DISCOVERY FARMS MINNESOTA

MDA Discovery Farms Program Field Data and Sample Collection SOP

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DEPARTMENT OF AGRICULTURE

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Pesticide & Fertilizer Management Division

Standard Operating Procedure (SOP)

MDA Discovery Farms Program Field Data and Sample Collection SOP

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Acronyms and Abbreviations

Acronym/Abbreviation	Full Text
cfs	Cubic Feet per Second (ft^3/sec)
Cl	Chloride
CoC	Chain of Custody
CSG	Crest Stae Gauge
CST	Central Standard Time
degF	Degrees Fahrenheit
DI	Deionized
DFM	Discovery Farms Minnesota
DOP	Dissolved Orthophosphorus
EFI	Equal Flow Increment
EOF	Edge-of-Field
MAWRC	Minnesota Agricultural Water Resources Center
MDA	Minnesota Department of Agriculture
mL	milliliter
MS	Measured Stage
MVTL	Minnesota Valley Testing Laboratory
NH_3	Ammonia
NO_2+NO_3	Nitrite + nitrate
RP	Reference Point
SOP	Standard Operating Procedure
SWCD	Soil and Water Conservation District
TKN	Total kjeldahl nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
t-tube	Transparency Tube

Monitoring Station Site Codes

Code	Monitoring Station Site
BE1	Blue Earth County Discovery Farm
CH1	Chisago County Discovery Farm
DO1	Dodge County Discovery Farm
GO1	Goodhue County Discovery Farm
MC1	McLeod County Discovery Farm
NO1W	Norman County Discovery Farm
RW1N	Redwood County (north) Discovery Farm
RW1S	Redwood County (south) Discovery Farm
RE1	Renville County Discovery Farm
RO1	Rock County Discovery Farm
ST1	Stearns County Discovery Farm
WI1	Wilkin County Discovery Farm
WR1	Wright County Discovery Farm

SAMPLE COLLECTION

QUICK REFERENCE GUIDE

Once accustomed to the standard operating procedures for sampling at Discovery Farm Minnesota sites, the following Quick Reference Guide may be a useful checklist or reminder to assure all tasks are completed.

IN FIELD:

i. Observe site conditions, collect mental notes and observations.
ii. Collect a measured stage reading.
iii. Fill out the site inspection electronic survey using the Survey123 app throughout the visit with all relevant information.
iv. Inspect equipment and cables to make sure everything is in good working order.
v. Take site photos to document current field and site conditions.
vi. Labels bottles and collect samples (if applicable), place immediately on ice.
vii. Replace used bottles with sanitized ones (flumes) and replace sampler bag (tile).
viii. RESTART the automated sampler program(s) and reset any appropriate datalogger processes.
ix. Perform any necessary site maintenance (e.g. sync clock times, replace desiccant, vegetation maintenance, download camera SD cards, etc.)
x. Make sure equipment enclosure box is locked upon departure.

AT OFFICE:

i. Schedule a SpeeDee pick up, if applicable.
ii. Review electronic survey notes and submit online.
iii. Fill out the MVTL Chain of Custody (CoC) form. **Verify accuracy – bottle IDs, dates, times should match between labels and CoC.**
iv. Ship samples on ice to MVTL via SpeeDee Delivery.
v. Notify MDA of any equipment issues or other issues that were noted on site.
vi. Scan MVTL CoC to MDA staff.

ANALYTE PRIORITY
QUICK REFERENCE GUIDE

The following table was developed to serve as a reference for sample collection priority to submit for analysis if only a partial bottle was collected. If all programmed pulses are collected in the autosampler bottles, there should be approximately three liters (3,000 mL) in each bottle. With adequate water volume, please fill each MVTL bottle to the neck (1,500 mL combined between the two MVTL bottles).

Flume samplers are programmed with a two-part sampler program. Bottle 1 is set to trigger at the same flow interval/pace but with a higher water volume collected per sample pulse. This allows adequate water volume collection for very small but sometimes frequent runoff events. With only one pulse collected (600 mL), the user should be able to split equally between both MVTL sample bottles and submit for all seven analytes. Bottles 2 through 4 contain 24-pulses at 125 mL each. Table A below highlights the priority of analytes for limited water volume in bottles 2. If limited water volume exists (less than 4 pulses) for bottle 3 or 4, combine the water with the previous bottle.

Table A: *Analyte priority order for* ***surface water runoff*** *at Discovery Farms Minnesota monitoring sites if adequate water volume from bottle 2 does not exist after a runoff event.*

Priority Level	Parameter	MVTL Bottle	Preferred Minimum Water Volume Needed for Analysis (mL)	Cumulative Water Volume (mL)	Minimum Pulses of Water *
1	TSS	1-liter unpreserved	100-200	100-200	1+
2	TP	500mL H_2SO_4 preserved	100	200-300	2+
3	DOP	1-liter unpreserved	50	250-350	2-3
4	NO_2+NO_3-N	500mL H_2SO_4 preserved	50	300-400	3
5	TKN	500mL H_2SO_4 preserved	50	350-450	3-4
6	NH_3	500mL H_2SO_4 preserved	50	400-500	>4
7	Chloride	1-liter unpreserved	50	450-550	>4

* 1 pulse of water = 125 mL (sampler bottles 2-4 for surface water flume samples).

i. As a general rule, never dump any water out. If you have a question about potentially dumping a sample, please contact MDA personnel prior to dumping.
   a. If there is only one pulse of turbid water, submit the sample for **TSS only**. If the one pulse of water is very clear (snowmelt runoff), submit the sample for **TP only**.

ii. With two pulses of water total (250mL), add approximately 150mL to the 1-liter unpreserved bottle and the rest to the 500mL preserved (H_2SO_4) bottle – submit for **TSS, TP and DOP only**.

iii. With three pulses of water (375mL), pour 150mL into the 1-liter bottle and the rest into the 500mL bottle – submit for **TSS, TP, DOP and NO_2+NO_3-N only**.

iv. With <u>four pulses</u> of water (~500mL total), add approximately half to the 1-liter bottle and the other half to the 500mL bottle – **submit for all analytes**: TSS, TP, DOP, NO_2+NO_3-N, TKN, NH_3 and CL.

v. If multiple bottles are collected (2-3), but the last bottle is incomplete (less than four pulses of water collected), COMBINE the last bottle with the bottle before it and collect the suite of samples from the combined water.

   a. Be sure to thoroughly agitate the water to effectively mix the samples together.
   b. **Example**: Bottles 1 and 2 are complete; bottle 3 only has three pulses of water collected. Combine bottle 3 with bottle 2. Mix sample thoroughly.
      i. Make sure to list the "start" time for the combined sample as the first pulse of bottle 2 and the "end" time for the sample as the last pulse collected for bottle 3.
   c. **<u>IMPORTANT</u>**: Due to the two-part program, bottle 1 and bottle 2 can NEVER be mixed. Only bottles 2-4 can be mixed together if needed.

Subsurface tile samplers are programmed with a one-part program and single 2.5-gallon collection bottle capable of compositing up to 56 pulses (at 125 mL each). The sample analyte priority is different for subsurface tile because TSS is less of a priority (in fields without open surface intakes) and the focus with subsurface tile is often nitrate-nitrogen (NO_3-N). Table B lists the sample priority for subsurface tile samples when the water volume is limited. If the subsurface tile is actively flowing during a site visit with limited water volume collected, a discrete grab sample should also be collected in addition to the partial composite sample.

Table B: *Analyte priority order for* ***subsurface tile water*** *at Discovery Farms Minnesota monitoring sites if adequate water volume does not exist after a subsurface drainage event.*

Priority Level	Parameter	MVTL Bottle	Preferred Minimum Water Volume Needed for Analysis (mL)	Cumulative Water Volume (mL)	Minimum Pulses of Water *
1	NO_2+NO_3-N	500mL H_2SO_4 preserved	50	50	1
2	TKN	500mL H_2SO_4 preserved	50	100	1
3	NH_3	500mL H_2SO_4 preserved	50	150	1-2
4	TP	500mL H_2SO_4 preserved	100	250	2
5	DOP	1-liter unpreserved	50	300	2-3
6	TSS	1-liter unpreserved	100-200	400-500	3-4
7	Chloride	1-liter unpreserved	50	450-550	>4

* 1 pulse of water = 125 mL

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Purpose

The objective of Discovery Farms Minnesota (DFM) is to generate water quality data at the farm scale under real world conditions. The program creates an opportunity for producers to learn from each other about the relationship between agriculture and water quality. Discovery Farms Minnesota aims to improve communication among the agricultural community, consumers, researchers, and policy-makers.

DFM is modeled after the successful Wisconsin Discovery Farms program, which has been on the ground for over 15 years and has proven to be a reliable and accurate source for agricultural water quality information. The Wisconsin program has mentored Minnesota and shared valuable resources and information. A few strong points Minnesota has taken away from the Wisconsin program is to clearly define the roll of all partners involved, maintain strong leadership (with separate, focused committees), start with an observation period for monitoring before BMPs are implemented and evaluated, and combine environmental data with farm management data. The potential for collaboration between the two states and others with similar programs is great. The goal will be to continue to build a strong relationship across state lines, which will increase the impact and value of these programs.

This SOP was tailored exclusively for DFM local partners (county Soil and Water Conservation District and Watershed Partnership staff). It is meant to serve as a guide for project partners collecting quantitative data from agricultural runoff (including both overland surface flow and subsurface tile drainage) specific to our monitoring locations and equipment.

1. Data collection

1.1. Electronic site inspections and site visits

A vital step to ensuring good quality data lies in the field notes collected by the observer during frequent site inspections. Detailed field notes should be collected during *every* site visit whether the visit was made for collection of a runoff event, base flow water quality sampling or scheduled site checkups and maintenance.

