a visual overview of the site review progress.

The Details panel on the left side of the dashboard displays key information of the currently selected site request. This panel functions as a pop-up, providing an overview of the site requester's information and the requested site's attributes.

The right side of the dashboard contains the embedded New Monitoring Site Request Form set to "edit" mode, which allows internal staff to view and edit form submissions without leaving the dashboard interface. This form is loaded by referencing the siteAttributes_viewLayer and using a dynamic URL:

https://survey123.arcgis.com/share/[FORM_ID]?mode=edit&globalId={field/GlobalID}

The bottom panel contains a record table displaying all site request form submissions. Selecting a row in the table updates the Details panel, map view, and embedded form simultaneously.

6. Results and Discussion

6.1 Testing the Datamap Workflow

To verify the full functionality of the new datamap workflow, we conducted a complete walkthrough from site request to monitoring data submission using the following steps:

A new site request was submitted using the New Monitoring Site Request Form (Figure 6).

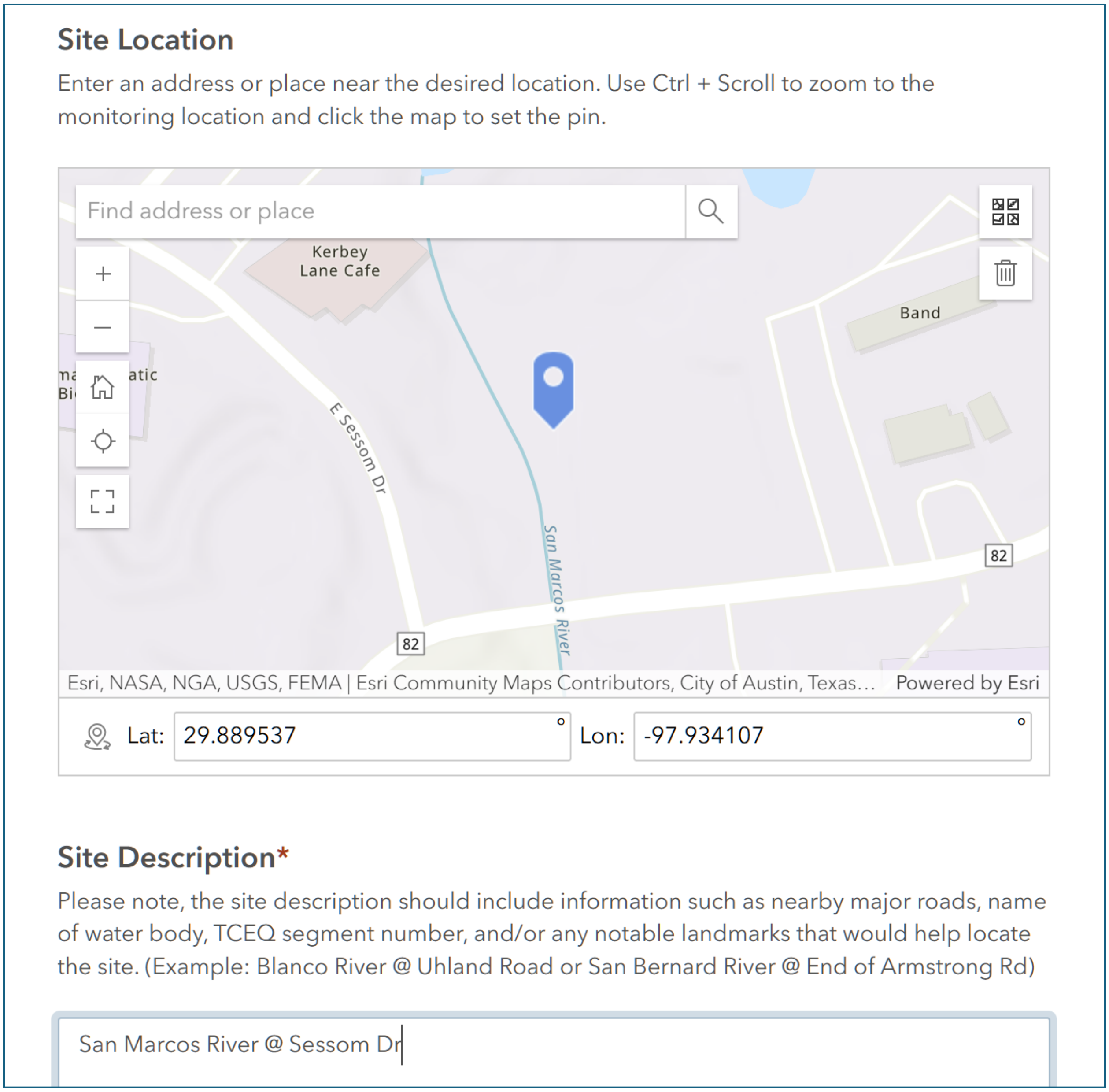


Figure 6. Submitting a new site request

Using the internal Site Request Review Dashboard, we confirmed the newly submitted site request was visible on the map and within the embedded editable form. Using the form, we updated site’s status from “new” to “approved” and filled out the site’s TCEQ stream segment number (Figure 7).

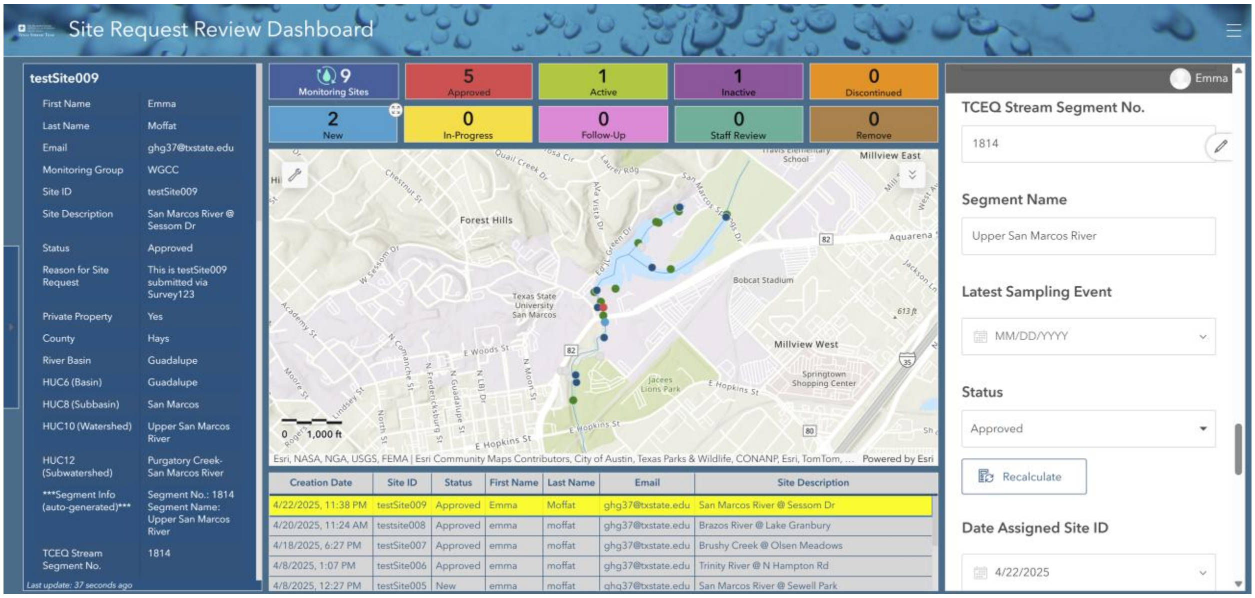


Figure 7. Editing and approving site in the Site Request Review Dashboard

Next, we opened the Core Environmental Monitoring Form and verified the newly approved site appeared in the dynamic site list (Figure 8.)

