



<i>Title:</i> TOS Standard Operating Procedure: NEON Aquatic and Terrestrial Site Navigation		<i>Date:</i> 01/24/2022
<i>NEON Doc. #:</i> NEON.DOC.005247	<i>Author:</i> K. Murphy	<i>Revision:</i> B

TOS STANDARD OPERATING PROCEDURE: NEON Aquatic and Terrestrial Site Navigation

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1 DESCRIPTION

1.1 Purpose

The purpose of this SOP is to provide guidance for using ArcGIS Online (AGOL) tools to effectively navigate around a NEON Aquatic or Terrestrial site. This document provides sampling navigation guidance to field staff intended to minimize accidental plot disturbance and to reduce the environmental impact from repeated sampling.

1.2 Scope

This document provides a change-controlled version of an Observatory procedure. Documentation of content changes (i.e. changes in particular tasks or safety practices) occur via this change-controlled document, not through field manuals or training materials.

1.3 Applies To

The procedure described in this document is used in the following protocols:

Table 1. List of protocols that reference this procedure to navigate a site.

Doc #	Title
NEON.DOC.001024	Canopy Foliage Sampling
NEON.DOC.000987	Measurement of Vegetation Structure
NEON.DOC.014049	Mosquito Sampling
NEON.DOC.001710	Litterfall and Fine Woody Debris
NEON.DOC.003162	Wadeable Stream Morphology
NEON.DOC.014042	Plant Diversity Sampling
NEON.DOC.000481	Small Mammal Sampling
NEON.DOC.004130	Wetland Soil Sampling
NEON.DOC.003045	Periphyton, Seston, and Phytoplankton Sampling
NEON.DOC.014048	Soil Biogeochemical and Microbial Sampling
NEON.DOC.002905	Water Chemistry Sampling in Surface Waters and Groundwater
NEON.DOC.001194	Zooplankton Sampling in Lakes
NEON.DOC.003046	Aquatic Macroinvertebrate Sampling
NEON.DOC.001199	Surface Water Dissolved Gas Sampling
NEON.DOC.001711	Coarse Downed Wood
NEON.DOC.014037	Measurement of Herbaceous Biomass
NEON.DOC.014050	Ground Beetle Sampling
NEON.DOC.014045	Tick and Tick-Borne Pathogen Sampling
NEON.DOC.000693	Reaeration in Streams
NEON.DOC.001193	Sediment Chemistry Sampling in Wadeable Streams
NEON.DOC.001191	Sediment Chemistry Sampling in Lakes and Non-Wadeable Streams
NEON.DOC.001295	Fish Sampling in Wadeable Streams
NEON.DOC.001296	Fish Sampling in Lakes



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Doc #	Title
NEON.DOC.001197	Bathymetry and Morphology of Lakes and Non-Wadeable Streams
NEON.DOC.001714	Agricultural Biomass SOP, Ag Productivity
NEON.DOC.003564	Herbarium Specimen Prep SOP
NEON.DOC.014038	Below Ground Biomass
NEON.DOC.002792	Secchi Disk and Depth Profile Sampling
NEON.DOC.003039	Aquatic Plant, Bryophyte, Lichen, and Macroalgae Sampling
NEON.DOC.003044	Aquatic Microbial Sampling
NEON.DOC.014040	Plant Phenology
NEON.DOC.001886	Stable Isotope Sampling in Surface and Ground Waters
NEON.DOC.014039	Digital Hemispheric Photos for Leaf Area Index
NEON.DOC.001709	Bryophyte Productivity
NEON.DOC.001715	Cactus Biomass and Handling
NEON.DOC.014041	Breeding Landbird Abundance and Diversity
NEON.DOC.001085	Stream Discharge
NEON.DOC.001718	DSLR Configuration
NEON.DOC.001716	Toxicodendron Biomass and Handling

1.4 Acknowledgments

This document is based on field and data processing procedures developed by Melissa Slater and Rachel Swanson.



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2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain higher-level information that is implemented in the current document. Examples include designs, plans, or standards.

AD[01]	NEON.DOC.004300	EHS Safety Policy and Program Manual
AD[02]	NEON.DOC.004316	Operations Field Safety and Security Plan
AD[03]	NEON.DOC.001155	NEON Training Plan
AD[04]	NEON.DOC.050005	Field Operations Job Instruction Training Plan
AD[05]	NEON.DOC.000724	Domain Chemical Hygiene Plan and Biosafety Manual

2.2 Reference Documents

Reference documents contain information that supports or complements the current document. Examples include related protocols, datasheets, or general-information references.

RD[01]	NEON.DOC.000008	NEON Acronym List
RD[02]	NEON.DOC.000243	NEON Glossary of Terms
RD[03]	NEON.DOC.002652	NEON Data Products Catalog

2.3 Acronyms

Table 2. List of acronyms for commonly abbreviated terms used in this document.

Acronym	Definition
AGOL	ArcGIS Online

2.4 Definitions

Attribute Table: A database of tabular information about a set of geographic features, usually arranged so that each row represents a feature and each column represents one feature attribute. Attribute tables are often joined or related to spatial data layers, and the attribute values they contain can be used to find, query, and symbolize features or raster cells.

Layer: Geographic representation of a dataset in ArcGIS Online

Style: Combination of the attribute displayed and the symbology

Symbology: Graphic symbol visually representing data on map



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3 SAFETY

This document identifies procedure-specific safety hazards and associated safety requirements. It does not describe general safety practices or site-specific safety practices.

