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MN LAKE PLANT SURVEYS:

DATA COLLECTION AND GIS MANUAL

PREPARED BY

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This is a companion document of the Minnesota Lake Plant Survey Manual (Perleberg et. al) that contains the design and methodology of how to quantify the aquatic plant communities of Minnesota lakes. Each chapter in this document describes the steps for collecting data for specific surveys. Each chapter can be printed separately and act as a standalone document, as such there are some overlapping sections.

This document contains the following chapters:

Chapter 1. Introduction to Collector for ArcGIS

Chapter 2. Floating-leaf and Emergent Plant Mapping - Using *Collector for ArcGIS* and ArcMap toolbar

- Collecting data with iPad
- Editing Protocol
- Photo interpretation for aquatic plant communities

Chapter 3. Score the Score survey - Using *Collector for ArcGIS* and custom ArcMap toolbar

- Generating shoreline points
- Collecting data with iPad
- Reference photograph management
- Editing lakeshore boundary lines

Chapter 4. Point Intercept Survey - Using FileMaker iPad App and custom ArcGIS toolbar

- Using custom toolbar to generate points, process field data and summarize data
- Using Filemaker go App to collect field data

Chapter 5. Editing Score the shore Data

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CONTENTS

CHAPTER 1. INTRODUCTION TO COLLECTOR FOR ARCGIS

The following instructions will cover the designed protocol to collect, edit, and analyze data for the mapping of emergent, floating leaf, and matted submerged aquatic vegetation. This will cover the collection of data with the use of mobile application *Collector for ArcGIS (also referred to as "ArcCollector")*. This document will also cover the data management practices of where the data are stored, proper editing procedures (as well as how to edit using the old method (GPS points and lines), and finally common analysis that can be calculated. This document will not cover the purpose, classification structure, or methodology of delineating these communities; consult the Minnesota Lake Plant Survey Manual, aquatic plant mapping chapter for these details.

ABOUT COLLECTOR FOR ARCGIS

Collector for ArcGIS is a mobile application that is integrated with a central ArcGIS (SDE) geodatabase on a MNDNR Central Office server. Data collected using the mobile device (iPad) application are synced to the central geodatabase through the secured enterprise portal. All the data are secure, backed up, and access is controlled. There are two ways to access/view this central database: by signing into the enterprise portal (https://arcgis.dnr.state.mn.us/portal) through the app or online, or by a direct database connection (controlled link) through ArcMap.

- There are several advantages to this system:
  - Polygons are created and attributed in the field.
  - Data collection is significantly faster and easier.
  - Drop down menus force consistency and accuracy.
  - Data are centralized (no random shapefiles on multiple PC's).
  - Multiple users can collect, edit, and use data simultaneously.
  - Edits are versioned, enabling a "go back" if future errors are discovered.
  - Edits are made fast and easy with *Topology and Custom Editing tools.*
  - Photographs are directly imbedded in the database which provides a centralized storage location and allows users direct access to photos.

REQUIRED EQUIPMENT AND SOFTWARE

Additional equipment and training are required to take advantage of the centralized data collection and storage offered through Collector for ArcGIS. The same types of equipment are used for several methods….

- Mobile device, this can be either iOS (IPad, IPhone) or Android device (e.g., Nexus tablet, Samsung Note). We found the large screen of the iPad to be the most user-friendly, and it is recommended.
- *Collector for ArcGIS* Application: This is a free download from the application store of your device.
- Garmin GLO GPS receiver (for Floating and Emergent mapping). The accuracy of the GPS receiver in most mobile devices is not very accurate. The Garmin GLO is a wireless GPS receiver with better accuracy (though not survey grade) that uses a Bluetooth connection to your mobile device.
- Waterproof case: A durable waterproof case is recommended for fieldwork, and one without a plastic screen protector is recommended (such as the "Lifeproof Nuud").
- Stylus pen (optional): seems to be easier and more accurate to make detailed polygon edits on the touch screen, and is recommended. After testing several models we found the "Adonit jot pro" to be the most favored.
- Boat mount (optional): is very handy for securing device and positioning it for ease of use, we found the "Ram" products work great.

INITIAL SETUP

There are initial use setup steps for authentication and controlled access to the editable database. This is done to ensure data security, and ensure those with access to the editable database have training and purpose.

These steps may take a few days, so plan accordingly.

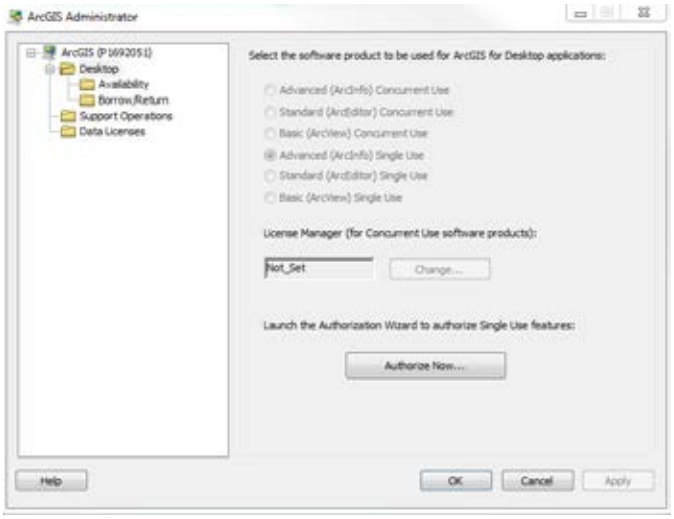
INSTALLING/UPDATING ARCMAP SOFTWARE

You must first update to the most recent version of ArcMap (10.6 or later) as it contains required tools. Check by opening ArcMap →Help->About

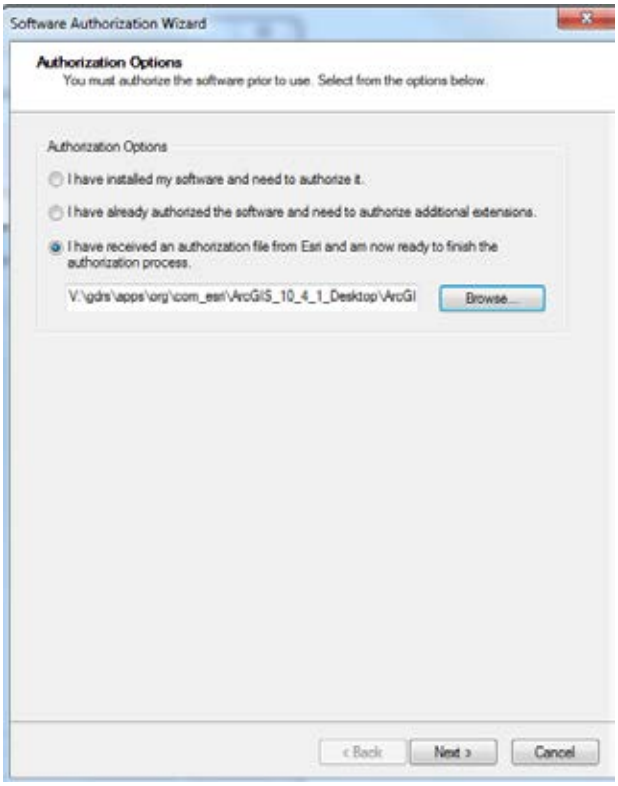
To Update: Open Software Center (search under start menu) → Available Software Tab→ ArcMap 10.6 → Install

After install you may be prompted to authorize the software. You need to have the "Advanced - Full" licensing for spatial analyst extension.

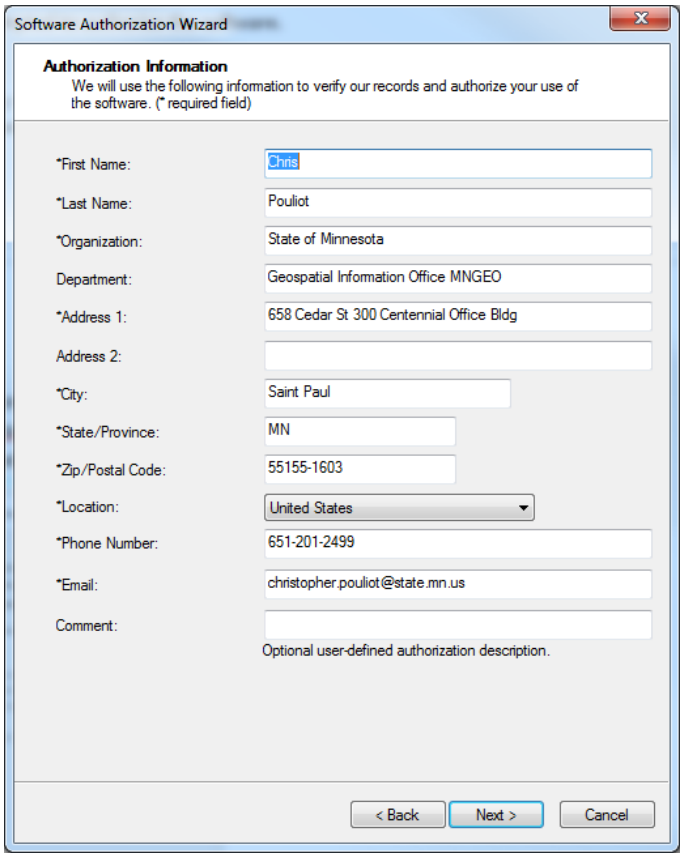
1. Open ArcGIS Administrator → All Programs → ArcGIS
2. Click Desktop → Authorize Now

a. 

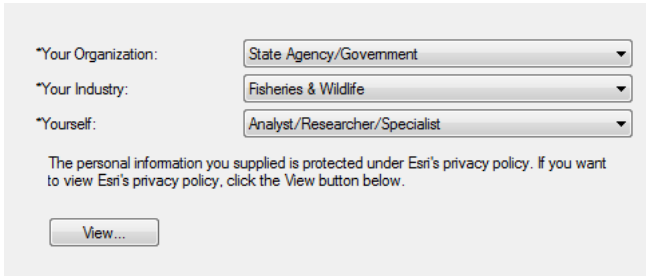
3. Select “I have received and authorization file….”
    a. Browse to V:\gdrs\apps\org\com_esri\ArcGIS_10_6_Desktop
    b. Select **ArcGISforDesktopAdvanced_SingleUse_Full.prvc**

c. 

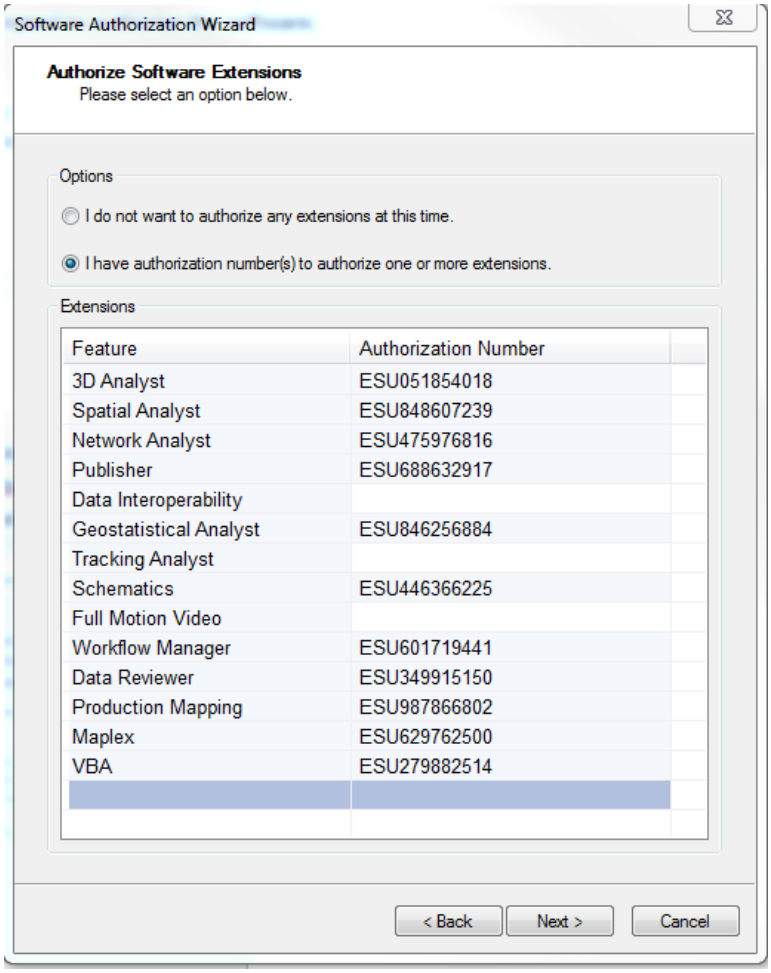
4. Leave the default Authorization details as listed

a. 

5. Enter your user details

a. 

6. Make sure at least Spatial Analyst extension has a license code

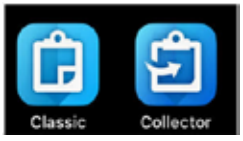
a. 

b. If not, the next screen will allow you to add it

INITIAL IPAD SETUP

After you've procured an IPad (or other device) ensure the "Collector for ArcGIS" application is installed. If not, go to the App Store and download it.

Note- As of this manuals update there are two versions of the Collector for ArcGIS app. "Collector for ArcGIS" and "Classic". Both apps work from the same central database. The newest version of the app has several addition features (such as navigating to points and better layout for small devices).



TESTING GARMIN GLO CONNECTION

Make sure the Garmin GLO is charged, and turned on.

- Blue blinking light indicates it is transmitting
- Flashing green indicates it's searching for satellites
- Solid Green light indicates it has GPS position
- Orange light battery charge

On IPad → go to setting app → Bluetooth → Turn On

Under "My Devices" window → Garmin GLO #XXXX should be visible → select pair device icon to connect.

Check that the location is accurate (use maps app or collector app) the GLO needs to have a firmware update on occasion (especially if it is purchased new).

CHAPTER 2. COLLECTOR FOR ARCGIS FOR FLOATING-LEAF AND EMERGENT MAPPING

The Floating-leaf and Emergent Mapping project is used to delineate and attribute aquatic plant stands in the field

The Floating-leaf and Emergent mapping project on Collector for ArcGIS has two separate features, the polygon feature (used to create polygons around plant stands), and a point feature (used to note points of interest such as rare occurrences).

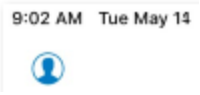
(IPad screenshots shown, layout on other devices will vary)

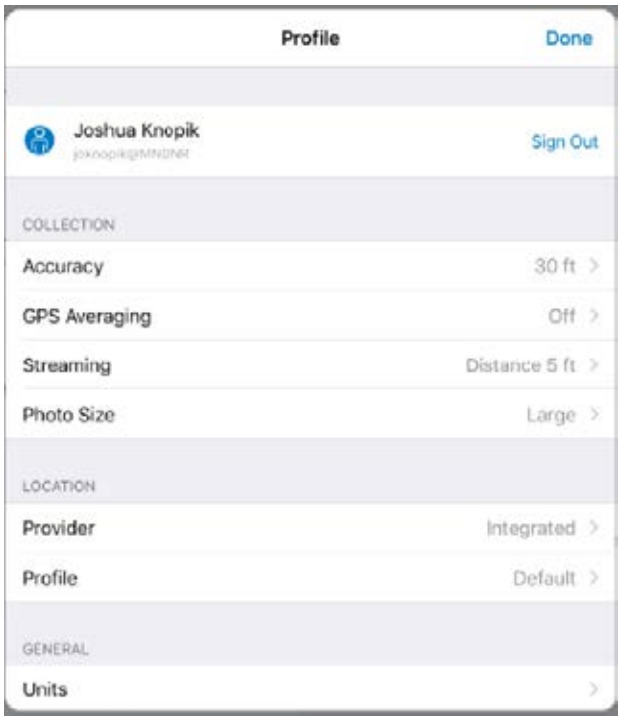
STEP 1. DOWNLOADING WORK AREA

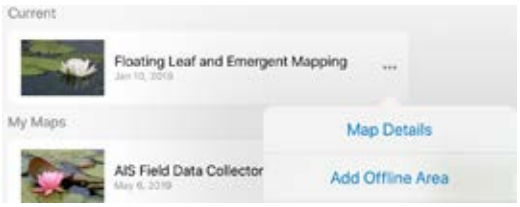
1. Connect to the local Wi-Fi Connection
2. Open ArcCollector
3. Tap **ArcGIS Enterprise**
    a. Enter URL **https://arcgis.dnr.stste.mn.us/portal**

    b.
4. Sign in- using your ArcGIS Portal username and password (see initial setup above).
    a. **Username@mndnr** (exp. joknopik@mndnr)
    b. Your Active Directory login (the one you use to sign into your work PC).

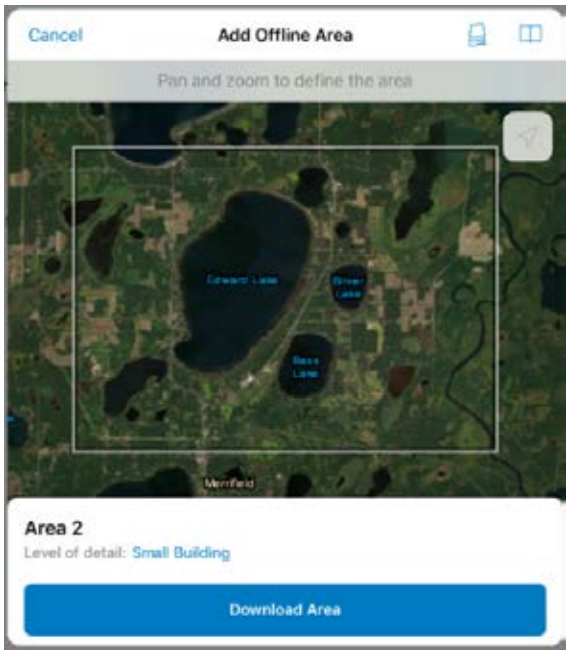
    c.
5. Adjust the collection setting by tapping the profile icon (upper left) to get to app settings

a. 

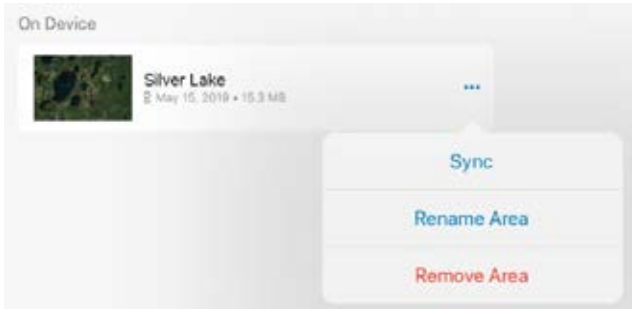
6. Adjust settings to match the following:
    a. Accuracy: 30ft
    b. Streaming: Distance 5ft
    c. Photo Size: Large
    d. 

7. Download map to device by selection the **...** options → Add Offline Area
    a. 

8. Select work area by zooming to your lake of interest,
9. Then select the scale that best fits.
    a. Scale is in common terms in reference to the level of detail noted in imagery.
    b. It's recommended to zoom to "Building" (1:1200) or smaller for quality imagery.
    c. Download time is dependent on file size and connection speed; large file sizes can take a long time to download (up to an hour)

d. 

10. You can rename work areas by tapping the work area **…** options.

a. 

11. You can download multiple work areas by tapping the upper right **…** options → Add Offline Area

a. 

CUSTOM BASEMAPS

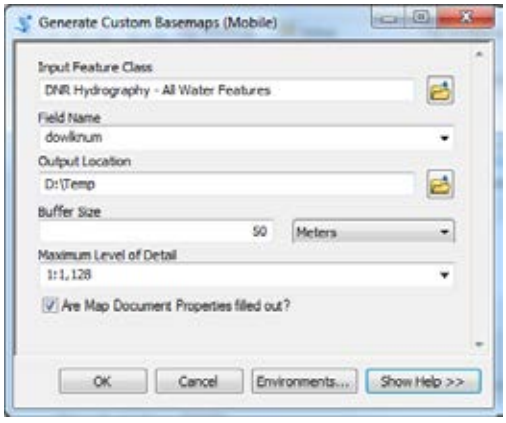
A tool has been developed to create custom basemaps (raster tiles) with other imagery. Other useful imagery to use as basemaps can be FSA imagery, False color Infrared or others (see Photo Interpretation section for more info on imagery). The tool uses a selected polygon(s) (lake boundary) as the extent of the imagery to clip out. This tool will not work with ArcGIS

online basemap imagery…only layers available on Quick Layers (FSA imagery, false Color IR, etc.).

Once an image tile has been created, you need to manually copy it to the iPad through the iTunes.

You still need to also download the work area as normal (even if you don't like the ESRI Imagery…you still need the blank database), see downloading work area section above.

CREATING CUSTOM IMAGERY RASTER TILES:

1. On the iPad, use the collector app to download the work area as normal (even if you don't like the ESRI Imagery…you still need the blank database), see above section.
2. In ArcGIS Map Document- Fill out Map Document Properties (this is a requirement for the tool… weird, I know)
    a. Go to File→Map Document Properties
    b. Fill in the following properties
        i. Title
        ii. Etc.
3. If the World Imagery Layer is in table of contents, remove this layer (this layer causes the tool to crash).
4. Add desired imagery
    a. Turn on the imagery layer(s)
5. Add hydrography layer (tool uses a selected boundary line to define tile)
6. Select the desired lake(s)
7. Open Tool
    a. Toolbox→MNDNR Tools V10 →General Tools →Generate Custom Basemaps (Mobile) toolbox.
    b. 

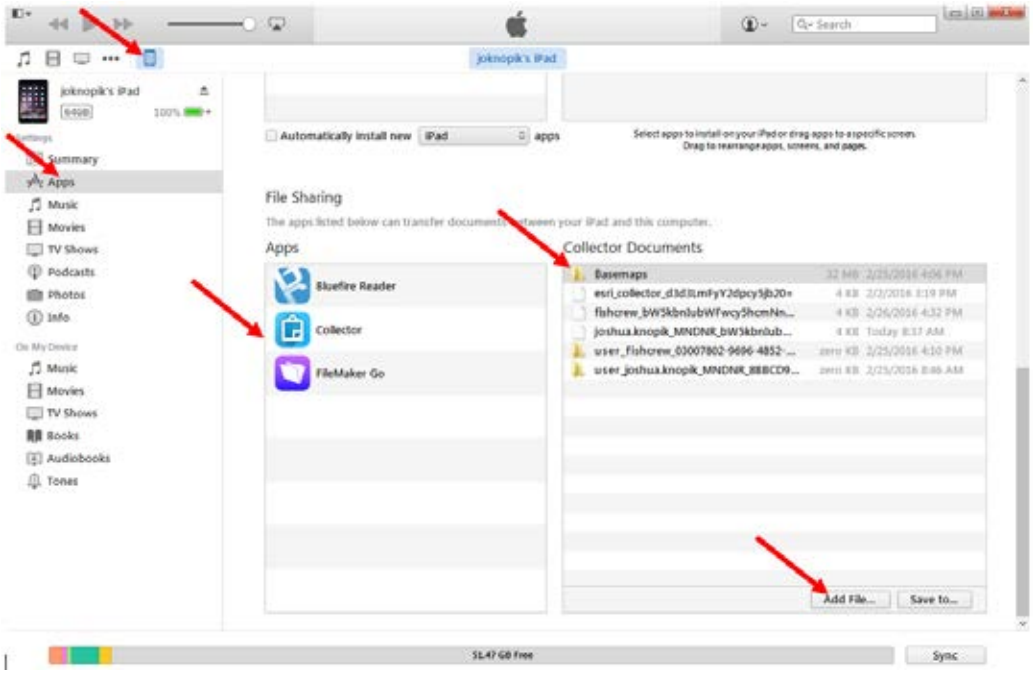
c. Input Feature Class: DNR – Hydrography layer
d. Field Name: Use DOWLKNUM
e. Output Location: your preferred local drive
f. Buffer size: 20m - 50m is recommended
g. Max level of detail: smallest available scale recommended

8. Run Tool
9. Runtime can take **a few hours** depending on connection speed, size of areas, and resolution!
   Note: The tool doesn't always notify when complete- review the geoprocessing → results tab.

INSTALLING CUSTOM BASEMAPS TO IPAD

Next you need to import the custom basemaps to the iPad by plugging it directly into the PC

1. Open iTunes
2. Go to iPad→Apps→Collector for ArcGIS→Basemaps→Add File



3. Navigate to the folder housing your basemaps
4. Select basemaps→ OK

BE SURE TO DOWNLOAD A WORK AREA THAT INCLUDES ALL LAKES (SEE PREVIOUS SECTION)

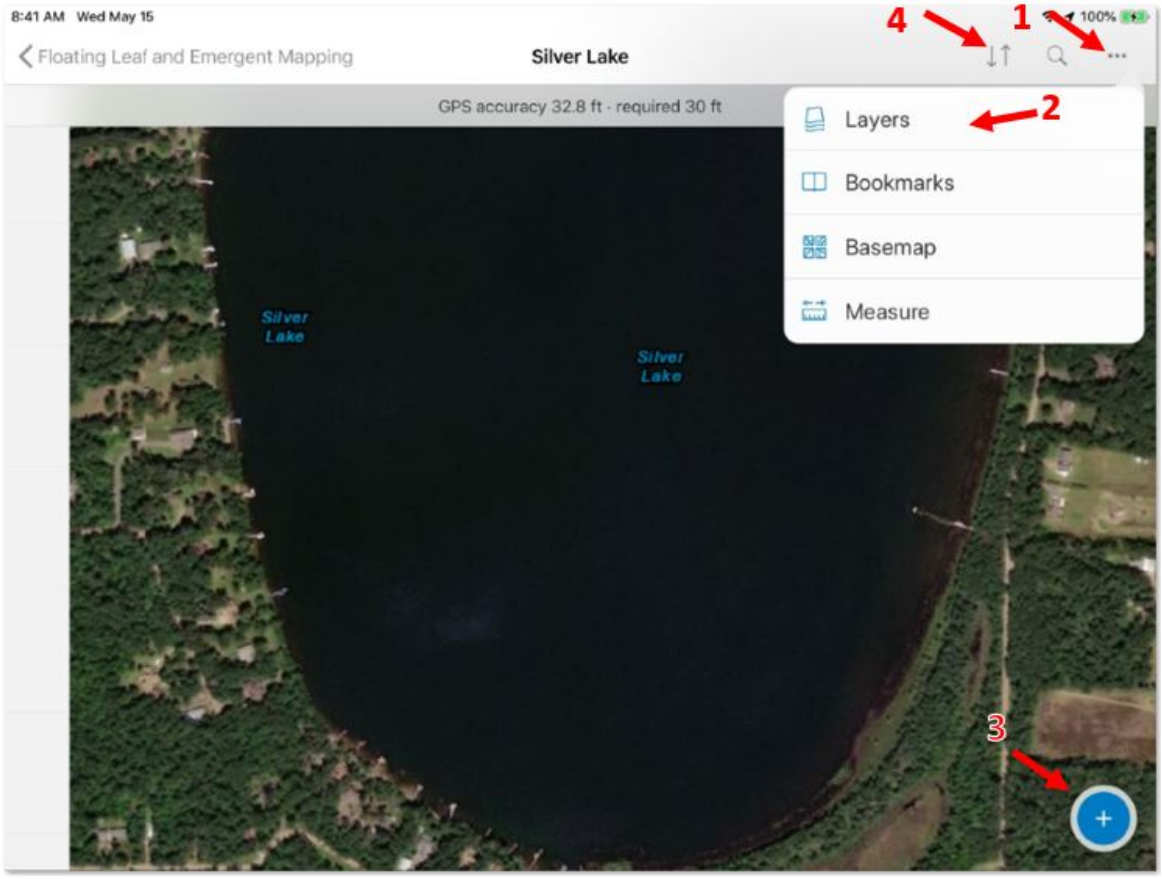
STEP 2. COLLECTING FIELD DATA

You can only collect features (points, lines, polygons) and their attributes that are already associated with the project.

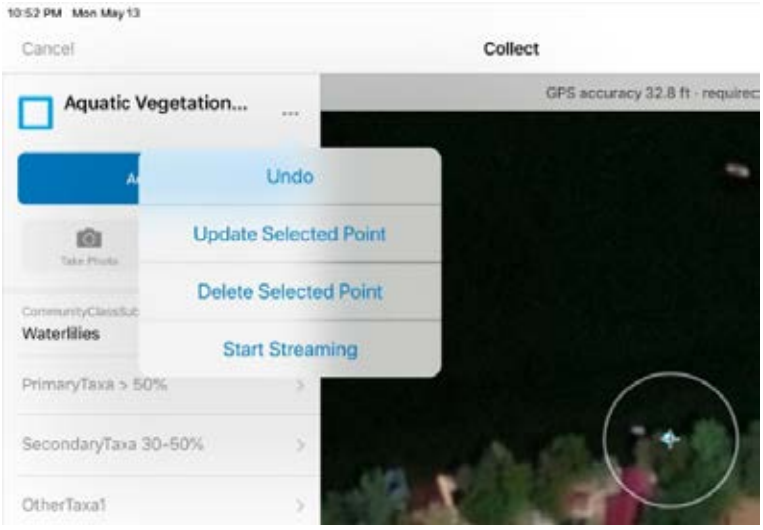
COLLECTOR APP MENUS

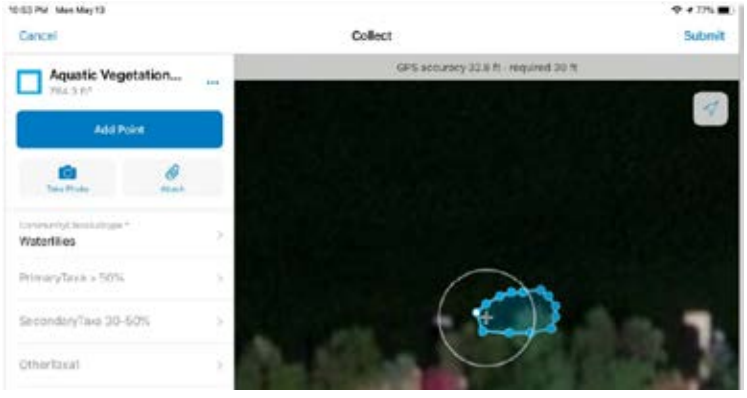
Project Home Screen

1. The "…" icon to turn access options menu.
2. Layers to turn on/off available layers
3. To collect a new feature
4. Syncs data to Central geodatabase (need to be connected to Wifi)



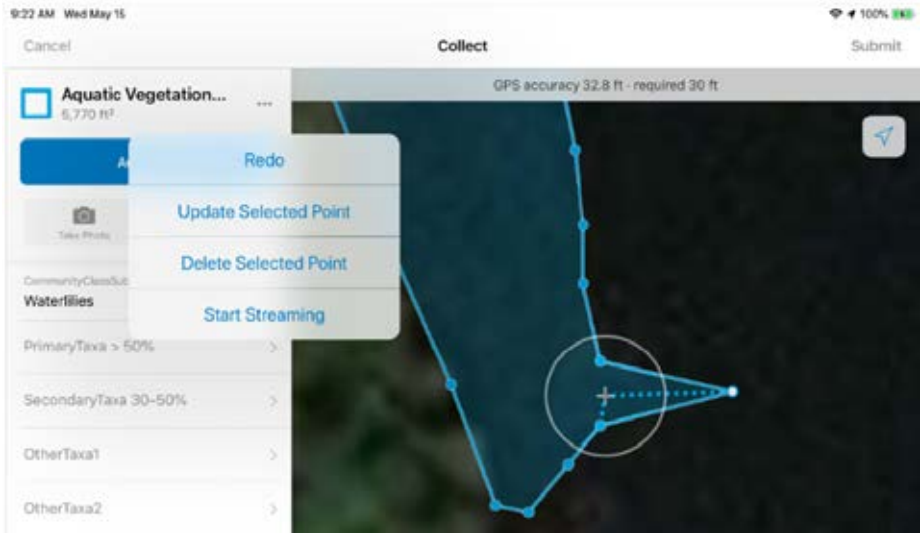
COLLECTING A NEW POLYGON

1. Tap the "+" to start collecting a new feature
2. Select the Community Class
3. Tap the "…" options then tap the "Start Streaming".
    a. 

4. Navigate around the plant stand.
    a. Tap "Stop Streaming" if you need to pause streaming to navigate around a hazard.
5. Continue adding other taxa attributes as you navigate around plant stand.
6. Tap "Stop Streaming" when completed with delineation.
7. Use touch screen to complete a polygon where it is impossible to navigate.
    a. Slide image around to place point at "+" in center of magnifier
    b. Tap add point to add vertex
    c. Work in a consistent direction (either clockwise or CCW).
8. If plant stand goes to shoreline, then complete the polygon by adding points along the shoreline as accurately as possible.
9. Tap "Submit" to save polygon
    a. 

EDITING A POLYGON

Oh no! You forgot to add a taxa, or messed up the polygon, Fear not!

1. Tap the problematic polygon to highlight it (turns teal colored)
2. Tap the “edit” icon
3. Change attributes as needed
4. To change polygon shape
    a. Touch the problematic point to make it “Active” (white)
    b. Slide image around to place new point at “+” in center of magnifier
    c. Tap the “…” options → “Update Selected Point”
        i. This will move the selected point to where the “+” is.
        ii. 

    d. Use “Undo” or “Delete Selected Point” as needed.
    e. Additional vertices can be added by just tapping “Add Point”
    f. Some experimentation is needed to “get the feel for it”
    g. Tap “Submit” to Save edits
    h. Or “Cancel” to discard edits, this only discards the recent edits not the polygon

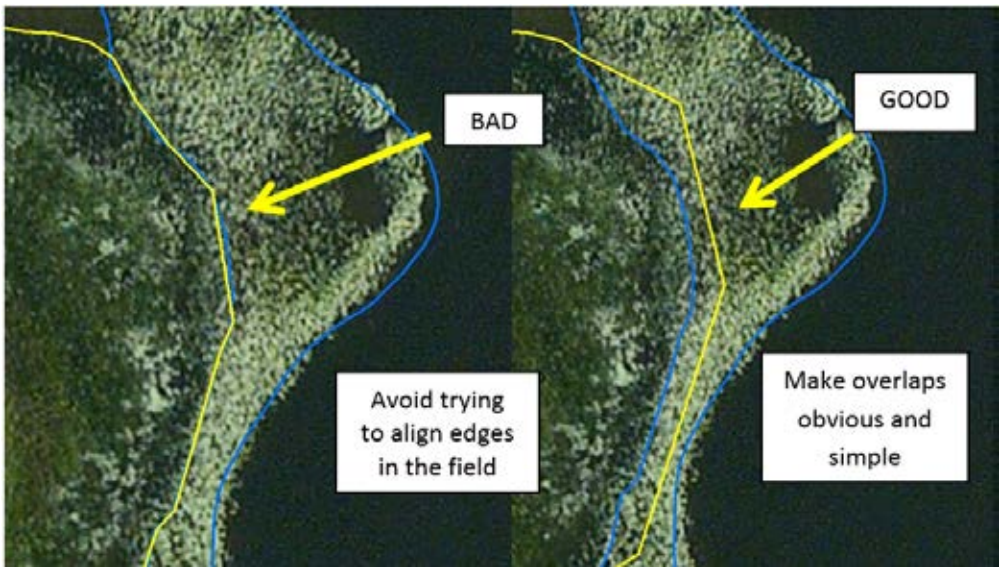
ADJACENT POLYGONS MADE EASY

One rule of emergent mapping is there should be no overlapping polygons <u>in the final product</u>, if the plant community changes from “Waterlilies” to “Waterlilies and Other”, a new polygon must be made. These polygons will likely share a border, but cannot overlap. Creating shared borders in ArcCollector is painful and tedious. However, overlaps can be fixed quick and

easy with topology tools (see editing section) in ArcMap. Here are some tips to make collecting and editing of adjacent polygons fast and easy.