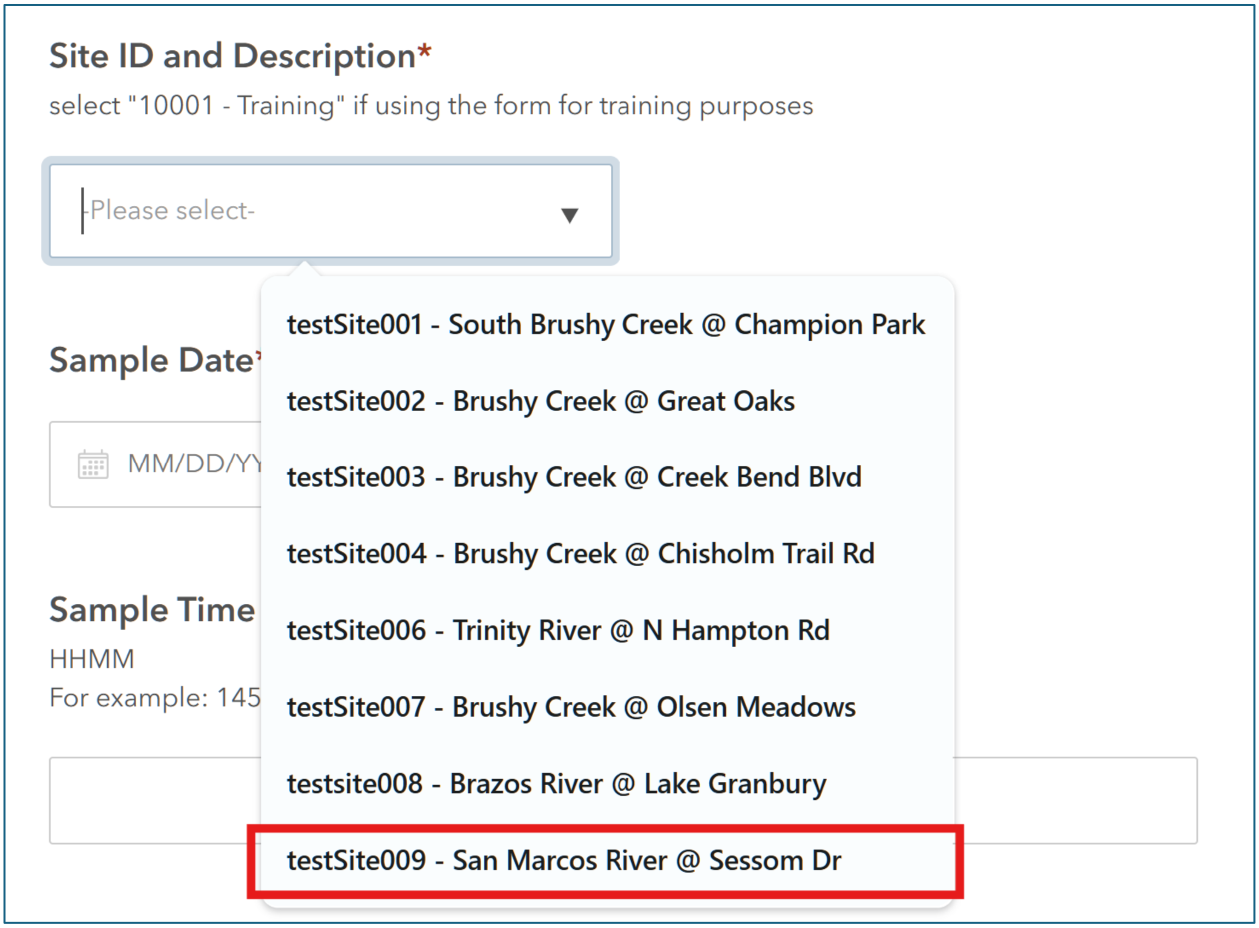


Figure 8. The newly approved site appears in the dynamic site list

As we filled out the form, we verified that the time constraints, calculations, and data validation logic was functioning as intended (Figure 9-11).