1.1.1. Getting started with Survey123

An electronic site inspection survey through the Esri Geospatial Cloud (using the Survey123 app) has been created specifically for DFM monitoring stations which outlines the preferred and required information that should be recorded when making a site visit. The survey provides ease of use and consistency across all monitoring stations and greatly improves accuracy. Preceding the roll-out of Survey123 during the 2018 monitoring season, paper field sheets were utilized for documenting sample collection notes and field conditions. Applying the use of Survey123 eliminated the need for tracking paper copies of multiple site visits throughout a monitoring season. It also eliminated the need for scanning and managing hundreds of files. The Survey123 app works with most android and iOS devices. The app can be used on a laptop or desktop computer, smart phone or tablet. A tablet without a data plan is fine as long as there is access to Wi-Fi to submit the surveys at a later time.

1. Download and install (free) **Survey123 for ArcGIS** onto a smartphone or tablet. Survey123
2. Open the app and select the three horizontal bars icon in the upper right corner.
3. Sign in using your assigned username and password (Figure 1). Username and password must be set up and provided by MDA staff.

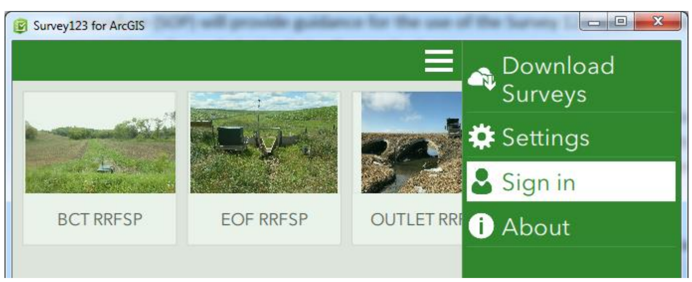


Figure 1. Survey123 app sign in screen.

4. Select the three-bar icon again and choose "Download Surveys" (Figure 2).

Figure 2. Survey123 app location to download published surveys.

5. Surveys that have been shared with you will be available to download or update (Figure 3). The list below is subject to change.

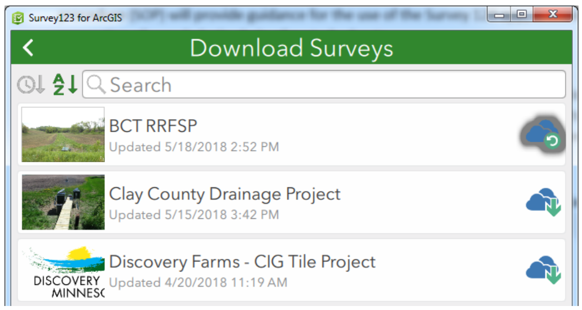


Figure 3. Survey123 app page to download or update published surveys.

6. Once the applicable "survey" has been downloaded, select the back arrow in the upper left corner.
7. Select the desired survey and hit "Collect" (Figure 4) to begin entering field notes and observations. Some entries will have a red asterisk after them which means they are **required** fields. They must be filled out before the survey can be submitted or you will receive an error.

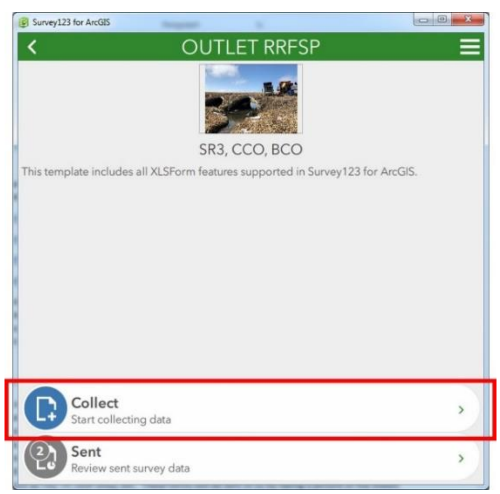


Figure 4. Survey123 app screen showing the option to begin a new survey (Collect) or review surveys that have already been submitted (Sent).

8.  Once all fields are filled in, double check entries for completeness as well as typos, incorrect auto-corrects, spelling and grammatical issues. When finished, select the check mark in the bottom right corner. There will be three options available from the "Survey Completed" screen (Figure 5):
    a. <u>Send Later</u> > a copy will be saved in the app "Outbox." This option should be selected if you are not currently connected to Wi-Fi and/or you want to review the survey content again before submitting.
    b. <u>Send **Now**</u> > Submit the finalized survey immediately. The tablet or smartphone must be actively connected to Wi-Fi or have mobile service.
    c. <u>**Continue** this survey</u> > return to the survey to finish editing.

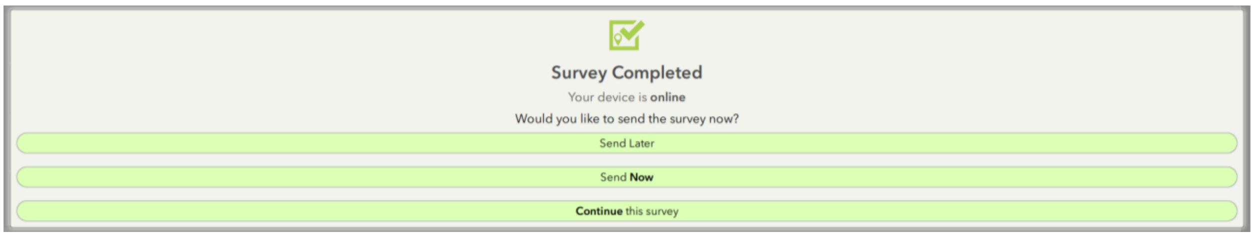


Figure 5. Survey123 app screen showing options for a completed survey.

9.  Another option to hitting the lower-right check box, is to hit the "X" in the upper left corner. A "Confirm Close" pop-up will appear with three additional options (Figure 6):
    a. **Close** this survey and **lose changes** > Closes the survey down and doesn't save any of the changes that were made.
    b. **Continue** this survey > return to the survey to finish editing.
    c. **Save** this survey in **Drafts** > saves a copy of the survey in "Drafts" rather than the app "Outbox" – the draft version can be clicked on at a later time, modified and then submitted when ready.

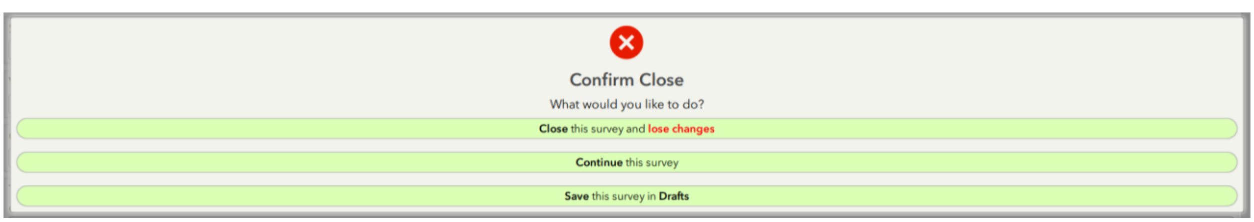


Figure 6. Survey123 app Confirm Close options.

10. After a survey has been sent, a copy will be saved on your device. The "sent" surveys are formatted to save under the following format (SiteID mm/dd/yyyy). The date and time of the last modification will also be shown (Figure 7).

Figure 7. Survey123 app screen showing the list of completed and submitted surveys.

1.1.1.1. IMPORTANT NOTES/TIPS FOR USING SURVEY123:

- Any field with a red asterisk (*) is required to be filled in when completing the survey. If one of these fields is left blank, the user will receive an error upon completion of the survey and be advised on where to correct the error. The user will not be able to submit the survey until all required fields are filled in.
- When collecting photos in Survey 123, there are two options that are available. 1) Select the camera icon ( ) to take a picture using the electronic device or the folder icon ( ) to upload a photo from a file on the electronic device. IMPORTANT: Please only use the camera icon option to take pictures using the tablet or smart phone. If photos are uploaded into the survey app via the folder icon, the photo loses all its metadata (date and time of photo taken, etc.) and does not get automatically labeled.
- During daylight savings time, make sure to continue recording your notes in Central Standard Time (CST). You will need to adjust the time back one hour. If you are using a dedicated tablet, consider semi-permanently changing the device time to CST.
- When scrolling up and down using your finger in the survey, it is possible to inadvertently move the cursor around which could click on and select a different option than what you previously chose. Be aware of this and make sure all entries are finalized before submitting.
- When using the talk-to-text or text-to-speech function, be sure to review the notes for accuracy. Often times, capitalization and punctuation are not correct using these functions. Ensure all entries are correct as predictive text can sometimes take over and is not always accurate.

1.1.2. Site visits

Prior to leaving the office for a site visit, field staff should visit the DFM website (http://discoveryfarmsmn.org) and click on **Real-time Data** to be better prepared for what is expected at the site upon arrival (i.e. – number of pulses collected, erroneous sensor readings, etc).

Once at the site, be observant! Observe the condition of the field, crop, equipment, water appearance and flow conditions, etc. Table 1 provides a checklist of items to consider for inclusion into the electronic survey notes when a site visit is being made.