1. Accurately map and complete polygon one.
2. Accurately start mapping polygon two (leaving the shared boundary for last)
3. Use the touch screen to complete polygon two
    a. **Intentionally and obviously overlap** polygon one.
    b. Use as **few points as needed, make it a "simple segment"**
        i. 

    c. Later in ArcMap we will use topology "Align tool" to snap this "simple segment" to the "Complex segment" to create the shared boundary in two quick mouse clicks! (see editing section)
4. Avoid trying to match boundaries in the field, it is slow and will complicate editing later

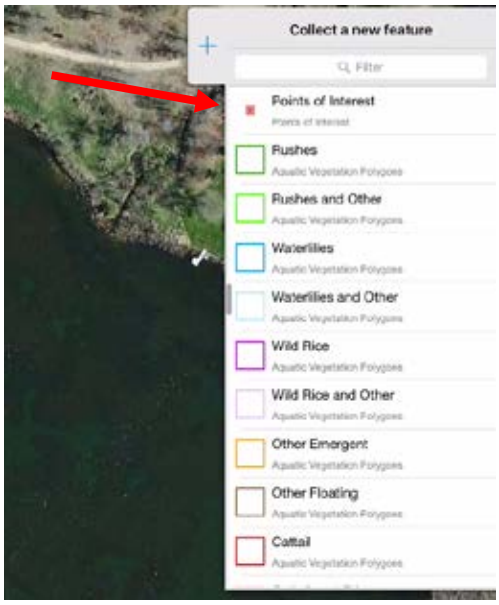
5. 

COLLECTING POINTS OF INTEREST

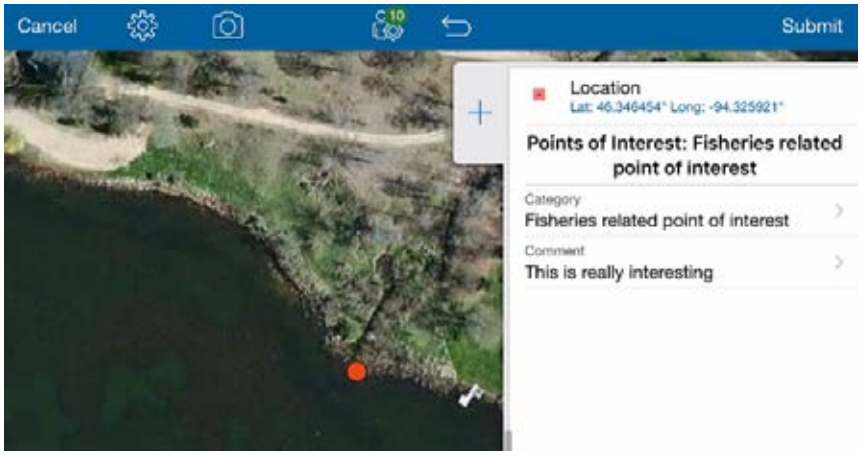
In some cases it may be useful to document a points of interest noted during the survey. Points of interest could include the location of an unknown plant, rare plant, or to document an APM violation. Multiple reference photos can be attached to this point to aid documentation. In cases of rare features, inform the Natural Heritage Information curator of the data as soon as reasonable, as NHI data should not be stored long term in this database.

To collect a point of interest:

1. Tap "+" Create Features icon (6).
2. Tap Point of Interest



3. Select appropriate category (i.e. Violation or other APM interest)

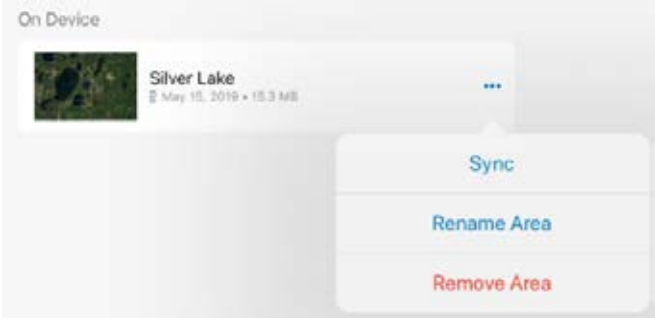


4. Tapping on imagery will move the point
5. Add Comments
6. Tap camera icon (B) to add photo (optional)

STEP 3. SYNCING COLLECTED DATA

Once all plant stand data on the lake have been collected the final step with the application is to sync your edits to the central database. This is done by going back to the project menu - tap "Map" (in the upper left corner).

1. Connect to a Wi-Fi network (could be the office, or local coffee shop)
2. Tap "On Device"
3. Tap the sync icon (Number indicates number of edited (new) features)

a. 

4. After sync has completed, verify by reviewing the Aquatic_Veg_Mapping.mxd arcMap project (see next section).

IF SYNC FAILS – TRY TROUBLESHOOTING SECTION or CONTACT I.T. —DO NOT REMOVE DATA FROM DEVICE

5. After you have verified that the data has been synced, you can remove it from the device
    a. Tap **…** options
    b. Remove Area

You can now download a new work area, and collect more data!

TROUBLESHOOTING SYNC ISSUES

Sync errors are not common, but can be frustrating when they do occur. The good news is that most sync issues can quickly remedied.

ERROR 1: USER PASSWORD INVALID DURING SYNC

Likely cause: Your AD password changed

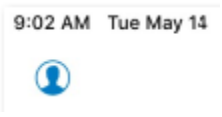
Fix:

1. Ensure Wi-Fi is connected (iPad home→ settings→ Wi-Fi or open safari web browser to check)
2. Hit iPad Home button twice (this shows all open apps)
3. Swipe up to close all open apps
4. Open collector app and try again

ERROR 2: USER PASSWORD INVALID WHEN TRYING TO DOWNLOAD NEW WORK AREA

Likely Cause: Another user is signed in- happens with shared iPads

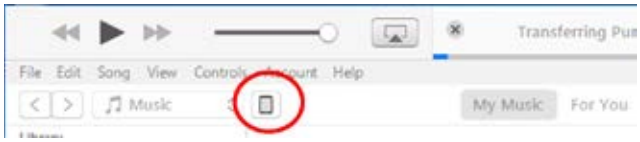
Fix:

1. Ensure Wi-Fi is connected (iPad home→ settings→ Wi-Fi)
2. Confirm existing data has been synced
    a. Open Collector App
    b. Note when last sync occurred
    c. Tap the profile Icon
        i. 

    d. Contact the person who collected the data and ask them to sign back in→ REMOVING THE DATA WILL DELETE THEIR DATA.
        i. If the person is unavailable to sign in see "Removing Data via ITunes" section
3. Sign the user out, and sign in with your username
    a. Collector can have multiple users data stored in memory (only one user can edit at a time).

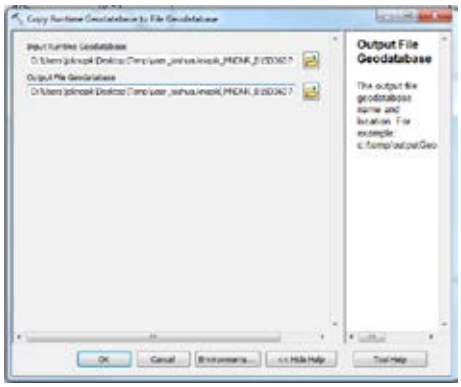
REMOVING DATA VIA ITUNES

In rare situations it may be necessary to remove the data from the iPad manually and save it. This may be need to be done if someone signed into the iPad, collected data and is longer available to sync it back.

1. Install iTunes software on your PC.
2. Plug iPad into your PC.
3. Open iTunes and click iPad icon to view contents of the iPad
    a. 

4. Select Apps→ Scroll to bottom → Select Collector
5. Select the checked out geodatabase folder (listed as username_XXX, also check date)
6. Save to.. select an output location

a. 

7. This saves the checked out data to your selected output location.
8. There are two ways to get the data back to the central geodatabase:
    a. Email this folder to MNIT GIS Staff and they will transfer the data for you.
    b. Manually copy/paste the "new data" using ArcMap
        i. Convert runtime file (copied "new data" folder from iPad) to geodatabase
            1. Open "Copy Runtime Geodatabase to File Geodatabase" tool
            2. 

            3. Input: Navigate to the (XXXXXX.geodatabase) in the copied folder from iPad
            4. Output folder: any convenient location
        ii. Checkout the lake area (see Checking Out Data section)
        iii. Add the "new data" feature class into the project
        iv. Start editing the "CHECKED_OUT" Layer
        v. Select all the "new data" points
        vi. Go to main Edit Tab → Copy
        vii. Go to main Edit Tab → Paste
        viii. Choose CHECKED_OUT" Layer
        ix. Open "CHECKED_OUT" Layer attribute table → verify the "new data" pasted appropriately

x. Select old points (with no data) → Delete them

STEP 4. EDITING COLLECTED DATA

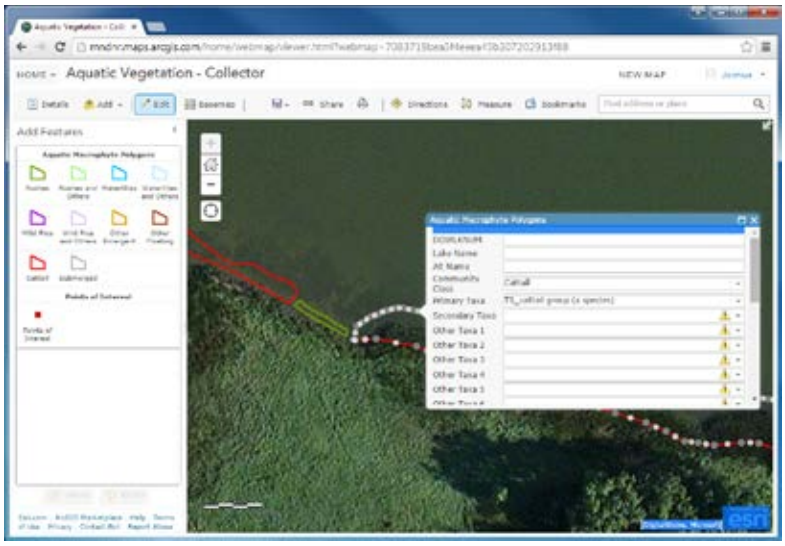
There are two ways to edit the data that have been collected. The ArcGIS Online web editor is great for quick and simple edits, and ArcMap is used for making refined and detailed edits.

VIEW/ EDIT DATA WITH ARCGIS ONLINE

Collected data can be viewed using the ArcGIS Online website. After syncing your daily field collection, it is recommended to view your data online to ensure it was synced. Editing with the online editor is similar to, but more user friendly than, that with the mobile device. Website editing does not have the advanced editing feature (topology editing) that is available in ArcMap. The website editing option is great for quick verification and simple edits.

1. Sign into ArcGIS Online Login
2. Type "Vegetation" into search
    a. Open Aquatic vegetation project
    b. 

3. Use web tools to navigate, view and edit your data



4. Editing
    a. Features can be edited by selecting the edit icon
    b. Double click on problematic polygon
    c. Edit the attributes as needed
    d. Edit the vertices as needed
    e. Select edit to save edits

QUICK GUIDE TO EDITING AQUATIC PLANT STAND DATA

AQUATIC VEGETATION MAPPING EDITOR TOOLBAR

1. **Check Out Data** – Checks out selected data from central database and saves a copy to local D: drive.
2. **Check In Data** – Checks edited data back into central database.
3. **Refresh Database –** Runs reconcile and Post function on database (for same day edits).
4. **Align Edge Tool** – Matches one edge to another so they are coincident.
5. **Replace Geometry** – Reshape selected feature but keep all attributes.
6. **Validate Topology in Current Extent** – Finds topology errors in current extent.
7. **Topology Inspector** – Shows list of topology errors.
8. **Magic Attribute Updater**– Updates spatial attributes (DOW, Lake name, etc.) and calculates other fields.
9. **Promote Polygons** – Moves selected polygons from ***Raw Data*** to ***Verified Data*** feature class.
10. **Retire Data** – Moves selected polygons from ***Verified Data*** to ***Retired Data*** feature class.
11. **Generate Report -** Creates a summary report, maps, and excel output for selected data.
12. **About** – Contains info on current toolbar version.
13. **Help** – General help document.

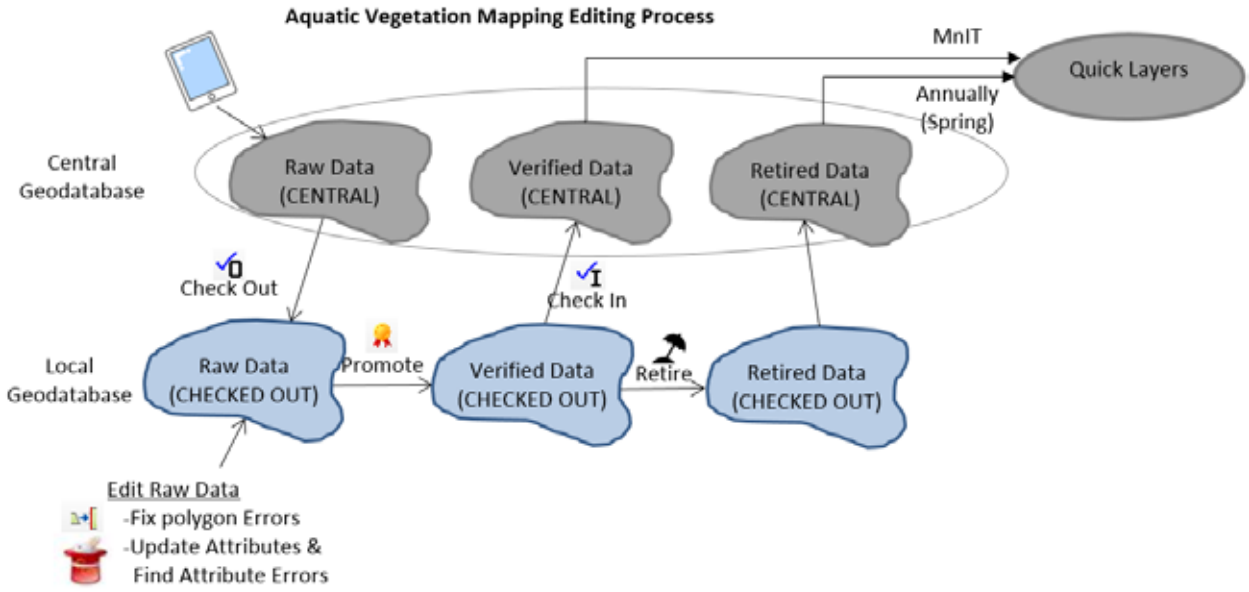
EDITING YOUR DATA:

1. Open Aquatic_Veg_Mapping.mxd and save to your PC
    a. Navigate to V:\gdrs\apps\org\us_mn_state_dnr\emergent_vegetation and Double click to open project.
    b. File→ Save As → navigate to a logical location (temp folder) on your PC and rename as desired.
2. Zoom to Lake
3. Select **Check Out Data(1)** and make box around lake
4. Edit ***Raw Data (CHECKED OUT)*** feature class
    a. Click **Validate Topology(6)** to see overlap errors
    b. Use **Align Tool(4)** to align edges of over lapping polygon
        i. click “simple segment” first, then click “complex segment”

        ii. click **Validate Topology(6)** again to verify edit
    c. Use **Topology Edit Tool(3)** if move individual vertex or line segments in needed
    d. Use **Reshape Tool (on regular Editor Toolbar)** to reshape polygon along shoreline
        i. Click outside polygon to start, and double click outside polygon again to stop reshape
    e. Use **Replace Geometry Tool(5)** to replace a polygons shape but keep its attributes.
    f. Use **Topology Inspector(7)** to view list of overlap errors
    g. Click **Magic Attribute Updater(8)** to update attributes, calculate missing field values, find common attribute errors (printed in "**errors**" field)
    h. Use **About(10)** to see current version of the tool
    i. Use **Help(11)** to view help document
5. After all edits to ***Raw Data (CHECKED OUT)*** feature class are done,
    a. Select all polygons and Click **Promote Polygons(5)** to move them to **Verified Data (CHECKED OUT)** feature class
6. Click **Check in Data(2)** to finalize your edits
7. Close and delete your project (the Check In data can no longer be edited).

EDITING DATA IN ARCGIS

The raw data is located on the centralized SDE geodatabase in the ***Raw Data (CENTRAL)*** feature class. However, this central geodatabase cannot be edited directly, so a copy must first be created or "Checked Out" to your local PC. This local copy is called ***Raw Data (CHECKED OUT)***. This ***Raw Data (CHECKED OUT)*** feature class will be what gets edited. Once all the edits have been made, the polygons will then be **moved** or "Promoted" into the ***Verified Data (CHECKED OUT)*** feature class. This ***Verified Data (CHECKED OUT)*** feature class is your last chance to review the edits. If the lake survey has been repeated, the older data gets moved to the ***Retired (CHECKED OUT)*** feature class, and the most current data remains in ***Verified Data***. Once everything looks good the data then gets "Checked In" to the centralized geodatabase. The ***Verified Data (CENTRAL)*** and ***Retired (CENTRAL)*** feature classes will then be used to update the Emergent Vegetation Layer on Quick Layers (annually-in the Spring).



There are a few initial setup steps for editing the data in ArcMap. The majority of the required infrastructure has been preloaded on the Aquatic_Veg_Mapping.mxd that is available on the GDRS.

For the Curious: The data is ultimately stored on a SDE geodatabase (on a server in the MNDNR Central Office). This SDE geodatabase is also published on the ArcGIS Online server. All edits are made to this SDE geodatabase either through the Collector app (iPad), ArcGIS Online website, or directly through ArcMap. A specific connection file is needed to access this SDE database through ArcMap. This connection is already preloaded in the Aquatic_Veg_Mapping.mxd.

UPDATE ARCMAP

You must first update to the most recent version of ArcMap (10.6 or later) as it contains required tools. To Update: In Windows Explorer, navigate to: V:\gdrs\apps\org\com_esri\ArcGIS_10_6_Desktop\ArcGIS_10_6_Media

a. Double-click on the Setup.exe.
b. It will install over the top of your current ArcGIS 10.X software

THE AQUATIC_VEG_MAPPING.MXD

The majority of the required infrastructure has been preloaded on the Aquatic_Veg_Mapping.mxd that is available on the GDRS. This was done to simplify the process and aid in consistency. You should open this .mxd project and save it to your local PC so others can use the original project.

1. Navigate to V:\gdrs\apps\org\us_mn_state_dnr\emergent_vegetation\Aquatic_Veg_Mapping and double- click to open project.
2. File→ Save As → navigate to a logical location (temp folder) on your PC and rename as desired.

Check data connections:

5. If the feature classes fail to open, or the links are broken (red exclamation mark) you probably need to update PostGres Drivers
    a. Open ArcGIS Managers Application: (green monster on MNDNR Quick Layers toolbar)
        i. 
    b. Select **Install PostGres Drivers** button

i. 

Useful toolbars to have open:

1. DNR QuickLayers Toolbar
2. Editor Toolbar

AQUATIC VEGETATION EDITING TOOLBAR

The *Aquatic Vegetation Mapping Editing Toolbar* should already be installed with the Aquatic_Veg_Mapping.mxd. However, if you do need to install it, follow these steps in ArcMap:

1. Go to Customize tab →Add-In Manager→ Options tab→Add Folder button
    a. Navigate to V:\gdrs\apps\org\us_mn_state_dnr\emergent_vegetation
    b. Click ok,
    c. Select "load all add-ins without restrictions"
    d. Click close
2. Next go to Customize tab → Toolbars → Check "**DNR Emergent Vegetation**"

TOOLBAR OVERVIEW

The Aquatic Vegetation Mapping Editor Toolbar is a custom toolset created to simplify editing of collected aquatic vegetation data. A detailed description of the toolbar is provided in the subsequent sections.

1. **Check Out Data** – Checks out selected data from central database and saves a copy to local D: drive.
2. **Check In Data** – Checks edited data back into central database.
3. **Refresh Database –** Runs reconcile and Post function on database (for same day edits).
4. **Align Edge Tool** – Matches one edge to another so they are coincident.
5. **Replace Geometry** – Reshape selected feature but keep all attributes.
6. **Validate Topology in Current Extent** – Finds topology errors in current extent.
7. **Topology Inspector** – Shows list of topology errors.
8. **Magic Attribute Updater**– Updates spatial attributes (DOW, Lake name, etc.) and calculates other fields.
9. **Promote Polygons** – Moves selected polygons from ***Raw Data*** to ***Verified Data*** feature class.
10. **Retire Data** – Moves selected polygons from ***Verified Data*** to ***Retired Data*** feature class.
11. **Generate Report -** Creates a summary report, maps, and excel output for selected data.
12. **About** – Contains info on current toolbar version.
13. **Help** – General help document.

Once all the initial set up is done it's time to start the editing process! The editing process can be broken into five general steps: 1. Check out the data, 2. Fix the raw data polygon geometry errors, 3. Fix the raw data attribute errors, 4. Promote the Raw data to Verified data, 5. Check in the data.

SAME DAY EDITS

If you are want to edit your data on the same day that you collected it, the central database needs to be updated before your data is visible. I know this is strange, we've asked ESRI to fix it, but until they do this is what we need to do.

1. Sync your data from the collector app
2. Open the Aquatic_Veg_Mapping.mxd project
3. Press the Refresh Database button (3)- hit OK
    a. NOTE: this can take several minutes

This process is automatically run every night, so it is unnecessary in most cases.

1. CHECK OUT DATA

The first step is to check out the lake data you need to edit. It is recommended to check out only **one lake** at a time.

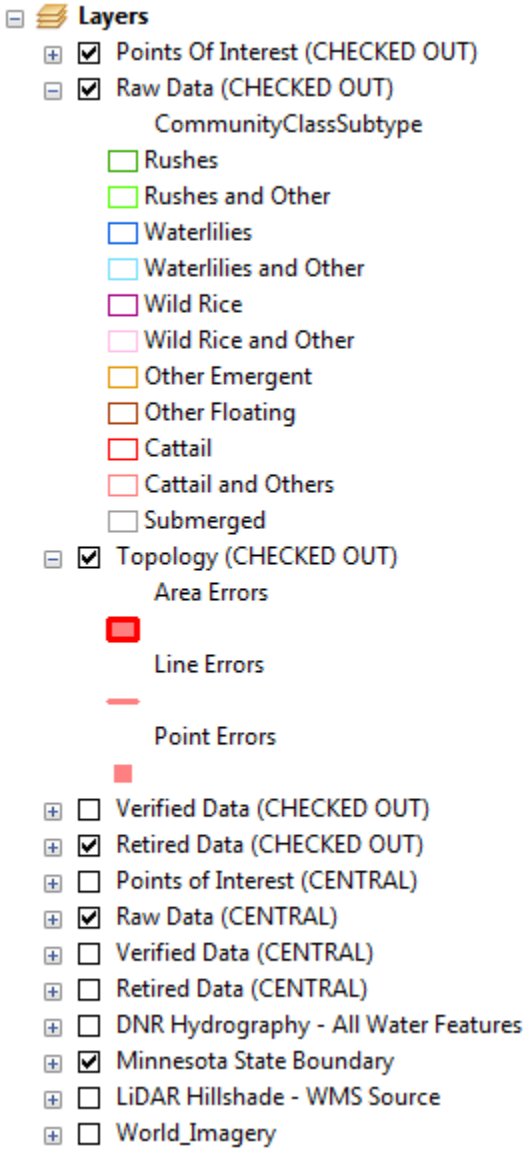
1. Turn ON the ***Raw Data(Central)*** and ***Points of Interest(Central)*** feature classes
    a. It is OK to have other layers turned on (i.e. Lakes Outline).
2. Zoom to your lake data
3. Click **Check Out Tool(1)** 
4. Make extent bounding box around your lake data*
   *In some cases you may have to select polygons of adjacent lakes, this is OK (may happen in a chain of lakes).
5. Click Yes

The **Check Out Tool** may take a few minutes (depending on your local connection speed) and will automatically add following new layers to the map project:

- Points Of Interest (CHECKED OUT)
- Raw Data (CHECKED OUT)
- Topology (CHECKED OUT)
- Verified Data (CHECKED OUT)
- Retired Data (CHECKED OUT)

6. Turn OFF the four ***(CENTRAL)*** layers to avoid confusion!

7. Turn OFF the ***Verified Data (CHECKED OUT)*** and ***Retired Data (CHECKED OUT)*** (optional)



2. EDITING POLYGONS

The next step, and where you will likely spend the most time, is editing the polygon geometries. Remember that overlapping polygons are not allowed in the final (*Checked in*) data!

There are several tools to reduce time and increase accuracy of your edits.

EDITING WITH TOPOLOGY

The **Topology (CHECKED OUT)**, is a special layer called a topology layer. A topology layer is like a friendly Conservation Officer- it will look for broken rules and give you a warning when it finds a violation! In this case the only rule we have is that polygons must not overlap. This topology layer can be turned off/on as needed.

Editing with topology tools has a bit of a learning curve; both patience and practice are needed. However, once you have the hang of it, it will save an amazing amount of time! See the **Editing Aquatic Plant Stand Data - Training Exercise** if you want a better understanding of how geodatabases and topology editing works.

*Note: the topology tools in the **Aquatic Vegetation Editing Toolbar** are a subset of the most commonly used tools from the full **Topology Toolbar**. The full Topology toolbar can be turned on by going to Customize -> Toolbar -> Topology (optional)

VALIDATE TOPOLOGY IN CURRENT EXTENT TOOL

Use the **Validate Topology Tool(6)**  to look for errors in the current extent

1. Start editing ***Raw Data (CHECKED OUT)***
    a. Right click layer→Edit Features →Start Editing
2. Zoom to lake polygon layer
    a. Right click ***Raw Data(CHECKED OUT)*** layer → Zoom to Layer
3. Click **Validate Topology(6)** 
    a. This shows you each instance a rule is broken. Overlaps are shown in red.
4. Zoom in to logical starting point and start editing

Note**, the ***Topology (CHECKED OUT) layer only updates <u>after</u> you click **Validate Topology**, so you will have to click the **Validate Topology** tool after you make an edit (or before moving extents) to verify your edit was correct…which means you may be hitting this button often!

ALIGN EDGE TOOL

Now that we see where we have overlapping polygons we will use the **Align Edge Tool (4)**  to match the edges of coincident polygons.

5. Select **Align Edge Tool (4)** 
6. Click on <u>line to be moved</u> "A", purple dashes appear – (hard to see). This will be the "Simple Segment" if you followed the recommendations in the collecting data section.

7. Click on line to be matched to "B" (purple dashes appear). This would be the "Complex Segment" as previously described

8. Click on **Validate Extent (6)** to refresh topology layer (to verify that your edit was successful)

This is what we wanted to see

9. Move to next area - repeating steps 5-8

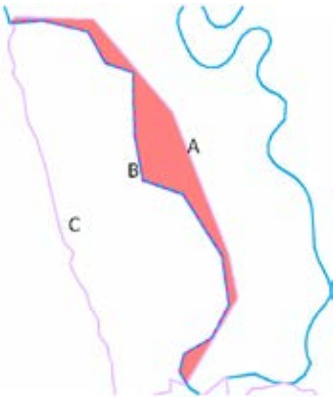
***Note-** Press and hold the "**C**" key to get the "Pan Hand" to move to the next area (or press and hold roller on you mouse)

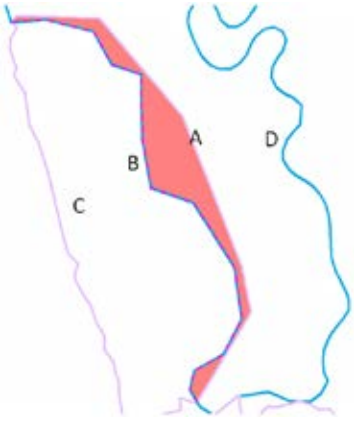
10. Save edits often!

The **Align tool** can also be used to fill small gaps between concurrent polygons!
Sometimes manually moving vertices is required and you can use the **Topology Editor tool (Customize → Topology toolbar)** to move coincident vertices or coincident edges.

- The regular **Edit Tool** arrow in the standard **Editor Toolbar** can also be used, but only moves the vertex of one polygon

COMMON PROBLEMS WITH ALIGN EDGE TOOL

1. The biggest mistake is inadvertently aligning to the whole polygon as seen below
   a. 

   b. Line A→C: this will cause the blue polygon to merge with the Pink one, making one large Blue one...bad news!
2. Deleting the polygon
   a. 

b. Line D→C: this will cause the pink polygon to vanish...worse news

3. When this happens:
   a. Use undo button  or
   b. Use Ctrl+Z or
   c. Enroll in an anger management course before hurling your PC out the window, or
   d. Go for a walk and speak with a Jamaican accent (It's surprisingly difficult to be in a bad mood when your ta'kin ja'makin'!)
4. Detect these issues early by clicking the **Validate Topology Tool**  before moving to the next area (or after each line edit).

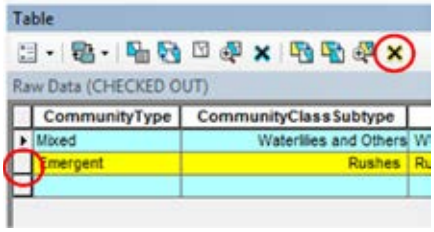
TRICKY SITUATIONS

The following steps will help address common tricky situations.

ISLANDS AND INCLUSION STANDS

In some cases there may be inclusions or pocket stands within a larger community. It is important that these inclusions are not overlapping the larger polygon. The following steps use the **Cut Polygons Tool** and **Trace Tool,** in the standard editor toolbox, to cut out inclusion stands within larger communities. This same approach is used for cutting out islands or holes in a larger community.

1. Select the larger polygon
2. On (standard) Editor Toolbar →click **Cut Polygons Tool**  , then click **Trace Tool** 
   a. Note: if using aerial imagery to cut out an island, the **Segment Tool**  may be useful
3. **(A)** Click on a vertex of the smaller inclusion polygon
4. Follow around the inclusion polygon → double click to finish tracing.
5. **(B)** Click **Selection Tool**  → then click on <u>the small</u> inclusion polygon
6. Open attribute table → there should be two records selected (the inclusion polygon, and the cutout of the larger polygon).

7. **(C)** Click grey box to highlight the cutout record
   a. 

8. Delete the highlighted cutout record.
9. Click **Validate Topology** to verify the proper record was removed.

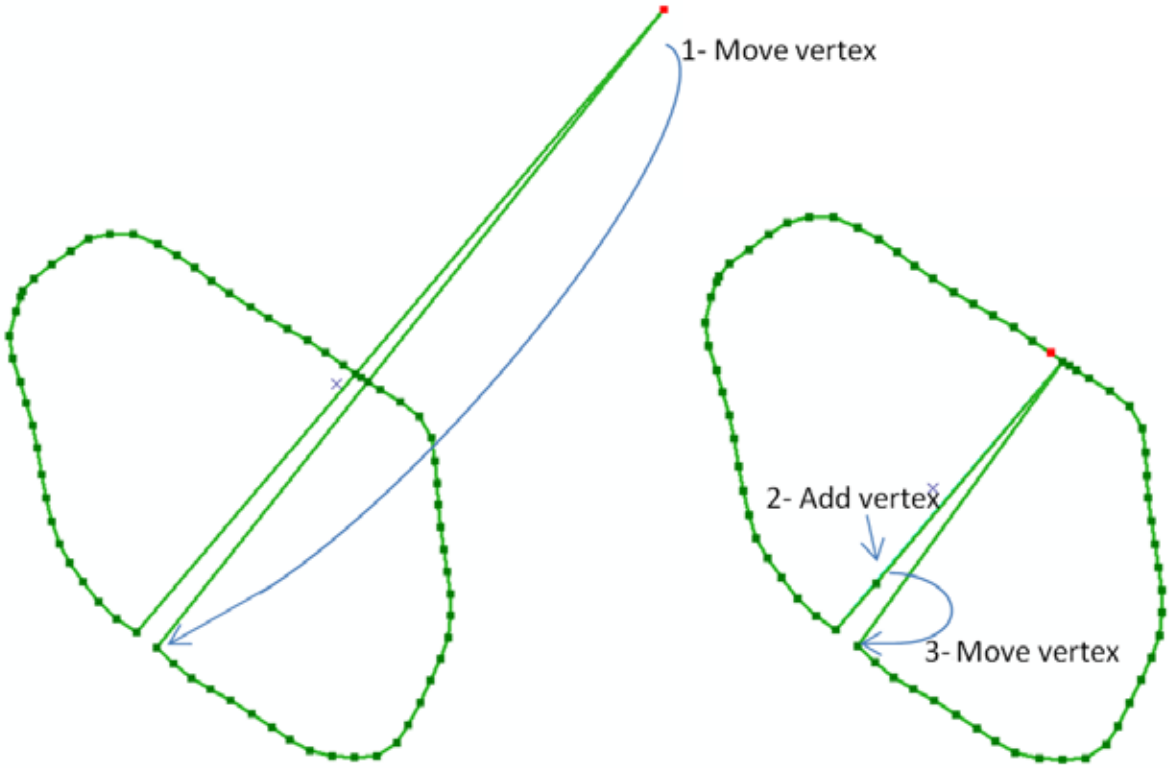
PROBLEMATIC GEOMETRIES

The Northeast Pointer

One common phenomenon that occurs with Collector for ArcGIS is what I'm calling the "Northeast Pointer". This occurs when you attempt to tap **Submit** on the iPad App, but actually tap just to the side of the **Submit Icon**, causing the placement of an errant vertex on the upper right corner of the extent. This results in what looks like an arrow pointing to the Northeast. Deleting the errant point will not properly fix the problem.

1. Move the errant point- snap it to the appropriate vertex
   a. Click errant point and drag it to appropriate vertex
2. Add a vertex on a remaining segment
   a. Right click on line segment → Insert Vertex

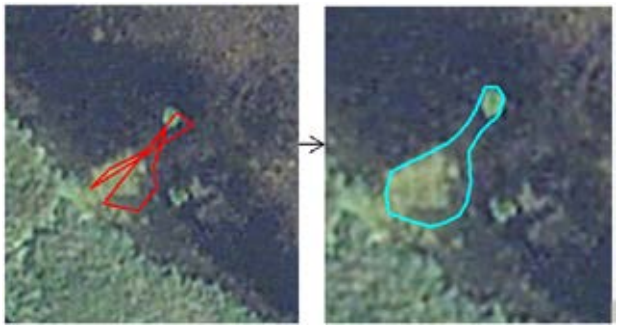
3. Click and drag the new vertex to move it to the appropriate



Twisted or really messy polygons

Sometimes it is easier and faster to replace a shape rather than try to fix it; however we don't want to lose the attributes when we replace the polygon. The **Replace Geometry Tool (5)** will let us digitize a new shape while maintaining the attributes.

1. Click **Edit tool** , then select messy polygon
2. Click **Replace Geometry Tool**
3. Use imagery and/or trace old polygon to generate new shape while keeping attributes
    a. Click the **Segment Tool** to create new segments
    b. Click the **Trace Tool** to trace parts of the old feature or conjoining features



SHORELINE EDITING

The following steps use the **Reshape tool**, ***LiDAR***, and ***imagery*** to modify polygons adjacent to shorelines.