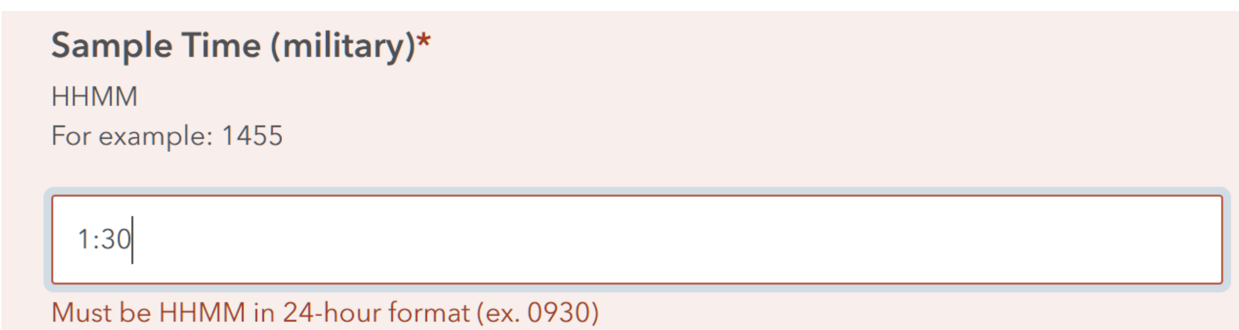


Figure 9. Time constraint warning message

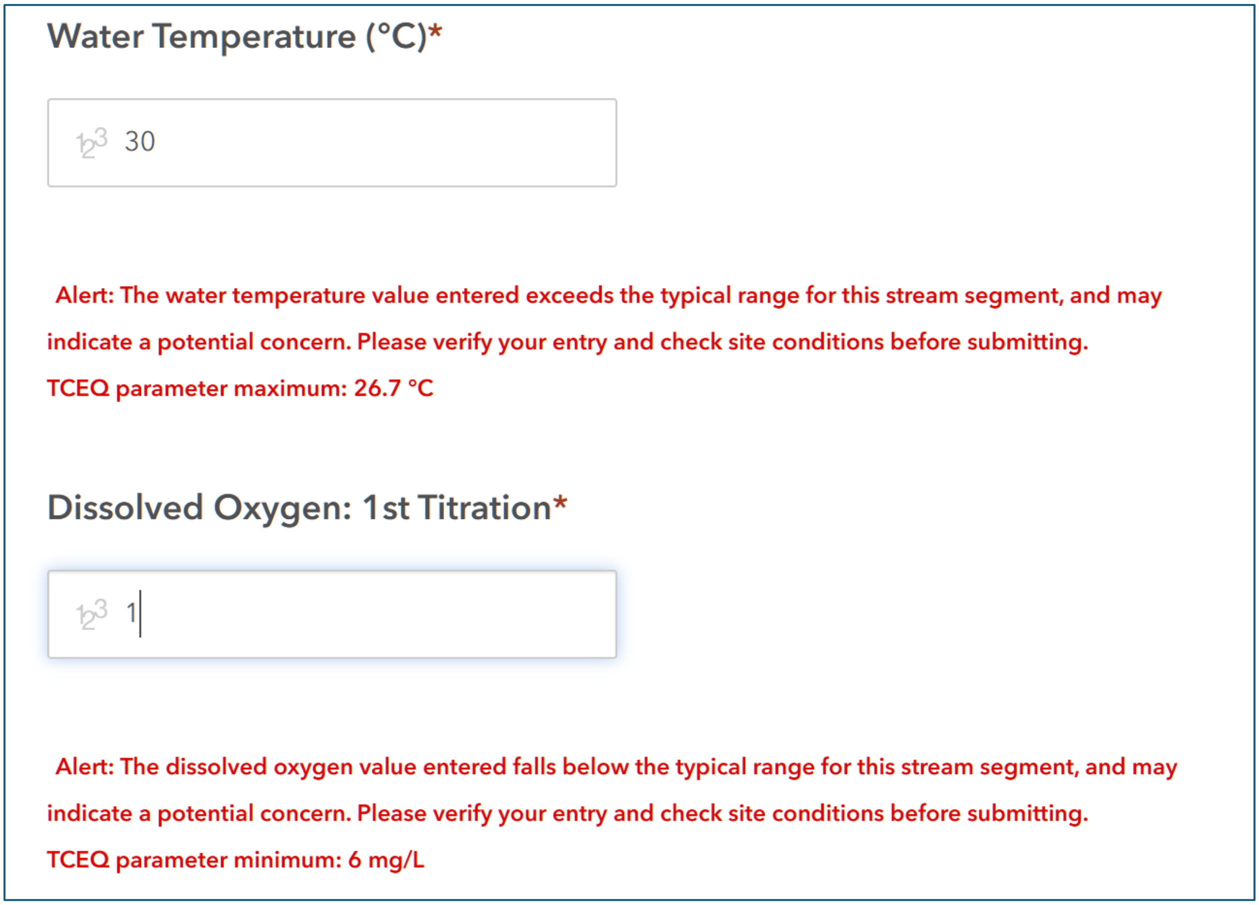