Table 1. *Site visit checklist for documentation.*

TYPE	INFORMATION NEEDED / SITE CHECKLIST
Basic Notes	▪ Date and Time (military - CST, Central Standard Time) ▪ Site ID (for ID format, refer to Figure 11) ▪ Observer (first and last name, or initials)

TYPE	INFORMATION NEEDED / SITE CHECKLIST

Field Measurements	▪ Measured stage (MS)
	  ○ Flume: staff gauge reading to the nearest 0.01 feet
	  ○ AgriDrain: (Reference Point (RP) minus the tapedown measurement) = MS (feet)
	▪ Transparency Tube measurement (cm)
	▪ Manual Rain Gauge reading (inches) and date range
	▪ Visit type (rain event, snowmelt runoff, base flow sampling, site maintenance)

Datalogger Information	▪ Datalogger time (military, CST)
	▪ Stage reading
	  ○ Head_ft (flume bubbler sensor), feet
	  ○ Head_APG (flume ultrasonic sensor), feet
	  ○ T_stg (tile area velocity flow meter), feet
	▪ CumRain (cumulative rainfall value), inches
	▪ Battery Voltage (v)
	▪ Reminders to reset pulse counter processes (Fisco_cnt, Tisco_cnt)
	▪ Reminder to reset the Fflw_acc process
	▪ Check datalogger sensor variables under the Current Conditions screen. Verify there are no errors and sensors are reading appropriate (expected) values. If not, please alert MDA staff.

Stage Accuracy	▪ Calculate the difference between the flume MS and the datalogger (Head_ft or Head_APG) ▪ Calculate the difference between the tile MS and the T_stg ▪ If differences are greater than +/- 0.02 feet, the offset should be changed to correct the values (OTTcorr, APGcorr, T_stg_corr)
QAQC	▪ Were the bottles in the sampler sanitized with phosphate-free detergent, or was the tile sampler liner bag replaced? ▪ Was a field duplicate, field replicate, or equipment blank collected? ▪ Specify the associated bottle number the duplicate is paired with, or specify the time a grab sample was collected for a field replicate.
Auto Sampler Notes	▪ Were samples collected? How many bottles completed? ▪ If samples are being collected, a sampler info sheet also needs to be completed that shows the start/stop dates/times for each bottle. ▪ If currently sampling, what bottle (1-4) is it on? What pulse number is it on? ▪ Sampler screen display message – any errors? Were there any errors throughout the sampling report? ▪ Was the program restarted after sample collection? ▪ Define start/stop dates and times for each bottle, paired with the sample ID.
Current Weather Conditions	▪ Sunny, mostly sunny, partly sunny, partly cloudy, mostly cloudy, overcast. ▪ Is it raining? Have there been any significant rain events recently? If so, how many inches of rain fell in the area? Was it a high intensity rainfall? Low intensity? Long soaker rain? ▪ Wind speed and direction ▪ Current temperature ▪ Is there any rain forecasted in the near future? ▪ **Example:** 78 degF, mostly sunny (10% clouds), 2.25" inches of rain fell over the last 36 hours, low intensity soaker rain, wind is 20-25mph out of the NE (with gusts up to 35mph). No rain is forecasted for the next 7 days.
Current Agronomy Conditions	▪ Was the field recently tilled, planted, or harvested? ▪ Was the field recently treated or sprayed with anything? ▪ Manure recently applied? ▪ How tall is the crop – at what progression in the growing season is it? ▪ Is the soil saturated or dry, is ponded water present? ▪ Was overland flow observed in nearby fields or into ditches/ravines? ▪ Are there any erosional or depositional issues in the field or upstream/downstream of the flume?

TYPE	INFORMATION NEEDED / SITE CHECKLIST
Flume/Tile Observations	▪ SUBSURFACE TILE ○ Is flow present in the tile: low, moderate, fast flow, turbulent? ○ Appearance of the water: very turbid, somewhat turbid, cloudy, clear, crystal clear ○ Are backwater conditions present? ▪ FLUME ○ If dry, is the flume free from debris and sediment? ○ If flow is present, what are the conditions like? If no water or flow is present, record "no flow." ○ Low, moderate, fast flow, turbulent? ○ Are backwater conditions present? ○ Appearance of the water: very turbid, somewhat turbid, cloudy, clear, crystal clear. ○ Is there ice/snow in the flume? How thick is the ice? Is water flowing under/over it? Did flow resume, start, or stop after the flume/channel were cleared?
Maintenance Completion and Equipment Observations	▪ Is the battery voltage sufficient (above 12.0 volts)? ▪ Was the desiccant replaced? Desiccant status: new, good, bad, needs to be changed. ▪ Was the stage reset in the datalogger? ▪ Was the data downloaded? Was the battery changed out? ▪ Is the equipment functioning properly? ▪ Does the sampler tubing need to be replaced? Does vegetation at the site need to be maintained? ▪ Is the flume level, or does it need to be leveled? ▪ Was the flume cleaned of debris and sediment? ▪ Is the rain gauge unit level? Is the rain gauge plugged with debris? Was it unplugged and cleared? Would the blockage have interfered with recent rainfall data? ▪ Were the solar panels cleaned, or do they need to be cleaned? ▪ Does the sampler line, bubbler line or pump tubing need to be replaced? ▪ Are the flume and field timelapse cameras operating as they should? New batteries? SD swapped out? ▪ Were the times sync'd between instruments (datalogger, autosampler(s), field camera(s). Please note if they were fast or slow, by how many minutes and at what time the correction was made. ▪ Is there any signs of mice or rodents around the equipment or in the shelters? If so, plug any obvious access holes into the box, purchase Decon/traps or a deterrent, and remove any bedding or feces. Have they chewed through any of the cables or sampling tubing?

1.1.3. Field measurements

During significant runoff events, it is vital to be on site (even if the automated sampler has not completed its sampling program) to check equipment, take notes, collect a measured stage reading, transparency tube measurement and site photos. If a problem is determined during an event, corrective action may be possible prior to the end of event to ensure high data quality. All field measurements and observations should be recorded on the electronic field notes survey.

1.1.3.1. Measured stage

Measured stage is one of the most essential items to document while making a site visit and is a measurement of the instantaneous water level (or stage). These readings are used both on-site and at the conclusion of the monitoring season to verify that the equipment is or was reading accurately. DFM monitoring stations collect water quality samples based on the stage of the water, which is then converted into flow. Therefore, it is imperative that stage readings are accurate so the datalogger remains on track with accurate calculation of the flow.

A measured stage reading should be collected during *every* site visit, regardless of the visit type (e.g. for sample collection or maintenance). On occasion, it may even be beneficial to collect two or more stage readings during a visit (e.g. at the beginning and end of a visit during storm flow when stage has the potential to change drastically even over a few minutes). **It is important to**

also record the date and precise time, on the datalogger, associated with each measured stage reading.

FLUME (overland flow):

- A measured stage reading for overland flow through a standard H flume is found by reading the staff gauge mounted on the inside flume wall (see Figure 8). The water level on the staff gauge should be read to the **nearest 0.01 feet** (or 0.005 feet if possible). Double check the value and record it in the electronic survey.
- If no water or flow is present within the flume, record "**0.00**" in the electronic survey.

AGRI DRAIN (subsurface tile):

- Agri Drain structures are typically used for conservation drainage projects and are convenient because they allow easy access to the subsurface drainage water for monitoring purposes. Stop logs can be placed in the Agri Drain at variable heights to hold back subsurface drainage water in the field. Stop logs will be placed to a height so that the upstream tile remains fully submerged when subsurface drainage is occurring. The top stop log board will have a v-notch weir which allows for greater stage resolution at lower flows. The stage of interest will be the height of water that is flowing through or over the v-notch weir. An area velocity sensor will be mounted in the upstream tile to measure both stage and velocity.
- To collect a measured stage, a Reference Point (RP) with an assigned value will be needed. The procedure will be to measure the distance between the known RP (top edge of the Agri Drain wall) and the surface of the water on the upstream side of the v-notch weir, which is called a "tapedown." The "tapedown" value will then be subtracted from the RP value to calculate the height of water in the tile going through or over the v-notch weir. Figure 9 shows a view into an Agri Drain. For an example of how to calculate the Measured Stage for subsurface tile water in an Agri Drain, see Table 2.

Table 2. *Example calculation of a Measured Stage in an Agri Drain structure.*

KNOWN INFORMATION		MEASURED STAGE
Reference Point (total distance from top edge of the Agri Drain wall to the bottom of the v-notch weir):	3.78 ft	(3.78 – 3.56) =
Tapedown measurement (RP to water surface)	3.56 ft	**0.22 feet**

Figure 8. *Flume staff gauge, record to the nearest 0.01 feet (or 0.005 feet if possible).*

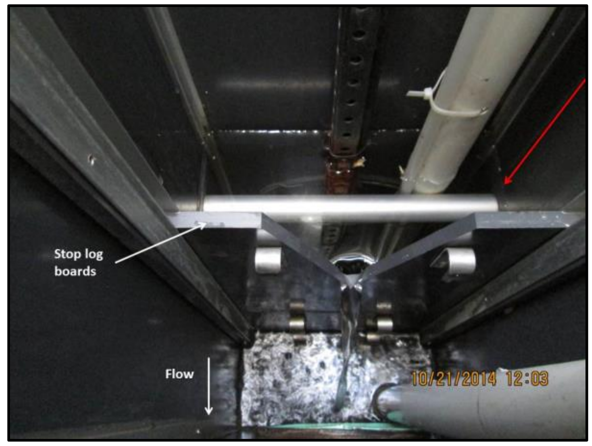


Figure 9. *View into the Agri Drain structure. The red arrow indicates where a tape measure should hit the water on the upstream side of the stoplog boards to collect a tapedown measurement.*

Reference Points are variable depending on the height of the Agri Drain structure installed. Table 3 provides the established reference point value for each Discovery Farm tile monitoring site that utilizes an Agri Drain. Tapedown measurements will be subtracted from these values during a site visit to determine the stage accuracy reading from the datalogger. These values are also pre-loaded in each site-specific electronic survey. It is possible for these Reference Point values to change with an adjustment to the stop log configuration. The MDA will inform local partners of such changes when they are necessary.