Personnel working at a NEON site must be compliant with safe field work practices as outlined in the Operations Field Safety and Security Plan (AD[02]) and EHS Safety Policy and Program Manual (AD[01]). Additional safety issues associated with this field procedure are outlined below. The Field Operations Manager and the Lead Field Technician have primary authority to stop work activities based on unsafe field conditions; however, all employees have the responsibility and right to stop their work in unsafe conditions.



4 PERSONNEL

4.1 Training Requirements

All technicians must complete required safety training as defined in the NEON Training Plan (AD[04]). Technicians must also complete procedure-specific training for safety and implementation of this procedure as required in Field Operations Job Instruction Training Plan (AD[05]). Additional training materials can be found in the Training Center.

4.2 Specialized Skills

It is advised to have a baseline familiarity with AGOL functions and capabilities especially as it pertains to the use of the Field Maps application for the purposes of backcountry navigation. Due to the possibility of malfunctioning electronics, technicians are required to know how to navigate the backcountry using map and compass and/or the Garmin GPS units.

Required skills for operating the ESRI apps include:

- Downloading, syncing, and updating mobile applications
- Verifying online map updates are successfully transferred to mobile device
- Using ArcGIS Field Maps for backcountry navigation
- Shooting an accurate azimuth with a compass

Preferred skills for operating Field Maps application include:

- Creating a custom map from an existing NEON map on AGOL
- Adding features to a map
- Making a map available for offline use



5 CONTINGENCIES AND NOTES

- Each domain's GIS liaison should ensure that the offline maps are up to date.
- Each user should log in with his or her own AGOL credentials to access the layers, maps, and offline areas prepared by the GIS liaison and made available through their domain group.
- At the domain office or field house prior to entering the site, the field team should sync the offline map on the field phone. The data in AGOL may have been modified since the last download and any updates need to be captured. Additionally, most field sites do not have reliable cellular or data service, so it is important to make these updates beforehand.
- It is good practice to leave the map open after updating so that the accelerometer in the device can place its location without service.



6 STANDARD OPERATING PROCEDURES

SOP A Create an offline map in AGOL

Maps generated in AGOL can be fully customized with relevant layers and information. By adjusting the settings, the maps can be available for offline use to navigate a field site without cellular service.

A.1 Log onto AGOL

1. <https://www.arcgis.com/home/signin.html>
2. Sign in with "Your ArcGIS organization's URL"

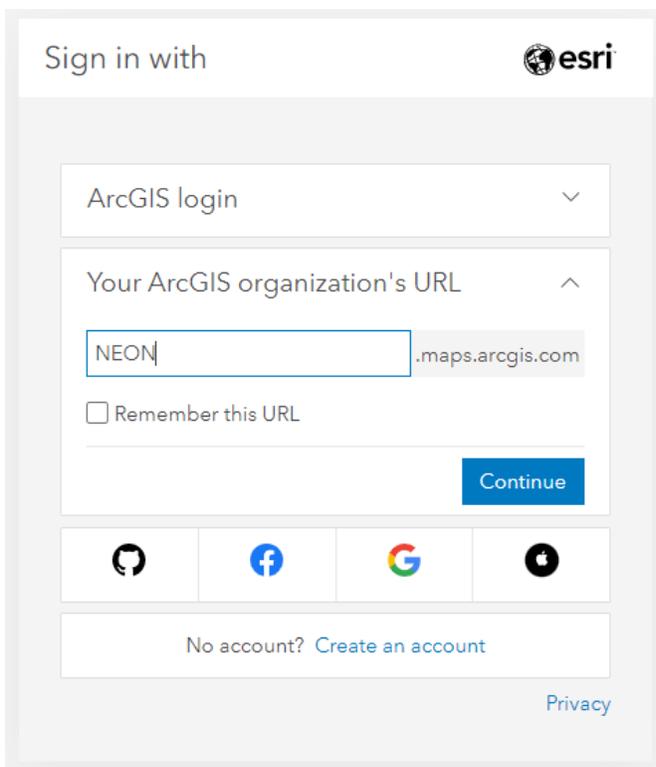


Figure 1. The Enterprise Sign In screen for ArcGIS Online.

3. Enter our ArcGIS organization's URL "NEON.maps.arcgis.com". Hit "Continue." (Figure 1).

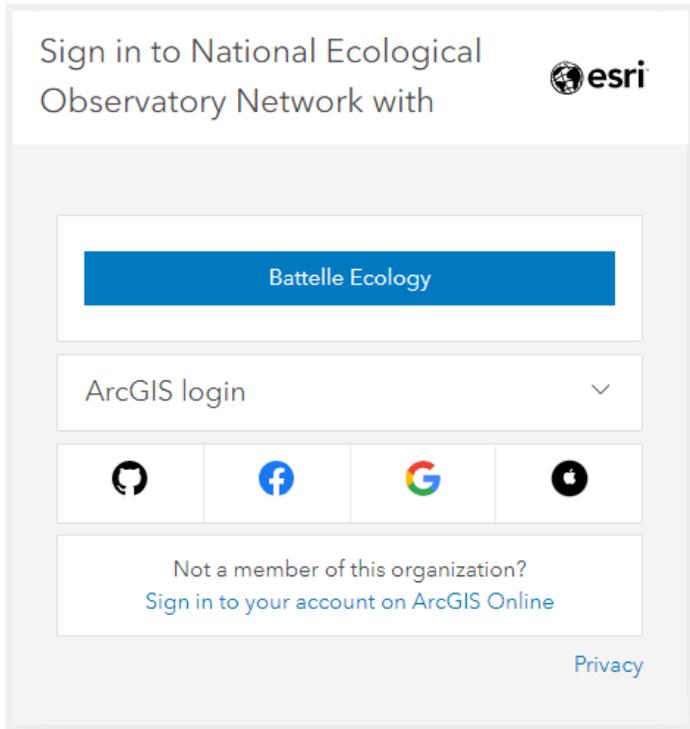


Figure 2. The Enterprise selection screen for ArcGIS Online.