Figure 10. Data validation warning messages

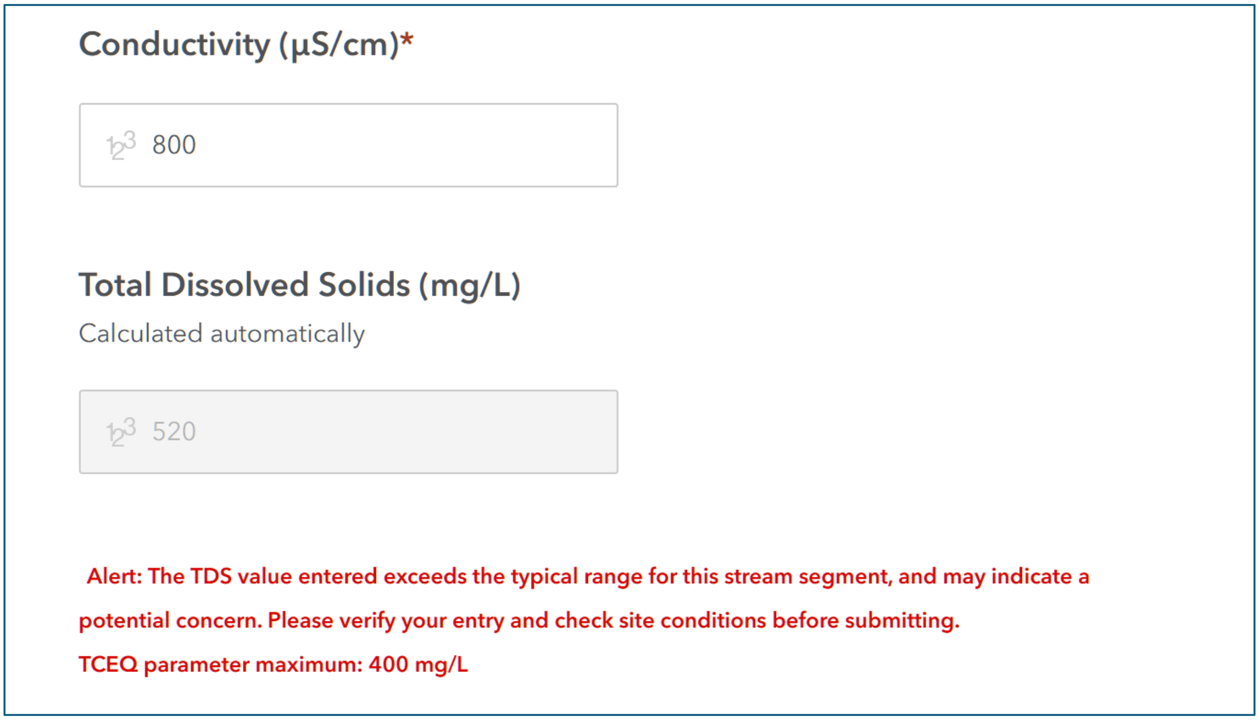
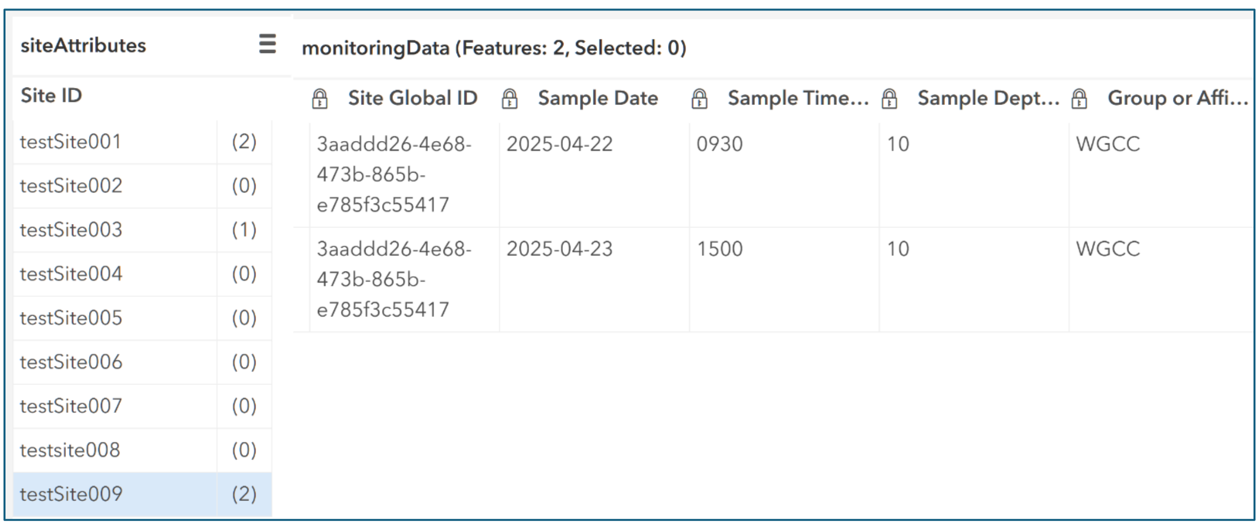