Table 3. *Reference Point values for each active Discovery Farm with an Agri Drain subsurface tile setup.*

County	Discovery Farm ID	Reference Point (feet)
McLeod	MC1-T	4.33
Redwood	RW1N-T	6.84
Redwood	RW1S-T	4.82
Wright	WR1-T	2.855

1.1.4. Transparency tube

Transparency tube (t-tube) readings are a quick and effective way to get a general sense of the instantaneous water clarity (**Error! Reference source not found.**). T-tubes will be provided for each site (60 cm or 100 cm) to collect a reading whenever the flume is flowing during a site visit. Prior to collecting a reading, make sure the t-tube is thoroughly rinsed and clean of any residual sediment from a previous measurement. **Remove sunglasses and keep your back to the sun when looking down into the tube**. Fill the tube to the brim with runoff water and take the reading immediately. Do not allow water to sit in the t-tube as particulates may begin to settle out. Slowly release the water through the valve until the white and black secchi disk and/or screw are just barely visible on the bottom of the tube. If time permits, collect a second reading and take an average of the two. Record the value in the site inspection document to the nearest 0.2 cm. If subsurface tile water is also being monitored and the field has open tile intakes or the water has a cloudy or hazy appearance, a t-tube reading should also be collected (refer to Section 1.2.4.2 for manually collecting a grab sample of subsurface water).

Before dumping the runoff water out of the t-tube, document the clarity by taking photos. Hold the t-tube in front of the camera with the numbers and water level clearly exposed. If possible, hold the t-tube in front of the flume so field runoff conditions can also be seen in the background. Figure 10 shows a few examples.

Figure 10. *Example photos of transparency tube reading collected while surface runoff was occurring.*

1.1.5. Site photos

Time-lapse field cameras are installed at each of the Discovery Farm sites and are programmed to take multiple photos per day (see Section 2.10 for further description). The cameras are stationary and are installed to capture a view of the upstream field from the flume at edge-of-field monitoring locations or downstream of the flume (looking upstream) if the site layout allows. In addition, there will be a second time-lapse camera installed directed at the staff gauge within the flume. The flume time-lapse cameras will collect one picture every 30 or 60 minutes. The purpose of the flume cameras is to document the stage within the flume as a backup and to assure the equipment is reading accurately.

Stationary photos from time-lapse cameras are excellent for highlighting the changes in the adjacent vegetation and field conditions over time from winter snow conditions, snowmelt runoff, rain events, canopy development, drought and even fall harvest. Stationary photos, however, do not showcase the *entire* area of interest. Although photos are being collected on a daily basis, it is required that photos be collected by the observer during *each* site visit.

Table 4. Recommended photos to collect during site visits.

SITE PHOTOS
▪ Upstream channel/field ▪ Downstream channel/field ▪ View of entire flume with runoff occurring (if applicable) ▪ Overview of entire monitoring site ▪ Equipment photo ▪ Photo of collected sample bottles (mixed well) ▪ T-tube photo with flume/channel in the background ▪ Tile runoff / Agri Drain ▪ Before and after photo of any site maintenance (flume cleaning, snow removal, vegetation removal, equipment alteration) ▪ Photo of the sampler info sheet containing sample start/stop dates/times and any associated errors

The electronic site visit survey has specific photo options built directly into the survey that allows the user to take photos with the app during a site visit. Those photos are then attached directly to the survey when it is submitted. It also provides the option to submit up to 10 additional miscellaneous photos. If possible, it is preferred that the device collecting the survey (laptop, smart phone, tablet) is set to Central Standard Time. **It is required that the user takes photos *through* the survey to collect and submit the photos rather than navigating to a folder on the device and uploading photos to the survey**. When photos are uploaded to the survey after-the-fact, they lose all metadata associated with the photo (date, time, etc.). Other photos not attached to the survey must be uploaded to the Cloud website www.dropbox.com or submitted to MDA staff via mail on a SD card or USB drive. Table 4 provides a list of common photos that may be taken during a standard site visit.

Photos taken at the monitoring site are *crucial* in assisting in the correction of raw stage and flow data at the end of the season. Photos not attached to Survey123 entries should be named using a consistent naming convention. Naming and describing the photo assists MDA personnel with understanding what the observer was taking a photo of as well as to make reviewing and sorting through photos more time efficient. Save photos using the following naming convention:

YYYY_MM_DD_Site_photo description.jpg

For example:

- 2021_07_01_MC1_upstream field.jpg
- 2021_08_15_MC1_downstream erosion.jpg
- 2021_09_20_WR1_harvest.jpg
- 2021_10_14_RW1N_runoff event.jpg
- Multiple photos: 2021_10_14_RW1N (1).jpg, 2021_10_14_RW1N (2).jpg, 2021_10_14_RW1N (3).jpg, etc.

1.2. Sample collection

Water quality samples are an important part of the overall DFM project. Samples are collected using a variety of methods and into different bottles, depending on the laboratory analysis. This section describes how all samples should be labeled, the different methods used for sampling as well as the different bottles that need to be filled for laboratory analysis. All samples should be placed immediately in an ice filled cooler following collection to ensure sample integrity. Section 3.2 describes additional steps that need to be taken once the collector returns to their home office.

1.2.1. Sample ID description

Each sample collected will utilize a unique sample ID (Figure 11) that will specify the Discovery Farms ID (three to four letter abbreviation), station type ("T" for tile and "F" for flume), year (yy) and sample number for the specified year (001, 002, 003… etc).

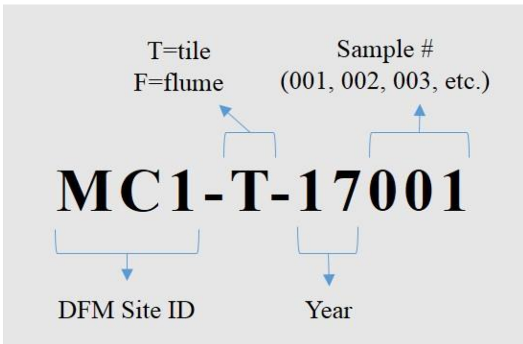


Figure 11. Description of sample bottle labeling.

1.2.2. Sample bottle labeling

Each sample bottle must be properly labeled before being submitted to the lab. Labels will be preprinted on weatherproof labels with the Sample ID and Discovery Farms account number. The user will need to fill in the date and sample time (military, Central Standard Time – CST; **Error! Reference source not found.**). If the sample is a flow-composited sample, the sample END date and time must be recorded on the label. The DFM program summarizes data based on the water year (October 1 through September 30). Samples collected between October through December would be included in the water year for the *next* calendar year. For example, a sample collected on 10/01/2021 which is the first sample collected for that water year would be labeled MC1-T-22001. Despite being collected in calendar year 2021, the sample was collected in *water year* 2022.

Figure 12. *Example of completed sample bottle label. Black font is pre-printed. Sample end date and collection time (blue font) are written in at the time of sampling.*

1.2.3. ISCO 6712 sampler keypad basics

ISCO 6712 automatic samplers will be used for the collection of water quality samples. Figure 13 shows the 6712 keypad and Figure 14 highlights the functions for each icon. This can be found in the 6712 Portable Sampler Installation and Operation Guide available from Teledyne ISCO website.

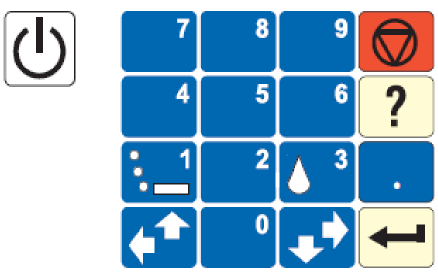


Figure 13. *ISCO 6712 autosampler keypad.*

Key	Name	Function
	Standby	Turns sampler on or off.
	Stop	Stops the pump or distributor. Pauses a running sampling program. In programming screens, returns to a previous screen.
	Enter	Accepts a menu choice or number entry and goes to next screen.
?	Help	In programming screens, displays a brief help message.
	Down-Right Arrow	Selects the menu option right or below the current choice.
	Up-Left Arrow	Selects the menu option left or above the current choice.
0	Numbers	Types a number.
.	Decimal Point	Types a decimal point.
1	Pump Reverse	Press when at the main menu to run the pump in reverse.
3	Pump Forward	Press when at the main menu to run the pump forward.

Figure 14. ISCO 6712 autosampler keypad icon descriptions.

1.2.4. Equal-flow incremented sampling

Surface runoff samples will be collected on an equal-flow increment (EFI) composite basis. The ISCO 6712 autosampler configuration will consist of four polyethylene one-gallon bottles. Once the water level in the flume reaches a defined activation stage (typically 0.04 feet), the total runoff volume (ft^3) will begin to accumulate and record in the datalogger. When the cumulative volume reaches a predetermined threshold value, sampling will commence, and the sampler will trigger the first pulse into Bottle 1. Each cumulative threshold value (trigger value) is equal to one pulse of water collected every 0.01 inches of runoff. This is determined by the surface watershed acreage. After the cumulative threshold value is reached and the first pulse of water is collected, the cumulative flow counter will then start over, counting from zero. When the threshold is reached again, another pulse will be collected and composited into the bottle. The amount of flow in the flume will dictate how fast the composite bottle is filled (more flow equals faster fill time). When the first bottle is full, the sampler distributor arm will move on to the next consecutive sample bottle. This process will continue until the fourth bottle is full or flow subsides. Bottle 1 is programmed to be an EFI composite sample of six pulses at 600 mL each. Bottles 2-4 are EFI composited samples of 24 pulses at 125 mL each. The sampler has a two-part program implemented to ensure that both small and large runoff events will have adequate sample volume for submittal to the laboratory. Due to the two-part program, water from bottles 1 and 2 can never be mixed together, however, bottles 2 and 3, and bottles 3 and 4 can be mixed if necessary.