- Also see **Photo Interpretation for Aquatic Vegetation Mapping** section for useful tips and information!
- ***Beware – Many of the lake boundaries on Quick Layers are not sufficiently accurate for vegetation mapping!**

Lakes are complex and dynamic systems; water levels, shoreline erosion or deposition, and changing plant communities can all physically change a lake shoreline. Lake boundaries in GIS are ultimately reliant on the technologies available when the boundaries are developed. Advances in data storage and remote sensing have made available significantly higher resolution imagery. New tools such as LiDAR have increased the available data, and consequently the level of precision to which shoreline boundaries can be generated. Legal definitions and jurisdictional guidelines are social factors that impact lake boundaries, but these often differ from environmental/biological needs of resource managers. These are just some of the reasons lake shore boundary layers in GIS are complex and ever changing.

Useful Quick Layers and tools include:

1. ***DNR Hydrography- All Water Features*** for current lake boundary
2. ***LiDAR Hillshade – WMS Source*** to aid in shoreline delineation – Imagery alone is prone to issues!
3. Useful imagery sources can include, but are not limited to:
    a. ESRI World Imagery
    b. FSA Color Imagery
    c. FSA Color Infrared Imagery
    d. NWI (National Wetland Inventory)

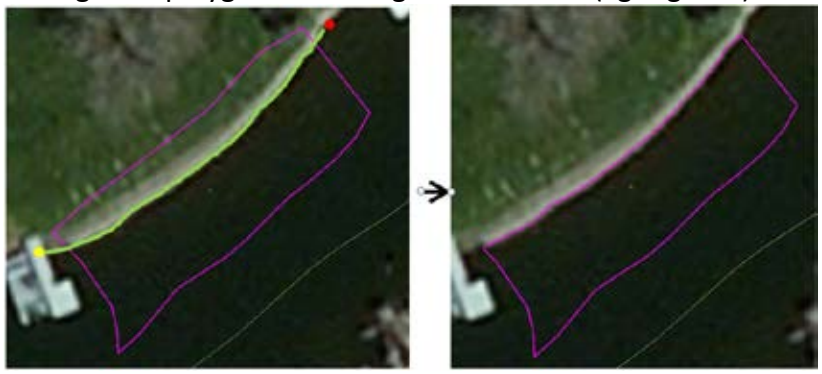
e. Best available DEM

4. Add **Effects** toolbar
   a. 

   b. Customize → Toolbars→Effects
5. Setting basemap imagery transparency between 40-60%, with LiDAR Hillshade below it can be very useful.

Compare the ***DNR Hydrography- All Water Features*** lake boundary to the ***ESRI World_Imagery*** (Zoom to a scale of at least 1:2000). Few lake boundaries have been updated and are accurate enough to "clip to", meaning we have to manually clip the polygons to the shoreline using LiDAR and imagery interpretation!

To reshape polygons along shoreline using imagery:

1. Select the plant community polygon
2. Select **Reshape Feature Tool** 
3. Select the **Segment Tool** 
   a. Starting OUTSIDE of the polygon (red dot), click to create a series of vertices through the polygon- following the shoreline (light green).
   b. 
   c. Double click OUTSIDE the line to end (yellow dot).
   d. The "smaller half" will be erased automatically
      i. If the shoreline overlap is larger than the plant stand, you may have to trim the shoreline overlap multiple times.
4. **Reshape Feature Tool** also works inside-out
   a. Place first vertex INSIDE polygon,
   b. Add more vertices following shoreline
   c. Double click INSIDE polygon to finish

d. 

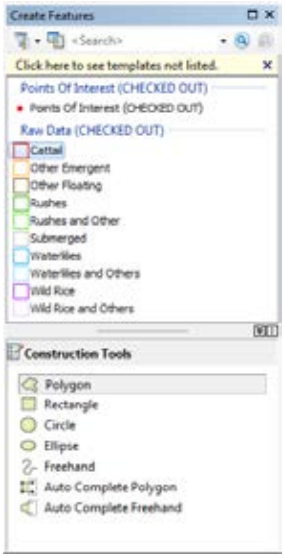
To reshape polygons to an accurate lake boundary line: If your lake has a very accurate lake boundary, you can use the trace tool to clip the polygon to.

1. Select the plant community polygon
2. Select **Reshape Feature Tool** 
3. Select the **Trace Tool** 
4. Click on the lake boundary line outside of the plant community polygon → follow the lake boundary line
5. Double click to finish

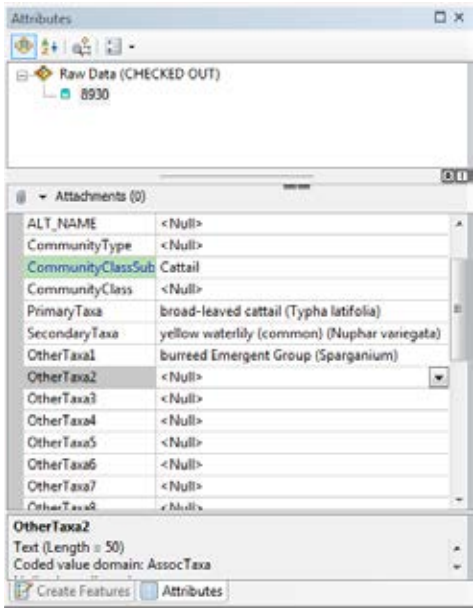
CREATING POLYGONS FROM GPS TRACKS (THE OLD METHOD)

With the ease and efficiency of using Collector for ArcGIS to map aquatic plant communities, it's unlikely you need to use the previous method of using GPS points, lines and paper notes. However, if you do have data collected with the old method, you can still get data in the new database…and you can even use the speedy topology tools!

1. Zoom to your lake boundary
2. Check out the (blank) area (See Chapter One).
    a. Use the **Check Out Tool (1)** and create a box around your lake (even though there is no data associated with the lake). A blank copy of the database will be downloaded.
    b. Other layers can also be turned on (i.e. hydrography layer)
3. Add your raw data shapefiles (GPS tracks, points) to the project.

4. Start editing the ***Raw Data (CHECKED OUT)*** feature class (see Chapter Two).
5. On standard **Editor Toolbar** click **Create Features** 
    a. Select the community class (i.e. Cattail)
    b. Select the construction tool (i.e. Polygon)
        i. 

    c. Click on the map to start making polygons, Double click to close polygon
        i. Use **Trace Tool**  to easily follow GPS lines or shorelines
        ii. Use the **Segment Tool**  to create new segments where tracing isn't appropriate
6. Open **Attribute Template Tool**  (on standard **Editor toolbar**)
    a. Newly created record should be selected
7. Use dropdowns to fill in taxa fields (*Primary, Secondary*, and *Other taxa*).
    a. Note - these dropdown lists are identical to those on the Collector App

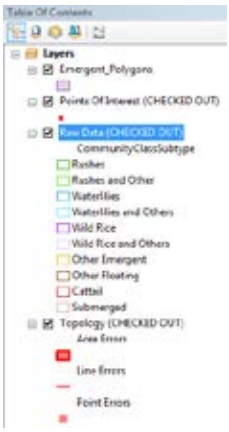
b. 

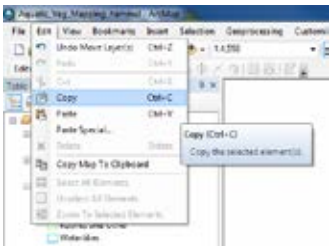
c. Don't fill in other attributes (DOW, Lake Name, Community Type, Community Class, etc.), they will get calculated with **Magic Attribute Update Tool** later.
d. Using the standard attribute table is another way to add attributes

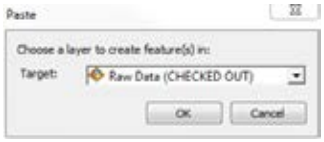
COPYING OTHER POLYGON DATA INTO GEODATABASE

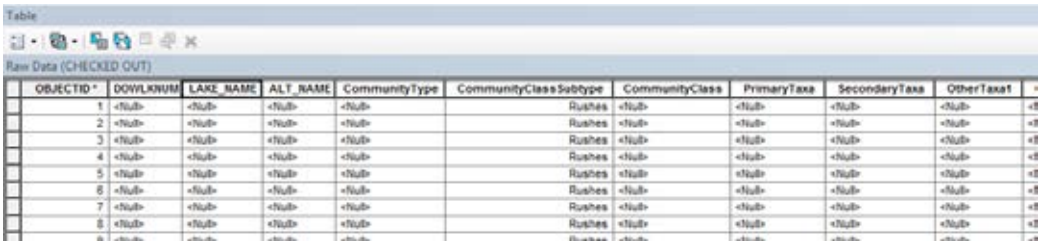
In some cases the data collected from your handheld GPS may already be polygon, or you have previously collected data you want to import to the new classification structure. You can easily import these polygons into the RawData(CHECKED OUT) feature class and continue the data editing process.

1. Zoom to your lake boundary
2. Check out the (blank) area (See Chapter One).
    a. Use the **Check Out Tool (1)** and create a box around your lake (even though there is no data associated with the lake). A blank copy of the database will be downloaded.
    b. Other layers can also be turned on (i.e. hydrography layer)
3. Add your other polygon data shapefiles to the project.

a. 

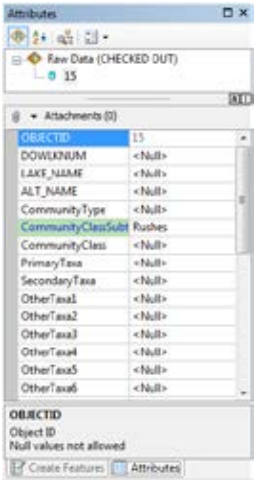
4. Start editing the ***Raw Data(CHECKED OUT)*** feature class (see Chapter Two).
5. Select the polygons from the shapefile that you want to copy.
6. Edit → Copy
   a. 

7. Edit → Paste → select Raw Data(CHECKED OUT)
   a. 

   b. This will copy the polygon geometry and any identical field attributes
   c. After it copied the polygons, turn off the polygon shapefile to reduce confusion
8. Next, update the taxa field attributes, starting with the CommunityClassSubtype field. There are two ways to do this.
   a. From the **Raw Data(CHECKED OUT)** attribute table:
      i. Open the attribute table.
      ii. Note the CommunityClassSubtype, it defaulted to “Rushes”
      iii. 

      iv. Go through each record
         1. Select the appropriated CommunityClassSubtype

2. Then Select the appropriate PrimaryTaxa, SecondaryTaxa, OtherTaxa

b. From the Attribute editor window 
   i. Select a polygon from **Raw Data(CHECKED OUT)**
   ii. Select the Attribute editor from the standard editor toolbar 
   iii. Select the appropriate CommunityClassSubtype
   iv. Then Select the appropriate PrimaryTaxa, SecondaryTaxa, OtherTaxa
   v. 

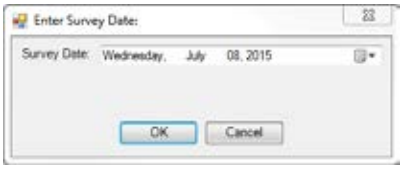
For the Curious: The *Community ClassSubtype* field is called a "subtype". The taxa fields (*PrimaryTaxa, SecondaryTaxa*, and *Other taxa*) are based off lookup tables called "domain tables". The *Community ClassSubtype* value determines which domain table (dropdown option) is available for the *PrimaryTaxa* and *SecondaryTaxa* fields. For example, if "Cattail" is selected, only cattail species (broadleaf, narrowleaf, etc) are available for *PrimaryTaxa*.

3. UPDATE ATTRIBUTES

After all the geometry errors have been corrected, the next step is to update the attributes. All of these spatial updates and calculations have been combined into the **Magic Attribute Update Tool (8)**  .

1. Select all the polygons for the lake
   a. In most cases this would be all the polygons in the ***Raw Data(CHECKED OUT)*** feature class.

b. Exception would be if polygons from adjacent lake were checked out and not edited (may happen in a chain of lakes)

2. Click the **Magic Attribute Update Tool(8)**
3. Select the Survey Date
   a. 

   b. The default is from the **created_date** field
      i. If Collector App was used this date should be correct.
      ii. If GPS lines were used to create polygons (old method), Select the date the survey was conducted.
   c. This will only prompt the first time the tool is run.

*NOTE- An Internet connection is required for this tool to work (runtime varies depending on connection speed, often taking 1-2 minutes).

For the Curious: The **Magic Attribute Update** actually uses a web service (hence internet is needed) to get the lake data. It updates the lake specific fields (*DOWLKNUM, LAKE_NAME, ALT_NAME*) of the polygons that are overlaying the lake boundary. It then calculates the following fields: *Community Type, Community Class, ObservedTaxa, StandAcres*, *Year*, *errors* and *SurveyDate* based off other fields in the table…all with the click of a button…Like Magic!

FIND ATTRIBUTE ERRORS

Next we want to check the attribute table for errors. There are a few common errors, so we built the **Magic Attribute Update Tool** to find them and note them in the **errors** field.

1. Review the errors listed in the **errors** field of the attribute table
   a. Common errors include:
      i. Missing Primary Taxa – self explanatory
      ii. Missing Secondary Taxa – If "Rushes and Other" is the Community class, and the secondary taxa is missing, what is the secondary taxa?
      iii. Missing Lake Data – vegetation polygon was outside the lake boundary
         1. To fill in, manually Copy (Ctrl + C) and Paste (Ctrl + V) information from the record above
            a. Often occurs with fringe communities (i.e. Cattails)

b. And/or on lakes with inaccurate lake boundaries

iv. Invalid Taxa Value- Occurs when a Heading value is selected (i.e. "__WETLAND TAXA__")

2. Invalid taxa errors can also be noted as species codes in the **PrimaryTaxa** and **SecondaryTaxa** fields of the attribute table.
    a. This occurs because the CommunityClassSubtype was changed and the taxa options no longer make sense.
    b.

CommunityClassSubtype	PrimaryTaxa	SecondaryTaxa
Waterlilies	SCS	ELSP
Wild Rice and Others	wild rice (Zizania palustris)	yellow waterlily (common) (Nuphar variegata)
Rushes and Other	bulrush (genus) (Schoenoplectus)	yellow waterlily (common) (Nuphar variegata)

    c. In the highlighted example above the CommunityClassSubtype was changed to Waterlilies, now the primary taxa (SCS = bulrush (genus) schoenoplectus) is not consistent with the community type.
    d. This is fixed by first selecting the correct CommunityClassSubtype, then selecting the correct PrimaryTaxa and SecondaryTaxa.
3. To assist fixing errors:
    a. Review **Comments** field
    b. Review ***Points of interest(CHECKED OUT)*** feature class
4. The **Magic Attribute Update Tool** can be run multiple times as needed to verify that errors are corrected.

DON'T GUESS IF YOU CANNOT RECALL -LEAVE IT BLANK- MISSING DATA IS BETTER THAN INACCURATE DATA

UNLISTED TAXA

There may be a few situations in which the dropdown list is missing a mapped taxa. This is most likely to happen when a "wetland" plant is found inhabiting shallow water. This could also happen when mapping in flooded area (oak trees are not aquatic plants; check the flood stage of the waterbody or consult your local friendly forester if you need to map them!)

Unfortunately, it is not easy to update the taxa lists, and this will only be done during the off season update (occurring late autumn). There are a few ways to handle missing taxa. The preferred method is to select the genus level option, and use the **comment** field to record the taxa name. If the genus option is not available, use the "unknown (type)" and make a **comment**. These comments will be reviewed and appropriate changes made during the autumn update. To handle unlisted taxa during the editing process, consult either Fisheries GIS Staff, EWR Lake Habitat Program staff, or use the MNTAXA species code.

For the Curious: The taxa fields (*PrimaryTaxa, SecondaryTaxa*, and *OtherTaxa_X*) are based off lookup tables called *domain tables*. The root data in these fields are called *coded values*, (based off of EWR Lake Habitat Programs taxa code list), whereas the *description* of the value is what appears in the data field. For example, "NV" is the *coded value*, and "yellow waterlily (common) (*Nuphar variegata*)" is the *description* that is appears in the field. To use the field calculator to calculate the taxa fields, the coded value (taxa code) must be used (i.e. PrimaryTaxa = "NV"). Consult V:\gdrs\apps\org\us_mn_state_dnr-\emergent_vegetation\CollectorPlantCodes for a complete list of these coded values and descriptions.

4. PROMOTE DATA / RETIRE DATA

The **Verified Data** feature class only houses the most current data. The **Retired Data** feature class is the repository for old data. When a lake is resurveyed, the old data gets moved from the **Verified Data** to the **Retired Data** feature class. This way it is separated from the most recent data but is still easily accessed for analysis. When a lake is surveyed 3 or more times, all the retired data will be stacked. You will need to use the attribute table to select the polygons by year and export them to a new local layer.

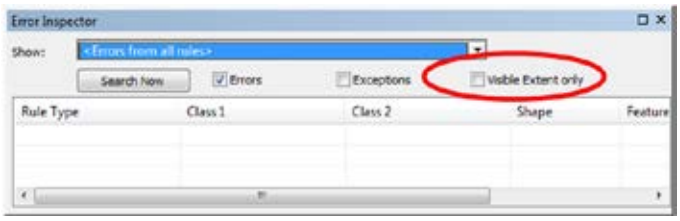
Check if there was a previous survey done **before** promoting data

1. Turn on the ***Verified Data (CHECKED OUT)*** feature class to see if there is existing data from a previous year
2. IF OLD DATA EXISTS, RETIRE IT BEFORE PROMOTING NEW DATA
3. Select the Old Data → Click **Retire Data Tool (10)** 

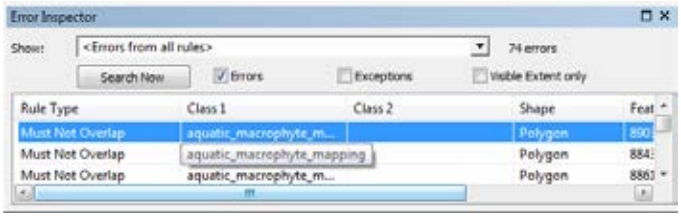
DON'T PANIC if you 'lost your data' TURN ON THE ***Retired Data(CHECKED OUT)*** LAYER!
Remember, retiring the data **moves** the data from ***Verified*** to ***Retired (CHECKED OUT)***

After all the Raw Data has been cleaned up and corrected, it's time to **Promote (9)**  the data from "Raw" to "Verified." All data strive to be verified, and only clean and happy data are given this honor. So before bestowing this honor upon your data make one last set of quality checks:

2. Find remaining topology errors
    a. Click **Topology Inspector(7)** 
    b. Uncheck "Visible Extent only"

i. 

c. Click "Search Now"
   i. Any remaining topology errors will be listed

ii. 

d. To quickly find remaining error:
   i. Select error→Right click→ Zoom To

3. Click **Magic Attribute Update(8)** again
   a. Right click on "**errors**" field heading → Sort Descending
4. Double- check Comments
5. Double- check Comments in ***Points Of Interest (CHECKED OUT)*** feature class

You should now have clean and happy data…Promote them!

4. Select the polygons you want to promote (usually all the polygons)
5. Click the **Promote Tool(9)** 

DON'T PANIC if you 'lost your data' TURN ON THE ***Verified Data(CHECKED OUT)*** LAYER!

Remember, Promoting **MOVES** the polygons from ***Raw Data (CHECKED OUT)*** to ***Verified Data (CHECKED OUT)***!

Note: if you are editing your data over the course of a few days, it is best to save the map project and continue editing later, rather than promoting only some of the polygons.

5. CHECK IN DATA

Now that the data has been promoted and is in the ***Verified Data (CHECKED OUT)*** feature class, you can give it one last review if desired.

Once you are satisfied with your edits, it's time to **Check In** the edits to the centralized database and make the changes permanent.

1. Save your edits and stop editing.
2. Click the **Check In Tool(2)** 
    a. Runtimes vary due to size and connection speed.
3. That's IT!! Kick back and marvel in your awesomeness!

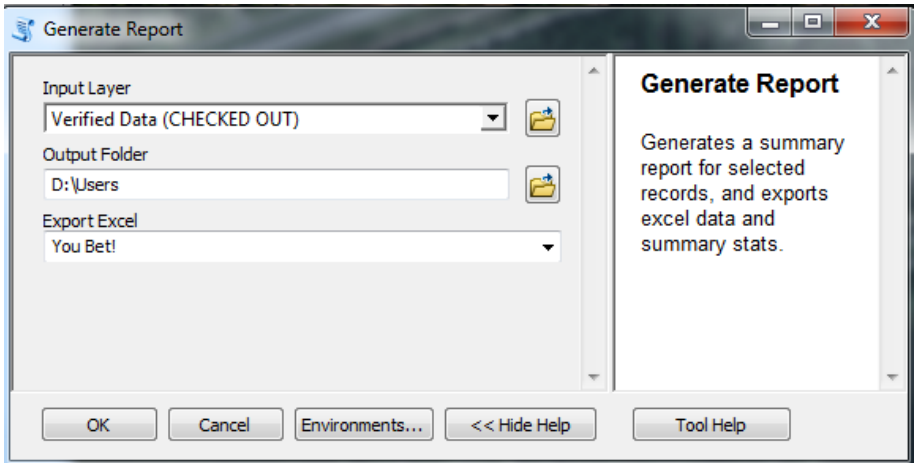
After the tool has run (could take a few minutes) all of the **(CHECKED OUT)** feature classes will change to **(CHECKED IN)**. These features can no longer be checked in, so **any further edits are useless!** However, you can use the **Verified Data(CHECKED IN)** feature class to run analysis on!

USEFUL ANALYSIS

Now that we have great data on the aquatic plant community it's time for data analysis! Here are a few methods and tools that can be useful in analyzing your data.

GENERATE REPORT TOOL

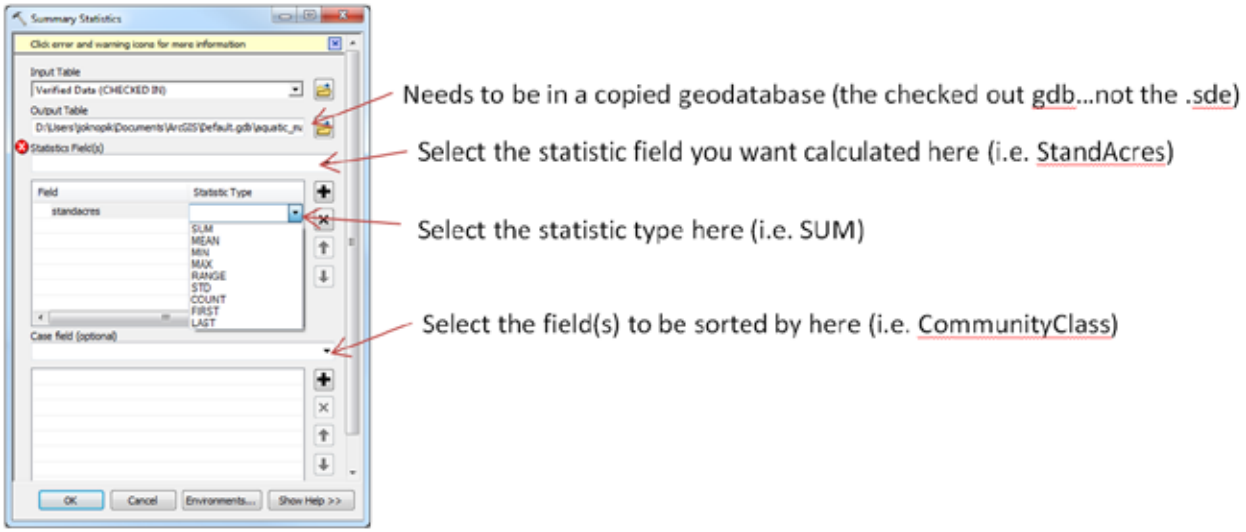
The **Generate Report** tool  was created to aid in efficiently making accurate and consistent reports and maps. To use the tool:

1. Select all the data for one lake (can be with "CHECKED OUT" or "CENTRAL" data)
2. Click the **Generate Report** tool.
3. Enter Parameters:
    a. Input Layer- the Layer with selected data - usually "Verified (CHECKED OUT)".
    b. Output Folder – folder where you want report and excel saved to.
    c. Excel Export – Do you want an excel file with raw and summarized data?
    d. 

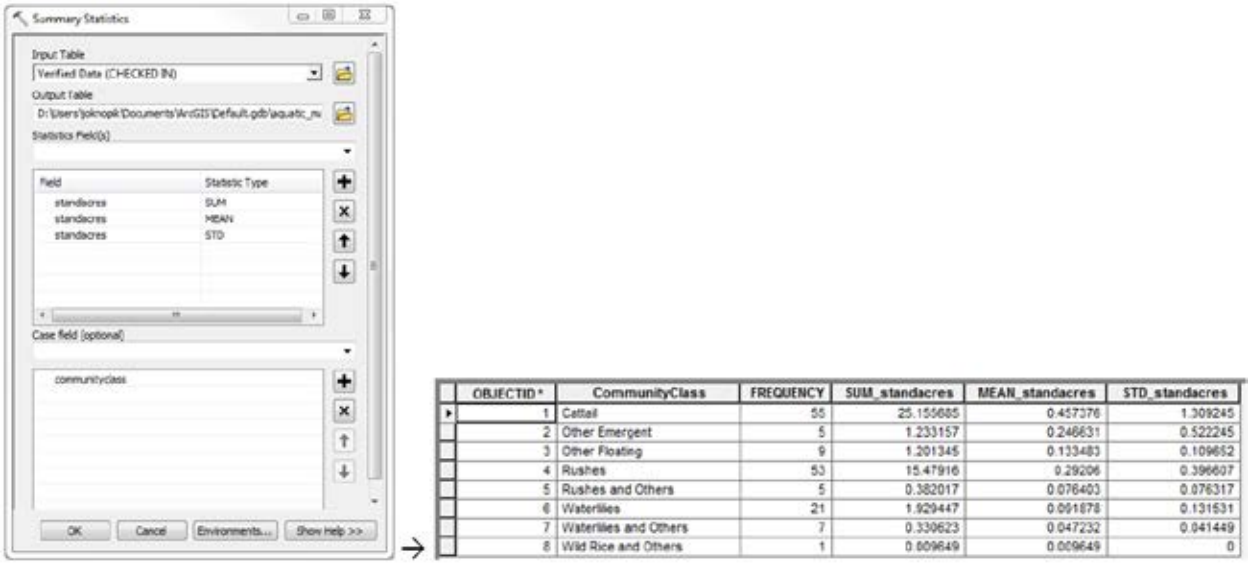
OTHER SUMMARY STATISTICS

The ArcMap **Summary Statistics** tool (Analysis Tools→Statistics) is great for generating quick summary tables. There are a few nuisances to note when using summary statistics with geodatabases.

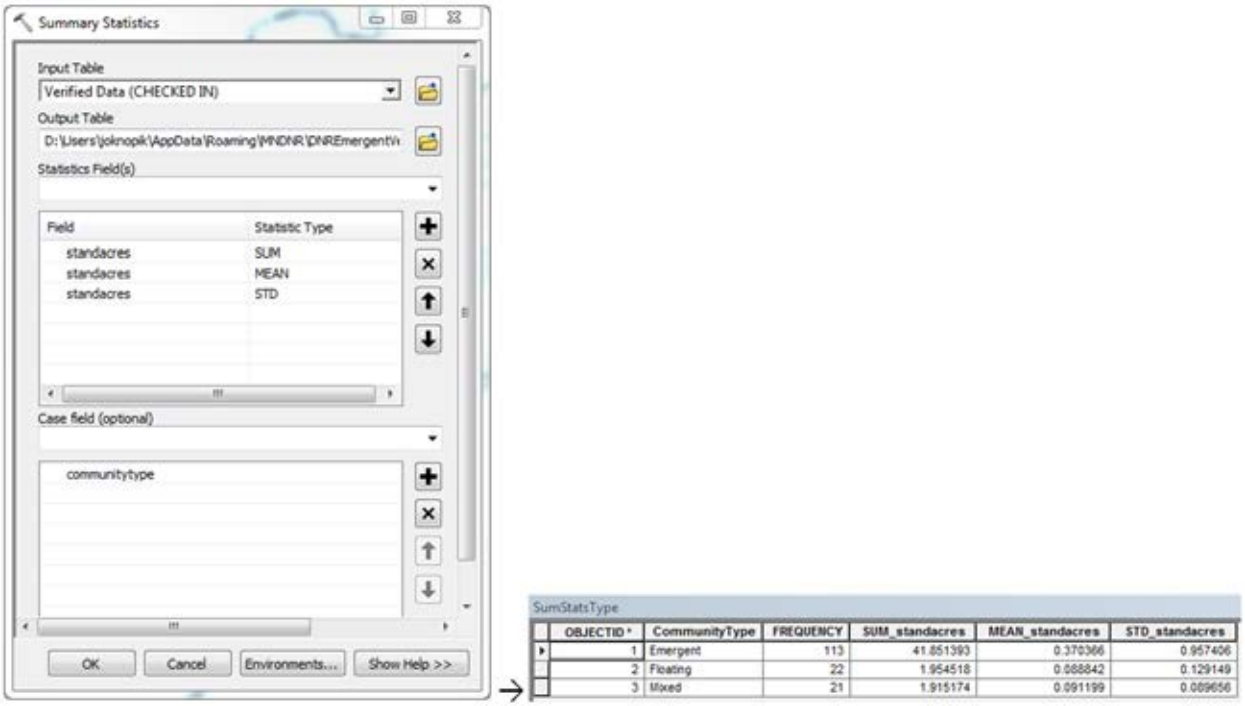
For the field values to display the description appropriately the *Output Table* must be in the same temporary geodatabase (use source tab to find location of geodatabase, should be D:\Users\<username>\AppData\Roaming\MNDNR\DNREmergentVegetation, AppData is a hidden folder) as the *Input Table*, and this cannot be the sde.



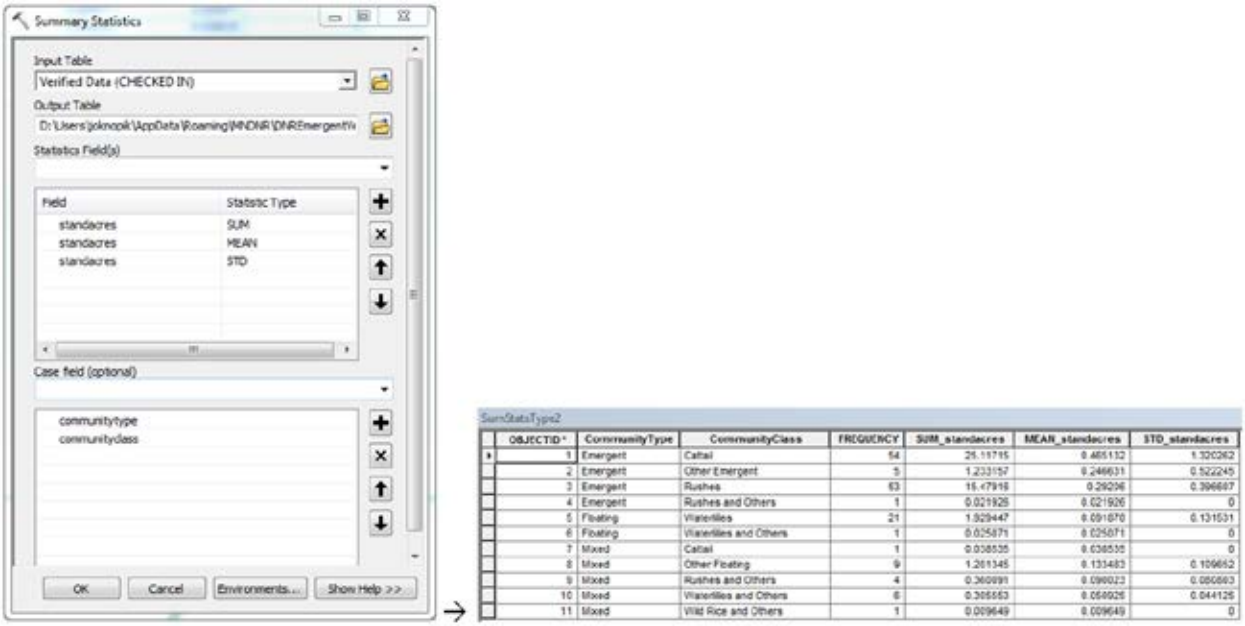
Summarizing by CommunityClass



Summarizing by Community Type



Summarizing by both CommunityType then by CommunityClass



EXPORTING TABLES TO EXCEL

Open attribute table→Select all records → right click →Copy Selected records→ paste directly into excel

OR

Use the **Table to Excel** Tool (Conversion Tools→Excel) to export tables to maintain the description

Be sure to check “Use field alias as column header” and “Use domain and subtype description”

PHOTO INTERPRETATION FOR EMERGENT AND FLOATING PLANT COMMUNITIES

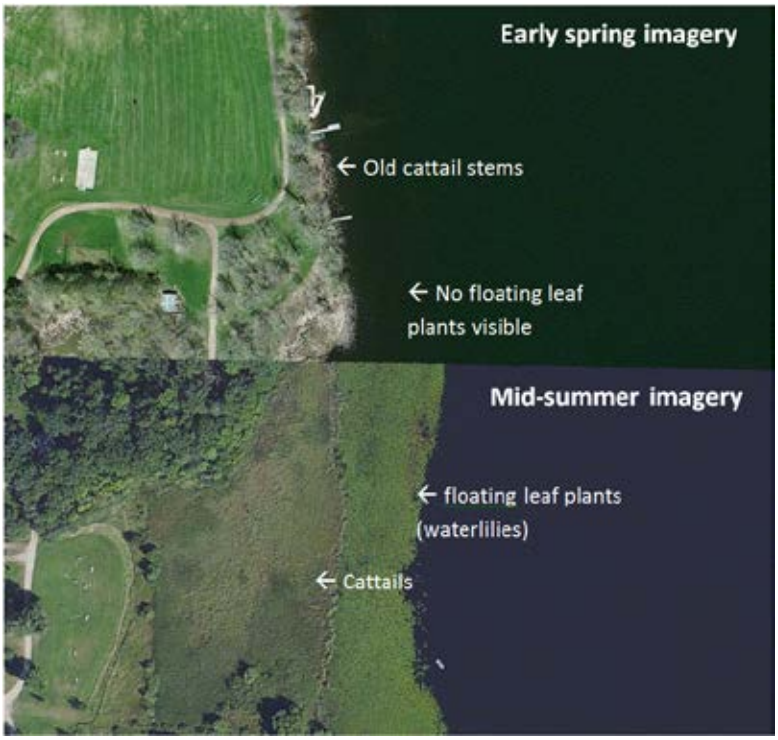
Aerial photo interpretation for delineating aquatic vegetation communities can be beneficial and effective; however, it should not be solely relied on as field verification is mandatory. Using aerial imagery to assist in delineating aquatic vegetation communities can, especially with the aerial imagery on the iPad, be done accurately and efficiently in the field while also looking at the plant community first hand. Here are some tips and tricks to more accurately use aerial imagery for mapping aquatic plant communities.

PHOTO INTERPRETATION BASICS

The following elements should be considered when interpreting aerial imagery for aquatic vegetation communities.