Figure 11. Data validation warning message and TDS automatic calculation

After submitting the monitoring data, we confirmed that the monitoring records were correctly linked with their associated site (Figure 12).



siteAttributes

Site ID	
testSite001	(2)
testSite002	(0)
testSite003	(1)
testSite004	(0)
testSite005	(0)
testSite006	(0)
testSite007	(0)
testsite008	(0)
testSite009	(2)

monitoringData (Features: 2, Selected: 0)

Site Global ID	Sample Date	Sample Time…	Sample Dept…	Group or Affi…
3aaddd26-4e68-473b-865b-e785f3c55417	2025-04-22	0930	10	WGCC
3aaddd26-4e68-473b-865b-e785f3c55417	2025-04-23	1500	10	WGCC

Figure 12. Monitoring records automatically linked to site record in ArcGIS Online

This walkthrough of the datamap process showed that the relationship class is maintained, and both site and monitoring records are automatically linked as data is submitted.

6.2 Data Quality Issues

During our test runs, we did not encounter any significant data quality problems. Autopopulated fields performed correctly, and all records linked properly between forms and feature layers. We did, however, identify several areas where data quality issues could arise in real-world use. For example, inconsistency or incorrect user input in Survey123 forms could occur such as selection error, mistyped response, or improper formatting. Additionally, while domains and constraints help limit input errors, they cannot fully prevent missing or duplicated submissions, especially in the case of poor internet connectivity or user confusion. Though these issues did not occur during our testing phase, they represent realistic concerns for long-term system use and highlight the importance of user training and routine data validation.

6.3 Limitations

ArcGIS Dashboards presented a limitation due to its restricted support for displaying data from related tables. This constraint made it difficult to integrate monitoring data directly into the Dashboard interface. To address this, we created a view layer of the siteAttributes layer, which allowed us to display and edit necessary site request information on the Dashboard without disrupting the relationship between the data layers. Another limitation we encountered was the need to create related tables in ArcGIS Pro before uploading them to ArcGIS Online. This required additional software steps and coordination, especially when making edits or changes to the data structure after it had already been published online. One final limitation was the autopopulation of segment numbers, names and TCEQ Stations to site records. Though we resolved this issue using attribute expressions for pop-ups, recording these fields is still semi-manual.

6.4 Concerns and Problems

Through the development of the project, our team encountered a steep learning curve while learning new tools and workflows. Creating related tables, configuring forms within Survey123 Connect, and building ArcGIS Dashboards were all new processes for the team and involved huge amounts of troubleshooting and research. We also had to learn the importance of assigning and linking GlobalID-GUID site relationships correctly to ensure that monitoring form submissions were properly connected to their corresponding site records.