4. Click Battelle Ecology (Figure 2) to sign in using your Battelle Ecology credentials

A.2 Groups

1. To access domain-specific information, after logging in select 'Groups' and 'My Organization's Groups' (Figure 3).

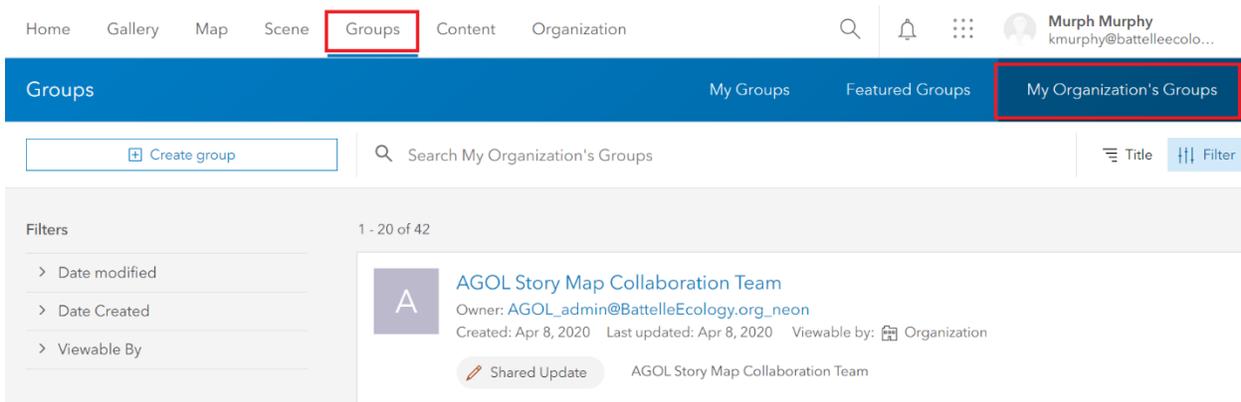


Figure 3. The location of all of the Organization's Groups.

2. Navigate to the desired domain's page, then click 'Join Group.'



A.3 View Existing Map

1. From the domain's homepage, select 'Content' (**Figure 4**).

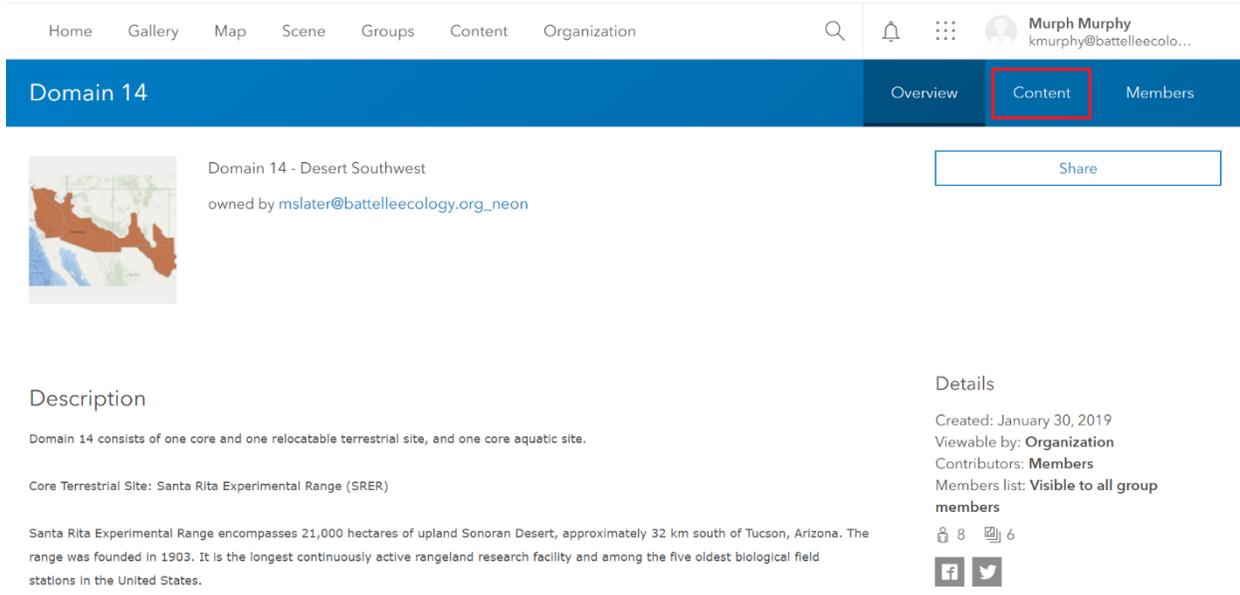


Figure 4. The 'Content' tab houses all the maps and layers shared with the Group.