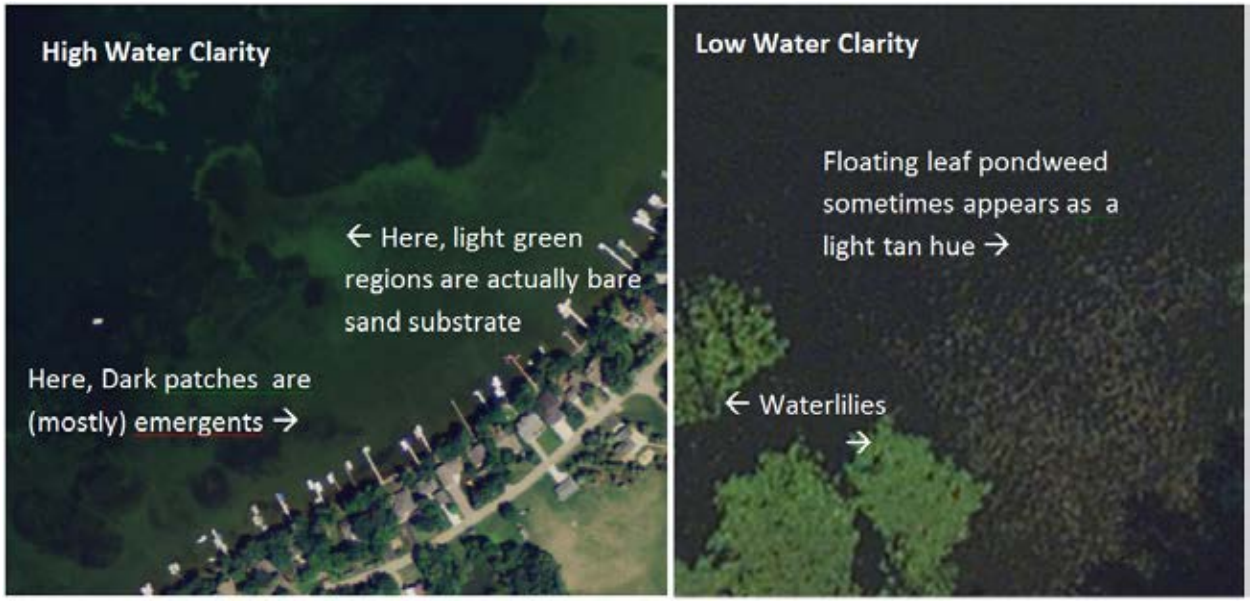
Timing

The imagery date is of critical importance to what can be interpreted from the imagery. Early spring imagery, such as the 2014 ESRI World imagery for northern MN that was likely taken in May, is pretty useless for aiding in delineating aquatic plant communities because they have not yet emerged. However this imagery can sometimes be used for cattail stands as the previous year's stems are still present.



Tone and Color

The tone and color of the object is the most used element for evaluating imagery. Often different plant communities will have different color signatures. For example waterlily communities are often a different shade of green as compared to other floating leaf plants (such as watershield) on the same imagery. Caution must be taken with very clear and shallow water, as substrate can sometimes be seen and misleading.



Texture

Texture is defined as the "characteristic placement and arrangement of repetitions of color in an image," a more intuitive description of texture is the "roughness" of an area. For example, a waterlily community may have the same shade of green as a cattail stand, however the water lily community will often look "courser" and the cattail community will often look "smoother" in texture. If the boundary between "smooth" and "course" is well defined, the imagery can be used to delineate the boundary of these communities.

Shadow

Most aerial imagery is taken between 10am and 2pm to avoid long shadows. Most aquatic plant communities are not very tall, so the use of shadows to assist with delineations is limited. Rather, shadows from trees along the shoreline actually obscure the adjacent aquatic vegetation community in some cases. This is especially the case on the Eastern shoreline of lakes with a wooded riparian zone in some areas with the ESRI World Imagery. The heavy

shadows from the trees completely obscure the adjacent plant community and shoreline features. The use of other imagery and/or LIDAR is usually needed.

Site Association

Site association refers to how objects are situated in relationship to each other. An example of this with aquatic plant communities is zonation by depth, where cattails typically occupy nearshore and waterlilies typically occupy deeper zones.

Shape

Shape is one of the most used elements in aerial imagery interpretation overall, but it has limited applications when it comes to delineating aquatic plant communities. Some plant communities will sometimes grow in distinctive shapes, most notably isolated waterlily stands are often circular in shape.

USEFUL IMAGERY

Pros and cons of available imagery

Source	Pros	Cons	Good for:	Bad for:	Notes:
ESRI World Imagery	Very High resolution	Northern MN imagery taken early spring	Cattails	floating leaf	Cattails often tan in color
		Varied Resolution	emergents in clear water		
			sometimes floating leaf pondweed		sometimes floating leaf pondweed is light tan hue
2013 Color FSA	good, mid summer timing	Very low resolution	Waterlily beds, some emergents, wetland	small emergent stands	
2012 Fall Color/ CIR	good resolution, Color Infrared	getting dated, Limited to Coverage	emergents, some floating	wild rice	great imagery where available
2011 Fall Color/ CIR	good resolution, Color Infrared	getting dated, Limited to Coverage	emergents, some floating	wild rice	great imagery where available
2010 FSA Color	good, mid summer timing	lower resolution	emergents, some floating		
2010 FSA B/W	good, mid summer timing	dated, lower resolution, shadow contrast	some shoreline boundaries		limited usefulness

CHAPTER 3. SCORE THE SHORE

This section describes the GIS-related components of a Score the Shore survey, including, generating survey points, and using Collector for ArcGIS to collect edit, summarize and export data.

This systematic spacing of survey sites is required for Score The Shore (Chapter 2 of Lake Plant Survey Manual) and Quantitative Near-shore Sampling (Chapter 6 of Lake Plant Survey Manual). Repeat surveys should be conducted using the same sampling points as previous survey. If sample points already exist for a lake, use these points to conduct future surveys.

A reasonably accurate lake shoreline boundary is needed before generating survey points. Some of the lake boundaries available on Quick Layers are inadequate for the level of precision required. Verify the lake boundary layer is accurate; see Editing Shoreline Boundary Tip Sheet before continuing!

A custom toolbar has been developed to facilitate the dataflow from point creation to data analysis. The general survey overview is as follows: Step 1. Use the Point Generator tool (on StS Toolbar) to create survey points. Step 2. Use Collector for ArcGIS app to collect the field data (or paper datasheet). Step 3. Use the Calculate Score tool (on StS Toolbar) to QC and calculate site scores. Step 4. Use Export tool (on StS Toolbar) to export results.

GETTING STARTED WITH ARCMAP

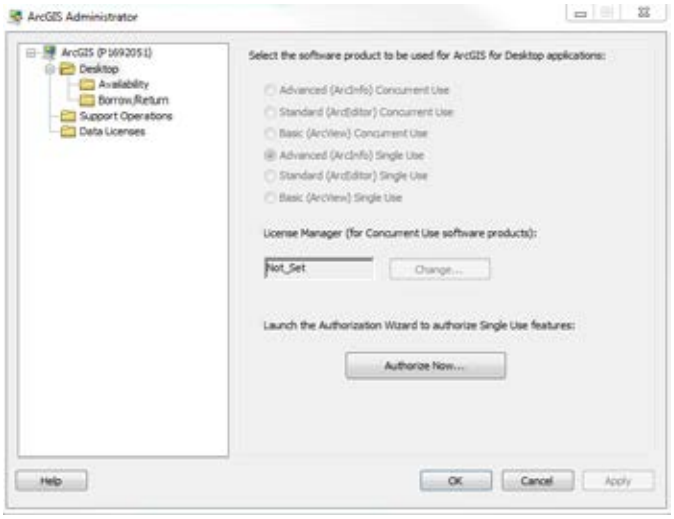
UPDATE ARCMAP

You must first update to the most recent version of ArcMap (10.6 or later) as it contains required tools. Check by opening ArcMap →Help->About

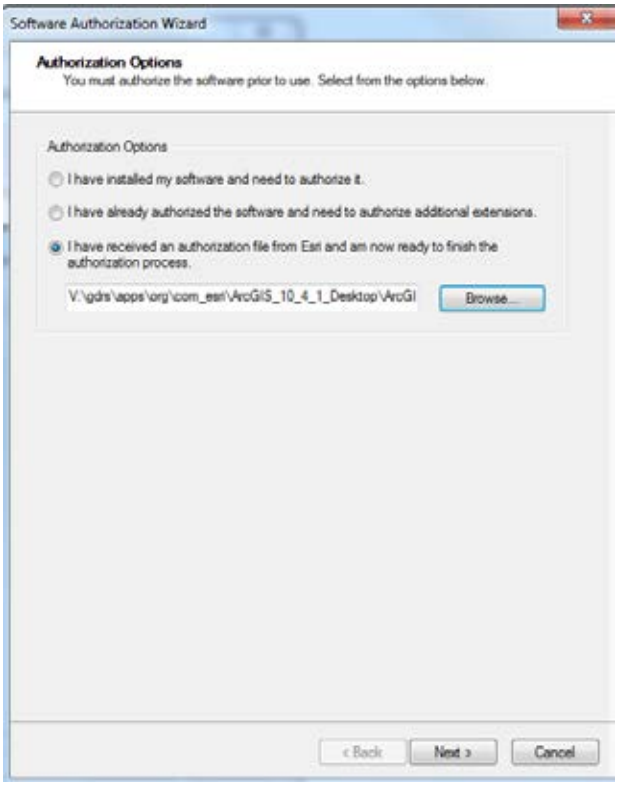
To Update: Open Software Center (search under start menu) → Available Software Tab→ find ArcMap 10.6 → Install

After install you may be prompted to authorize the software. You need to have the “Advanced - Full” licensing for spatial analyst extension.

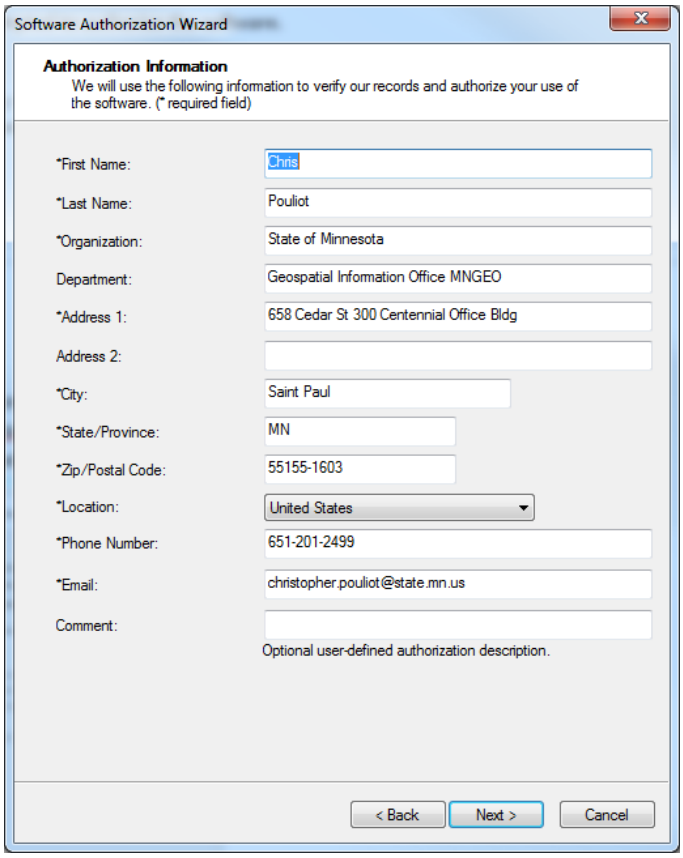
1. Open ArcGIS Administrator → All Programs → ArcGIS
2. Click Desktop → Authorize Now

a. 

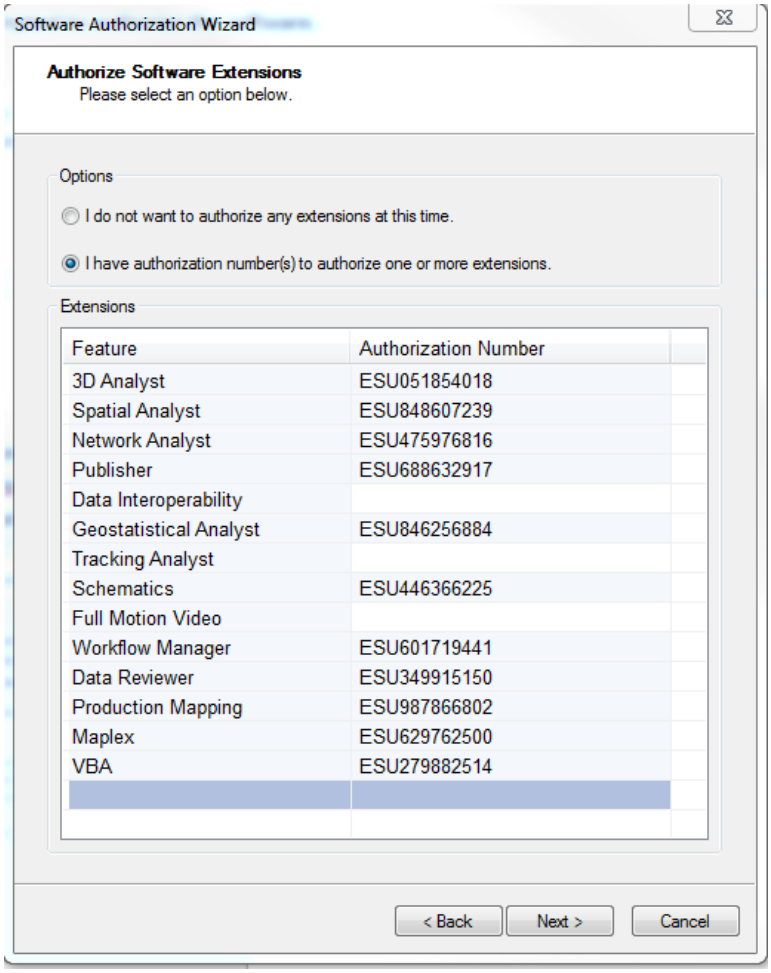
3. Select “I have received and authorization file….”
    a. Browse to V:\gdrs\apps\org\com_esri\ArcGIS_10_6_Desktop
    b. Select **ArcGISforDesktopAdvanced_SingleUse_Full.prvc**

c. 

4. Leave the default Authorization details as listed

a. 

5. Make sure at least Spatial Analyst extension has a license code

a. 

b. If not, the next screen will allow you to add it

SCORE THE SHORE MAP DOCUMENT

The majority of the required infrastructure has been preloaded on the ScoreTheShoreDataEdit.mxd that is available on the GDRS. This was done to simplify the process and aid in consistency. You should open this .mxd project and save it to your local PC so others can use the original project.

1. Navigate to V:\gdrs\apps\org\us_mn_state_dnr\score_the_shore\ScoreTheShoreDataEdit and double- click to open project.

2. File→ Save As → navigate to a logical location (temp folder) on your PC and rename as desired.
3. DO NOT CHANGE THE LAYER NAMES (the tools need these names to work)

Check data connections:

4. If the feature classes fail to open, or the links are broken (red exclamation mark) you probably need to update to ArcMap 10.6 or later

STEP 1. SCORE THE SHORE TOOLBAR

A custom toolbar has been developed to facilitate the dataflow from point creation to data analysis.

Installing the toolbar:

1. Go to Customize tab →Add-In Manager→ Options tab→Add Folder button
    a. Navigate to V:\gdrs\apps\org\us_mn_state_dnr\score_the_shore\StS_Toolbar
    b. Click ok,
    c. Select "load all add-ins without restrictions"
    d. Click close
2. Next go to Customize tab → Toolbars → Check "**DNR ScoreTheShore**"

TOOLBAR OVERVIEW

The Score the Shore Toolbar is a custom toolset created to simplify the process of creating points, editing and exporting the data. A detailed description of the toolbar is provided in the subsequent sections.

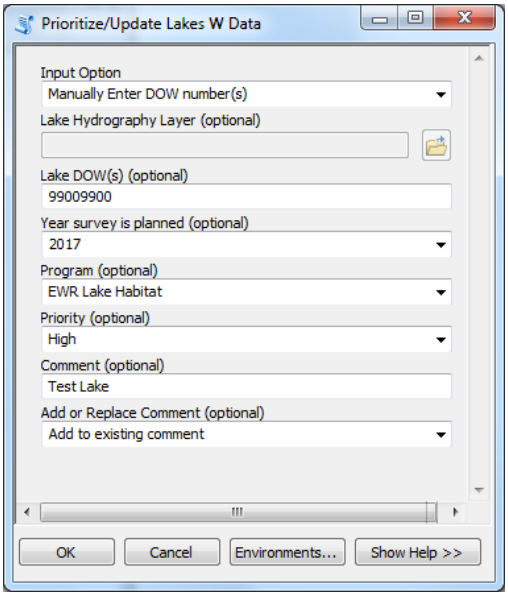
1. Update Lake Boundary – Saves editied boundary line to central location to be used to update Quick Layers.
2. Create Points – Generates the sample points, navigation points and shorline segments.
3. Check Out- Saves a local copy of a workarea for editing and to calculate scores.
4. Calculate attributes – Calculates the station scores, updates attributes, and finds errors.
5. Geotag Photos – Adds a photo location point and attaches photos.
6. Check In – Checks in the edited local copy.

7. Export Records – runs summary statistics, and exports selected records to specified excel workbooks.
8. Help – accesses helpful material
9. Set Priority/ Lakes with Data - Manipulate the “Lakes W Data” Layer

SETTING SURVEY PRIORITY

This survey is conducted by several programs with overlapping focus areas and priorities, thus can be challenging to coordinate sampling efforts. Using the **Lakes With Data** Layer can aid in determining what lakes have been surveyed and if someone is planning on being surveyed in the near future. To set a add a lake to the layer and set a priority use the “**Update Lakes With Data** Tool”.

Click The **Update Lake W Data**  tool:



1. Select Input Option:
    - Manually Enter DOW numbers – use this option to manually enter a DOW Number (8 digit format - XXYYYYZZ), or a comma space separated string of DOW Numbers: “XX00XX00, XX00YY00”. Note- All the listed lakes will get the same attributes.
    - From Hydrography layer Selection – use this option to select a single lake from the Hydrography layer
2. Select the following attributes: Year survey is planned, Program, and Priority.

3. Add Comment if desired
    - If comment added, select whether to “Add to existing comment” (default) or to replace existing comment.

Note the attribute table for handy info such: Watershed, estimated number of survey points, and whether it’s on the infested water list (and with what taxa).

CREATING POINTS

Creating survey points is fairly straight forward, just use the point generator tool. Only the current calendar year points will be visible on the collector app or on ArcGIS Online. If points from previous years exist, the station lines and navigation points will be visible, but the survey stations points will not be. If this happens select the lake and run the **Create Points** Tool.

Creating points:

1. Install the Score the Shore Toolbar Addin (see above)
2. Zoom to desired lake
3. Verify that points have not been generated for this year.
    a. If points have already been generated for this lake, STOP, use these points.
    b. If points do not exist yet for this year, but were generated in previous years, skip to step 5.
    c. If points have never been generated for this lake, continue to step 4.
4. Review the accuracy of the DNR Hydrography - All Water Features shoreline.
    a. Zoom to about 1:2000 and review against basemap imagery/Lidar hillshade
        i. If lake boundary is acceptable: Continue to step 5
        ii. If Lake boundary needs editing: Review Editing Lake Boundary chapter
5. Select **ONE** lake
6. Click the **Create Points** tool
    a. The **DNR Hydrography** Quick Layer is the default shoreline polygon. If using an updated lake boundary polygon feature, use the navigation folder to select the updated boundary.
    b. Click run.
7. Newly generated points will be created and appended (added) to the **StS_Points(CENTRAL)** Layer.
    a. Runtime usually takes about 1-2 mins.

NAVIGATION POINTS

The point generator tool will also create Navigation points. These points are reference points 100 feet perpendicular to the shoreline, the approximate location where the boat should be.

NOTE: NOT ALL SURVEY POINTS WILL HAVE ASSOCIATED NAV POINTS!

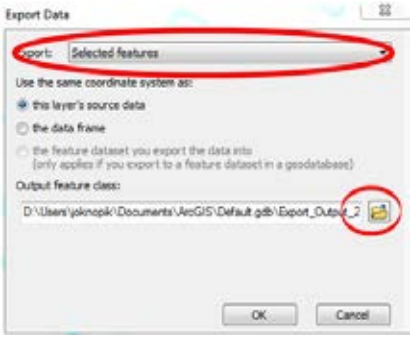
In areas where the shoreline makes sharp inward corners, alone channels, and near shore islands, the navigation points get omitted. For this reason DO NOT DOWNLOAD ONLY NAV POINTS TO GPS!

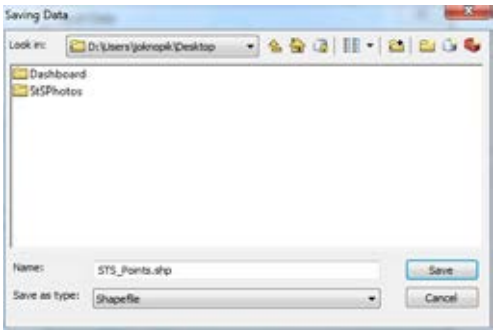
STATION SEGMENT LINES

The point generator tool will also create Station Segment Lines. These lines are approximately 100ft in length and can be useful for determining the bounds of the survey area. Note the segments are snips of the shoreline and do vary in length. Also note that station one (and stations on islands) is often made up of two 50ft line segments, thus the attribute table will show more line segments than station points.

DOWNLOADING WAYPOINTS FROM GEODATABASE

There are a few methods for downloading the points to a GPS from the geodatabase. Because of the large number of points in the **StS_Points(CENTRAL)** Feature class, the most intuitive method is to select the desired points, export them as a temporary shapefile, and then load them through the DNRGPS tool.

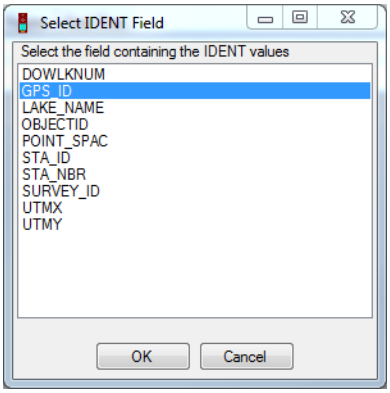
1. Select the desired points from the **StS_Points(CENTRAL)** Feature class
2. Right-click **StS_Points(CENTRAL)** in table of content → Data →Export Data
    a. *Export:* Selected Features
    b. *Output Feature Class:* navigate to a temporary folder on local Drive
    c. 

d. 

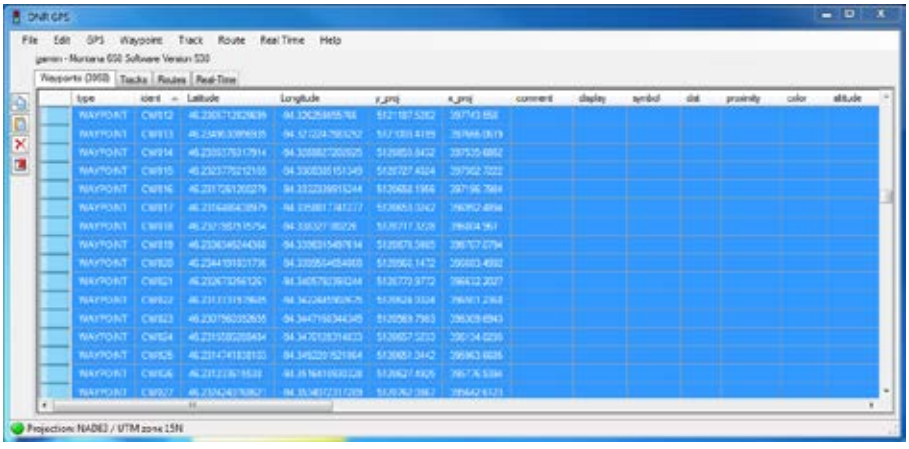
e. *Name:* Give appropriate name

f. *Save as Type:* Shapefile

3. Open DNRGPS tool
4. File →Load From → File → Navigate to shapefile
5. Select GPS_ID as Ident field

a. 

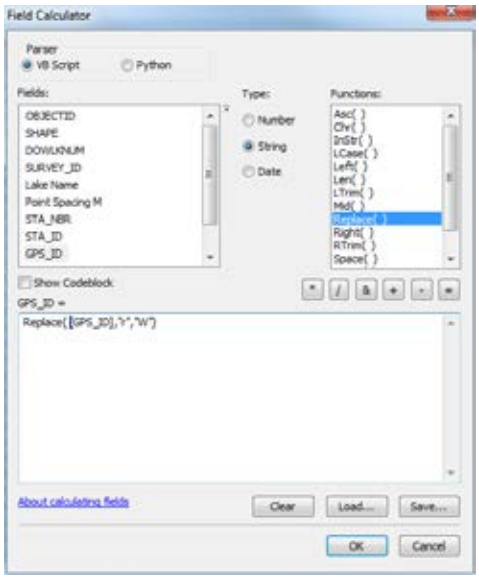
6. Use the ident field to sort the GPS ID's
   a. Verify all desired points are there

b. 

7. Select Waypoint → upload
8. Verify points are in GPS
9. Delete temporary shapefile

NOTE: The GPS ID is a concatenation of the first two letters of the Lake Name, + leading 0's + Site Number. In some cases there may be similar GPS ID's for two different lakes (i.e. Belle Lake and Bertha Lake) if this causes issues, you may want to recalculate the GPS ID for one of the lakes with a unique name.

To create a unique GPS ID: Open ArcMap → add **Temporary Shapefile**

1. Zoom to desired lake → select points
2. Open Attribute Table → Right click GPS_ID Field
3. Calculate Field
   a. 

2. Select the "String" radio button→ select Replace( ) function
3. The function: Replace([field to calculate], "letter(s) to get replaced", "letter(s) to replace with")
   a. Replace([GPS_ID], "r", "W")
   b. In above example, all r's in the GPS_ID Field, will be replaced with W's
   c. quotes are needed around the letters, and commas between elements

STEP 2. COLLECTING SCORE THE SHORE DATA WITH COLLECTOR FOR ARCGIS

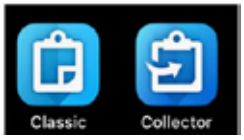
BACKGROUND

Collector for ArcGIS is a mobile application that is integrated with a central ArcGIS (SDE) geodatabase on a server computer in the MNDNR Central Office. Data collected using the mobile device (iPad) application is synced to the central geodatabase through ArcGIS Online, ESRI's secured cloud server. Once synced, all the data are secure, backed up, and access is controlled. There are two ways to access/view this central database: by signing into your ArcGIS Online account and viewing online, or by a direct database connection (controlled link) through ArcMap.

IPAD SETUP

After you've procured an IPad (or other device) ensure the "Collector for ArcGIS" application is installed. If not, go to the App Store and download it.

Note- As of this manuals update there are two versions of the Collector for ArcGIS app. "Collector for ArcGIS" and "Classic". Both apps work from the same central database. The newest version of the app has several addition features such as navigating to points and better layout for small devices. The newest version (not classic) is recommended for Score the Shore Survey as it has the capability to navigate to points.



SETTING UP COLLECTOR APP

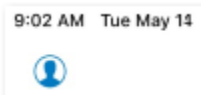
1. Connect to the local Wi-Fi Connection
2. Open ArcCollector
3. Tap **ArcGIS Enterprise**
    a. Enter URL **https://arcgis.dnr.stste.mn.us/portal**

b.

4. Sign in- using your ArcGIS Portal username and password (see initial setup above).
    a. **Username@mndnr** (exp. joknopik@mndnr)
    b. Your Active Directory login (the one you use to sign into your work PC).

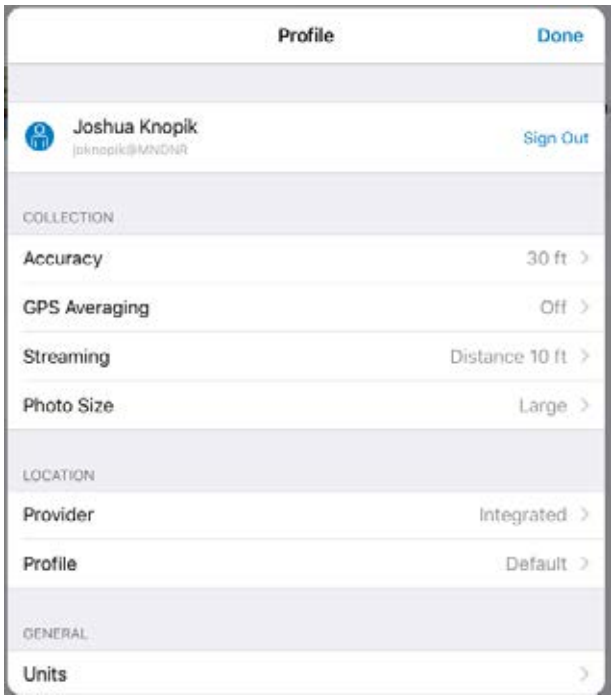
c.

5. Tap the profile icon (upper left) to get to app settings

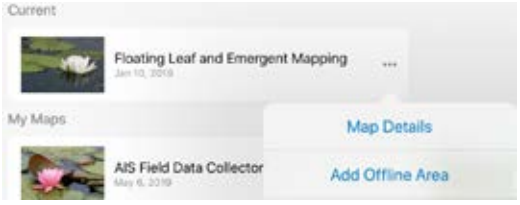


a.

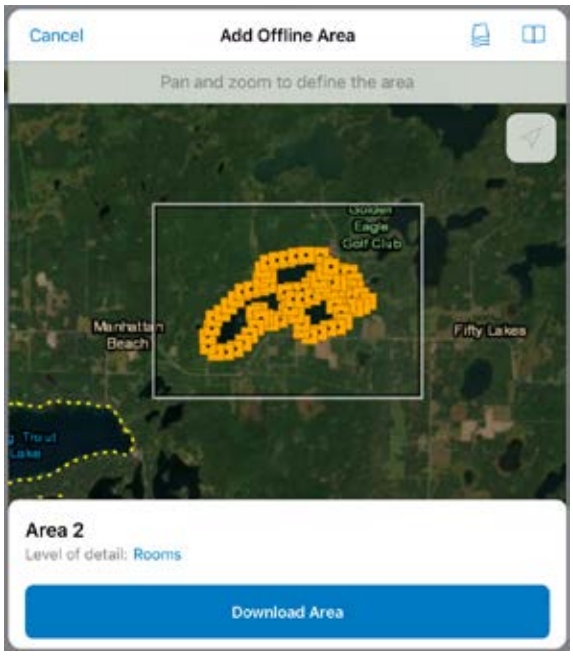
6. Adjust settings to match the following:
    a. Accuracy: 30ft
    b. Photo Size: Large

c. 

DOWNLOADING WORK AREA

1. Download map to device by selection the **...** options → Add Offline Area
   a. 

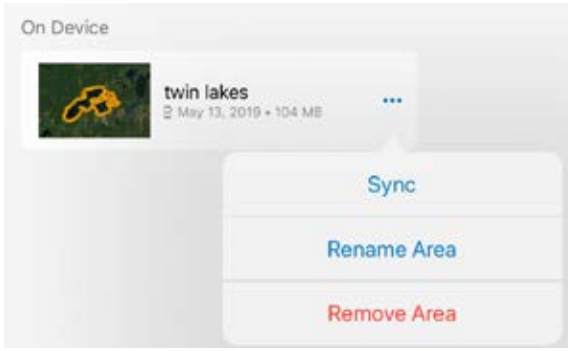
2. Select work area by zooming to your lake of interest,
3. Then select the scale (bounding box) that best fits.
   a. Scale is in common terms in reference to the level of detail noted in imagery.
   b. It's recommended to zoom to "Building" (1:1200) or smaller for quality imagery.
   c. Download time is dependent on file size and connection speed; large file sizes can take a long time to download (up to an hour). Most work areas take 10-15 minutes.

d. 

4. You can download multiple work areas by tapping the upper right **…** options → Add Offline Area

a. 

5. You can rename work areas by tapping the work area **…** options.

a. 

DOWNLOADING CUSTOM BASEMAPS

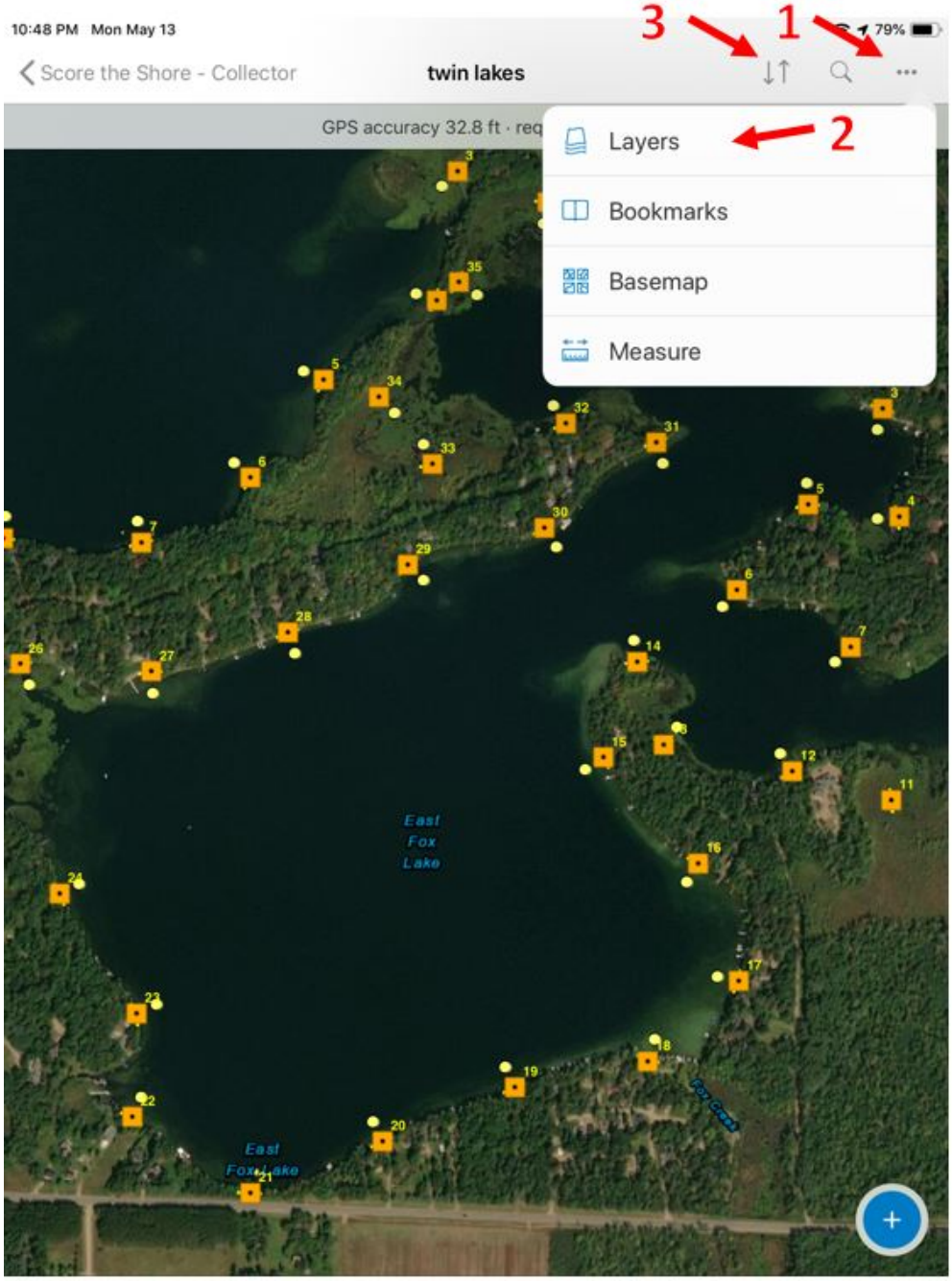
A tool has been developed to create custom basemaps (raster tiles) with other imagery. Other useful imagery to use as basemaps can be FSA imagery, False color Infrared or others (see Photo Interpretation section for more info on imagery). This tool will not work with ArcGIS online basemap imagery…only layers available on Quick Layers (FSA imagery, false Color IR, etc.). See Downloading Custom Basemaps section above.