Subsurface tile drainage samples will also be collected on an EFI composite basis and will be composited whenever subsurface drainage is occurring regardless of the stage in the Agri Drain. The ISCO 6712 autosampler configuration will consist of one 2.5-gallon polyethylene bottle. The single bottle configuration will be programmed to collect 56 pulses at 125 mL each (7,000 mL or around 1.85 gallons).

Cumulative threshold values for each monitoring site are presented in Table 5, as well as other site criteria such as flume height, tile diameter at the sampling point and activation stages.

Table 5. *Discovery Farms Minnesota surface and subsurface sampling criteria including flume height, tile diameter, activations stages and cumulative volume thresholds. Values are subject to change and are current as of April 2021.*

DFM SITE ID	**FLUME**			**TILE**		
	Height (feet)	**Activation Stage (feet)**	**Cumulative Threshold (ft^3)**	**Tile Diameter (inches)**	**Activation Stage (feet)**	**Cumulative Threshold (ft^3)**
MC1	3.0 ft	>0.04 ft	2,200 ft^3	12-inch	> 0.00 ft	2,200 ft^3
RW1N	2.0 ft	>0.04 ft	455 ft^3	8-inch	> 0.00 ft	455 ft^3
RW1S	2.0 ft	>0.04 ft	370 ft^3	8-inch	> 0.00 ft	370 ft^3
WR1	2.5 ft	>0.04 ft	870 ft^3	8-inch	> 0.00 ft	500 ft^3

Once the automatic sampler has completed filling bottles following an event, the samples must be manually collected and processed. Since most sites will be powered using solar panels, sample refrigeration will not be available on site. **Prompt collection of samples following runoff will be required**, especially during warmer periods of the year. An effort should be made to get out to the sites *during* runoff events when possible to ensure the equipment is working properly, take photos, collect samples and reset samplers as well to better characterize conditions during the event. Holding times are critical for dissolved (soluble) orthophosphorus and total suspended solids, both of which have shorter hold times than the other analytes. Refer to Table 6 for associated holding times.

Table 6. *Laboratory analytes, holding times, minimum detection levels and analytical method numbers for Minnesota Discovery Farms parameters.*

Analyte	Holding Time	Minimum Detection Level	Method #
Total Suspended Solids (TSS)	7 days	2 mg/L	EPA 365.1
Ammonia-N (NH_3)	28 days	0.16 mg/L	SM 4500 NH3, C-97
Nitrate+Nitrite (NO_3+NO_2)	28 days	0.05 mg/L	EPA 353.2
Total Kjeldahl Nitrogen (TKN)	28 days	0.2 mg/L	SM 4500 NH3, C-97
Total Phosphorus (TP)	28 days	0.005 mg/L	EPA 365.1
Dissolved Ortho-Phosphorus (DOP)	48 hours	0.005 mg/L	EPA 365.1
Chloride (Cl-)	28 days	3.0 mg/L	SM 4500 Cl E

1.2.4.1. Procedure for EFI Sample Collection

i. Record the display message on the autosampler head within the electronic survey. Specify the number of completed bottles or any errors that occurred. If the sampler is still collecting, record the current bottle number and pulse.
    a. If any unexpected error messages are displayed, document the error and troubleshoot the equipment if possible. Call an MDA Discovery Farms staff person if you have any questions.
ii. If a program is already running, you will need to stop the program by hitting the (stop) button. This will push the program into a *manual pause*.
iii. The main screen has four options: RUN, PROGRAM, VIEW REPORT, OTHER FUNCTIONS. Arrow down to **VIEW REPORT**, hit the enter button, select **VIEW DATA** from the next menu. Then, select **SAMPLING REPORT** from the third menu.
    a. VIEW REPORT → VIEW DATA → SAMPLING REPORT
iv. Once SAMPLING REPORT is selected, the sampler will run through the program sampling details, including when the program was enabled and the start and stop times associated with each pulse for each bottle. The arrow keys can be used to toggle back and forth if a date or time is missed or any of the pulse numbers.
    a. Document any errors that occur for each pulse, such as “no liquid detected” or “no more liquid” with the associated date and time.
v. RECORD the start/stop date/time for each pulse and bottle (Figure 15).
    a. Surface Flume:
        i. Bottle 1 = “**1, Bottle 1**” and “**6, Bottle 1**”
        ii. Bottle 2 = “**1, Bottle 2**” and “**24, Bottle 2**”
        iii. Bottle 3 = “**1, Bottle 3**” and “**24, Bottle 3**”
        iv. Bottle 4 = “**1, Bottle 4**” and “**24, Bottle 4**”
    b. Subsurface Tile:

i. Bottle 1 (one bottle configuration) = "**1, Bottle 1**" and "**56, Bottle 1**"
ii. In most cases, the tile sampler will *not* have completed the program and collected all 56 pulses. The end date and time will then be the last pulse collected.

Figure 15. *Pulse #, bottle #, and sample date\time readout from the ISCO 6712 automatic sampler. The two images above represent the start (left) and stop dates and times (right) for Bottle 1 (surface flume sampler) if the program had collected all six pulses.*

vi. If the sampler stopped collecting water before a bottle was completely filled, take the end date/time for the last pulse number collected. For example, if Bottle 3 only collected 17 pulses (out of 24), the start/stop time that would need to be recorded for that bottle would be listed under "1, Bottle 3" and "17, Bottle 3."
vii. Prepare and label (with the sample end date and time) the needed MVTL sample bottles. Two labels with the same ID, and two MVTL bottles will be needed for each one-gallon sampler bottle.
   a. 1 Liter (unpreserved)
   b. 500 mL (preserved with H_2SO_4)
viii. Ensure the sampler head is fastened securely (three separate latches), then carefully remove the automatic sampler from the metal enclosure box and set it on the ground (if cable length allows). Unfasten the latches and place the sampler head back up inside the enclosure box. Or, pull out the shelter drawer and carefully slide the sampler head off the base and set it behind inside the shelter.
ix. Make sure to identify which bottle is which -- 1, 2, 3 and 4.
x. Nitrile gloves should always be worn when handling water quality samples or collection bottles.
xi. Screw the lids tightly onto the one-gallon sample bottles. Aggressively shake each one-gallon sampler bottle individually for at least 30-60 seconds, making sure to invert the bottle numerous times. It is very important to adequately agitate the sample to assure that sediment particles and attached nutrients have been evenly distributed.
xii. After the sample is adequately agitated, immediately open and pour the representative sample into the appropriate labeled 500 mL and 1 L bottles.
   a. Do not overfill the 500 mL (preserved with H_2SO_4) bottle as overfilling will cause the acid preservative to overflow the bottle.
   b. Make sure lids are tight so that they do not twist open during transport in a cooler to the lab.
xiii. Once samples have been collected, immediately place bottles into a cooler, on ice.
xiv. Used one-gallon bottles must be taken back to the office to be rinsed and sanitized using a non-phosphate concentrated cleaning solution before being deployed again. A

second full set of one-gallon sample bottles should be provided for each monitoring station to allow for swapping between dirty/used and sanitized bottles. Please refer to Section 2.3 for the bottle washing procedure.

xv. **IMPORTANT:** To prepare the sampler for the next runoff event, it will need to be reset (or restarted) so that the program can start over again. Click on the (stop) button, and toggle to either **RUN** (or RESUME PROGRAM).

a. RESUME PROGRAM will restart the sampler from the last bottle and pulse number that the sampler was on before the manual pause. This option would only be used if the sample was not actually collected and the program was meant to continue until runoff was completed.

xvi. The next screen will ask you to select which bottle number you want the program to begin on so that the distributor arm moves to the correct location. Enter "1" for bottle 1 and hit enter. Figure 16 shows the default screen readout when the sampler has been resumed and is ready for the next runoff event.

Figure 16. *Autosampler default display screen for a restarted program (left = flume; right = tile). When triggered again from the datalogger, the sampler will begin with 1 of 6 pulses in Bottle #1 (flume), or 1 of 56 pulses (tile).*

1.2.4.2. Grab sample collection using the automated sampler

Discovery Farm subsurface tile samplers are programmed to collect an equal-flow incremented composite sample whenever subsurface tile drainage is occurring. Infrequently, it may be necessary to collect a grab sample from the automated sampler if there are equipment issues, or the flow is so low (trickle flow) that multiple pulses for an EFI sample wouldn't be collected in less than 10-14 days' time.