2. Select the authorized domain map – the one created by “AGOL_admin.”
3. From the metadata page, select ‘Open in Map Viewer.’
4. Zoom to the area of interest:
 - a. Different layers will become visible based on the zoom level.
 - b. If a layer is ‘grayed-out,’ change the zoom level to make it visible.
5. Select the middle tab, ‘Show Contents of Map,’ from the map options. Check all the layers that should be viewable and uncheck or delete the layers that should be hidden or removed (**Figure 5**).
 - a. The recommended viewable content for site navigation will depend on what information the user finds most pertinent to the field work. For example, an uncluttered map with relevant information for TCK sampling may include: Plot centroids, Plot polygons; and exclude Tower footprint, tower flux, NEON Field Sampling boundaries, Aquatic reach, etc.

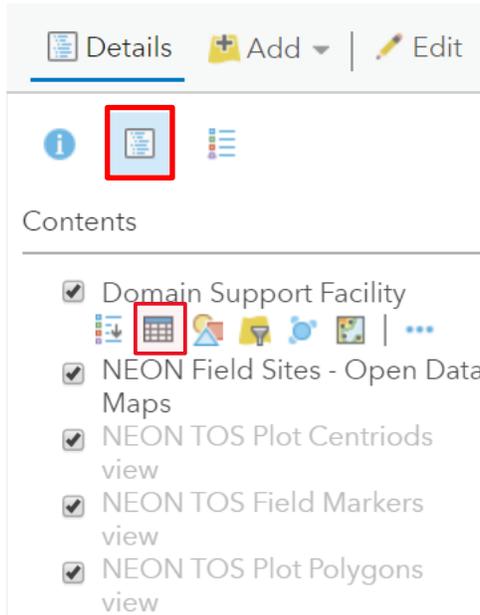


Figure 5. The “Show Contents of the Map” icon positioned next to the information icon shows the available layers in the map. The “Show Table” icon located below the layer name in the Contents list shows the associated attribute table.

6. To view a layer’s attribute table, click on its name in the ‘Show Contents of Map’ menu and select the grid icon below labeled ‘Show Table’ (**Figure 5**).

A.4 Add layers to map in AGOL (Optional)

1. Add additional layers that are not present in the authorized domain map by either searching for an existing layer, uploading a new layer to AGOL, or creating a new layer.



Home ▾ D16 Pacific Northwest Domain Map-Copy ✎

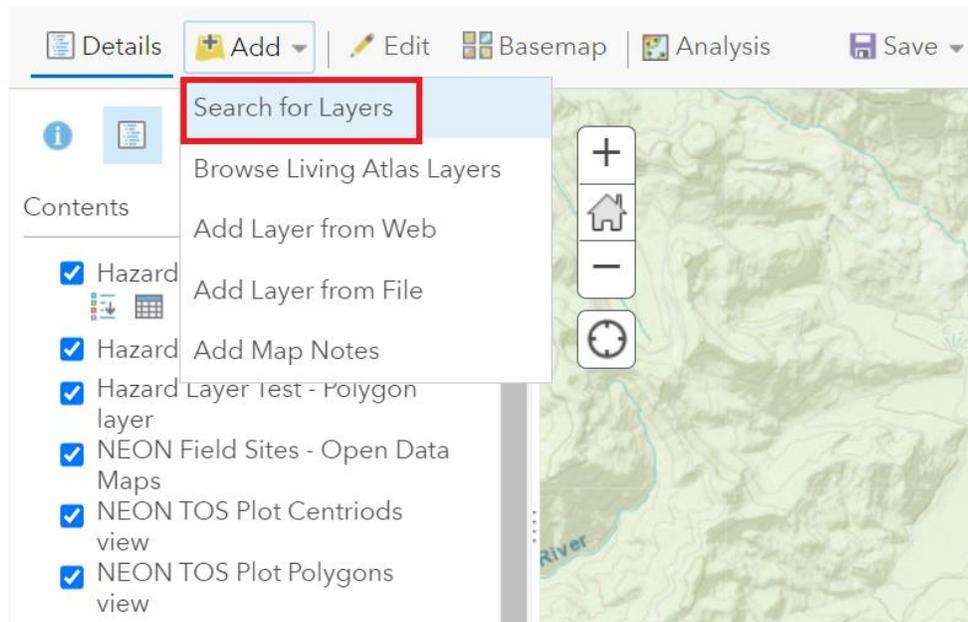


Figure 6. “Search for Layers” to add layers to the map that are already in AGOL.

2. To add a layer from an existing shapefile that *has* previously been added to AGOL:
 - a. Click ‘Add Content to Map’ in the tool bar, then select ‘Search for Layers’ (See **Figure 6**).
 - b. In the ‘Content’ dropdown menu select a search filter. *Recommended: ‘My Content,’ ‘My Groups,’ ‘My Organization.’*
 - c. Use the ‘Search for Layers’ search bar to find a specific layer.
 - d. Click the plus sign on the layer item to add it to the map.
3. To add a layer from an existing shapefile that has *not* previously been added to AGOL:
 - a. Open ‘Windows Explorer’ window and navigate to the local location of the shapefile as instructed by the domain’s GIS liaison.
 - b. Zip all associated file extensions together, e.g. .shp, .prj, .dbf, etc.
 - c. On the AGOL Map Viewer screen, click ‘Add’ in the tool bar, then select ‘Add Layer from File’.
 - d. Click ‘Choose File’, and select the zipped folder and click ‘Open’.
 - e. Select ‘Keep original features’, then click ‘Import Layer’.
 - f. Follow guidelines to adjust the style by selecting the attribute to show and its symbology.