COLLECTOR APP MENUS

Project Home Screen

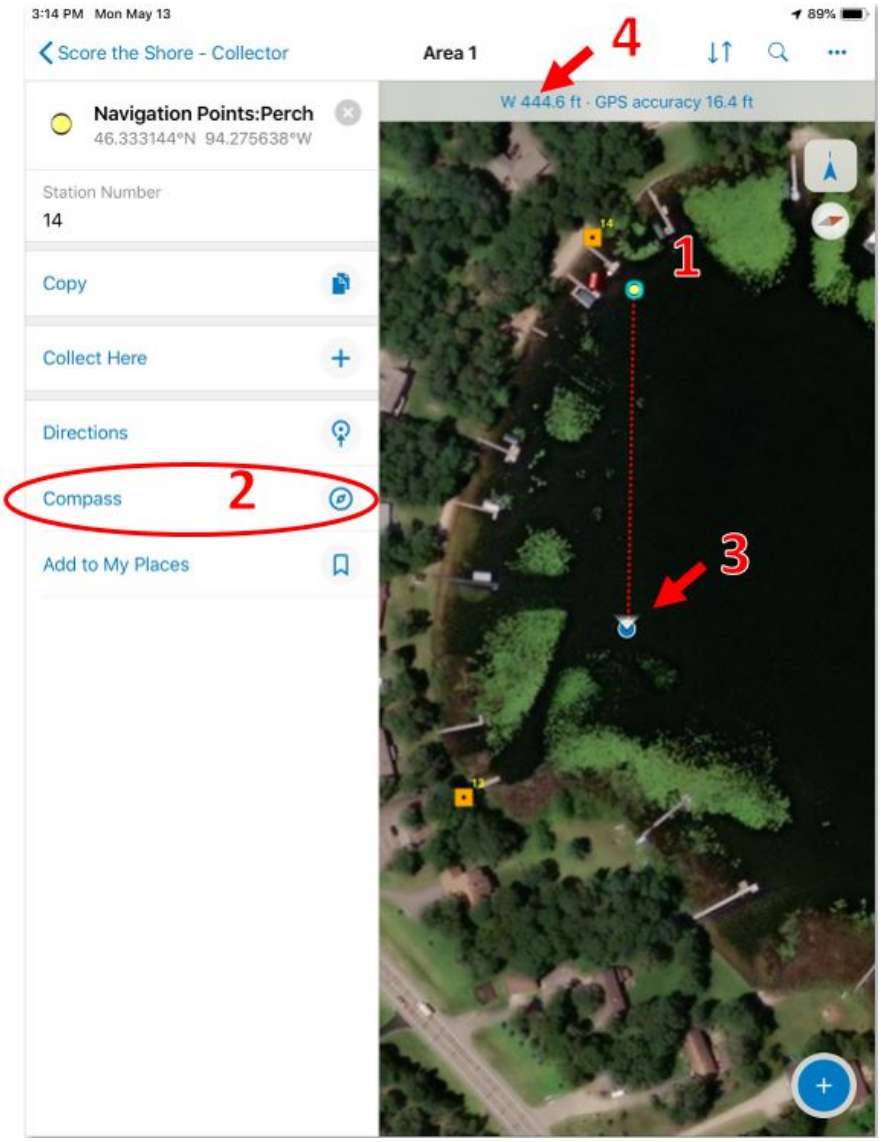
1. The **...** options opens main map options
2. Turn on/off layers and view legend
3. Sync Edits (need WiFi connection)

a.



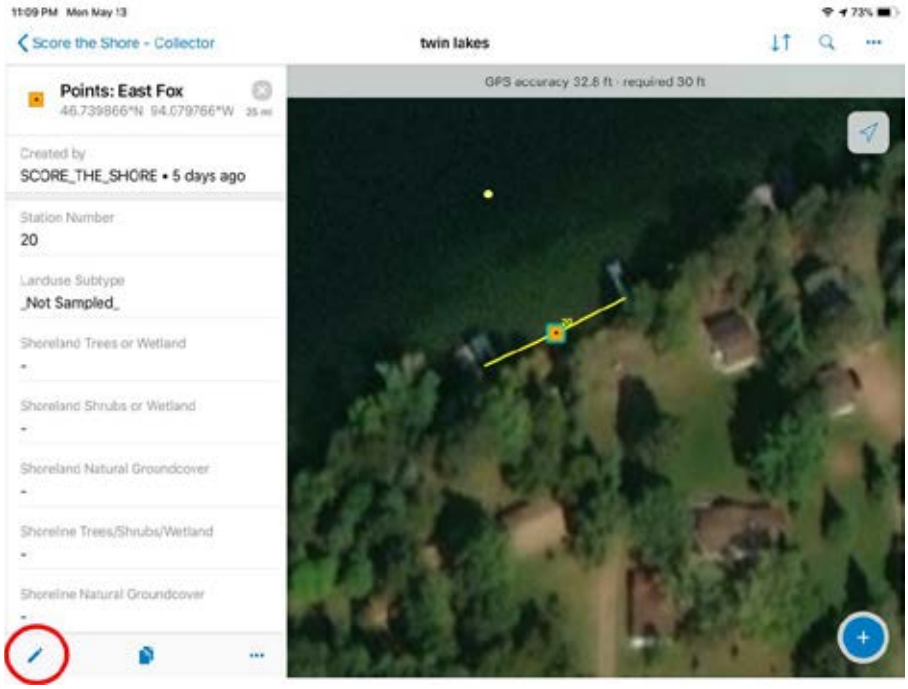
NAVIGATING TO POINT

Navigation points are created with the point generator tool to aid in navigating to 100ft of the shore segment midpoint to aid in taking reference photos. Note: these navigation points are automated and some shoreline irregularities cause a few to be omitted.

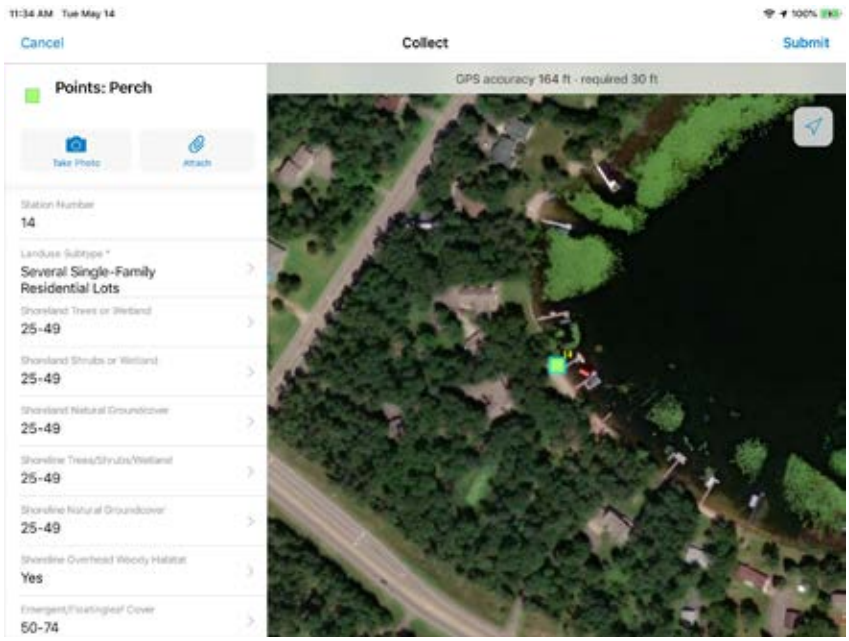
1. Tap on the Navigation point
2. Tap on Compass
3. Orientate the boat to follow the red direction line.
    a. Note the white heading chevron on your location dot
4. Note the distance to destination.
5. 

COLLECTING DATA

Collecting data is fairly straight forward

1. Tap on the **Shore point** you want to collect data on
2. Tap Edit Icon
   a. 

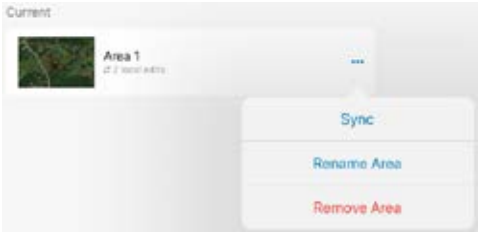
3. Tap Attribute → select option (noted by checkmark)→Tap Done
4. Tap **Camera** (Take Photo) icon to take the reference photo
5. Tap **Landuse subtype** to update the land use attribute.
   a. Tap "Reset To Default Values" to ensure suggested values are used
6. Fill in rest of attributes as appropriate
7. Tap Submit to save edits

a. 

SYNCING DATA

Once all the daily data has been collected the final step is to sync your edits to the central database. This is done by going back to the project menu - tap “Map” (in the upper left corner).

6. Connect to a Wi-Fi network (could be the office, or local coffee shop)
7. Tap **< Score the Shore - Collector** to return to main menu
8. Tap **...** options
9. Tap the Sync icon (Number indicates number of edited features)

c. 

10. After sync has completed, verify by signing into the ScoreTheShoreDataEdit.mxd with ArcMap.

IF SYNC FAILS – TRY TROUBLESHOOTING SECTION—DO NOT REMOVE DATA FROM DEVICE

11. After you have verified that the data has been synced, you can remove it from the device
    d. Tap **...** options
    e. Remove Area

You can now download a new work area, and collect more data!

TROUBLESHOOTING SYNC ISSUES

Sync errors are not common, but can be frustrating when they do occur. The good news is that most sync issues can quickly remedied.

ERROR 1: USER PASSWORD INVALID DURING SYNC

Likely cause: Your AD password changed

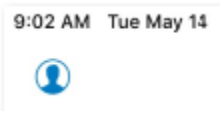
Fix:

6. Ensure Wi-Fi is connected (iPad home→ settings→ Wi-Fi or open safari web browser to check)
7. Hit iPad Home button twice (this shows all open apps)
8. Swipe up to close all open apps
9. Open collector app and try again

ERROR 2: USER PASSWORD INVALID WHEN TRYING TO DOWNLOAD NEW WORK AREA

Likely Cause: Another user is signed in- happens with shared iPads

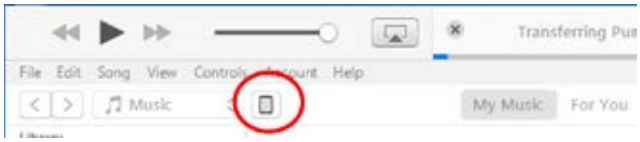
Fix:

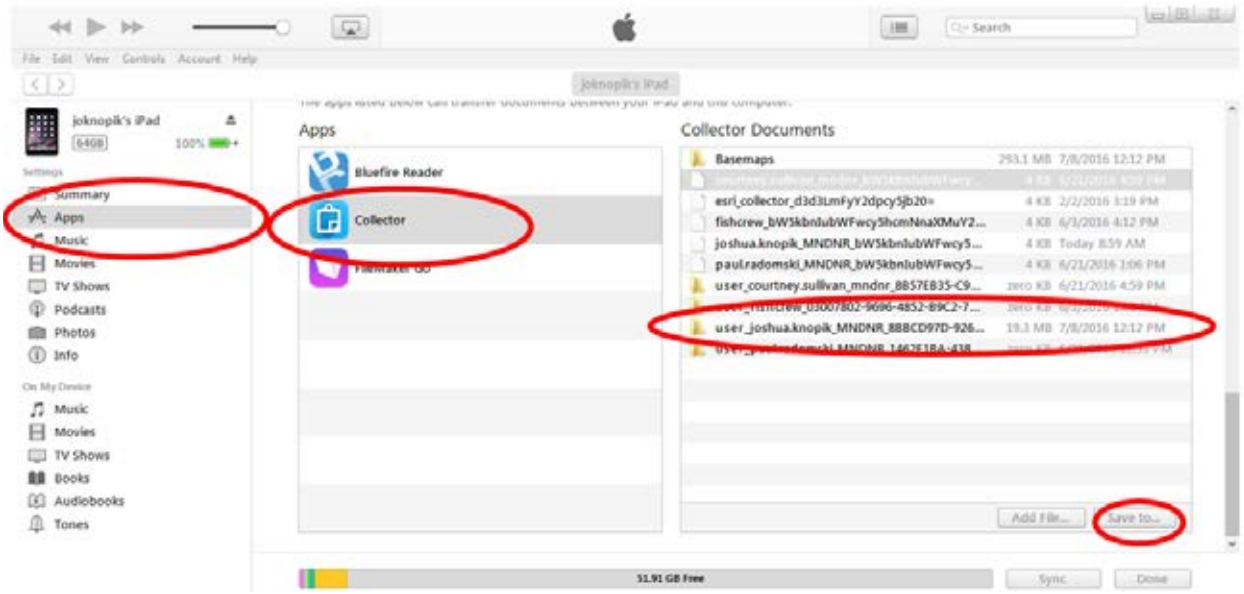
4. Ensure Wi-Fi is connected (iPad home→ settings→ Wi-Fi)
5. Confirm existing data has been synced
    a. Open Collector App
    b. Note when last sync occurred
    c. Tap the profile Icon
        i. 

    d. Contact the person who collected the data and ask them to back sign in→ REMOVING THE DATA WILL DELETE THEIR DATA.
        i. If the person is unavailable to sign in see “Removing Data via ITunes” section
6. Sign the user out, and sign in with your username
    a. Collector can have multiple users data stored in memory (only one user can edit at a time).

REMOVING DATA VIA ITUNES

In rare situations it may be necessary to remove the data from the iPad manually and save it. This may be need to be done if someone signed into the iPad, collected data and is longer available to sync it back.

1. Install iTunes software on your PC.
2. Plug iPad into your PC.
3. Open iTunes and click iPad icon to view contents of the iPad
   a. 

4. Select Apps→ Scroll to bottom → Select Collector
5. Select the checked out geodatabase folder (listed as username_XXX, also check date)
6. Save to... select a temporary output location
   a. 

   b. This saves the checked out data to your selected output location.
7. There are two ways to get the data back to the central geodatabase:
   a. Email this folder to MNIT GIS Staff and they will transfer the data for you.
   b. Manually copy/paste the "new data" using ArcMap
      i. Checkout the lake area (see Checking Out Data section)
      ii. Use the "Runtime to file geodatabase" conversion tool
         1. Convert the saved file (from the iPad) to a new filegeodatabase in the temp folder
      iii. Add the "new data" feature class into the project

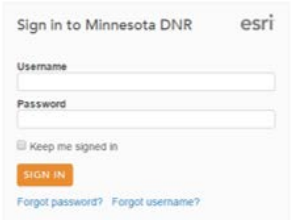
iv. Start editing the “CHECKED_OUT” Layer
v. Select all the “new data” points
vi. Go to main Edit Tab → Copy
vii. Go to main Edit Tab → Paste
viii. Choose CHECKED_OUT” Layer
ix. Open “CHECKED_OUT” Layer attribute table → verify the “new data” pasted appropriately
x. Select old points (with no data) → Delete them
xi. Run score calculator (see Calculating Score Section) and continue with editing process as described in following section

ENTERING PAPER DATA - ARCGIS ONLINE

If Score the Shore field data was collected with paper datasheets, there are two ways to enter it into the central geodatabase; Using ArcGIS portal Web App, or directly in ArcMap. The ArcGIS online method is a little more user friendly, but will still require using the custom Score the Shore Toolbar in ArcMap for final edits.

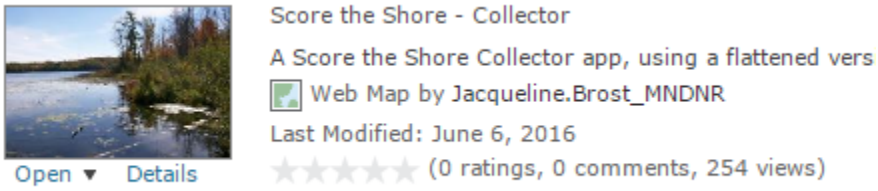
ENTERING DATA WITH ARCGIS ONLINE

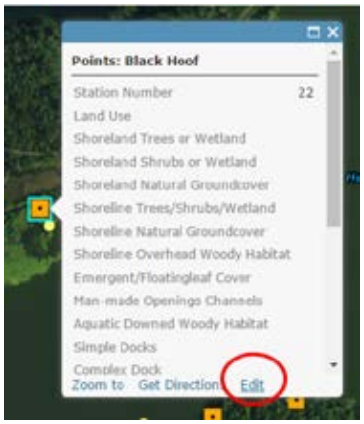
*The ArcGIS portal web app is in constant development and new features and functionality are being added relatively frequently. Because of this, the information presented below may not be the most current

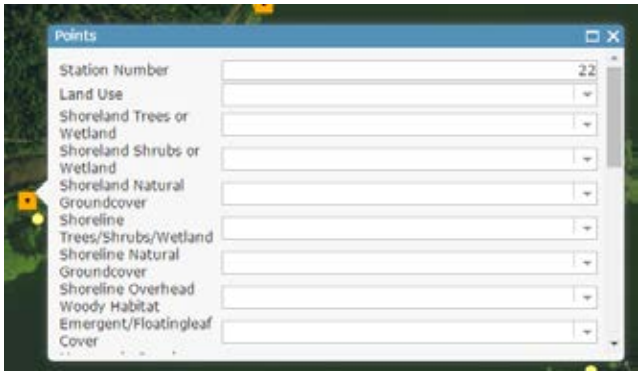
1. Sign into ArcGIS portal https://arcgis.dnr.state.mn.us/portal
2. Sign in- using your ArcGIS Online username and password.
   a. 

   b. Example: Josmith@mndnr or generic fisheries crew
3. Click Groups tab

4. Click on Score the Shore



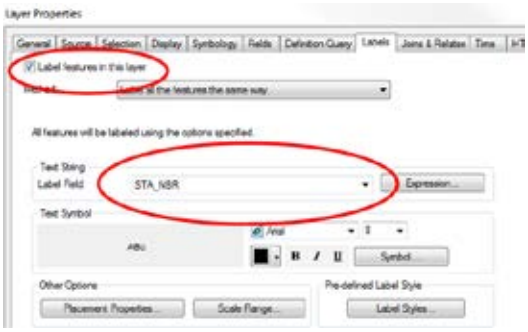
5. Search for the lake you surveyed
6. Click on the site number you started with and click edit
   a. 

7. Start entering data – **Make sure to fill in all fields
   a. 

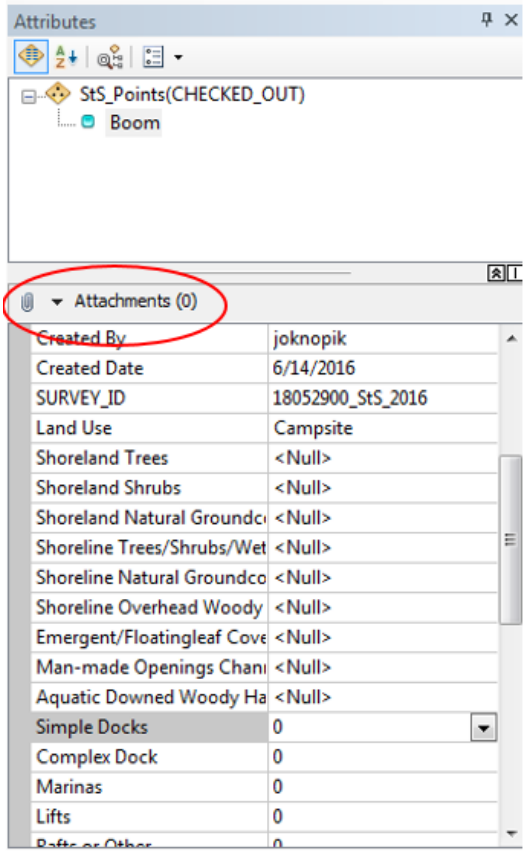
8. When you finish entering the data click on close and repeat steps 6-8 until all data is entered.

ENTERING DATA IN ARCMAP

1. Open the Score the Shore project from V:\gdrs\apps\org\us_mn_state_dnr\score_the_shore\ScoreTheShoreDataEdit.mxd
   a. Save As to a local temp location
   b. Add StS Toolbar (see page StS Toolbar section)

2. Set labels for the sts_points layer to STA_NBR (Station Number)
    a. Right click sts_points layer → properties→Labels tab
    b. 

3. Check Out your lake work area
    a. Select the lake points
    b. Click **Check Out (3)** tool
4. Start editing StS_Points(CHECKED_OUT) layer
5. Select a point
6. Open Attribute edit window (on editor toolbar)
7. Use Dropdowns to fill in attributes
    a. Fill in attributes from **Land Use Subtype** to **Sample Notes** (other attributes will be filled in with calculator tool)
    b. Note- *Developed* field should update after *landuse subtype* has been selected. If it doesn't double make sure you are editing the Landuse Subtype NOT Landuse field.
8. Attaching reference photos (optional)- Reference photos can be directly attached to the points in the Central geodatabase.
    a. In the Attribute edit window → Click the attachments icon to open attachment wizard

i. 

ii. Click Add → Browse to photo location → Select desired photo

iii. This process needs to be repeated for each point.

b. If photos were taken with a georeferencing camera it may be helpful to first use ArcGIS **Geotagged Photos** Tool (see ArcMap Help) so you can get a visual reference of where the point was taken.

9. Repeat steps 5-8 for each point, once all data has been entered continue to "Calculating Scores" of next section.

STEP 3. QC DATA & CALCULATE SCORE

To calculate scores and edit your field collected data, use the Score the Shore custom toolbar. (See StS Toolbar section for installation). The process overview is to **Check Out (3)** the raw data from the central geodatabase (this makes a local copy to edit). This will add a new layer called **StS_Points(CHECKED_OUT)**. This layer gets updated and scores calculates, using the **Calculate Scores (4) tool**. Once calculations are made and errors corrected, you will use the **Check In (6) tool** to make the changes to the central database.

CHECKING OUT DATA

The first step in the score calculation/editing process is to create a local copy of the data on your PC. This local copy is then edited with the scores and numerous fields being calculates. If your entering paper data you likely already did this step.

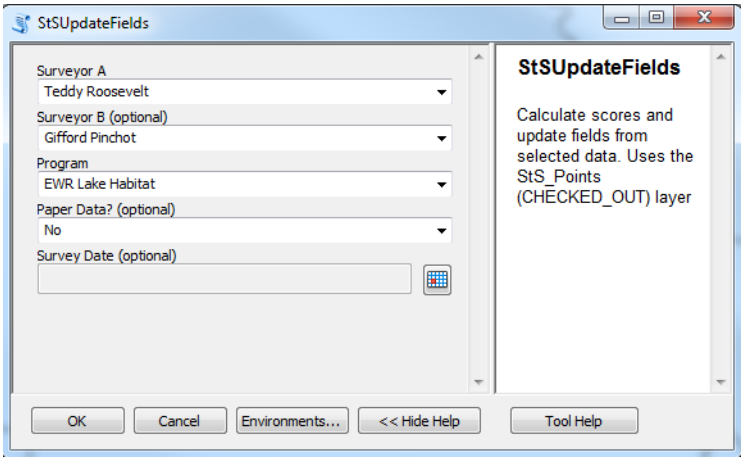
To check out that data:

1. Select lake points you want to edit
2. Click the "**Check Out**" tool (3)
    a. A new layer StS_Points(CHECKED OUT) is added to the map – DO NOT CHANGE THE LAYER NAMES (the tools need these names to work)

CALCULATING SCORES

The **Calculate Score tool (4)** is used to calculate the scores and update several attributes in the StS_Points(CHECKED_OUT) feature.

1. Start editing the StS_Points(CHECKED_OUT) feature
2. Select the records to be updated (select by surveyor on lakes with multiple crews working)
3. Click the **Calculate Score tool (4)**

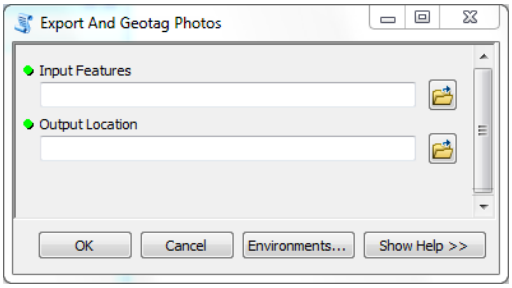


4. Select the surveyor A and B from drop list (Only for the first time running the tool)
    a. NOTE: If surveyor names are not in the drop list, open the attribute table and manually enter the name of surveyor(s) in one of the selected records
5. Enter the Survey date ONLY FOR PAPER DATA ENTRY (or if you entered via ArcGIS Online). If you collected data with Collector App, this can be left blank
6. Run tool
7. Check the **Errors** field to find missing values → Update as necessary

8. Re-run the **Calculate Score tool** to update the scores
    a. Entering Surveyor A or B will only be necessary the first time you run the tool (the tool skips these calculations the subsequent times– even though the dropdown menu is still there.)

GEOTAGGING PHOTOS

The **Geotag Photos (5)** tool has two primary functions: 1. Export the attached photos of the selected points as jpegs to a defined folder, 2: Create a point layer of the location the photo was taken.



1. Input Features: the layer with the selected points
2. Output Locations: Folder location where you want the photos to be exported to and points to be stored.
3. Use the HTML icon (not hyperlink) to view the photo points in ArcMap.

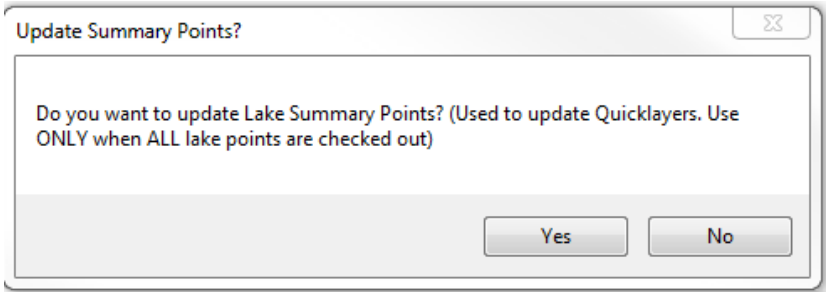
Attaching Photos to Points

If reference photos were taken, but not attached to the survey point (i.e. paper data w/camera) review "Entering Data with ArcGIS" section for details

CHECKING IN DATA

Once all your data have been edited, it is time to update the Central geodatabase. Note this steps often takes 1-2 minutes (more if you added attachements).

1. Save and stop editing the *StS_Points(CHECKED_OUT)* feature class.
2. Click the **Check In Tool(6)**
3. Click OK
4. Choose whether to update the **Summary Points** and **Lakes with Data** features.
    a. These features are used to update Quick Layers periodically.

b. You MUST have ALL POINTS for the lake selected if you choose YES, otherwise only some of the points will be used for the summary statistics.
c. If in doubt click “No”
d. 

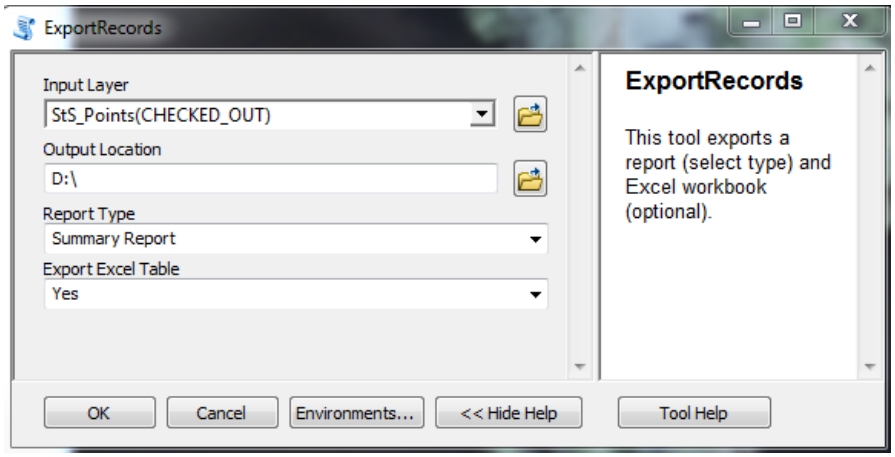
The StS_Points(CHECKED_OUT) will change to StS_Points(CHECKED_IN). Further edits made to this layer will not be able to be checked in – You only get **one** Check IN- if you need to make subsequent edits to the StS_Points(CENTRAL), you will need to create a new check out. The StS_Points(CHECKED_IN) feature class is useful for mapping and analysis.

STEP 4. DATA ANALYSIS/ GENERATE REPORT

GENERATE REPORT TOOL

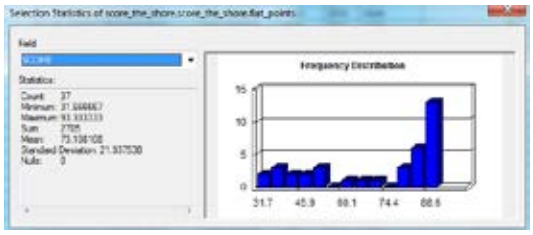
The **Generate Report** tool  was created to aid in efficiently making accurate and consistent reports and maps. To use the tool:

1. Select all the points for the lake - can be either (“CHECKED_OUT” or “CENTRAL”) layer.
2. Click the **Generate Report** tool
3. Enter Parameters:
    a. Input Layer – Layer you want to summarize data on
    b. Output Location – folder where you want report to be saved
    c. Report Type – Summary or Full
    d. Export Excel Table – Exports raw data and summary statistics

e. 

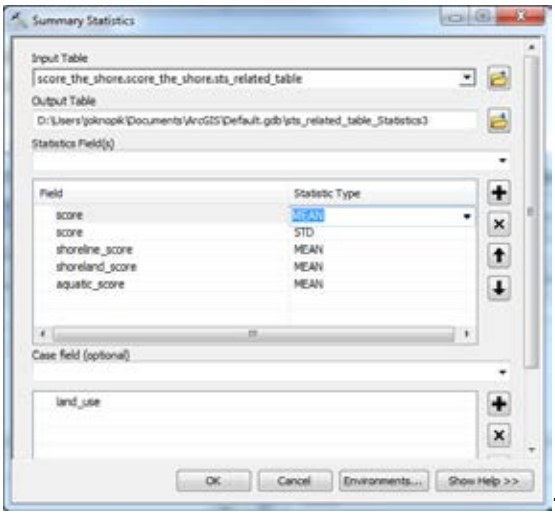
OTHER OPTIONS FOR SUMMARIZING DATA.

The quickest way to summarize the score the shore data is to use the summarize statistics tool.

1. With the attribute table open, select the lake records
2. Right click on the “Score” field
3. Select Summarize
4. 

If you want to run other summary statistics, use the Summary Statistics Tool

1. Select the records you want to summarize
2. Open the Summary Statistics tool
   a. Input Table: StS_Point(CENTRAL)
   b. Output Table: your default geodatabase or other local folder
   c. Statistic Field(s): select the field you want to be calculated (i.e. Score)
   d. Statistic Type: Select the desired statistic (Mean, StdDev, etc.)
   e. Case field: Select the field you want to be summarized on (i.e. the DOW Number)

f. 

→

sts_related_table_Statistics3

objectid *	Land Use	FREQUENCY	MEAN_score	STD_score	MEAN_shoreline_score	MEAN_shoreland_score	MEAN_aquatic_score
1	Campsite	1	48.333333	0	13	8	27
2	Resort or Commercial Campground	4	51.25	23.624179	17.75	16.25	17.5
3	Roadway	8	70	17.54012	25.675	15.25	28.675
4	Several Single-Family Residential Lots	12	55.416667	12.814232	18.333333	15.916667	21.25
5	Single-Family Residential	39	66.794872	21.269589	22.076923	21.051282	23.461538
6	Undeveloped Nonwetland	24	92.638889	12.35463	31.416667	30.541667	29.958333
7	Undeveloped Wetland	9	87.407407	18.392182	26	33	28.111111

PHOTOGRAPH DATA MANAGEMENT

Georeferenced photos of each sample point can be a very helpful means for data quality control and documenting future changes. This tip section addresses some issues noted with photo management.

IMAGE FILESIZE

Given the purpose of the photos and the limitations of network storage, limiting the file size of the images is necessary. It is recommended to set the resolution of your camera to about 3 Megapixels, so image file sizes stay about 1000 kb.

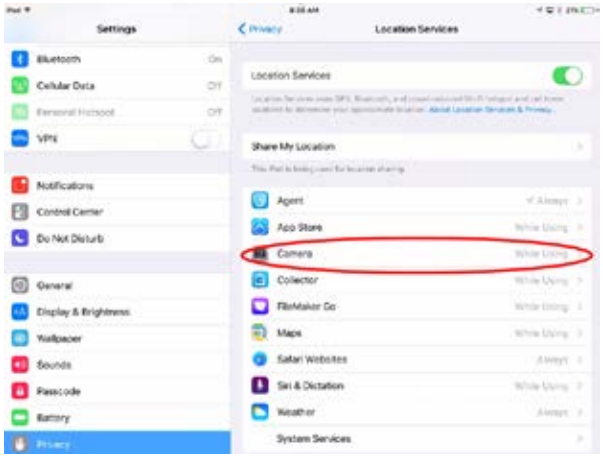
IPads do not have the option to reduce the file size of photos takes. A third party app, such as BatchResizer, is needed to reduce file size.

USING THE IPAD FOR GEO-REFERENCING PHOTOS

INITIAL SET UP

Before going afield, Turn On location services and set camera app to use location.

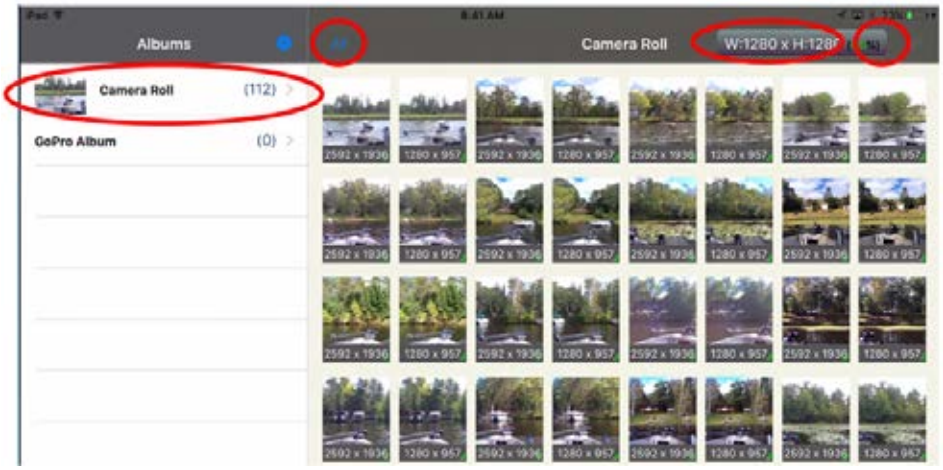
1. Go to setting app → Privacy

2. Tap Location services “On”
3. Tap Camera app to “While using”
    a. 

DOWNLOADING PHOTOS FROM IPAD

Before downloading photos from the iPad the file size of the photos should be reduced (to prevent server storage problems). This is done using the free BatchResizer app. Install this app if it is not already on the iPad.