***Process for grab sample collection*:**

i. If there is no program currently running; select **OTHER FUNCTIONS** from the main screen on the autosampler.

a. If a program is already running, you will need to stop the program by hitting the (stop) button. This will push the program into a *manual pause*. Toggle to **GRAB SAMPLE** from the paused screen. Once GRAB SAMPLE is selected, skip down to step iii below.

b. When collection has been completed, be sure to select **RESUME PROGRAM**.

ii. From OTHER FUNCTIONS → **MANUAL FUNCTIONS** → **GRAB SAMPLE**.

iii. Grab an extra one-gallon sample bottle and disconnect the pump tube from the bulkhead fitting (where the tube is connected into the base of the automated sampler). Place the tube over the one-gallon bottle, without touching the bottle edges.

iv. The screen will prompt you to enter a sample volume (in milliliters). Enter a number between **1500-2000 mL** and press the  (enter) button when you are ready to start collecting.

v. The sampler will rinse and purge the suction line before a sample is collected. The display will read "PUMPING______ml" when the sample is being collected and will purge again upon completion.

vi. **IMPORTANT**: Once the sample is collected, reconnect the pump tube to the bulkhead fitting. If this step is missed, the next triggered sample will be collected into the bottom of the enclosed shelter, rather than the one-gallon bottle. **The sampler program must also be restarted.**

vii. Prepare and label the needed MVTL sample bottles. Two MVTL bottles will be needed for each sample.

  a. 1 Liter (unpreserved)

  b. 500 mL (preserved, H_2SO_4)

viii. Screw the lid tightly onto the one-gallon sample bottle. Aggressively shake the bottle for 30-60 seconds to agitate the sample.

ix. Upon shaking, immediately pour the representative sample into the 500 mL and 1 L MVTL bottles. Remember to wear nitrile gloves when handling water quality samples.

x. After the grab sample has been collected, immediately place the labeled bottles into a cooler, on ice.

xi. The used one-gallon sample bottle must be properly sanitized before it is used again. Refer to Section 2.3 for the bottle washing procedure.

1.2.5. Analysis priority when water volume is limited

Surface Runoff Samples:

Table 7 was developed to serve as a reference for sample collection priority to submit for analysis if only a partial bottle was collected. If all programmed pulses are collected in the autosampler bottles, there should be approximately three liters (3,000 mL) in each bottle. With adequate water volume, each MVTL bottle should be filled to the neck (1,500 mL combined between the two MVTL bottles). Using bare minimum water volumes, a little over 400 mL of water is needed to run the full suite of seven analytes (approximately four pulses, with the exception of the first bottle). If less than three pulses of water are present in the bottle (< 400 mL), submit samples according to their priority level in

Table 7.

Table 7. *Priority of analysis to submit for the Discovery Farms Minnesota program if adequate water volume does not exist after a storm event. This table is applicable to Bottles 2-4 from the flume sampler only. One pulse of water is equal to 125 mL. Priorities are different for tile water.*

Priority Level	Parameter	MVTL Bottle	Preferred Minimum Water Volume Needed for Analysis (mL)	Cumulative Water Volume (mL)	Minimum Pulses of Water
1	TSS	1-Liter unpreserved	100	100	1
2	TP	500 mL H_2SO_4 preserved	50	150	2
3	DOP	1-Liter unpreserved	20	170	2
4	NO_2+NO_3-N	500 mL H_2SO_4 preserved	20	190	2
5	TKN	500 mL H_2SO_4 preserved	100	290	3
6	NH_3	500 mL H_2SO_4 preserved	100	390	4
7	Chloride	1-Liter unpreserved	20	410	4

With Bottle 1 containing six pulses at a higher water volume each (600 mL per pulse), it is possible for MVTL to run analysis on all seven parameters with only one pulse of water collected. The 600 mL should be well-mixed and split equally between the two provided bottles. Bottles 2-4 contain more pulses at a lower water volume (125 mL per pulse). There may be instances where the runoff event may only collect one to three pulses of water before runoff subsides. If Bottle 2 has less than four pulses collected, follow steps i.-iv. below where applicable. If bottles 3 or 4 have less than four pulses, combine bottles (step v. below)

i. As a general rule, never dump any water out. If you have a question about potentially dumping a sample, please contact MDA personnel to discuss.
    a. If there is only <u>one pulse</u> of turbid water, submit the sample for **TSS only**. If the one pulse of water is very clear (snowmelt runoff), submit the sample for **TP only**.
ii. With <u>two pulses</u> of water total (250mL), add approximately 150mL to the 1-liter unpreserved bottle and the rest to the 500mL preserved (H_2SO_4) bottle – submit for **TSS, TP and DOP only**.
iii. With <u>three pulses</u> of water (375mL), pour 150mL into the 1-liter bottle and the rest into the 500mL bottle – submit for **TSS, TP, DOP and NO_2+NO_3-N only**.
iv. With <u>four pulses</u> of water (~500mL total), add approximately half to the 1-liter bottle and the other half to the 500mL bottle – **submit for all analytes**: TSS, TP, DOP, NO_2+NO_3-N, TKN, NH_3 and CL.
v. If multiple bottles are collected (2-3), but the last bottle is incomplete (less than four pulses of water collected), COMBINE the last bottle with the bottle before it and collect the suite of samples from the combined water.
    a. Be sure to thoroughly agitate the water to effectively mix the samples together.
    b. **Example**: Bottles 1 and 2 are complete; bottle 3 only has three pulses of water collected. Combine bottle 3 with bottle 2. Mix sample thoroughly.
        i. Make sure to list the “start” time for the combined sample as the first pulse of bottle 2 and the “end” time for the sample as the last pulse collected for bottle 3.

c. **IMPORTANT**: Due to the two-part program, bottle 1 and bottle 2 can NEVER be mixed. Only bottles 2-4 can be mixed together if needed.

Subsurface tile samplers are programmed with a one-part program and single 2.5-gallon collection bottle capable of compositing up to 56 pulses (at 125 mL each). The sample analyte priority is different for subsurface tile because TSS is less of a priority (in fields without open surface intakes) and the focus with subsurface tile is often nitrate-nitrogen (NO_3-N). Table 8 lists the sample priority for subsurface tile samples when the water volume is limited. If the subsurface tile is actively flowing during a site visit with limited water volume collected, a discrete grab sample should also be collected in addition to the partial composite sample.

Table 8. *Priority samples to submit for* ***subsurface tile*** *water at Discovery Farms Minnesota monitoring sites if adequate water volume does not exist after a storm event.*

Priority Level	Parameter	MVTL Bottle	Preferred Minimum Water Volume Needed for Analysis (mL)	Cumulative Water Volume (mL)	Minimum Pulses of Water *
1	NO_2+NO_3-N	500mL H_2SO_4 preserved	50	50	1
2	TKN	500mL H_2SO_4 preserved	50	100	1
3	NH_3	500mL H_2SO_4 preserved	50	150	1-2
4	TP	500mL H_2SO_4 preserved	100	250	2
5	DOP	1-liter unpreserved	50	300	2-3
6	TSS	1-liter unpreserved	100-200	400-500	3-4
7	Chloride	1-liter unpreserved	50	450-550	>4

* 1 pulse of water = 125 mL

2. Site maintenance

Frequent site visits are important to ensure that the equipment is providing accurate data measurements and that the site is maintained so that it is ready to go for the next round of snowmelt or precipitation-driven runoff. The following section outlines typical site maintenance that is needed at the monitoring stations.

2.1. Changing variables in the datalogger

2.1.1. Making a stage adjustment

Measured Stage (MS) readings collected during site visits are vital for correcting raw data from the level measurement device (via the datalogger). It is possible for a stage sensor to "drift" over time. Drift essentially means that the stage output has slowly *drifted* or deviated from what the true value is. The datalogger is set to calculate the total flow volume from published equations for the flume and AgriDrain based on the height of the water. These equations are heavily reliant on an accurate stage reading to calculate an accurate water volume. It is very important to ensure that the stage readings are as accurate as possible.

As a general rule of thumb, if the difference between the MS and the current stage on the datalogger is **<u>greater than 0.02 feet</u>**, the datalogger stage should be reset to what the current MS is by using an offset or correction value. Prior to resetting any equipment, please verify that your MS value is accurate by taking one or more follow-up measurements. ***Always include values and comments in the electronic site inspection document if the datalogger stage has been altered,*** including the date and time of the change, what the old offset value was (if applicable), and what the new offset value is. There are specific prompted data fields within the electronic survey for these values when the calculated difference exceeds 0.02 feet.

If the equipment is showing drift repeatedly after being corrected during previous site visits, there may be an underlying issue. Please contact MDA staff to discuss these issues as it may be necessary to replace equipment sensors or troubleshoot further.

Process for changing the datalogger stage:

1) Calculate the difference between the measured stage value and the datalogger output under Current Conditions. The difference is equal to the measured stage (MS) minus the Head_ft (bubbler), Head_APG (ultrasonic) or T_stg (tile stage).
    a. Example:
        i. MS = 1.00 ft
        ii. Head_ft = 1.05
        iii. Difference = -0.05 feet
2) From the main home screen on the datalogger, select **PROCESSES** (Figure 17).
3) Navigate to and select the "**OTTcorr**" process (or other, see below) for the appropriate measurement device.
    a. OTTcorr = bubbler (flume)
    b. APGcorr = ultrasonic (flume)

c. T_stg_corr = area velocity (tile)

4) Select “SET” button
5) Enter the calculated offset (above example = -0.05 feet)
   a. The offset works by *adding* the offset to the output from the stage sensor.
   b. If there is already an offset value > 0.00 feet entered into the OTTcorr, APGcorr or T_stg_corr processes, you will first need to add or subtract the calculated difference from that existing value.
      i. If the MS stage is ***greater than*** the datalogger stage, you need to ***subtract*** the difference from the current offset.
      ii. If the MS stage is ***less than*** the datalogger stage, you need to ***add*** the difference to the current offset.

1. Select “OK” (green check mark icon).
2. A pop-up will appear asking “Do you want this to be the default power up value?” Select the green check mark again to accept.
3. Finally, select the small HOME icon to return to the main datalogger screen.
4. **IMPORTANT**: Navigate back to the Current Conditions screen and verify that the applied offset worked properly. Head_ft, Head_APG or T_stg should now be reading within 0.02 feet of the measured stage value.