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i. It is acceptable to choose 'Show location only' from the attribute list.

4. To create a non-existing layer in AGOL:

- a. A new layer would be created if the user wanted to add new information to a map in AGOL or if the user wanted to collect and store information such as sampling tracks or hazardous area from the field.
- b. From the main tool bar, select 'Content,' then choose 'Create' and 'Feature Layer' (Figure 7).

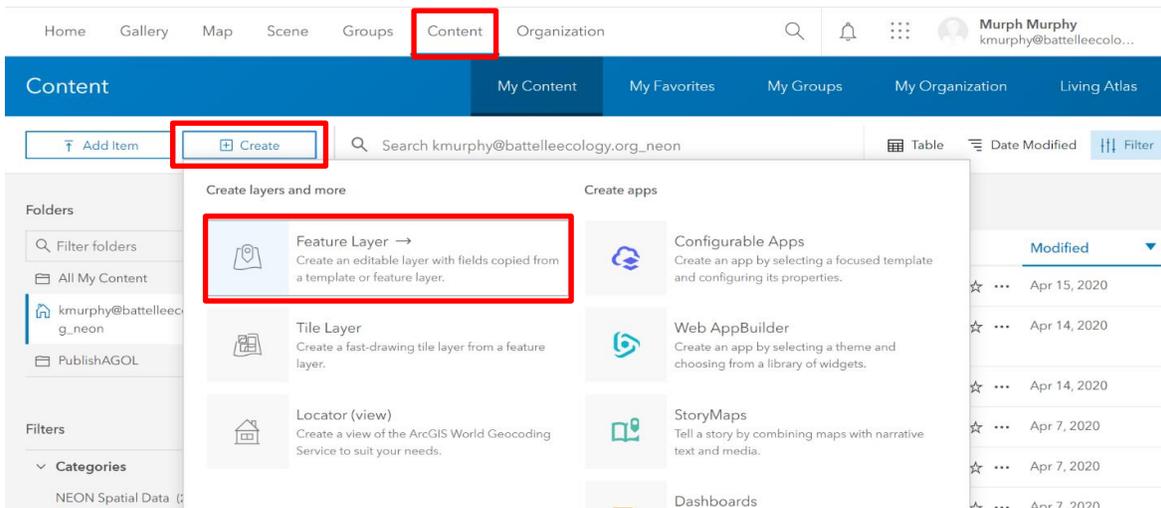


Figure 7. The Create tool is used to establish a blank feature layer to be populated with information in the field.

- c. Type 'polygon' in the search bar.
 - d. Select 'Points, lines, and polygons', then click 'Create' on the side pop-up.
 - e. Leave all three options (point layer, line layer, polygon layer) selected and click 'Next'.
 - f. Zoom to the region of the site on the pop-up map. The zoomed region can be coarse, but is helpful to provide a starting point. Click 'Next'.
 - g. Enter a title for the file, e.g. 'D12 YELL Mosquito Track'.
 - h. Add additional informative tags for domain, site, and other descriptors that would be helpful to organize the output file.
 - i. Click 'Done'.
 - j. This layer can be populated in the field using steps found in Section B.3.
5. Change symbology to the desired color-scheme. *This step is not necessary for authorized layers, but could be useful for personally added layers.*



- a. In the Contents list, click on the 'Change Style' symbol, , under the layer to be changed
- b. Under 'Select a drawing style,' click 'Options' to change the symbol, color, and/or size
- c. Click 'OK' and then 'Done' to save the new symbology

Home ▾ D16 Pacific Northwest Domain Map-Copy 

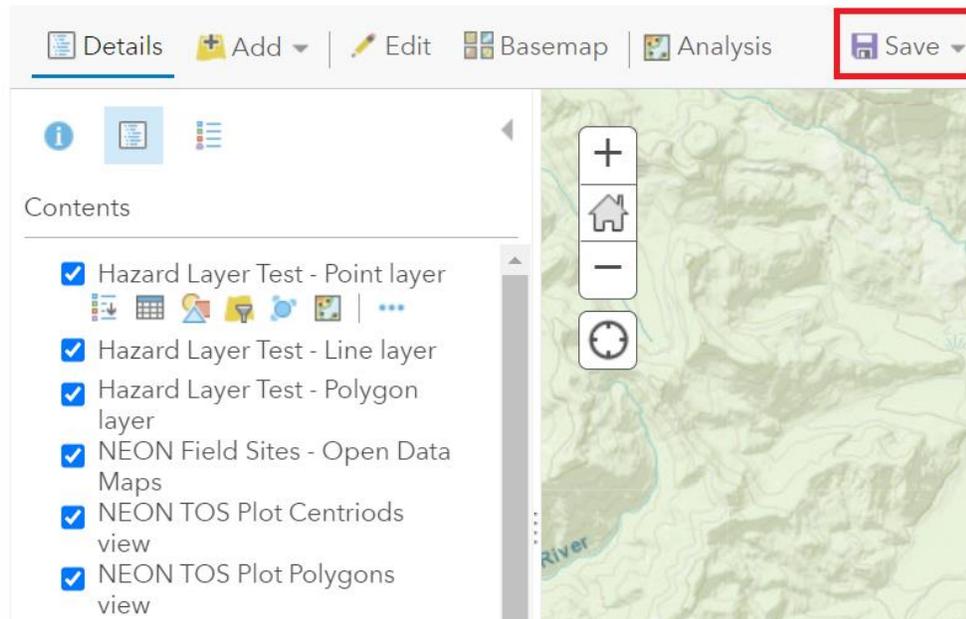


Figure 8. Above is the main tool bar shown on the Map Viewer. Use the 'Save' tool to make a personal copy of a map.