1. Resize the Photos
    a. Open “BatchResizer” App
        i. 
    b. Tap Camera Roll
    c. Select “All” photos
    d. Select output resolution (1280 x 1280)
    e. Tap execute icon

i. 

2. Plug iPad into the PC and Open using Windows Explorer

a. 

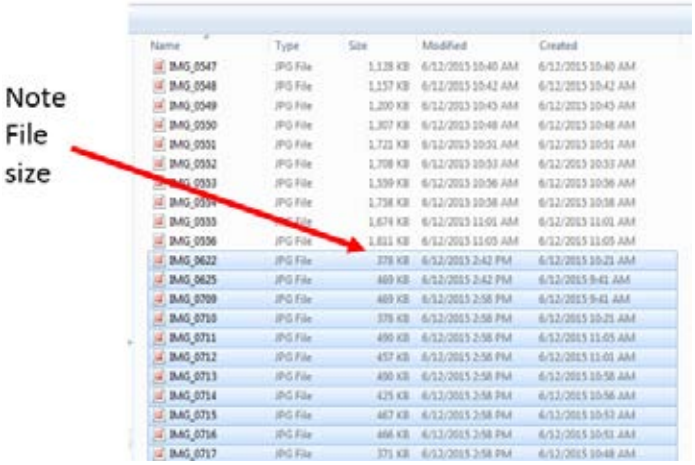
b. Computer\<username>'s iPad\Internal Storage\DCIM

c. Select the resized images

   i. Sort by name

   ii. Scroll down to find where the smaller sized files start

   iii. Tip: to select multiple files at once, click the first file →hold the Shift key→click the last file

iv. 

v. Copy Files

3. Paste photos to lake folder
    a. For the 2016 field season the photos are being stored at I:\EWR\Brainerd Area Office\A_EWR_FISH_SHAREFILES\2016_Score_The_Shore_Photos \LakeName
    b. Create a new folder for each lake
        i. Name folder DOW_LAKENAME_StS_2016
        ii. Note: If multiple crews were working on the same lake, all photos can be added to the same folder, BUT DO NOT OVERWRITE FILES IF THEY HAVE THE SAME NAME
        iii. Choose “Copy, but keep both files”
        iv. 

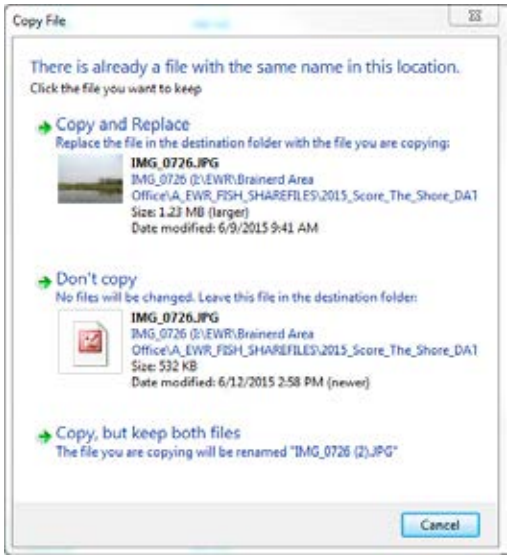
4. Proof your photos by looking through the folder and deleting duplicates, errant photos, and rotate upside down photos etc.

DOWNLOADING PHOTOS FROM CAMERA (NON IPAD)

The following instructions will work with most cameras, though there may be a few minor differences.

1. Plug camera (or memory card) into PC
2. Open windows explorer, Camera \Internal storage\DCIM (varies by model)
3. Select photos → Right click-> Copy (or ”Ctrl+C”)
4. Paste photos to lake folder
    a. For the 2016 field season the photos are being stored at I:\EWR\Brainerd Area Office\A_EWR_FISH_SHAREFILES\2016_Score_The_Shore_Photos\<LakeFolder>
    b. Create a new folder for each lake
        i. Name folder DOW_LAKENAME_StS_2016

ii. Note: If multiple crews were working on the same lake, all photos can be added to the same folder, BUT DO NOT OVERWRITE FILES IF THEY HAVE THE SAME NAME

1. Choose “Copy, but keep both files”
2. 

3. OR rename them

5. Proof your photos by looking through the folder and deleting duplicates, errant photos, and rotate upside down photos etc.

RENAMING PHOTOS

It is not required to rename these photos, however, renaming them so the image name has the LAKENAME_DOW_STS_YEAR_SITE# makes reviewing the photos for quality control and future comparison very convenient. Another benefit of attributed naming is if the file gets separated from the folder.

The recommended file naming structure is: LAKENAME_DOW_STS_YEAR _station

It may be helpful to run the geotag tool (saving to a temporary geodatabase, i.e. Default.gdb) in order to figure out which image is associated to a give station number (see geotagging section).

Note: The following tip can only be done IF THE PHOTOS ARE IN SEQUENTIAL ORDER STARTING WITH STATION 1

To do this the photos need to be taken in the proper order (meaning the surveyor started at station 1).

1. Open the lake folder with Window Explorer

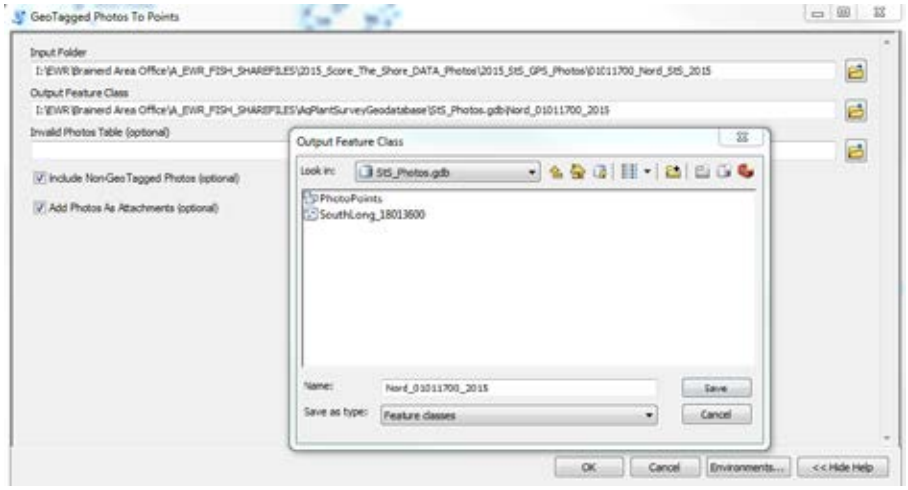
2. Sort the Images (starting with site 1)
3. Select All photos (Ctrl+A)
4. Right click the first file→Rename
5. Enter LAKENAME_DOW_STS_YEAR
6. Hit Enter

GEOTAGGING PHOTOS

Geotagging reference photos makes doing quality control checks very easy. Place all your photos (either by lake or by season) into one folder and run the geotagging tool (see geotagging tip sheet).

ArcMap now has a Geotagged Photos to Points tool (Data Management Tools.tbx\Photos\GeoTagged Photos To Points). You need to update to ArcGIS 10.2.2 (the tool in previous the version of ArcMap is buggy, and may not work consistently).

Using the Geotagged Photos to Points tool:

4. Open the Geotagged Photos to Points tool
    a. (Data Management Tools.tbx\Photos\GeoTagged Photos To Points) or search "geotagged"
    b. 

    c. Input Folder: navigate to lake folder
    d. Output Feature Class: I:\EWR\Brainerd Area Office\A_EWR_FISH_SHAREFILES\AqPlantSurveyGeodatabase\StS_Photos.gdb
        i. Putting the points in this geodatabase is recommended but optional
    e. View the photo points in ArcMap with the HTML icon (not hyperlink)

CHAPTER 4: POINT INTERCEPT SURVEY

This chapter covers two sections: 1. the generic use of the MNDNR Point Intercept Toolbar, and 2. The use of iPads using *FileMaker Go* and *FileMaker Pro* for the purpose of collecting lake plant data consistent with Minnesota DNR protocol. This document does not cover the purpose or collection protocol – please consult the Minnesota Lake Plant Survey Manual, specifically the quantitative plant survey – point-intercept chapter for these details.

SECTION 1: PI TOOLBAR

The purpose of this toolbar is to develop an easy to use set of tools to provide a consistent structure and data management for aquatic vegetation point intercept surveys. The general flow of data starts with point generation. The point generator tool saves finalized points to a program specific geodatabase. Data is collected with the integrated iPad FileMaker app (maintained by EWR Lakes Habitat Program). Quality control and analysis is done using the excel table created by the FileMaker iPad. This input file is used to create: A) a GIS layer for spatial viewing, and B) a new excel workbook containing summarized data with tables and charts.

INSTALLING PI TOOLBAR

In ArcMap: Customize Tab → Add in Manager →Options Tab → Add Folder:
V:\gdrs\apps\org\us_mn_state_dnr\PointIntercept\PI_Toolbar

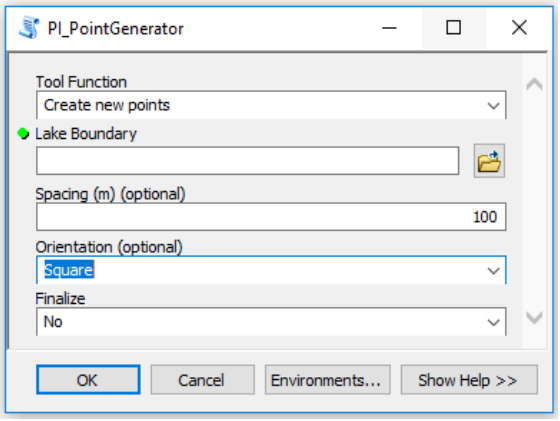
PI Toolbar

1- Generate Points
2- Import Shapefiles into common geodatabase
3- Convert iPad export excel file
4- Export PI Data from Quick Layers
5- Update programs central geodatabase
6- Create charts and graphs from selected records
7- Toolbar info and help document

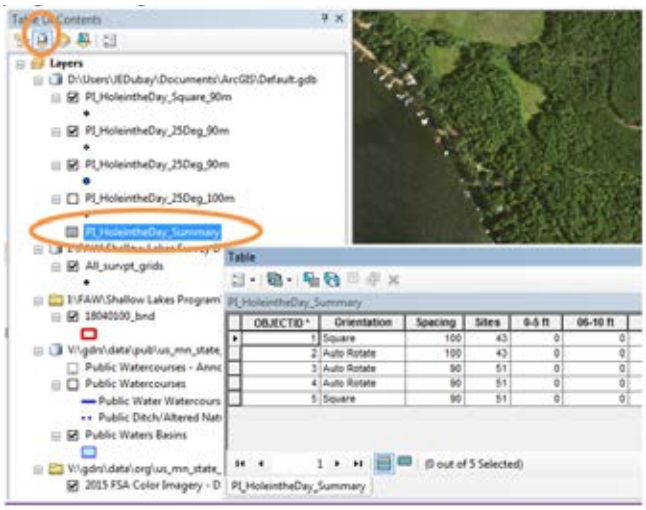
*** Most specialists will primarily only use tools 1, 2, & 3 in this toolbar.

GENERATE POINTS

The **Generate Points tool (1)** has two functions; 1. to search other programs databases for an existing grid of points. 2. generate a new grid of points across the lake using the spacing and orientation that you enter, it also makes a table of results. This tool should can be run several times to test which spacing/orientation works best. The temporary layers are deleted when "Finalize = Yes" is run.

3. Select your lake boundary from the drop down menu.
    a. 

4. Add your desired spacing in Meters. Program spacing guidelines are displayed in the "Show Help" window.
    a. Shallow Lakes Program spacing guidelines outlined below as optional reference:
        i. Basins <1000 acres should not exceed 99 points.
        ii. Basins >1000 acres should have a minimum of 100 points
            1. < 50 acres (~1 point per acre) = 65 m
            2. 50-150 acres = 65-100 m
            3. 150-250 acres = 100-140 m
            4. 250-500 acres = 140-195 m
            5. 500+ acres = 200+ m
5. Choose Grid orientation:
    a. Square: North / South orientation
    b. Auto rotate: Rotates points to best fit the lake.
6. Finalize:
    a. No: Creates temporary point layer (and summary table)
    b. Yes: Appends point to Central Geodatabase
7. Check the summary table to compare temporary layers. Switch to "List by Source" in your table of contents, and then open the summary table by right clicking on the table.

a. 

***Run the tool as many times as you need. Once you have the spacing and orientation that you like, Run tool again, changing "Finalize to Yes".**

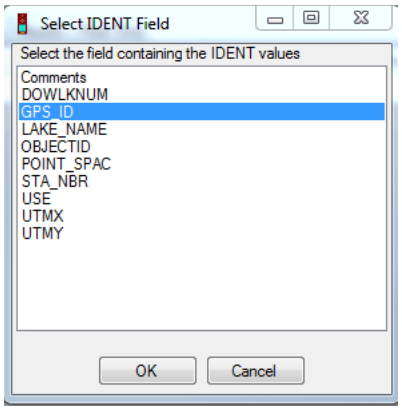
UPDATE LAKE BOUNDARY

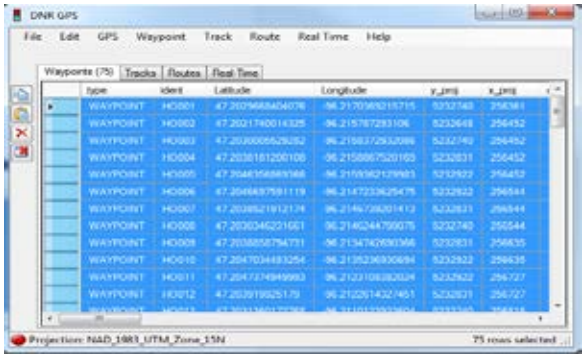
It may be necessary to update the lake boundary before generating new points. See the Editing Lake Boundary Chapter for detailed tips

DOWNLOADING WAYPOINTS FROM GEODATABASE

There are a few methods for downloading the points from the central geodatabase to a GPS. Because of the large number of points in **Central Points** Feature class, the most intuitive method is to select the desired points, export them as a temporary shapefile, and then load them through the DNRGPS tool.

10. Select the desired points from the **Central Points** Feature class.
11. Right-click **Central Points** in the table of content → Data →Export Data
    a. *Export:* Selected Features
    b. *Output Feature Class:* navigate to a temporary folder (scratch folder) on a local Drive & save the file so that you can find & identify it. Save as a shapefile.
12. Open DNRGPS tool
13. File →Load From → File → Navigate to shapefile
14. Select GPS_ID as Ident field

a. 

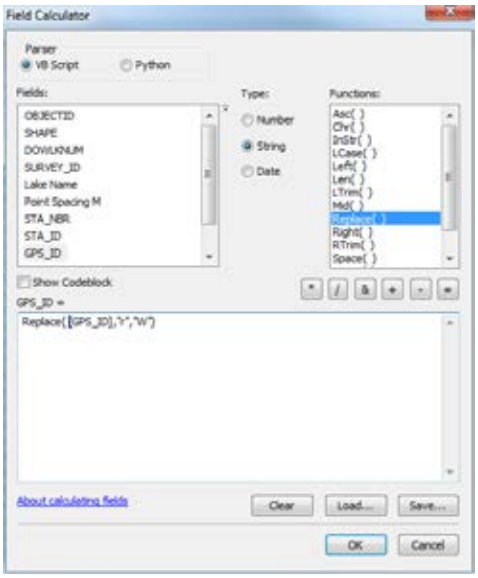
15. Use the ident field to sort the GPS ID's
    a. Verify all desired points are there
    i. 

16. Select all the Waypoints then click the waypoint dropdown box & click upload
    a. Give basic descriptive label for points in GPS if requested (ex. holeintheday_points)
17. Unplug the GPS & verify points are in GPS & are displaying properly.
18. Delete temporary shapefile from scratch folder

***NOTE: The GPS ID is a concatenation of the first two letters of the Lake Name, + leading 0's + Site Number (ex. Ho013). In some cases there may be similar GPS ID's for two different lakes (i.e. Belle Lake and Bertha Lake) if this causes issues, you may want to recalculate the GPS ID for one of the lakes with a unique name.

To create a unique GPS ID: Open ArcMap → add **Temporary Shapefile**

4. Zoom to desired lake → select points
5. Open Attribute Table → Right click GPS_ID Field
6. Calculate Field

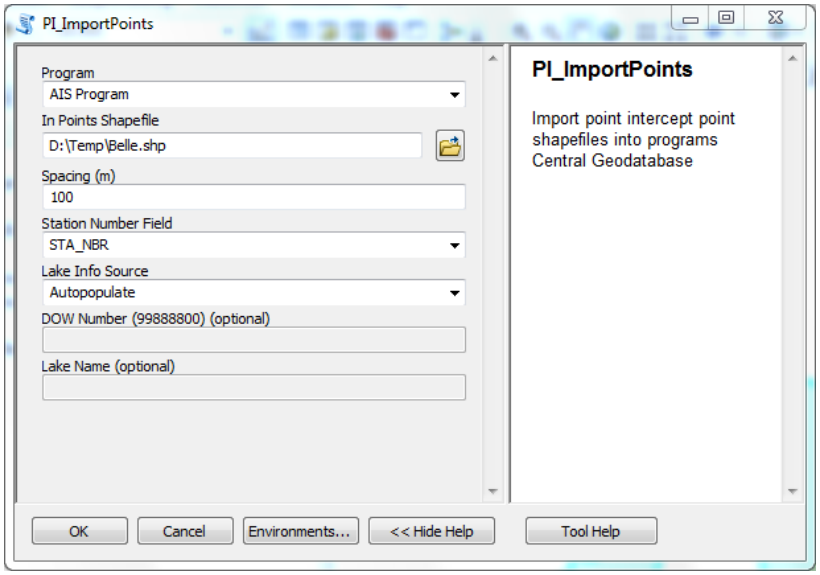
a. 

7. Select the “String” radio button→ select Replace( ) function
8. The function: Replace([field to calculate], “letter(s) to get replaced”, “letter(s) to replace with”)
   d. Replace([GPS_ID], “r”, “W”)
   e. In above example, all r’s in the GPS_ID Field, will be replaced with W’s
   f. quotes are needed around the letters, and commas between elements

IMPORT POINTS TOOL

The **Import Points Tool** is used to add previously generated survey points (usually shapefiles) into the selected programs central geodatabase.

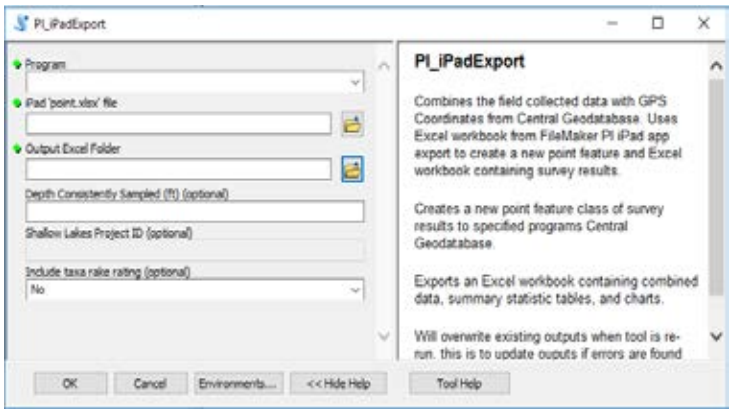
1.) Program: Select the desired program
2.) In Points Shapefile: Navigate to the shapefile that contains the survey grid points
3.) Spacing (m): Enter the grid spacing in meters
4.) Station Number Field: Select the field that contains the survey station(site) number
5.) Lake Info Source: Select whether to Auto-populate or manually enter the Lake Name and DOW. Auto populate is generally recommended.
6.) DOW Number: If manually entering lake info, enter the DOW (8 number format Ex. 99888800)
7.) Lake Name: If manually entering lake info, enter Lake Name (avoid special characters).

a. 

IPAD EXPORT TOOL

The **iPad Export Tool** is used to assist with quality control and survey data summary and analysis. This tool takes the "point" Excel spreadsheet from the iPad FileMaker App (maintained by the EWR Lake Habitat Program), and creates a new GIS feature class and layer and new excel workbook. The exported Excel workbook contains several worksheets that contain the survey data summary tables and charts, and a copy of the attribute table from GIS output.

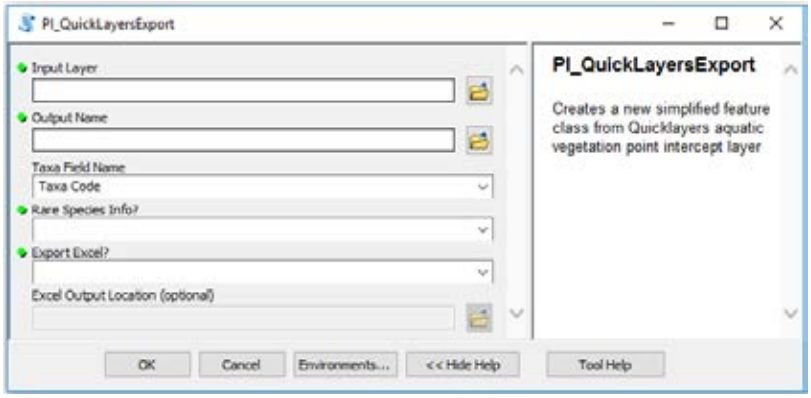
1.) Program: Select the program that owns the data
    a. This will set the GIS output location
    b. This will add program specific worksheets to the excel output
2.) iPad 'point.xlsx' file: Navigate to the .xlsx file that contains iPad exported data
3.) Output Excel Folder: Navigate to the desired output folder – the new Excel document will be automatically named
4.) Depth Consistently Sampled (ft): *Optional - enter the depth in feet that was consistently sampled in the field. This is used to set the appropriate limits for the summary tables and charts
5.) Shallow Lakes Project ID: *Optional - For SLP Only. Enter the Access database project number if known.
6.) Include taxa rake rating: *Optional - select Yes if taxa level rake ratings were collected (AIS protocol).

a. 

EXPORT PI DATA FROM QUICK LAYERS

The PI data available on quick layers does not export properly because there are too many taxa fields. The **Export PI Data from Quick Layers Tool** exports selected points, removing unused taxa fields and saves it as a new feature class in the desired output location.

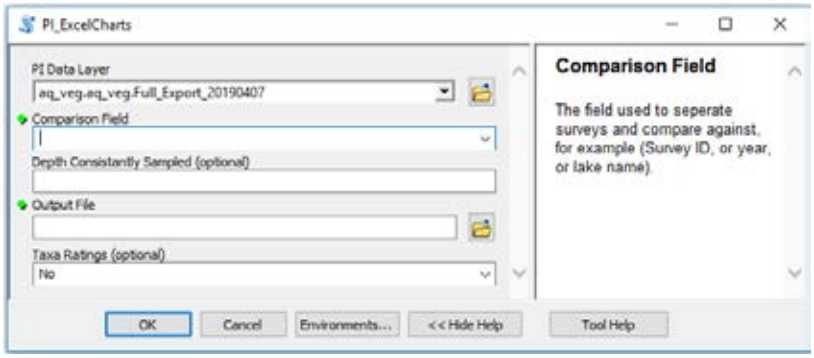
1.) Input Layer: Use **All Aquatic Plant Species Found -By VP Sampling Station** layer
2.) Output Location: Output must be a geodatabase (sorry shapefile users). Using the Default.gdb is generally recommended.
3.) Output Name: Name of the output feature (must not start with a number or contain special characters).
4.) Taxa Field Name: Taxa field name view (code, scientific, common name)
5.) Rare Species Info: Keep or hide rare taxa info
6.) Export Excel: Would you like to generate an excel spreadsheet of the data?
7.) Excel Output Location: Output location folder of exported excel table

a. 

CREATE CHARTS AND GRAPHS

The C**reate Charts and Graphs** Tool extracts data from selected records – Use Quick Layers or Full export Feature class) and creates an excel workbook containing tables and charts of the selected lake DOW. Comparisons will be made based off the comparison field. This output is useful for generating comparison tables and charts to use in data analysis and reporting.

1.) PI Data Layer: The layer containing the selected raw data points -Usually a quick layer or full export feature
2.) Comparison Field: Values from this field will get summarized and compared against.
3.) Depth Consistently Sampled (ft): *Optional - enter the depth in feet that was consistently sampled in the field. This is used to set the appropriate limits for the summary tables and charts
4.) Output File: Location and desired excel workbook file name.
5.) Taxa Ratings: Add a worksheet comparing taxa rake muchness values. Must have "Observed Taxa Rel Abund" field.

a. 

UPDATE CENTRAL GEODATABASE – DATABASE MANAGERS ONLY

Updates selected programs point intercept central geodatabase . This tool uses the current central databases excel export and creates a new feature class(s). This tool is protected by the PC's username, if your username is not on the approved list, should contact the toolbar administrator.

1.) Program: DNR Program
2.) Export Type: Selected project ID, Full Export only, or update whole geodatabase
3.) Project ID: If Selected project ID is
4.) DOWLKNUM: Updates all surveys with selected dowlkum
5.) Excel Export?: Creates an excel export of each exported feature
6.) Excel Folder: the Folder you want the exported excel to save in (file is auto names)

SECTION 2. FILEMAKER APP

This tips document covers the use of iPads using *FileMaker Go* and *FileMaker Pro* for the purpose of collecting lake plant data consistent with Minnesota DNR protocol. This document does not cover the purpose or collection protocol – please consult the Minnesota Lake Plant Survey Manual, specifically the quantitative plant survey – point-intercept chapter for these details.

FILEMAKER GO BACKGROUND

FileMaker Go is a free app from the Apple App Store that runs FileMaker-based custom apps on iPad and iPhone. These mobile custom apps have the full power and capability of FileMaker desktop custom apps. The FileMaker platform custom apps work seamlessly across iPad, Windows, and Mac.

REQUIRED EQUIPMENT

- iPad. We found the larger iPads to be the most user-friendly, and they are recommended (9.7 inch models).
- *FileMaker Go* Application: This is a free download from the Apple application store (version 17 is the latest).
- Waterproof case: A durable waterproof case is recommended for fieldwork, and one without a plastic screen protector is highly recommended.
- Boat mount (optional): is very handy for securing device and positioning it for ease of use, we found the “Ram” products work great.

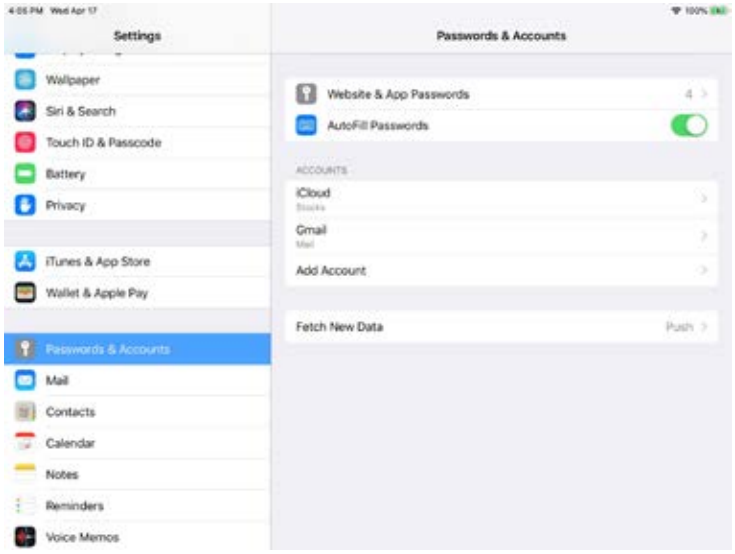
IPAD SETUP

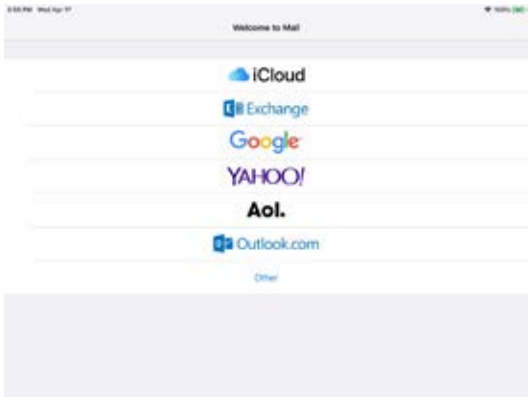
After you’ve procured an iPad ensure the FileMaker Go application (version 17) is installed. If not, go to the App Store and download it.

EMAIL CLIENT SETUP

An email client is needed to transfer files (FileMaker database and Excel worksheets) between your PC and the iPad. Unfortunately, the Office Outlook app has a significant added cost that is hard to justify the few times it’s needed. The current recommended option is to setup a third-party email such as a separate Gmail or the iCloud through Apple ID account.

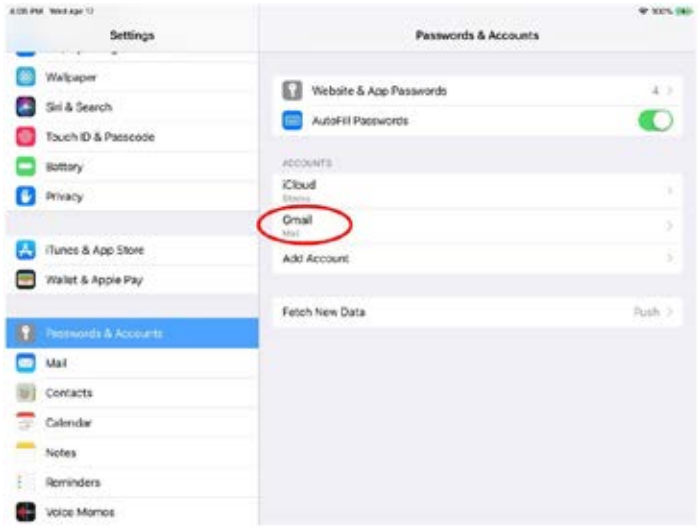
Check if email a client is installed by opening the Mail app to see if it opens an active email account. If there isn't one follow the steps below.

1. Settings → Passwords and Accounts →Add Account
   a. 

2. Select your account client (probably google for Gmail)
   a. 

3. Enter your third party (Gmail) account address and password
   a. 

4. Verify it's setup by going to Settings → Passwords and Accounts → you should see and account with email listed.

a. 

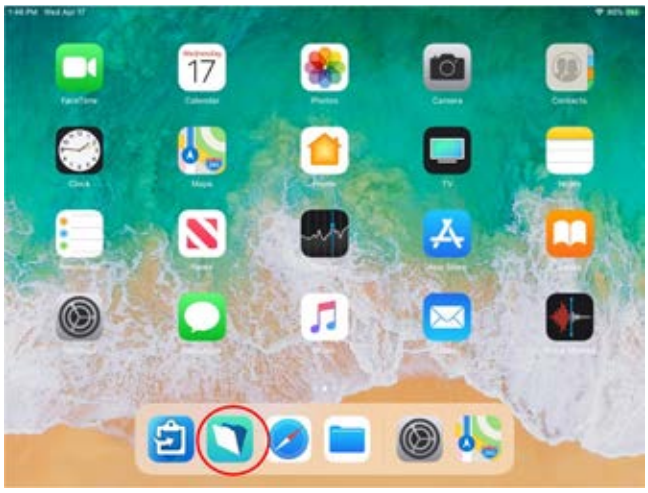
USING FILEMAKER GO TO COLLECT FIELD DATA

The *Lake Plant* Survey custom app has three features. First, a point-intercept data collection feature used to enter data while conducting the survey or to enter data from field paper forms after the survey. Second, it allows the surveyor to enter taxa observations from a targeted or random search survey that might be done along with a point-intercept survey or a stand-alone survey. Three, a file management feature used to add new files, save work files to a central server, and export files for use with ArcMap.

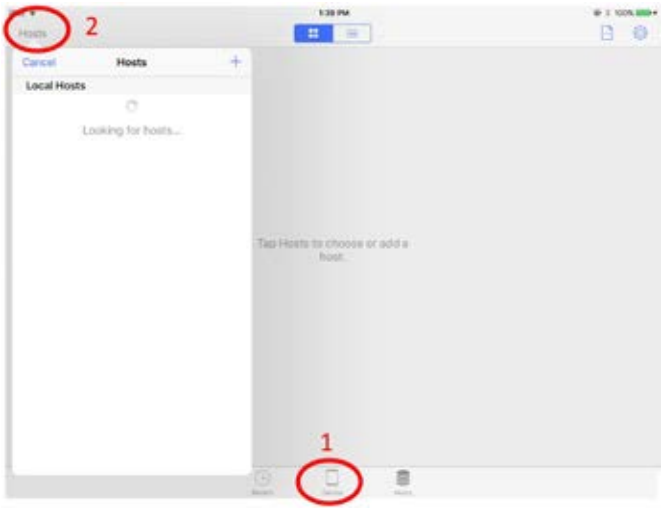
There are two ways to get a work file onto your iPad. If you can connect to the DNR-Staff Wi-Fi, then you can download the file from the server. If not, then email the file to your iPad.

DOWNLOADING NEW WORK FILE (DNR STAFF WIFI)

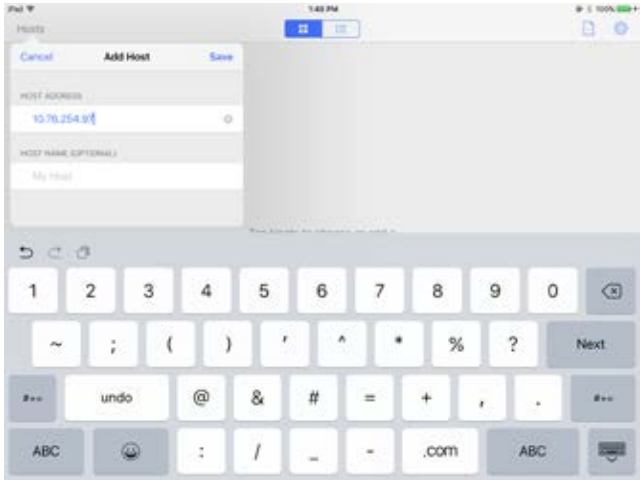
12. Connect iPad to the DNR-Staff Wi-Fi
13. Open FileMaker Go (we place the app in the bottom row for easy access)

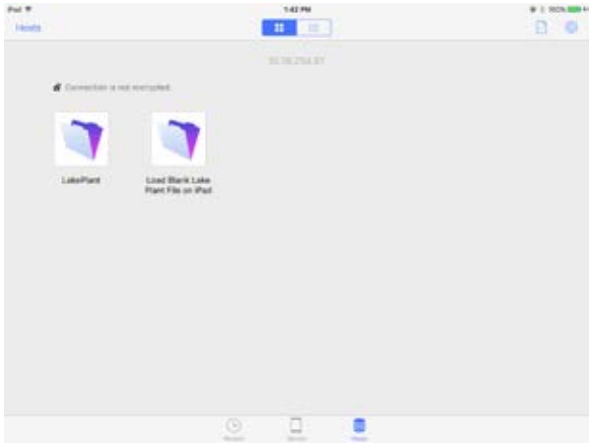
a. 

14. Tap **Host** icon at bottom of screen if not active.

a. 