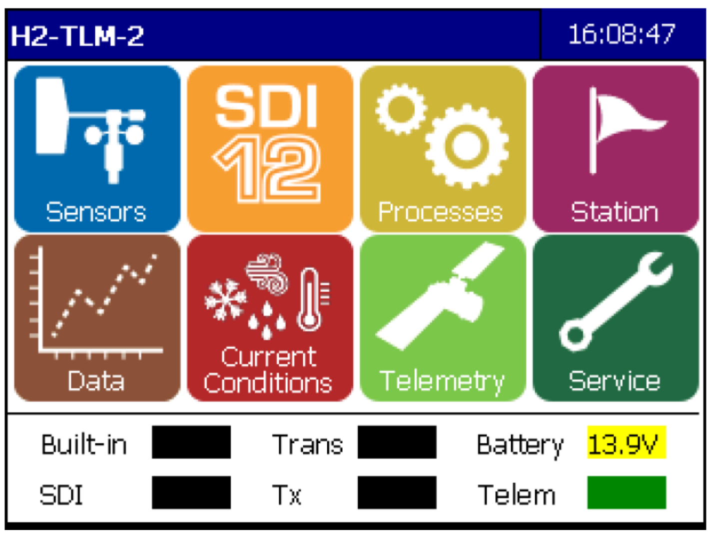


Figure 17. *Main screen for the FTS H2 datalogger.*

2.1.2. Resetting the sample pulse count

The **Fisco_cnt** (flume) or **Tisco_cnt** (tile) is the process which accumulates the number of pulses that have been collected. Bottle 1 in the flume is programmed for six pulses. Bottles 2-4 in the flume have 24 pulses each. The single bottle tile configuration has 56 pulses. <u>It is helpful to reset this number back to zero after each sample collection.</u> This is an easy visual measure for MDA staff to see that a local partner has been out to the site to collect the samples. It also makes the Discovery Farms website more user friendly when the pulse count is accurate so that local sampling partners can track the progression of the sampler program to know when new samples have been triggered.

Process for resetting the sampler pulsing:

1. **Processes**
2. **Fisco_cnt**
   a. Or **Tisco_cnt** for the tile sampler
3. **Zero**
4. Select the green check mark to accept this value as the default start up value.

2.1.3. Resetting the flume flow accumulator (Fflw_acc) process

The ISCO sampler program was modified in 2016 to better capture the large runoff events, since these events account for the majority of the runoff and sediment and nutrient losses. In order to better capture these events, the "F_trig" value was increased for all flume samplers. The "F_trig" value is the defined threshold of total flow volume (ft^3) for each site that initiates sample collection. The revised "F_trig" values are equivalent to 0.01 inches of runoff for each watershed.

Since the "F_trig" is increased, the sampler will not trigger as often during the small runoff events. Although small events do not account for a significant portion of the overall losses, they can be frequent, and it is preferred to collect a grab sample for concentrations instead of estimating. The sampler programs have been revised to collect less pulses into the first bottle, but each pulse will have greater water volume. The first one-gallon bottle will hold six pulses (previously 24) and each pulse will be 600 mL (previously 125 mL). The 600 mL allows for adequate volume for all MVTL analyses, split equally between both provided bottles when only one pulse of water is collected from a runoff event.

The "Fflw_acc" process is the continuous flow volume accumulator that tracks the total accumulated flow volume. When that value equals the "F_trig" value, the datalogger sends a signal to the sampler to collect a pulse of water. In order to ensure the sampler triggers during the small events, the "Fflw_acc" process must be artificially set to a higher value after each sample collection. As an example, the "F_trig" value for site WR1 is 870 ft^3. The "Fflw_acc" process should be set to "860" or "865". At the onset of the next runoff event, the sampler will trigger after stage reaches 0.04 feet and five or 10 cubic feet of flow has accumulated. This configuration allows for collection of samples covering a broader range of flows. Also, this ensures that adequate sample volume is obtained from small events to be able to submit to the lab for all seven water quality parameters.

Process for setting flume flow accumulator:

1. **Processes**
2. **Fflw_acc**
3. **Set**
4. Using the touchscreen, clear the numbers that are currently listed (using the backspace). Set value to the pre-determined "Fflw_acc" values in Table 1Table 9.

5. Select the green check mark to accept this value as the default start up value.

Table 9. *Discovery Farm F_trig and Fflw_acc process values for triggering sample collection for each farm monitoring location. Only current active farms are listed.*

Site	**Watershed**	**F_trig**	**Fflw_acc**
	acres	**ft^3**	**ft^3**
MC1	60.6	2,200	2,195
RW1N	12.5	455	450
RW1S	10.2	370	365
WR1	23.9	870	865

2.1.4. Changing between the bubbler and APG stage sensor

As a default, the datalogger should be set to read stage and trigger the automated sampler from the OTT bubbler because it is a more reliable and accurate instrument. If the OTT were to experience issues while runoff was occurring, the sampler would not trigger to collect a water sample and the even could be missed. Therefore, the user has the ability to switch the datalogger to calculate the total water volume from the APG ultrasonic (backup sensor). The Fflw_acc (volume accumulator) will then be calculated based off the stage data from the APG versus the OTT.

Process for switching default stage sensor to trigger sample collection:

1. Select "**Processes**" from the main screen on the datalogger.
2. Navigate to and select the "**Fflow_sel**" process
3. Select "**Set**"
4. Enter **0** for OTT bubbler (default) or **1** for APG ultrasonic
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value

2.2. Syncing clocks

Instruments:

- FTS H2 Axiom Datalogger
- ISCO 6712 Autosampler
- BirdCam Pro timelapse camera ("field" and "flume")

It is vital that the datalogger, autosampler(s) and timelapse camera date and times are all sync'd so that sample start/stop time and time-lapse camera pictures match up with the stage value from the datalogger. Stage values can fluctuate greatly even over a one-minute period during large runoff events. It has become apparent that especially for the time-lapse cameras, the device time can begin to lag over time. Syncing the time to your smart phone or tablet device is the most consistent method for making sure the times are accurate. Ensure the time remains in 24-hour military format and in Central Standard Time (CST), if daylight savings time is in place. If you do not have a smart phone or tablet, sync all time values to the datalogger. As a general rule, the time on all instruments should be checked at least <u>once per month</u>. There is a specific section in the electronic survey asking if clocks were sync'd or not. If so, enter the current device time in the space allotted and then the current time that the device was set/corrected to.

2.2.1. FTS H2 Axiom datalogger

1. From the home screen on the datalogger, select "**Service**" → "**Set Date/Time**" (Figure 18 and Figure 19).
2. Enter the date, time and time zone values. You can click on the <u>hh</u> or <u>mm</u> time values with the stylus pen to highlight them. Then, click the left and right arrows to increase or decrease values (Figure 20)
3. Select the green check mark (OK) to accept the changes when finished or click on the red X to cancel.

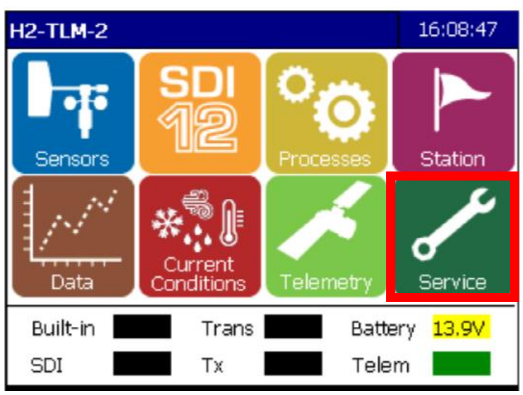


Figure 18. *Forest Technology Systems H2 datalogger "Home" screen.*

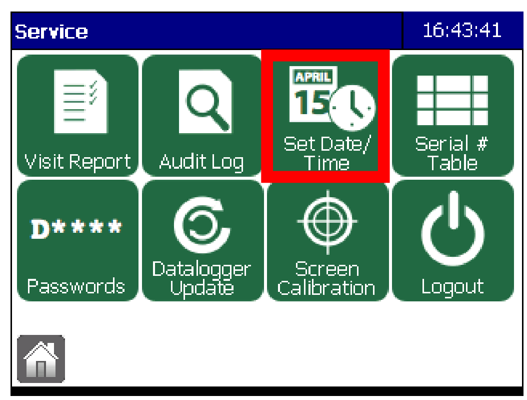


Figure 19. *FTS H2 datalogger "Service" screen.*

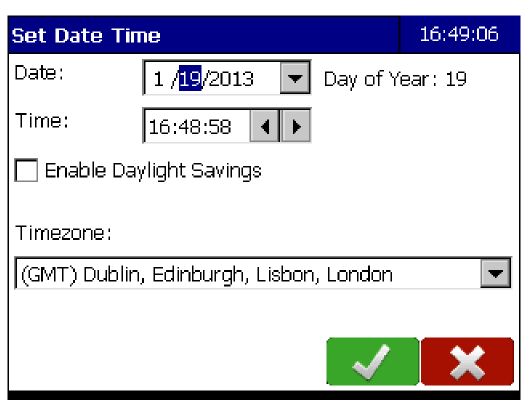


Figure 20. *FTS H2 datalogger "Set Date/Time" screen.*

2.2.2. ISCO 6712 autosampler

1. From the sampler screen main menu, follow the directions in Figure 21 (OTHER FUNCTIONS → MAINTENANCE → SET CLOCK). Note: You may need to "stop" the program first.
2. **DO NOT forget to <u>restart/resume</u> the program after the clock has been set.**

Table 8-1 Setting the Clock and Calendar

1	RUN PROGRAM VIEW REPORT **OTHER FUNCTIONS**	Select OTHER FUNCTIONS.
2	**MAINTENANCE** MANUAL FUNCTIONS PROGRAMMING STYLE	Select MAINTENANCE.
3	**SET CLOCK** PUMP TUBE ALARM INTERNAL BATTERY DIAGNOSTICS	Select SET CLOCK.
4	ENTER TIME AND DATE: HH:MM DD-MON-YY **14:00 22-JAN-01**	Enter the time and date.
5	SET CLOCK PUMP TUBE ALARM INTERNAL BATTERY DIAGNOSTICS	Press STOP to return to the main menu.