6. Save the customized map with a new name (**Figure 8**):
 - a. Click 'Save' from the ribbon above the map and select 'Save As'.
 - b. Name the map and add appropriate categories and tags. Tagging the map with identifiable information (e.g. Domain#, Site, map theme) helps users find the map when searching.

A.5 Map and Layer Accessibility

1. To share the map with other members of the organization:
 - a. Click 'Home' and select 'Content' from the drop-down menu.
 - b. Click 'MyContent' in the blue ribbon.



- c. Find the new map and/or layers and change their sharing level from 'owner' to 'organization'. Share map with the domain group as well (**Figure 9**).

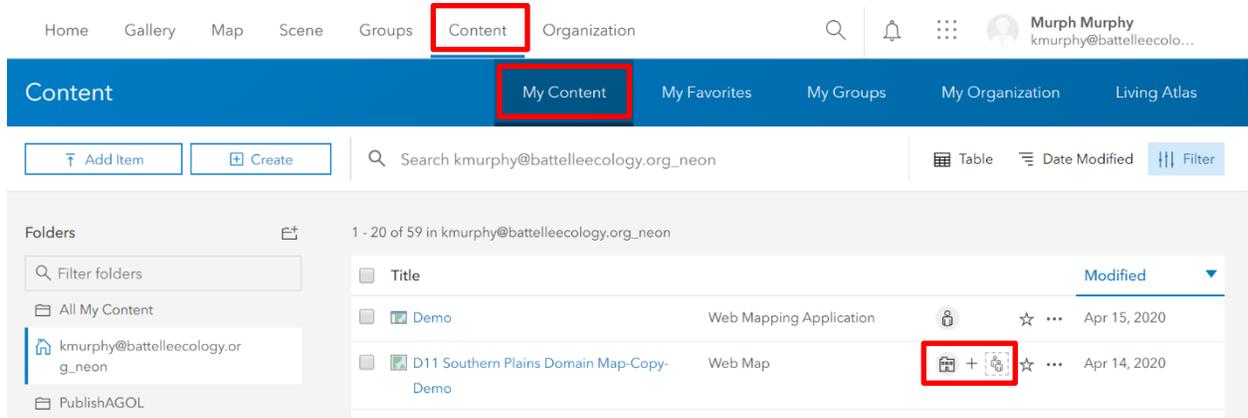


Figure 9. The icons illustrated on the 'Content' screen show each map's or layer's distribution scope. If the icon is a person, it is only shared with the individual that created it. If the icon is a building, it is shared with the organization. If the icon is a globe, it is shared with the public.

2. If any new layers were created or uploaded, select them from the list on the 'My Content' page (**Figure 9**).
3. On the feature layer's metadata page, click 'Settings.'



General Feature Layer (hosted)

Feature Layer (hosted)

Editing

Enable editing.

Keep track of created and updated features.

Keep track of who created and last updated features.

Enable Sync (required for offline use and collaboration).

• Who can edit features?

Share the layer to specific groups of people, the organization or publicly via the Share button on the Overview tab.
This layer is currently shared with: Organization, [Domain 16](#)

• What kind of editing is allowed?

Add

Delete

Update

Attributes only

Attributes and geometry

[Manage geometry updates](#)

Figure 10. Above are the feature layer settings. Check the “Enable Sync” box to allow the map to be viewed Offline. Check the “Enable editing” box to allow data for this layer to be collected in the field.

4. Scroll to the ‘Feature Layer (hosted)’ section and check ‘Enable Sync.’ If this is a layer that will be populated with data in the field, also check ‘Enable editing.’ (**Figure 10**)
5. Click ‘Save.’
6. Click on the Map name. From its description page, select ‘Settings.’
7. If all of the feature layers included in the map have been shared with the organization and enabled to sync, the ‘Offline’ section will be available.
8. Toggle ‘Enable offline mode’ on and select ‘Manage Areas’ (**Figure 11**).



Offline

Enabling offline mode allows this map to be downloaded and used in locations where there may be no internet connectivity. When offline mode is enabled, a user can download the map in apps that support offline workflows. [Learn how.](#)

Enable offline mode Advanced Options

Map Areas

While not required, it is recommended that you create map areas ahead of time to package data for specific areas you expect to be used offline. Using map areas makes taking maps offline easier and faster.

Available map areas: 1 Manage Areas

Save Cancel

Figure 11. These are the required settings to access a map offline, which will be necessary for use at most field sites.

9. Click 'Create Area' and then use the sketch rectangle tool, , to select the area of interest.
10. Once the area is selected, adjust the 'Level of Detail' to appropriate levels for field navigation. 'Town' and 'Small building' are good starting points. If there is an error indicating that the area is too large, adjust the 'Level of Detail'. Click Save.
11. The Map Area will take several minutes to 'Package.' As the size of the map area increases, the packaging time will as well.
12. Once 'Packaging' disappears from the name, the map area is ready to use offline.
13. If any updates are made to the map or its layers it is necessary to update the Map Area before opening in any of the field applications.