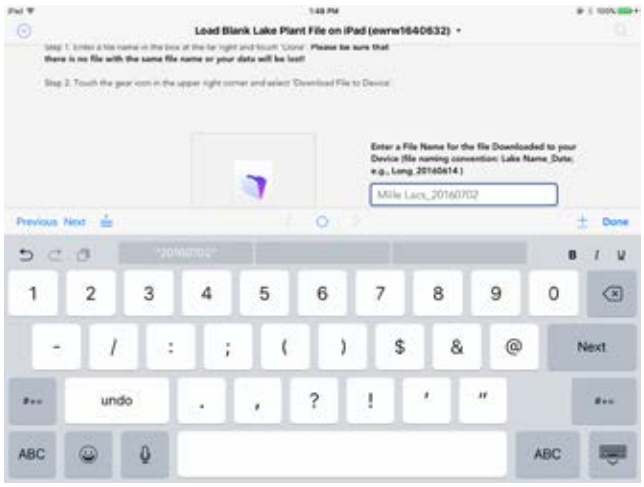
15. Tap "**Host**" at top left to enter center server ip address, then tap '**+**' to enter IP address
16. Enter Host Address – the current address for the host is 10.76.254.97

a. 

17. At least two FileMaker Apps are shown after entering host address.
    a. 

18. Tap the 'Load Blank Lake Plant File on iPad' app, which will load a blank *Lake Plant Survey* app to your iPad
    a. 

19. Follow the steps outlined in this app. Enter a new file name for your survey. The file naming convention we suggest is <lake name>_<survey start date>. Don't use a file name already on the device, as the file will be deleted.

a. 

20. After entering a file name, tap the gear at the upper right.

a. 

21. Tap '**Download File to Device**'.

a. 

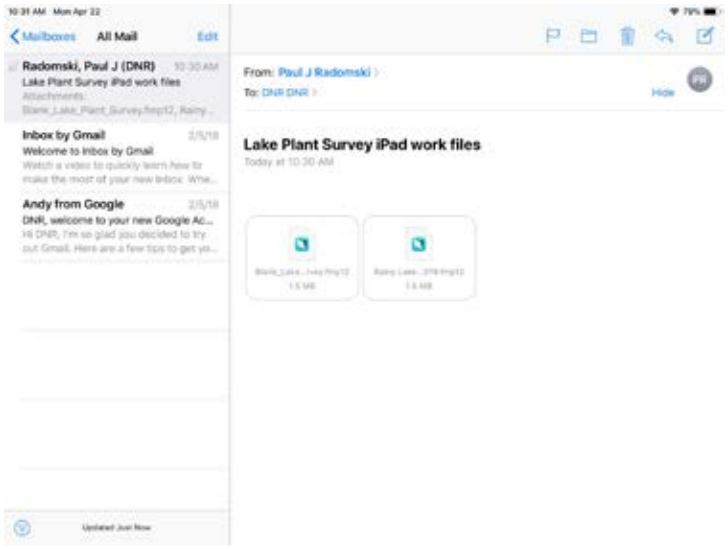
22. After File is downloaded, tap '**Close GoConnect**'

DOWNLOADING NEW WORK FILE (EMAIL)

If the DNR Staff Wifi is not available, you will need to use an email app to email yourself a copy if the “Blank_Lake_Plant_Survey” file to your device. If you do not have email setup on the device see the “Email Client Setup” section.

The latest work file can be found on the V Drive V:gdrs/apps/org/us_mn_state_dnr/PointIntercpt/Blank_Lake_Plant_Survey.

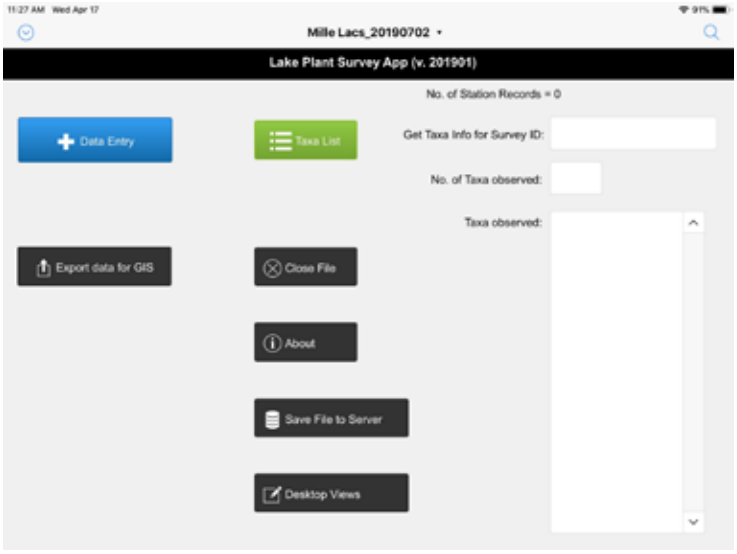
Copy a new file for each survey to ensure you are getting the most updated version of the working file.

1. Save a copy of the **Blank_Lake_Plant_Survey.fmp12** to your PC and rename it to a unique name ex. <Lakename>.fmp12
2. Email the **renamed.fmp12** file to the iPads email account (example@gmail.com)
3. It is reccomended to also have a **Blank_Lake_Plant_Survey.fmp12** file on your iPad as a ‘backup’ (in case you forgot to send yourself a new survey working file).
4. Open up your email on the iPad. Tap on attached work file(s) and download to iPad
   a. 

5. Tap ‘**Copy to FileMaker Go**’ icon

a. 

6. It copies the file to FileMaker Go, then the *Lake Plant Survey* app opens.

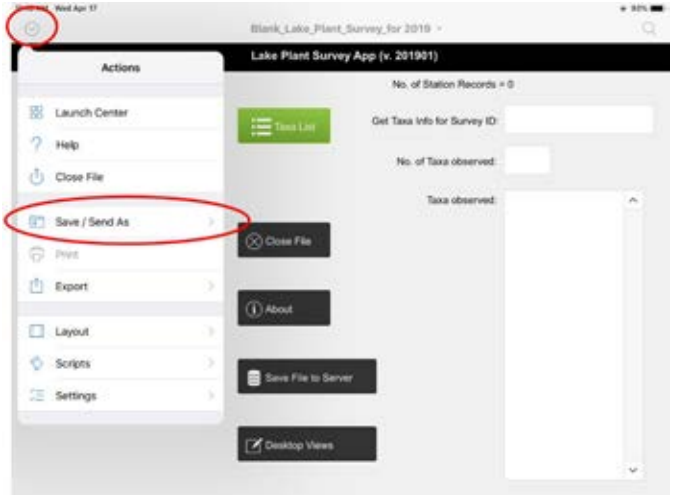
a. 

You are now ready to collect data

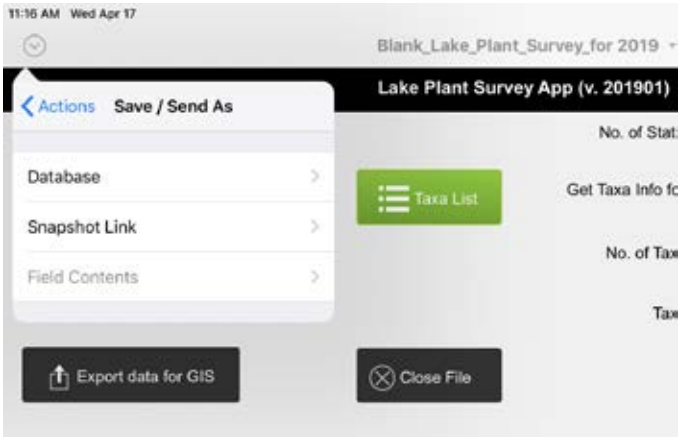
COPYING BLANK_LAKE_PLANT_SURVEY FILE ON IPAD

Do Not use the Blank_Lake_Plant_Survey, instead make a copy and rename it! This can be done in the fileMaker app while afield.

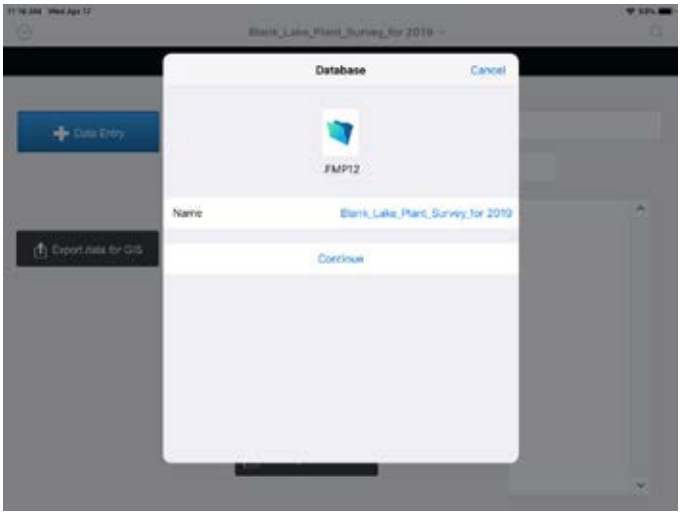
1. Create a file for a new survey (a copy of this blank working file) using the Actions icon at upper left:
2. Tap '**Save / Send As**'.

a. 

3. Tap '**Database**'

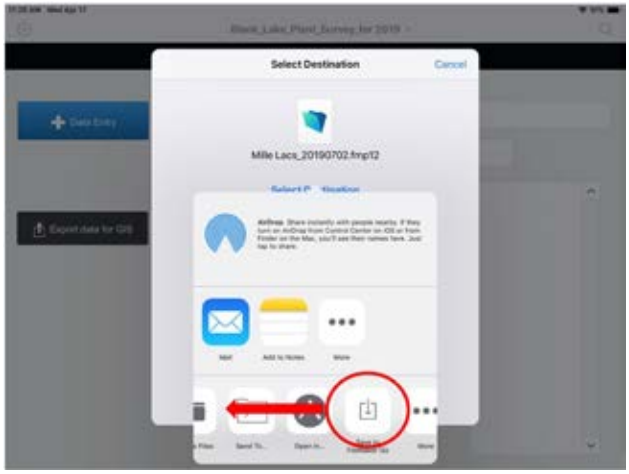
a. 

4. Rename file to the Lake Name.

a. 

b. 

5. Tap '**Continue**'. Select Destination by sliding the bottom options and touching '**Save to FileMaker Go**' icon.

a. 

6. Within FileMaker Go, on the Device you should see your new lake work file. You are ready to conduct your survey!

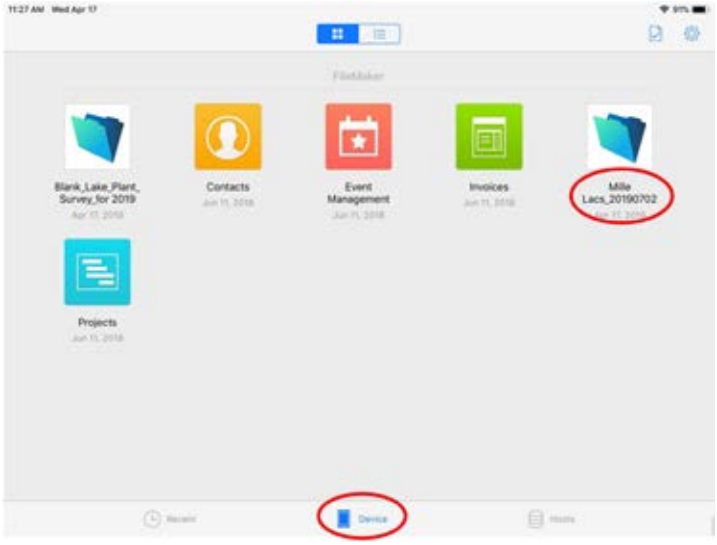
COLLECTING FIELD DATA

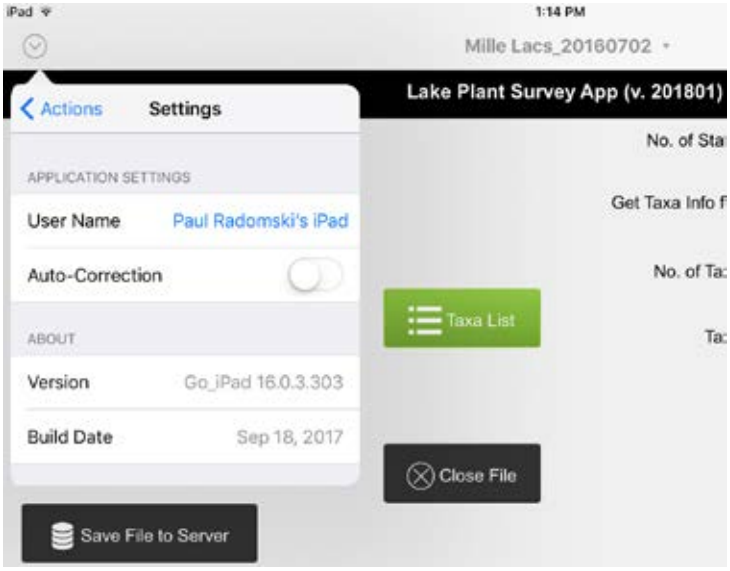
Before starting a new survey it's important to make a copy of the "Blank_Lake_Plant_Survey' File (previous section)

These steps work through a typical data entry process. You can edit and change data in the various fields without issue; **however, there is one kind of edit that creates issues that will need to be fixed later:**

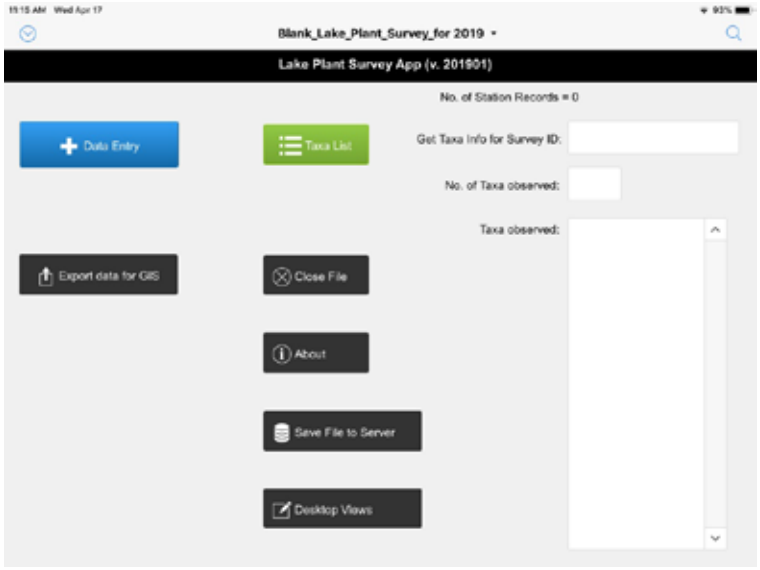
If you enter a station number and add taxa to that point, if you then change that station number, the taxa records will be unassociated with any station number.

This issue can be fixed on the desktop version of FileMaker when you review and finalize your data. All records are time-stamped which allows tracing records and it is easy to determine if taxa records get orphaned in this manner.

1. The *Lake Plant Survey* app for your specific survey should now be on your device. Tap the device icon at bottom center, then tap the file you created to start data entry.
   a. 

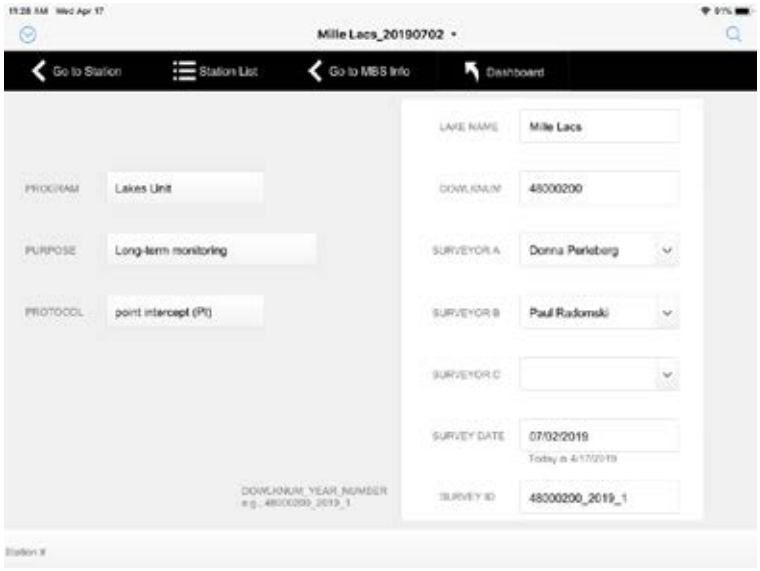
2. We find that turning off Auto-Correction helps. At the main screen, tap the icon in the upper left corner and tap '**Settings**'. Slide '**Auto-Correction**' off.
   a. 

3. You are now ready to begin collecting data! But first, you'll need to enter some basic information about the lake and the survey. Tap the file you just downloaded and created. You will see the main screen of the app. Note that no records are present!

a. 

IMPORTANT NOTE ABOUT EDITING: You can't delete records, so if you enter data in error, then delete the contents of the field or overwrite it with correct information.

4. Tap '**Data Entry**' button to enter basic information about the survey. Enter Program, Purpose, and Protocol. **Your choice of Program determines your station screen.**

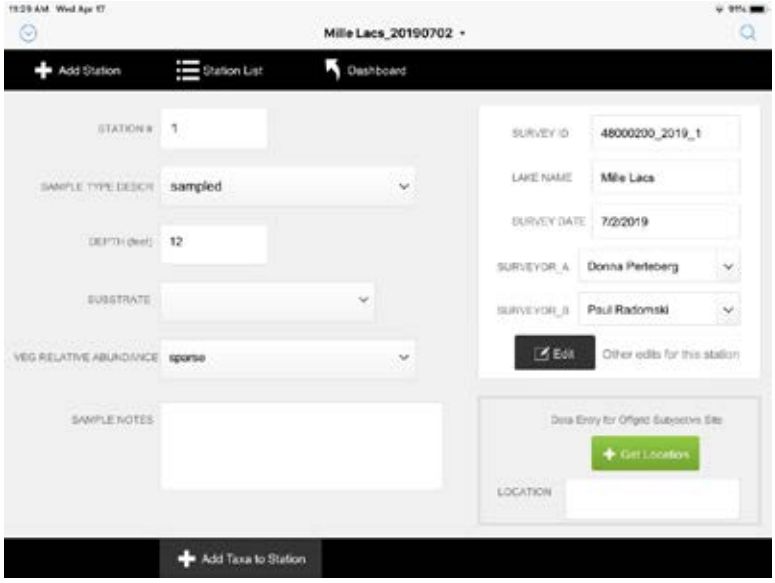


a.

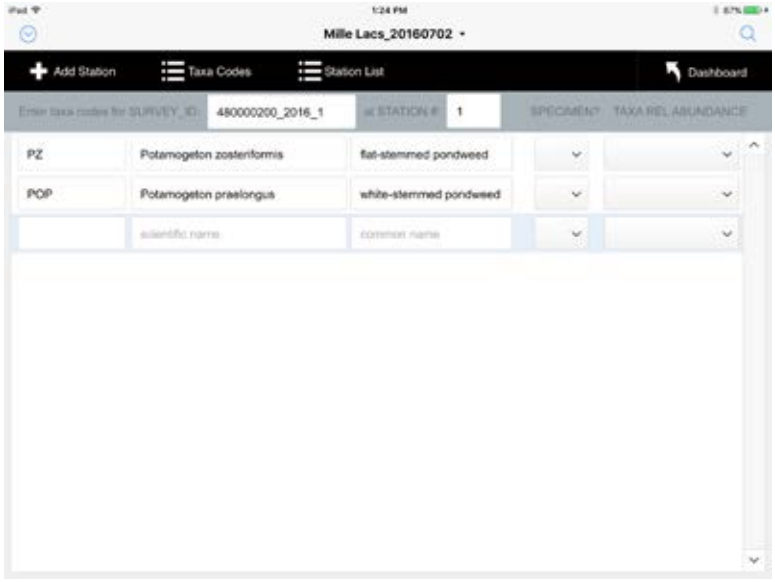
b. Enter the lake name, DOW lake number, surveyor A & B & C, and survey start date, and, if necessary, edit survey id # (convention is <DOW lake number>_<survey year>_<number>)

5. Navigate to your first point/station and start collecting data. Tap the '**Go to Station**' button at upper left to begin entering data for point.

a. Here is an example for the first sampled point/station (entered '1' for station, selected 'sampled' from popup menu as it was a PI station on grid, and '12' for depth).

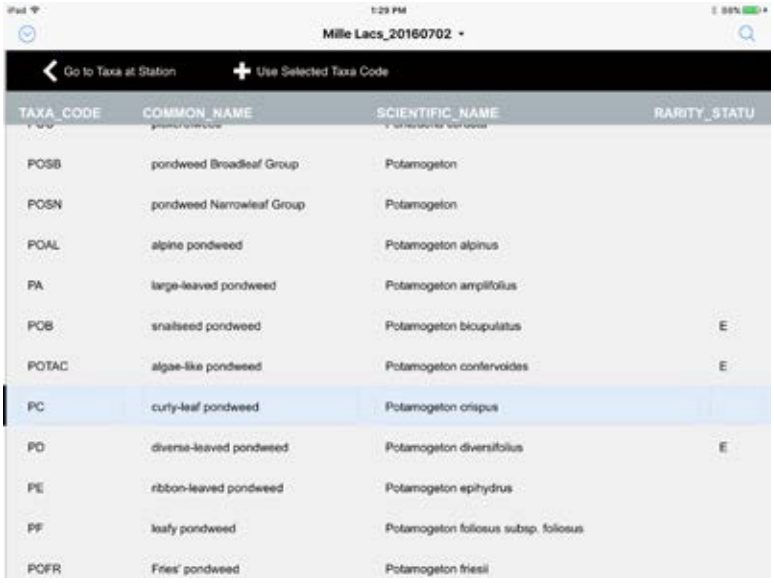
b. 

6. If aquatic plants were observed at point, tap **'+ Add Taxa to Station**' button at bottom of screen, and enter taxa code representing taxa observed.

a. 

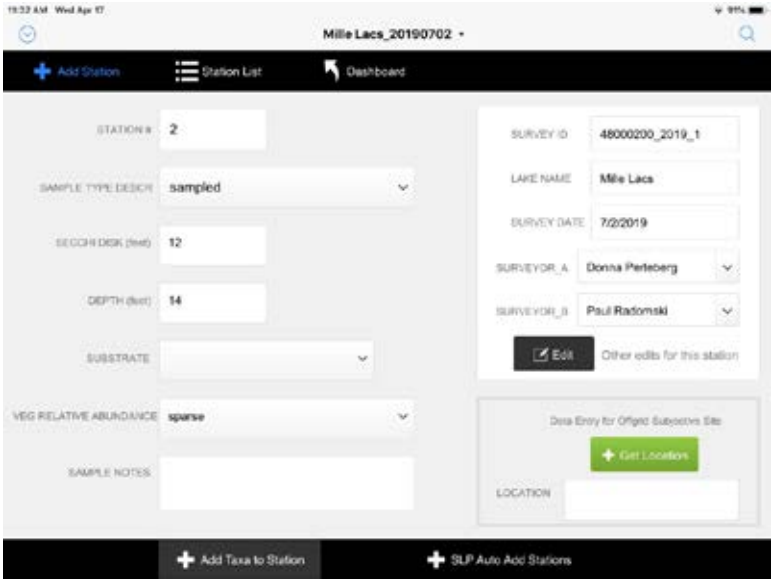
b. Optional: Taxa Relative Abundance can be entered for each taxa.

7. Don't know your taxa codes? That's unfortunate! Tap '**Taxa Codes**' (Top) to get the appropriate code. Scroll down the list by swiping the screen and select the taxa code you need. Once selected, then tap '**Use Selected Taxa Code'**. The taxa code list is ordered by scientific name, but includes Unknown Emergent, Unknown Floating-leaf, Unknown Submerged, and zebra mussel.

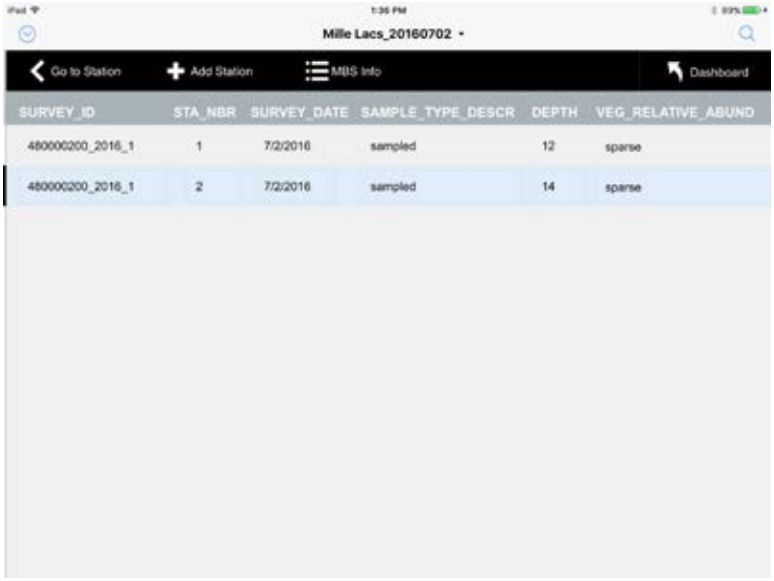
a. 

IMPORTANT NOTE ABOUT EDITING: You can't delete records, so if you enter data in error, then delete the contents or overwrite it with correct information; e.g., either with a taxa code also observed at this point or delete the contents of the taxa code field that is in error.

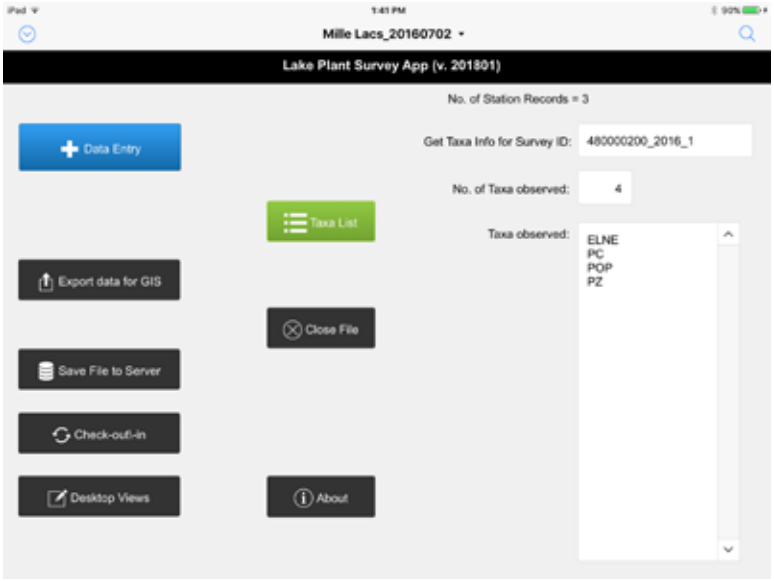
8. Enter next point/station by tapping **'+ Add Station'**. Enter appropriate information. Continuing sampling…

a. 

9. Forget something in station #1, then tap '**Station List**' button at top of screen. A list of stations entered is listed, select a station # to go to that record for edits (change data or add taxa to station). Here station #2 is selected, then tap '**Station**' button to go to that record.

a. 

10. To see the number of points/stations sampled or taxa observed, tap '**Dashboard**'. The main screen shows a quick summary of results.

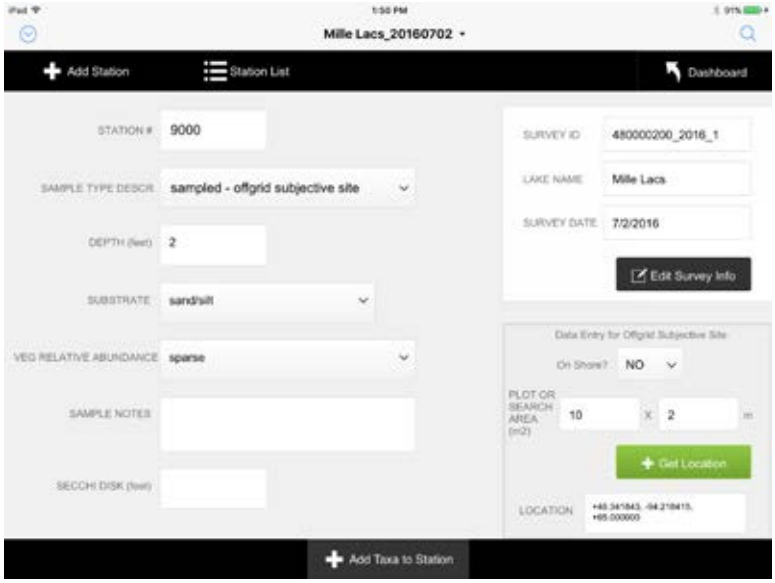
a. 

Off Grid Subjective Sites

To record taxa observed not at an established point or station (e.g., found new taxa traveling between points; searching for additional taxa after PI stations sampled, etc.), follow the same approach as above.

1. You will need to assign a **unique station number** for the survey (e.g., use a series of numbers higher than any PI station numbers).

2. Tap '**Get Location**' in the box at the lower right of the screen to get Lat/Long info

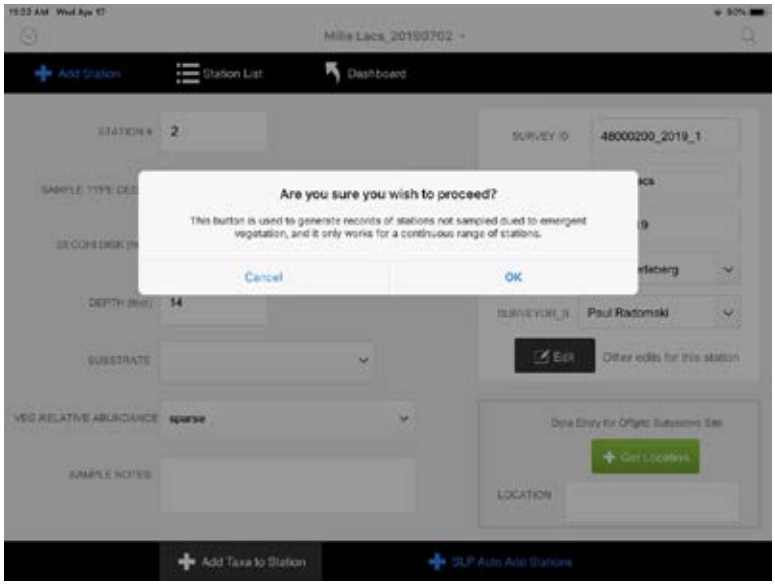
a. 

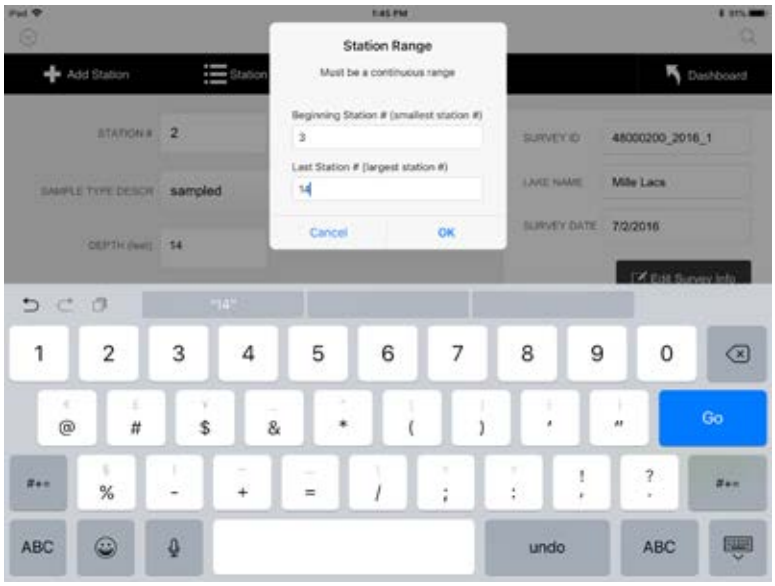
Extra Features

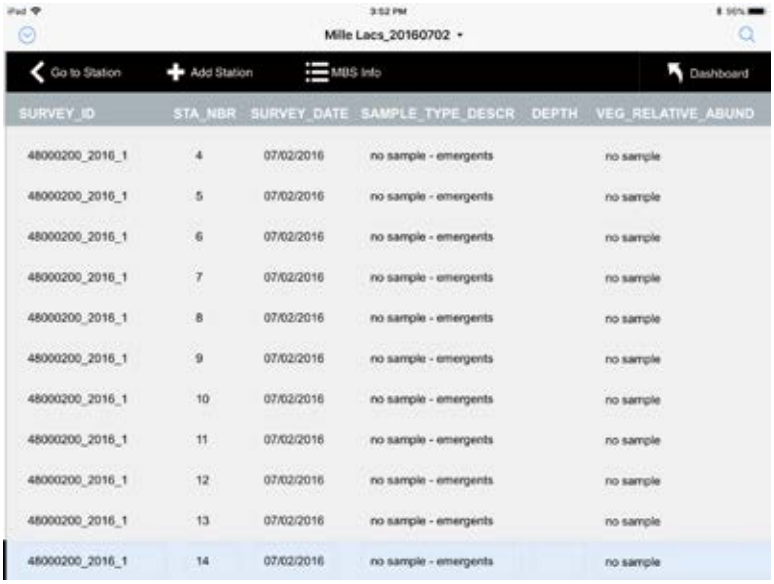
There are several special case features:

Shallow Lakes – Skip A Series Of Sites

For the SLP screen, to add a series of points not sampled due to emergent/floating vegetation that prevents access to the point, use the button 'SLP Auto Add Stations' in the lower right of the point/station input screen. It will then ask if you wish to proceed.

a. 

2. Enter the range of established points that you will not sample due to inability to navigate to them:
   a. 

3. Tap '**OK**' and the program will auto generate the series of non-sampled station records, and then display those records via the Station List screen:
   a. 

SURVEY_ID	STA_NBR	SURVEY_DATE	SAMPLE_TYPE_DESCR	DEPTH	VEG_RELATIVE_ABUND
48000200_2016_1	4	07/02/2016	no sample - emergents		no sample
48000200_2016_1	5	07/02/2016	no sample - emergents		no sample
48000200_2016_1	6	07/02/2016	no sample - emergents		no sample
48000200_2016_1	7	07/02/2016	no sample - emergents		no sample
48000200_2016_1	8	07/02/2016	no sample - emergents		no sample
48000200_2016_1	9	07/02/2016	no sample - emergents		no sample
48000200_2016_1	10	07/02/2016	no sample - emergents		no sample
48000200_2016_1	11	07/02/2016	no sample - emergents		no sample
48000200_2016_1	12	07/02/2016	no sample - emergents		no sample
48000200_2016_1	13	07/02/2016	no sample - emergents		no sample
48000200_2016_1	14	07/02/2016	no sample - emergents		no sample

Multi-Day Surveys

For multiple-day surveys, you should update the survey date at the first station of the new day.

1. Touch **'Data Entry'** and at the station list touch **'Add Station'**.
2. Enter station # (station #512 in the example below)

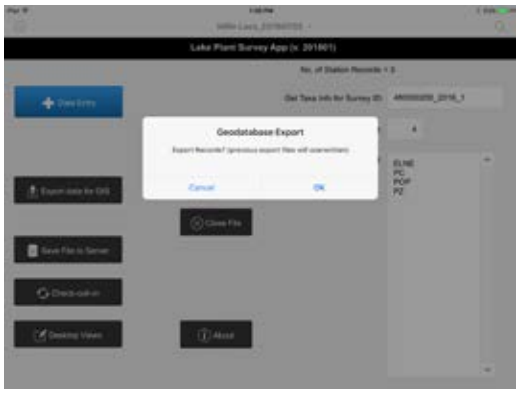
3. At the first station of the new day, tap '**SURVEY DATE**' and revise the date. Now all station records thereafter will have this sample date.
4. In addition, you can also change surveyors for the day by taping '**Edit Survey Info**' button, and revising the names listed in the surveyor fields (A,B,C). Again, now all station records thereafter will have these surveyors.

a. 