Another challenge was becoming familiar with XLSForm syntax in Survey123 Connect. This was essential for applying advanced form logic, including calculations, constraints, and conditional visibility settings, but it added to the complexity of the learning process.

One last problem our team faced was the Core Environmental Monitoring Form in Survey123 Connect repeatedly crashing. This is due to the form having seven pulldata("@layer") functions, which is known to overload the program, causing it to crash. To resolve this, we sequenced the pulldata calculations so that each field only populates if the previous field has a value. Even though Survey123 Connect still occasionally crashes while trying to edit this form, using conditional pulldata("@layer") functions significantly reduced the amount.

If our team continued with this project and more time was allotted, we would perform additional spatial analysis, evaluating site proximity to both each other and professional monitoring stations (within 400 meters). Based on this analysis, we would provide a summary of our findings and recommendations based on these analyses to improve site distribution and data accuracy.

7. Conclusion

We successfully developed and piloted an automated, GIS-enabled workflow that saved processing time and improved data accuracy for the Texas Stream Team. Using Survey123, ArcGIS Online, and ArcGIS Dashboards, our system worked as intended, demonstrating how automated workflows can significantly streamline environmental data management.

Throughout this project, we gained hands-on experience with ArcGIS Online components, data automation, and validation, and We also learned how to troubleshoot real-world GIS challenges and strengthened our skills in team coordination.

This project supports long-term goals in environmental conservation, public health, and water resource management. By automating and reorganizing data collection for the volunteer-based monitoring program, we make more accurate, timely, and accessible data possible. The new datamap workflow we created could be adapted to other industries or sectors that rely on community-generated data, such as urban planning, disaster response, and public health. Overall, this project shows how thoughtfully designed GIS workflows can increase efficiency and empower communities.

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Appendix I: Group Members Contribution

- Emma Moffat

Emma served as the project manager and primary GIS developer for the project. She was responsible for creating the related siteAttributes feature class and monitoringData table in ArcGIS Pro, establishing the relationship class, and uploading the datasets to ArcGIS Online. For the New Monitoring Site Request Form, she created the form and configured the layout, geographic attribute autopopulation, and conditional visibility. For the Core Environmental Monitoring Form, she configured the CSV used for data validation, as well as wrote the pulldata() functions for data validation. She helped Ella with the TDS and DO average auto-calculations and configure warning messages. Emma also created the Monitoring Site Dashboard Map, configuring map symbology and pop-ups. She helped Hiram create the Site Request Review Dashboard by embedding the New Monitoring Site Request Form into the dashboard and adding status indicators. She wrote all metadata, summaries, and descriptions for all ArcGIS Online Items.

For the proposal, progress report, and final report, Emma was responsible for writing the Data and Methodology sections and their associated slides on the PowerPoints. For all reports and PowerPoints, Emma revised and edited all sections and slides to ensure clarity and consistency. As project manager, she delegated tasks to other team members, scheduled client meetings, and ensured the team met deadlines.

- Hiram Zagala

In the proposal report, Hiram contributed by proofreading key sections, creating the Scope Map, developing the Budget Table, assembling the WGCC Timetable, and compiling the References. For the proposal presentation, he was responsible for briefing the Timetable and Budget slides. In the progress report, he updated the Scope Map, Dashboard, and Timetable; contributed to the presentation slides by briefing the Summary, Scope, Timetable, and Dashboard slides. For the final report, Hiram wrote the Abstract, Introduction, Problem Statement and contributed to the Concerns and Problems Appendix III: Additional Contacts and Resources for Information Collection section. In the final presentation, he wrote and briefed the Introduction and Dashboard slides. Additionally, he created the group's interactive Dashboard.

- Ella Rader

Ella authored several written components, including the Introduction, Summary, Purpose, Timetable, and Final Deliverables sections of the initial proposal report, and collaborated with Emma on Methodology. Ella also wrote the Conclusion and created supporting visual materials such as the timetable, data table, and data flow chart. During the proposal presentation, she created and presented the expected results and timetable slides, additionally, she created the conclusion, background, and data slides.