SOP B ArcGIS Field Maps

ArcGIS Field Maps is a mobile application that combines the capabilities of the previous ArcGIS applications – Explorer, Collector, and Tracker. It allows the user to access pre-made maps offline, record geographic data with associated notes and pictures in the field, and to effectively navigate a site. These points of interest and tracks can be uploaded to AGOL when connected to WiFi. Follow the steps outlined in SOP A to prepare feature layers and maps for offline use. If any changes have been made to the map or its layers since the offline area was created, it is necessary to update it. This is done by selecting the Manage Areas button (**Figure 10**), selecting the map area, and clicking “Update.”

B.1 Sign into ArcGIS Field Maps Application

1. If using a mobile device, download the ‘ArcGIS Field Maps’ app from the app store.
2. Sign in with ArcGIS Enterprise using the url: “https://neon.maps.arcgis.com” (**Figure 12**).



Figure 12. Sign in page on the ArcGIS Field Maps app specifying the correct URL.

3. Click ‘Battelle Ecology’ and sign in with Battelle credentials.

B.2 Open map in ArcGIS Field Maps

1. These steps must be completed while on WiFi. Leave the map open when navigating to the field site.
2. From the main page, scroll to the ‘Groups’ section and select the one for the desired domain.
3. In the domain group, the maps available for offline use will have an ‘Offline areas’ label (**Figure 13**).



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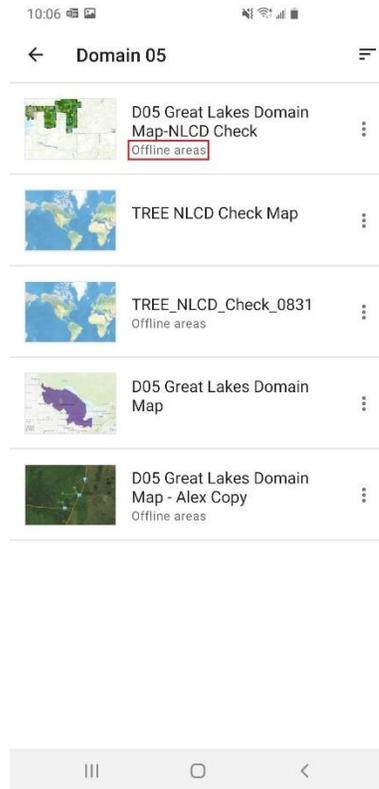


Figure 13. The maps that are ready for use in the field are tagged with 'Offline areas' as seen in the Groupview on ArcGIS Field Maps.

4. Click the map and select which map area to view. This may take a minute if it is the first time opening the map on a device.
5. Once open, layers can be turned visible or invisible by clicking on the layers' icon, , and checking / unchecking layers.
6. Leave the map open on the device and when in the field. The user's location will appear as a blue dot. Touch the arrow in the upper right-hand corner to show the direction the user is facing.
7. Touch any feature on the map to open its attribute table.

B.3 Collect data in ArcGIS Field Maps

1. Follow log-in steps in B.1.
2. Open the map as described in B.2.
3. To collect data, click on the blue plus icon (**Figure 14**).

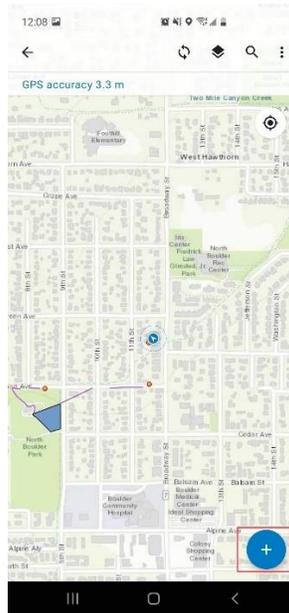


Figure 14. Map view in the Arc Field Maps app highlighting the location of the icon to add a new layer.

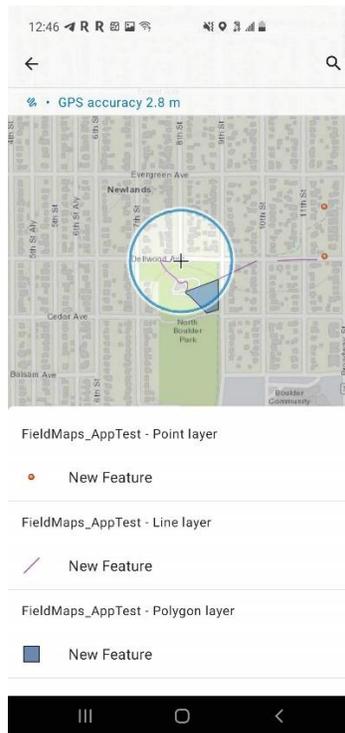


Figure 15. This list of layers were added in SOP A and can be collected in the field.

4. To collect point data, select 'New Feature' under the 'Point layer' label (Figure 15).



- The point will be immediately collected, but the user can update the location if it is not in the correct location (**Figure 16**).

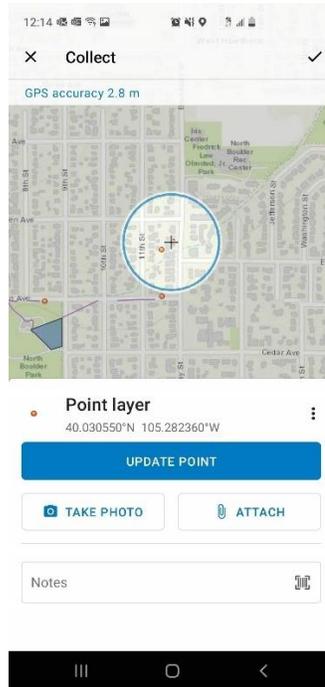


Figure 16. These are the editing and metadata options available when collecting point data.