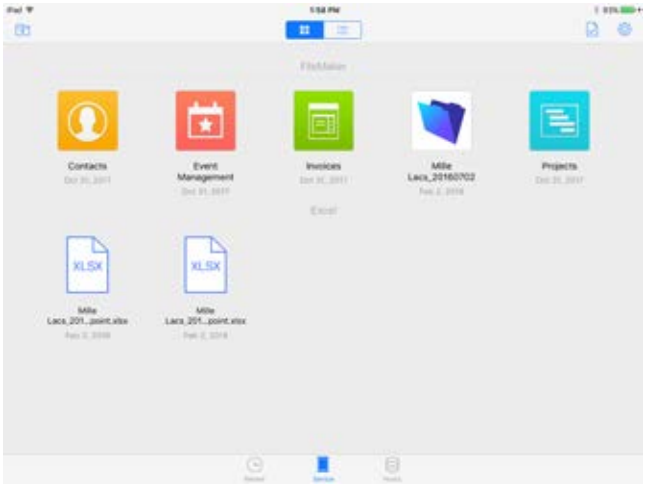
EXPORTING DATA FROM THE IPAD APP

Exporting all data is a simple button push. When you tap 'Export data for GIS' button, the app will create Excel Workbook files representing all data entered. The 'Point' worksheet has information on the stations, and taxa information for each station. There is a second 'MBS' workbook is created if MBS program data entered.

1. Go to the '**Dashboard**' screen.
2. Tap the '**Export data to GIS**'.
3. You will see a message about the files being overwritten if you already exported files with the same survey ID.

a. 

4. Tap '**OK**' to export records.
5. Tap '**Close File**' and tap '**Device icon**' on the bottom of the screen, then you will see your exported files (<survey ID>_point.xlsx).

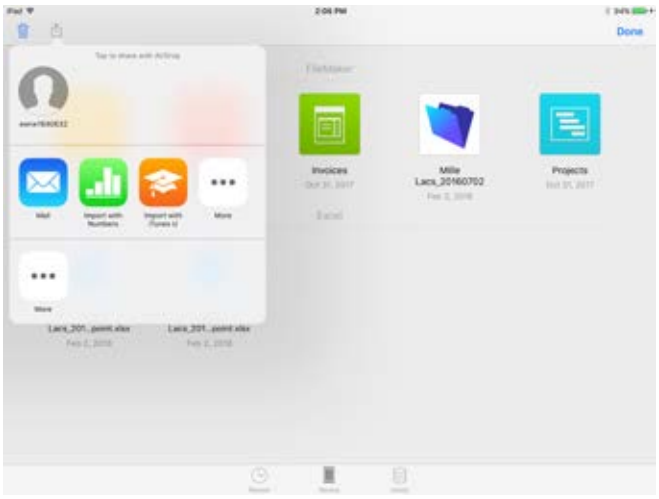


EMAILING 'POINT' FILE

1. Connect to Wi-Fi
2. If in the Lake Plant Surveys App, tap '**Close File**'
3. Tap '**Device icon**', then tap the file icon in upper right corner
4. Tap the '**xxx_point.xlsx**' file and do a quick review of the data
5. Tap the '**file icon**' in upper left corner

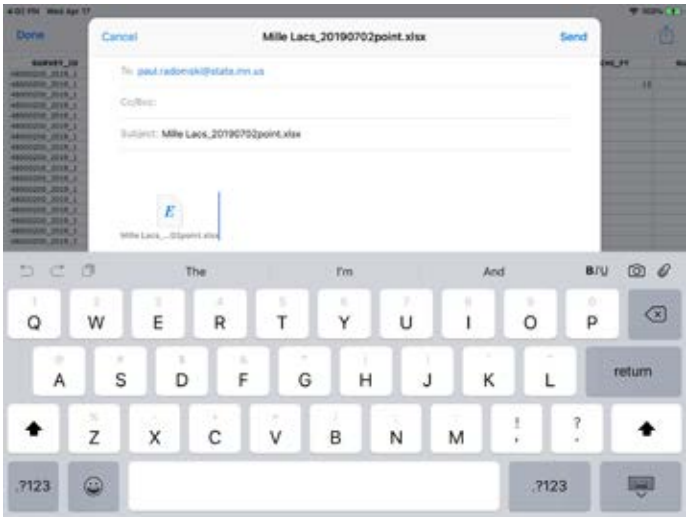
a.

6. Tap '**Mail**'

a. 

b. If there is no “Mail” option available, see “Email Client Setup” section.

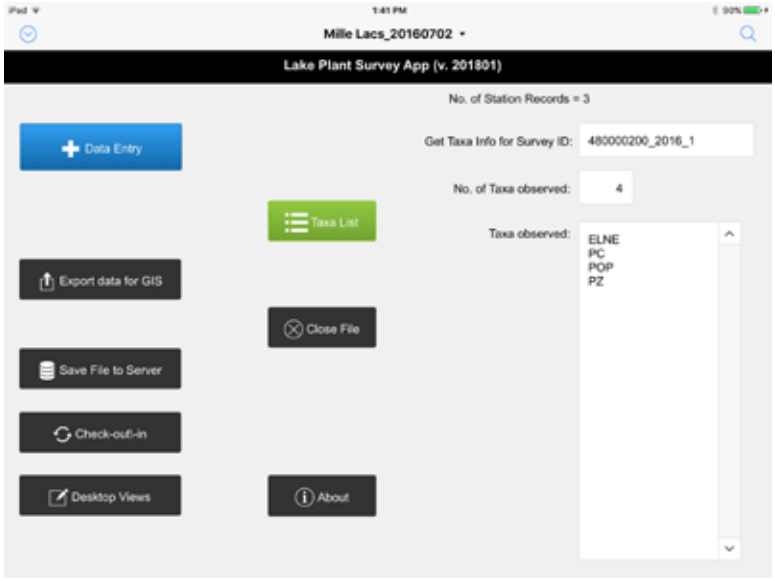
7. Send an email to yourself with these files attached

a. 

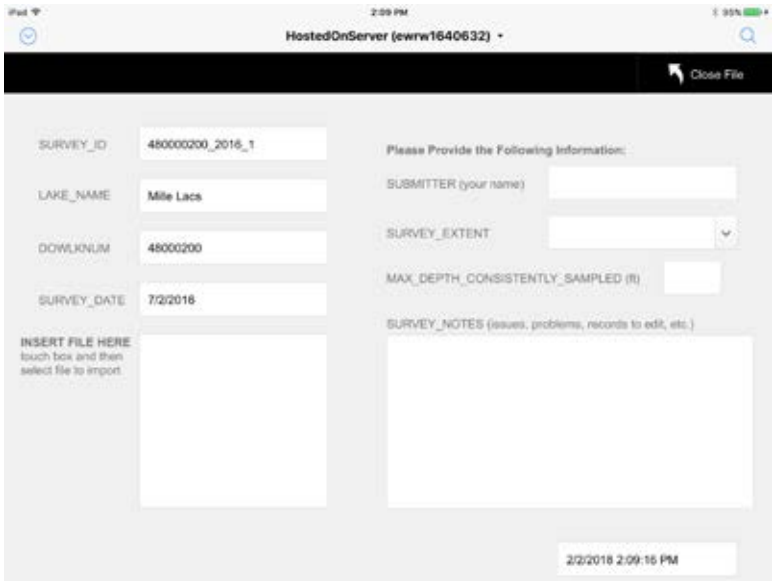
SAVING FIELD FILES TO SERVER

If your field data is managed by the Lake Habitat Program, then save your field data to their central server.

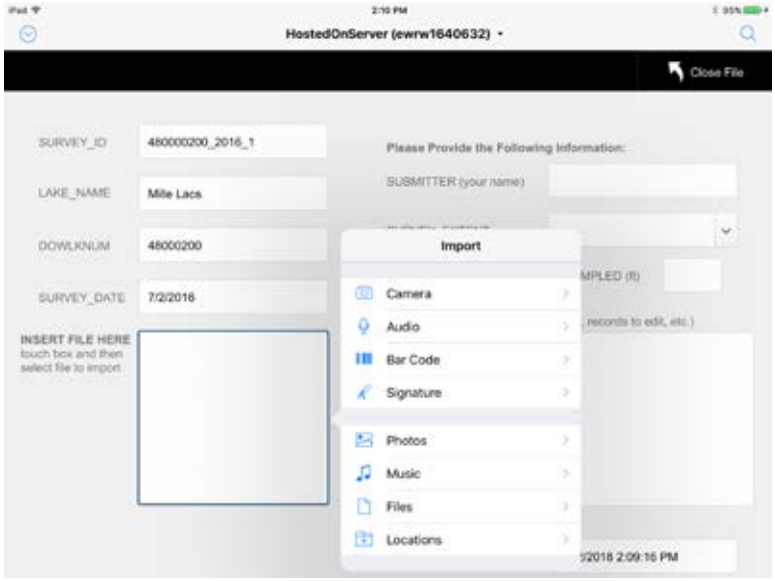
1. Connect iPad to the DNR-Staff Wi-Fi
2. Open FileMaker Go
3. Tap ‘Device’ icon at bottom of screen
4. Tap file you wish to save to server
5. On Main screen tap ‘Save File to Server’ button

a. 

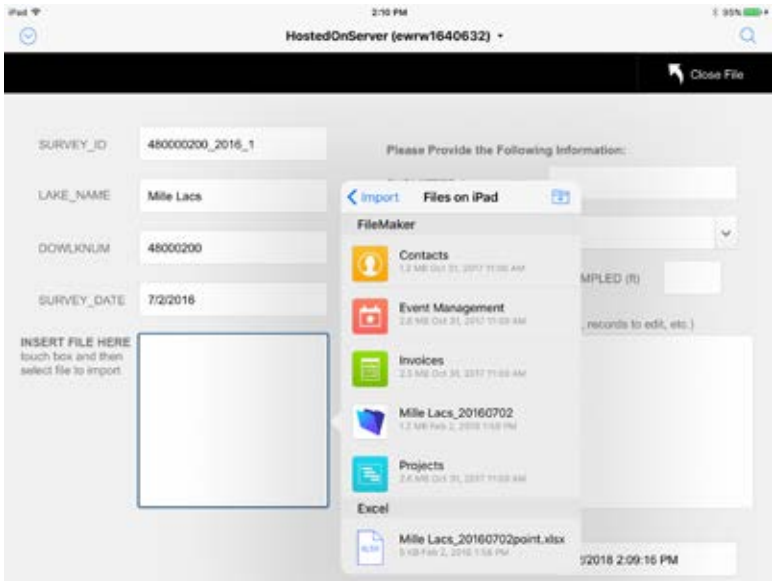
6. Continue and then tap '**Go to Your Record'**, which places a record on the server representing your survey database files for this survey. The survey id, lake name, DOW lake number, and survey start date are auto-populated (if not, then manually enter these data! If your database has blank records, then sometimes these fields are not auto-populated, sorry…)

a. 

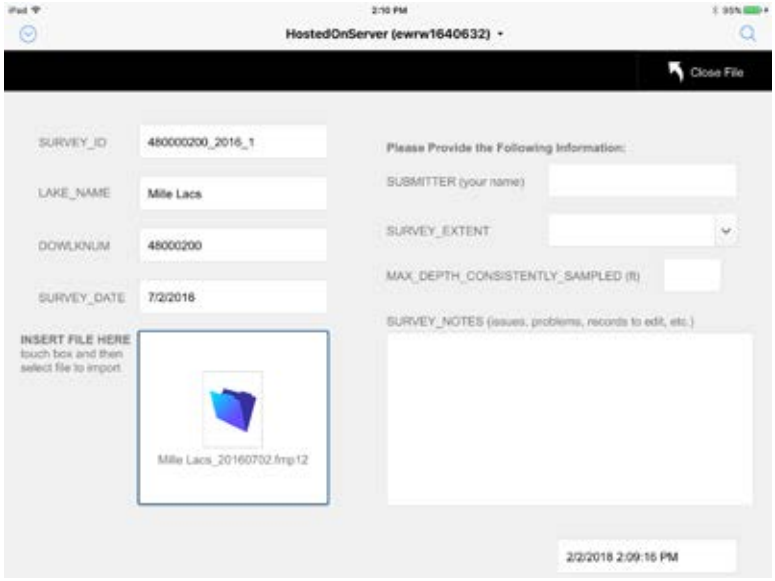
7. Tap box next to '**INSERT FILE HERE**'

a. 

8. Select the appropriate file representing the survey by tapping file

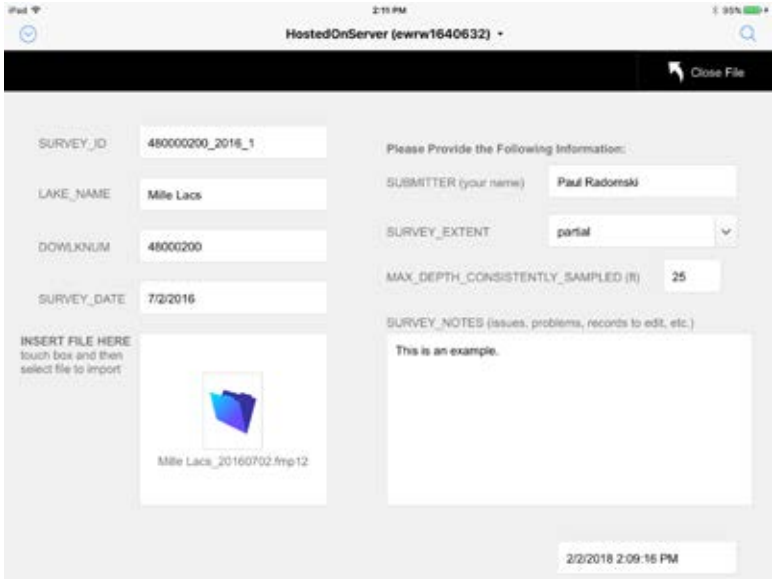
a. 

b.



9. Fill out remaining fields with your name, the survey extent, maximum depth consistently sampled (feet), and survey notes (document any issues necessary for editing). Survey extent options include: was the survey conducted for the whole lake, part of the lake, or just shoreline plots.

a.



10. Tap '**Close File**' button at top right of screen when entry is completed.

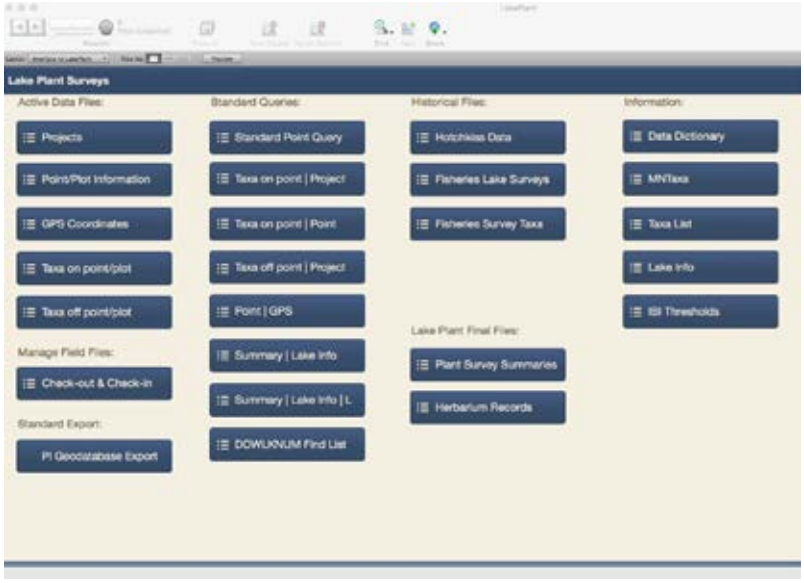
EDITING FIELD DATA WITH FILEMAKER PRO

Once you've gotten your field files to your desktop computer using iTunes, email, or if your field data is managed by the Lake Habitat Program by 'Save File to Server' routine noted above, then you can review and edit following a quality control checklist (see below).

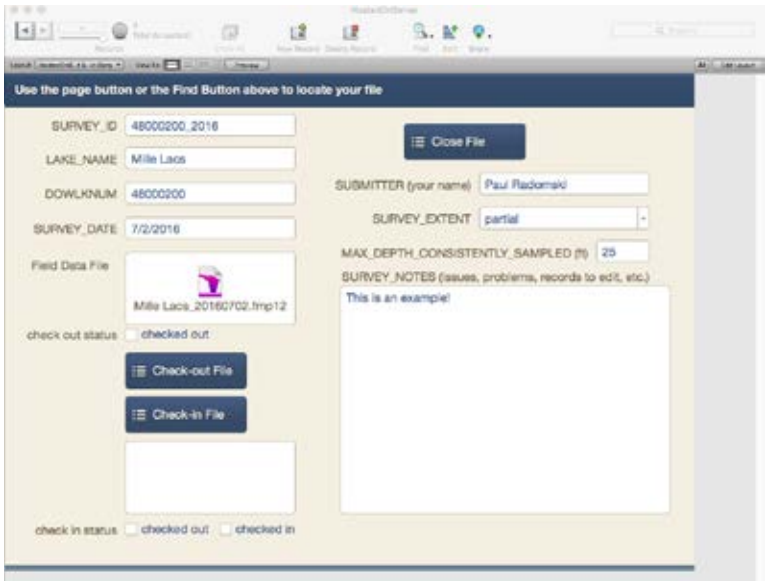
FileMaker is a complete database program, so going into details of its functions and capabilities is not appropriate here. However, if you are new to FileMaker please read Chapter 2 of the FileMaker User's Guide, which is part of FileMaker's documentation on using this program.

CHECK-OUT FILE FROM SERVER TO REVIEW AND EDIT

If your field data is managed by the Lake Habitat Program, then open FileMaker Pro and open the LakePlant Host:

1. Click the 'Check-out & Check-in' Button on the LakePlant FileMaker system.
   a. 

2. Find your survey file with page buttons in the upper left corner or use the Find feature.
3. Once your survey is found and shown, then Click the 'Check-out File' button. You will be asked where to copy the survey file to.

a. 

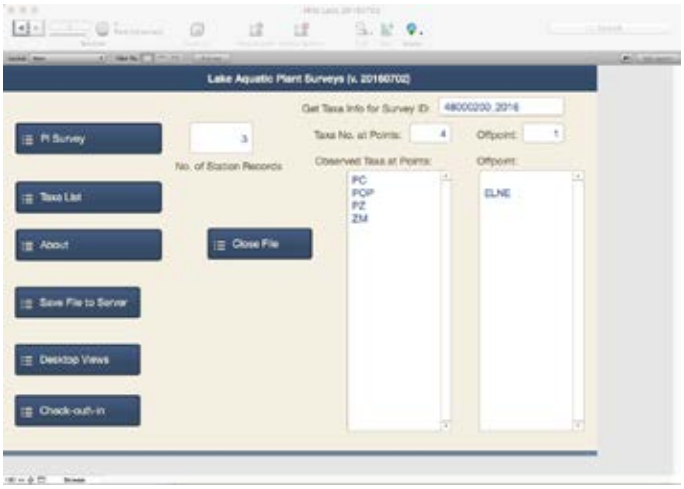
4. Once this is completed, the server will record that the file is checked out.
5. Click ‘Close File’ button

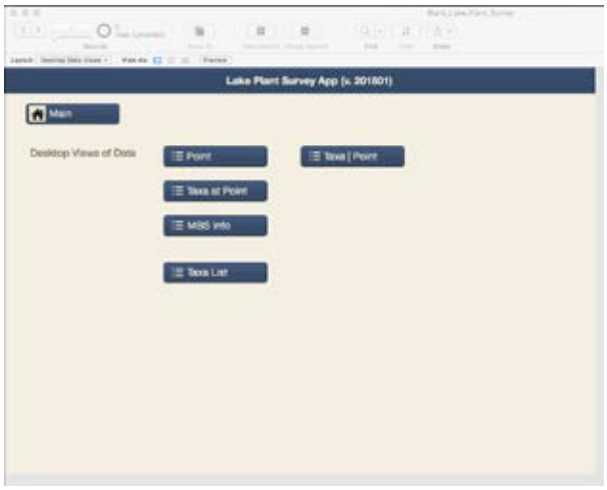
USING FILEMAKER PRO TO EDIT

When editing your field data with FileMaker:

1. Open your field file for editing by holding down the SHIFT key when opening this file in FileMaker (Account = admin Password = pjr)
2. Tap ‘Desktop Views’ button to go to edit

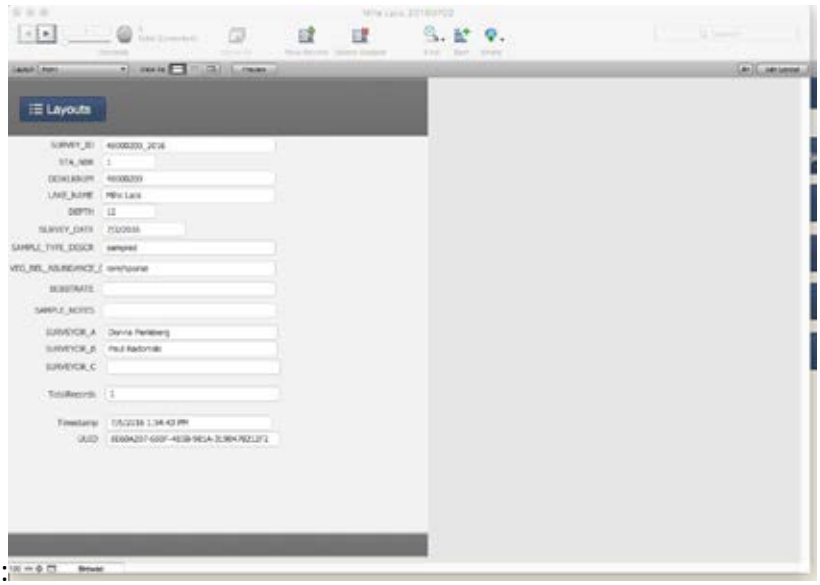
IMPORTANT NOTE ABOUT OPENING FILES using Step #1: A little care here - if you click too quickly on opening your file, it may automatically assume you are a "guest" and not prompt you for admin login. In addition, the Admin login may be "hidden" behind your file documents screen if you have that window maximized. Opening with Admin privileges allows the user to delete records. One can still edit existing records with “guest” privileges.



3. There are 3 files created by your survey (shown at left side of screen). The 'Point' database has information on the points/stations, the 'Taxa at Point' database has taxa information for each point/station, and the 'MBS Info' has any MBS survey data.
   a. 

4. Let us pick a file to work on – here the Point database – by clicking the 'Point' button with your mouse. You will see a form view of the first record (clicking the table icon will show a table view of your data).

a. Form view:



b. Table view:

5. To edit all point-intercept data at once, click 'Taxa|Point' button (Desktop View screen), this shows your relational data in one table (after clicking the 'table' view icon).

a. 

IMPORTANT NOTE ABOUT DELETING RECORDS - **If delete a point/station number or if you change a point/station number to a different number then any taxa records associated with the original point/station will remain and those taxa records may be unassociated any a point/station number.**

6. The common editing checklist includes:
    a. Check to see if the correct survey id is used for all records
    b. Make sure DOWLKNUM, surveyor names, survey date, and other basic information were correctly entered
    c. Delete blank records (blank records are generated by moving to different entry screens on the iPad and not entering data; these records can safely be deleted!)
    d. Check that the 'SAMPLE_TYPE_DESCR' field is consistent with the record

e. Check that the 'VEG_REL_ABUNDANCE_DESC' field is consistent with the record
f. Check taxa 'CODES' (sort on CODES in the table view and see if an inappropriate code may have been used)
g. Check for orphan records. If you changed station number after entering taxa, then some records may not have associated POINT data. Use the 'TIMESTAMP' fields for both TAXA AT POINT and POINT databases to understand any issues.
h. Address any corrections and edits from field notes and the SAMPLE_NOTES field in the POINT database

7. If you mess up something when you are editing a file, you can start over! Start over by repeating the above steps.

IMPORTANT NOTE ABOUT EDITING RECORDS QUICKLY - A common edit is that a field is missing or has the wrong information. For example, the survey date was entered wrong. First, use the 'Find' button to select records you wish to fix. Second, fix the first record's survey date. Third, use the 'Replace Field Contents' under the 'Records' menu to quickly replace the contents of that field to the current record's content for the entire found set.

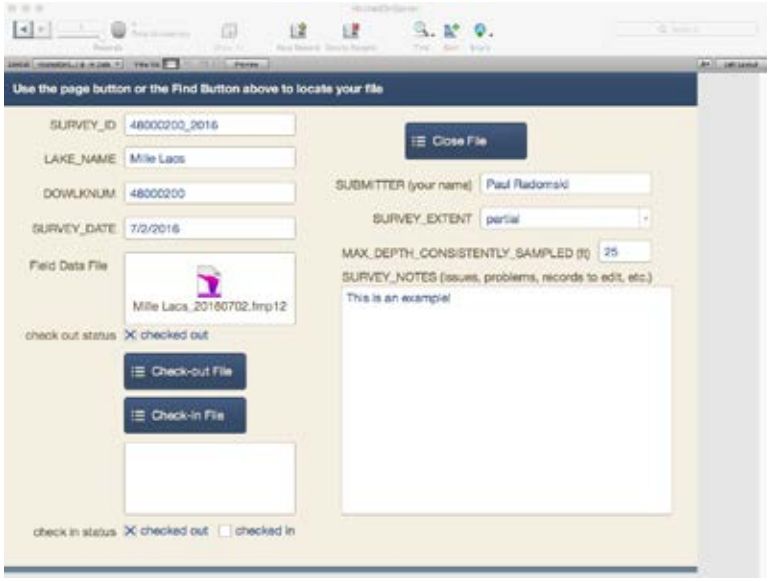
SUBMITTING EDITED DATA FILES TO SERVER

To conclude, if your data is managed by the Lake Habitat Program, you will need to check-in your edited file to the central server. After your file is checked in, the Lake Plant administrator will bring in your data and on a periodic basis all data will be exported to the central Geodatabase for finalization and publication to Quick Layers.

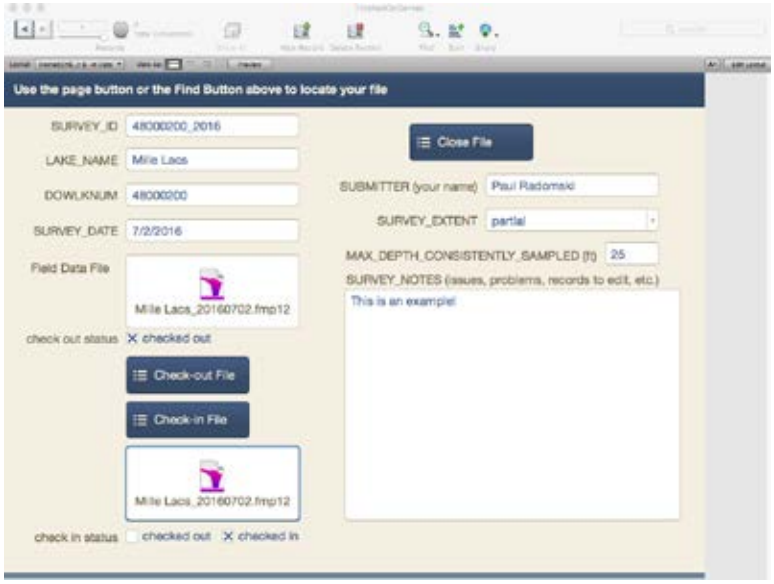
CHECK-IN FILE TO SERVER

Once all survey data on the lake has been collected and edited the final step with the application is to check-in the file. This is done in FileMaker. Open the LakePlant Host and:

12. Click the 'Check-out & Check-in' button
13. Find your survey file with FileMaker page buttons in the upper left corner or use the Find feature.

a. 

14. Once your survey is found and shown, then Click the 'Check-in File' button. You will be asked where the survey file is.

a. 

15. Once this is completed, the server will record that the file is checked in.
16. Click 'Close File' button

CENTRAL GEODATABASE UPDATE PROCESS

After your file is checked in, the LakePlant administrator reviews submitted data. Additional quality control checks are conducted. The administrator may have questions about some

aspects of your survey, and he or she will notify you when data has been integrated into the LakePlant Database.

On a periodic basis, all data within the LakePlant Database will be exported to the central Geodatabase. These finalized data will also be hosted on the central Geodatabase, and periodically those data will be prepared for publication to Quick Layers. See the latest GIS Manual for MN Lake Plant Surveys for information on access and use of this central Geodatabase.

CHAPTER 5. EDITING LAKESHORE BOUNDARY

BACKGROUND

A reasonably accurate lake shoreline boundary is needed for generating the shoreline survey points used in Score The Shore and Quantitative near-shore plots. Some of the lake boundaries available on Quick Layers are inadequate for the level of precision required. Before you generate survey points, it is important to verify the lake boundary layer.

There are several challenges for creating lake shore boundaries. Many lakes are complex and dynamic systems; water levels, shoreline erosion or deposition, and changing plant communities can all physically change a lake shoreline. Lake boundaries in GIS are ultimately reliant on the available technologies when the boundaries are developed. Advances in data storage and remote sensing has made available significantly higher resolution imagery, and tools such as LiDAR has increased the available data, and consequently the level of precision to which shoreline boundaries can be generated. Legal definitions and jurisdictional guidelines are social factors that impact lake boundaries, but these often differ from environmental/biological needs of resource managers. These are just some of the reasons lake shore boundary layers are complex and ever changing.

VERIFY/EDIT LAKE BOUNDARY

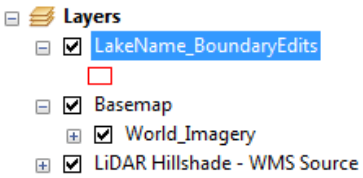
1. Open "**Lakes and Open Water**" layer from quick layers (Hydrography – Lakes and Open Water- Lakes and Open Water) → zoom to your lake. This layer is linked to the "Master" lake boundary database.
2. Use the drop arrow  to add basemap - ESRI world imagery (yes it's a little slow to load but is very good imagery)
3. Zoom to a scale of 1:2000 and pan around to verify the lake boundary is reasonable for generating survey points.
    a. The object is to correct major errors, not to be overly detailed in any edits.
    b. Making fine detailed boundary edits is very time consuming and doesn't significantly impact the sample points!
4. **If shoreline needs to be edited contact Fisheries GIS specialists for information about how to get the lake boundary updated. Allow adequate time for them to prioritize the workload!**

EDITING LAKESHORE BOUNDARY

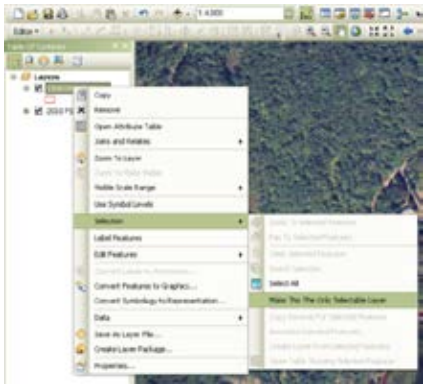
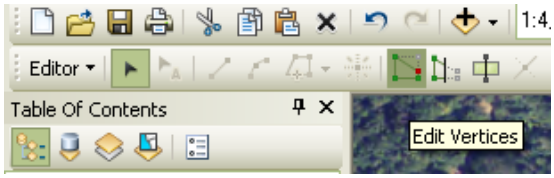
These steps are intended to be used only if the boundary update request was not made in timely manner and Fisheries GIS specialists are unable to update the Quick Layers boundary in the required time.

These instructions use a common feature class on a shared geodatabase; this reduces the need to have individual shapefiles saved locally. Only one person can actively edit the shared folder at a time, so these steps will create a "working copy" on your default.gdb, then add it to the shared folder once your edits are complete.

6. Open **DNR Hydrography – DNR Water Features** (All Water Features) layer from Quick Layers → select your lake
7. Export the selection layer to your **default.gdb** (D:\Users\<UserName>\Documents\ArcGIS\Default.gdb)
    a. Right click layer → Export Data → Select the output feature class navigation folder
    b. Select the **Default.gdb** 
    c. Give the feature a unique name (**LakeName_BoundaryEdits**)
    d. Click yes to add layer to map
    e. Turn off the **DNR Hydrography – All Water Features** layer from your project to reduce confusion

8. Add **LiDAR Hillshade – WMS Source** to map (Topography and Elevation)
9. Add imagery (especially ESRI basemap)
    a. Other useful sources can include, but not limited to:
        i. FSA Color Imagery
        ii. FSA Color Infrared Imagery
        iii. NWI (National Wetland Inventory)
        iv. Best available DEM
10. Reorder table of contents as follows→ LakeName_BoundaryEdits →Basemap Imagery→LiDAR Hillshade
    a. 

11. Add **Effects** toolbar 

    a. Customize → Toolbars→Effects
    b. Set Basemap imagery transparency between 40-60%
12. Zoom in on a scale of no less than 1:2000
13. Make edits to the lake outline- Edit the **LakeName_BoundaryEdits** feature class.
    a. Use the swipe tool on the Effects Toolbar to toggle between **Imagery** and **Lidar – Hillshade**
        i. Tip- try holding control key while using swipe tool
        ii. Make this LakeName_BoundaryEdits the only selectable layer to avoid confusion
            1. Right click → *Selection* →*Make this the only selectable layer*
            2. 
    b. Select one vertex and move it to where the boundary line should be
        1. 

        2. 

    Continue this process until the boundary line looks reasonable

    c. Alternatively, use the Reshape Feature tool on the Editing Toolbar  to reshape the boundary (see ArcMap Help)
        i. Place first vertex inside lake boundary,
        ii. Add more vertices following shoreline
        iii. Double click inside lake boundary to finish

iv. 

14. Save your edits often
15. Once your Lake Boundary has been edited. Use the **Update Lake Boundary Tool**. This saves your lake boundary to a central location, and fisheries GIS staff will use it to update the Quick Layers.

Tricky Scenarios: The following list highlights some of the tricky scenarios that can occur when delineating shoreline boundaries, and potential sources for added info.

a. Imagery issues:
    i. Often heavy tree cover can obscure shoreline
        1. Refer to LiDAR layer for added information
    ii. Dense stands of Aquatic vegetation can obscure shore line
        1. Review LiDAR
        2. Review other available imagery
        3. Review Color Infrared imagery
b. LiDAR issues
    i. Waves/dense vegetation can create a texture gradient making boundary difficult to determine
        1. Review color or infrared imagery
    ii. Docks and other structures can look like shoreline features
    iii. Review color imagery

c. Cattail stands – **DNR Hydrography** feature on Quick Layers typically excludes cattails from the boundary, however in some instances cattails, especially smaller stands, could be considered within the lake basin.
    i. Use professional judgment whether to include or exclude cattail stands
    ii. Remember the purpose of editing these boundaries is to make reasonable shoreline sample points…not to map plant communities.
    iii. Weight judgement in favor of existing boundary
d. Other useful sources of information
    i. Refer to National Wetland Inventory, or MBS plant community layer.
    ii. Refer to DNR Public Waters Delineations. These basins are delineated to the Ordinary High Water Level (OHWL) and in most cases should encompass the entire "open water" and emergent vegetation portions of the lake.