Ella spent many hours researching and learning the functionalities of ArcGIS Dashboards, Survey123 Connect, and XLS Form syntax, applying that knowledge to build and design the Water Quality Monitoring Data Form. Her work included formatting: text description, background color, font design, and logo insertion. She helped Emma with necessary calculations to the form, including total dissolved solids and Dissolved Oxygen. She helped Emma auto-calculate the DO average and configured warning messages for abnormal values entered outside of the defined parameters. Ella also contributed to the progress report by writing the Summary, Purpose, Monitoring Data Form, and Conclusion, and she created and presented multiple slides, including Problem and Concern, Conclusion, Timetable, Monitoring Data Form, and closing.

She authored the Introduction, Methods, Core Environmental Monitoring Form, Results and Discussion (Data Quality Issues, Limitations), Conclusion, and Broader Impacts for the final report. For the final presentation, Ella created the data, core environmental monitoring form, core environmental form cont., results and discussions, and conclusion slides. She wrote the conclusion and results, and findings, as well as findings, and helped Hiram tweak and edit the visuals for the poster. She presented the core environmental monitoring form, core environmental form cont., results and discussion, and conclusion slides. Ella's efforts supported both the technical implementation and communication of the project's goals and outcomes.

- Noah Lindsey

In the proposal report, Noah wrote and edited the literature review portion of the report. Noah found sources and case studies relevant to our project and wrote a description of their methods and results in order to aid our group as we worked to improve the efficiency of water quality monitoring. Noah also presented the information regarding the background and objectives of our project to our clients during our proposal. For the final report, worked to generate the cover page and contact information page. Additionally, Noah proofread the final report, especially the abstract. Noah also presented the problem that our project aimed to solve, the data that we produced in our web map, and a general overview of our project in conclusion.

Appendix II: Metadata

File Name	Metadata Description
siteAttributes.html	Metadata file of the siteAttributes point feature class made in ArcGIS Pro
monitoringData.html	Metadata file of the monitoringData standalone table made in ArcGIS Pro
AGOL_component_metadata.docx	A Word document listing the names, descriptions, and links for all components created as part of the new workflow. It also includes the names, descriptions, and links to all authoritative layers used by these components.

Appendix III: Additional Contacts and Resources for Information Collection

If the new group is using Esri applications such as Survey123, Survey123 Connect, and Dashboard for the first time, it is recommended that they review the following tutorials and links. This will help them build a stronger understanding of the tools and work more efficiently on the project.

- Esri Community: https://community.esri.com/
    - Without Esri Community, this project wouldn't have been possible. It is such a great resource to ask questions and find previously asked questions about Survey123 Connect and ArcGIS Dashboards that aren't found in the official documentation.
- Survey123
    - Survey123 Introduction: https://learn.arcgis.com/en/paths/try-survey123/
- Survey123 Connect
    - Survey123 Connect Documentation: https://doc.arcgis.com/en/survey123/desktop/create-surveys/quickreferencecreatesurveys.htm
    - Survey123 Connect Walkthough: (Very Helpful!) https://www.youtube.com/watch?v=8Ix_Zn2Qkto&ab_channel=Shawn%27sSpotlightonGIS
- XLSForms
    - XLSForm Documentation: https://doc.arcgis.com/en/survey123/desktop/create-surveys/xlsformessentials.htm
    - XLSForms for Survey123: https://learn.arcgis.com/en/paths/explore-xlsforms-for-survey123/
    - XLSForms Introduction: https://mediaspace.esri.com/media/t/1_8aqdogxu
- ArcGIS Dashboards
    - ArcGIS Dashboards Introduction: https://learn.arcgis.com/en/paths/try-operations-dashboard-for-arcgis/
    - ArcGIS Dashboards and Arcade Introduction: https://learn.arcgis.com/en/paths/visualize-data-with-arcade-in-dashboards/
- Arcade
    - Arcade Documentation: https://developers.arcgis.com/arcade/function-reference/
    - Common Arcade Questions: https://www.esri.com/arcgis-blog/products/arcgis-online/data-management/your-arcade-questions-answered

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