- To collect line data, select 'New Feature' under the 'Line layer' label.
- The initial point will be immediately collected, but the user is required to collect at least one more point, by clicking 'Add Point,' to complete the line.
- In the default settings, the line will be connected between the points in the shortest distance regardless of the path the user walked. An unlimited amount of intermediary points may be added, by clicking 'Add Point,' as the user walks to guide the ending line.
- If the user has a curved line or requires an exact track, the user may opt to enable streaming (**Figure 17**) by selecting the three vertical dots and choosing 'Start streaming'.

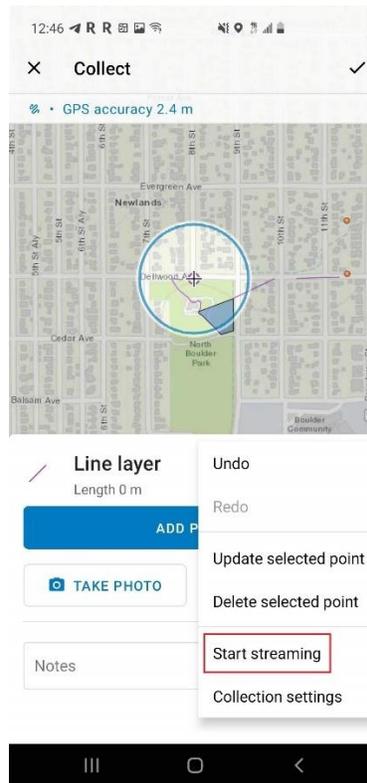


Figure 17. The streaming option enables the polyline to track the user’s exact path when navigating between points.

10. When the track is finished, the user should click the three vertical dots and select ‘Stop streaming.’
11. To collect polygon data, select ‘New Feature’ under the ‘Polygon layer’ label.
12. The initial point will be immediately collected, but the user is required to collect at least two more points, by clicking ‘Add Point,’ to complete the line.
13. In the default settings, the polygon will be connected the points in the shortest distance regardless of the path the user walked. An unlimited amount of intermediary points may be added, by clicking ‘Add Point,’ as the user walks to guide the ending polygon shape.
14. If the user has a non-traditional polygon to collect, the user may opt to enable streaming by selecting the three vertical dots and choosing ‘Start streaming’ (**Figure 17**).
15. When the track is finished, the user should click the three vertical dots and select ‘Stop streaming.’
16. Click the check mark in the upper tool bar when finished.
17. When data collection is finished for the day and the device is connected to WiFi, click ‘Sync’ to upload the data to AGOL.



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18. The layer has now been added to the AGOL network and can be used in ArcGIS Field Maps in the future.



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7 REFERENCES

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APPENDIX A AGOLOVERVIEW

ArcGISOnline (AGOL) is a cloud-based mapping and analysis solution. Similar to other ESRI products, AGOL makes maps, analyzes data, and has numerous sharing and collaborating features. At NEON, everyone is able to access AGOL through their Battelle Ecology email account. **Basic organization:**

- Home: Opening page, brief introduction to NEON
- Gallery: Highlights NEON's publicly available maps that have the most views
- Map: Similar to ArcMap- Platform to add layers, make maps, share final product.
- Scene: Mapping in an interactive 3D environment.
- Groups: Groups organize data around themes and teams. Groups can be private or public to the organization. Anybody can create a group. Content within a group can be shared to group members only or to the entire organization.
- Content: Data layers within AGOL. Content is uploaded by the user or pulled in the through the Living Atlas database. Curated by Esri with contributions from its partner and user communities, the Living Atlas contains valuable maps, data layers, tools, services, and apps for geographic analysis. Base layers are available as well.



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APPENDIX B REMINDERS

- Make all layers available to the organization and share them with the proper group.
- Ensure all layers have the sync setting enabled. If a layer will be used in the Field Maps app, it must also have the editable setting enabled.
- Enable maps for offline use and choose an area of interest in AGOL.
- Download or update the map every time before going into the field. Spatial data across all domains is updated together, so even though there may not be any changes to the current domain, there may be changes in another that will affect the layer.



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APPENDIX C EQUIPMENT

The following equipment is needed to implement the procedures in this document. Equipment lists are organized by task. They do not include standard field and laboratory supplies such as charging stations, first aid kits, drying ovens, ultra-low refrigerators, etc.

Table 3. Equipment list – Required for each team navigating a field site.

Supplier/ Item No.	Exact Brand	Description	Purpose	Quantity
Field phone	N	Provided android or apple mobile device for each active field crew	Host for the Arc Field Maps app	1
ArcGIS Field Maps	Y	Mobile application	Application for viewing data and navigating a site	1
Compass	N	Handheld device that indicates direction	Used in conjunction with backup paper map to navigate in the case that the field phone loses charge	1
Backup Paper Map	N	Non-digital aerial record of the field site	Used in conjunction with compass to navigate in the case that the field phone loses charge	1
Charging cable	N	Provided cable compatible with android or apple mobile device for each active field crew	Recharge battery of field phone	1