Figure 21. *Directions from the ISCO 6712 Autosampler manual on resetting the sampler clock and calendar date.*

2.2.3 TimeLapseCam Pro

1. Turn the small switch from "**ON**" to "**SETUP/PLAYBACK**" (middle option).
2. Press the <u>right</u> arrow button (OPTIONS >)
   a. The first option will be the "DATE & TIME".
   b. You may need to scroll through multiple options if this isn't the first option listed
3. Press the down (-) button to highlight the month. Continue pressing the up (+) or down (-) buttons to increase/decrease the number values. Press the right (>) and left (<) arrows to move to the day, year, hour and minutes (or press "OK").
4. **<u>IMPORTANT:</u>** When the correct date and time have been entered, move the small switch from "**SETUP/PLAYBACK**" back to "**ON**".

   a. The camera will do an automatic 30 second countdown before taking the first picture and resuming the programmed photo-taking interval.
   b. You may need to press the right arrow button “>” to initiate the time-lapse program.
5. Don’t forget to sync the times on BOTH cameras at the EOF sites (flume and field).
6. **NOTE:** Multiple variations of these Wingscapes brand cameras have come out over the years, and each batch varies slightly in appearance and functionality. Use the steps above as a guide only. See Figure 22 and Figure 23 for examples.

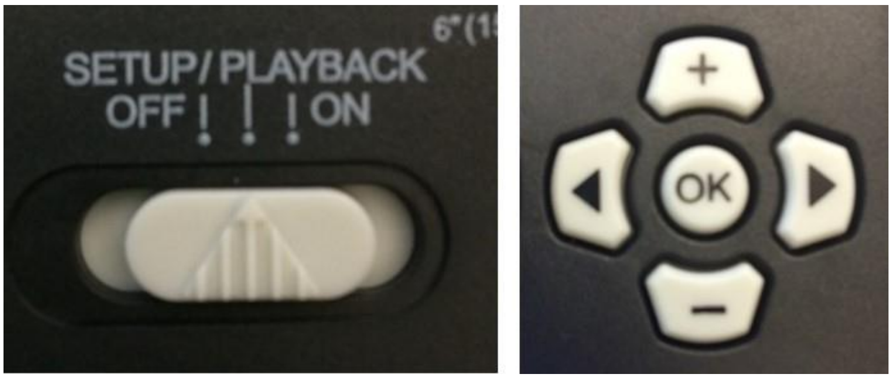


Figure 22. *Wingscapes time-lapse camera "on/off" slider (left) and "+/-/>/<" buttons to adjust settings (right).*

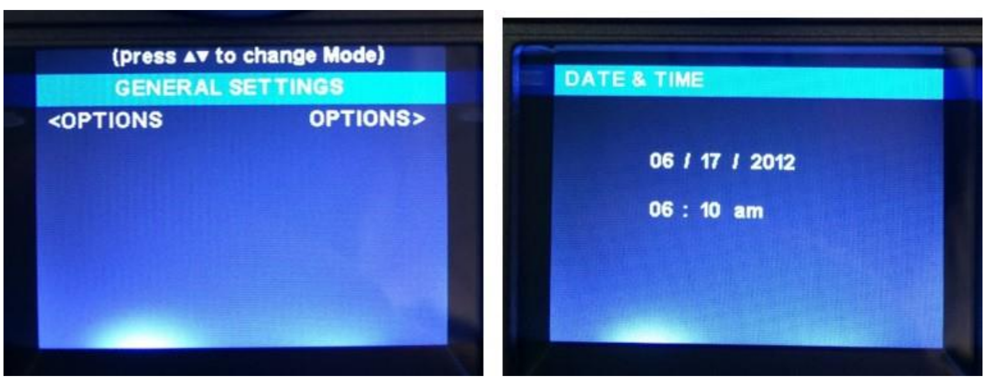


Figure 23. *Wingscapes time-lapse camera main "setup" screen (left) and "Date & Time" screen (right).*

2.3. Bottle cleaning

Bottle washing is a necessary step to eliminate sampling bias, reduce sample variability and to produce comparable data. Properly cleaned and sanitized bottles should be used after every runoff event or when the integrity of the bottles is in question.

Supplies needed:

- Non-phosphate detergent (e.g. 7X detergent)
- Distilled/De-ionized (DI) water
- Cleaning brushes (plastic)
- Cleaning basin (plastic, stainless steel, or glass)
- Nitrile gloves

Bottles and Lids

i. Follow directions for cleaning on the back of the non-phosphate detergent.
ii. Allow the bottles and lids to soak in the solution for at least 10 minutes.
iii. Use a bottle brush to mechanically remove any particles attached to the bottle. A toilet scrubber brush works well.
iv. Rinse at least three times with hot tap water, followed by triple rinsing with de-ionized water.
v. Allow bottles and lids to air dry while inverted.
vi. Once dry, visually inspect the bottles for spots indicating insufficient washing. If necessary, repeat process.
vii. Cap bottle with a clean lid before storing.

2.4. Winter maintenance

Monitoring at Discovery Farm Minnesota locations occurs 365 days of the year. Winter runoff in Minnesota is infrequent but does occur and it is imperative to keep a keen eye on the weather throughout the winter months and especially prior to anticipated snowmelt runoff. Generally, during winter months it will take a few consecutive days of above-freezing daytime temperatures, near or above freezing overnight lows and sunny skies to generate any runoff. If these conditions are foreseen, it should become a top priority to get out and prepare the site for potential runoff.

Flumes will drift and fill in with snow over the winter. It is also very possible for ice to accumulate and freeze on the bottom of the flume (sometimes layers of snow and ice). Ice buildup blocks the sampler and bubbler lines causing them to freeze and read erroneously high values which could potentially cause the automated sampler to falsely trigger. Prior to *any* winter runoff events, the flume will need to be completely cleared of snow and ice (Figure 24).

Figure 24. *Progression of flume cleaning. 1) Shovel and remove snow. 2) Carefully melt and chip out any ice. 3) Clear upstream and downstream flow paths.*

Flumes are not constructed to withstand significant weight. Take care to not stand inside of the flume if possible as this could also lead to the flume becoming un-level. Snow removal is fairly easy and can be done with a shovel. A plastic head shovel is preferred (as metal will easily chip the flume wall). Ice removal works best with manual labor and slowly chipping away at the buildup using hand tools (such as a rock hammer, regular hammer or chisel). Again, the fiberglass flume is *very* delicate. **Please be very careful when chipping ice in the flume.**

Propane heaters (paired with a canvas tarp) may also be used in cases with significant ice accumulation. A consistent heat source can prove useful to create small flowing channels of water on top of the ice. The water can help lubricate and aid in the ice removal, though extreme care must be taken with the heat sources around the fiberglass. Please refer any questions about winter maintenance to MDA staff.

In addition to snow and ice removal within the flume, snow will also need to be removed upstream and downstream from the flume. An adequate channel (generally 20-30 feet) needs to be cleared downstream from the flume to eliminate the probability for backwater (Figure 25). The hand dredged channel length and width will vary and be site specific depending on the slope away from the flume and potential for backwater. Backwater conditions need to be avoided as water will not be able to get away fast enough from the flume causing the stage to be inaccurately high and velocity to be slower. Coupled together, this causes an overestimate in the amount of runoff leaving the field.

On the upstream side of the flume, snow must be cleared out of at least a three to six foot cone (Figure 26). This prevents melt water from cascading over the snowpack and into the flume creating turbulent conditions. The cleared area allows for water velocities to stabilize and creates laminar flow. Often, the snowpack upstream from the flume may be a layered mix of compacted snow and ice. A large chisel and/or mattock and scoop shovel work the best for clearing this area.

__Figure 25.__ Snow removal area downstream from flume.

__Figure 26.__ Snow removal area upstream of flume.

2.5. Flume cleaning

After a runoff event, sediment and debris will likely remain on the floor of the flume (Figure 27). This residual sediment must be properly cleaned not only to prevent contamination of sample water during the *next* runoff event but also to ensure that the bubbler and sampler lines are not clogged with sediment and debris. Small handheld squeegees will be kept in the equipment enclosure boxes. Pour a small amount of water on the bottom of the flume to rinse. Use the squeegee to pull the water and debris out of the flume. Repeat as necessary. If the sediment is very dry, water may not be needed.

Make comments (and document with photos) in the electronic survey if this maintenance procedure is carried out. By pouring water into the flume, there is a small chance the bubbler could pick up a very slight increase in stage which would be erroneous and need to be removed from the data during review and corrections. A bubbler purge should be completed following cleaning of the flume.

Figure 27. Flume before (left) and after (right) cleaning.

2.6. Pump tubing replacement

New silicone sampler tubing should be installed annually or on an as-needed basis. Only sampler tubing made specifically for ISCO 6712 autosamplers will be used. Tubing should be inspected frequently to check for cracks or significant wear. It is important to replace tubing *before* it fails because debris could be pushed into the pump shaft seal degrading it over time. Equipment blanks (see Section 4.2) will assess contamination problems from sample tubing. Refer to ISCO's 6712 Portable Samplers Installation and Operation Guide for specific directions on pump tubing replacement (http://www.isco.com/pcfiles/PartPDF/SL000005/UP001ART.pdf).

IMPORTANT: When replacing the pump tubing, ensure that the correct end of the pump tubing connected to the sample line and the correct end is connected to the carousel (Figure 28). Reversing these will cause the sampler to not collect samples.

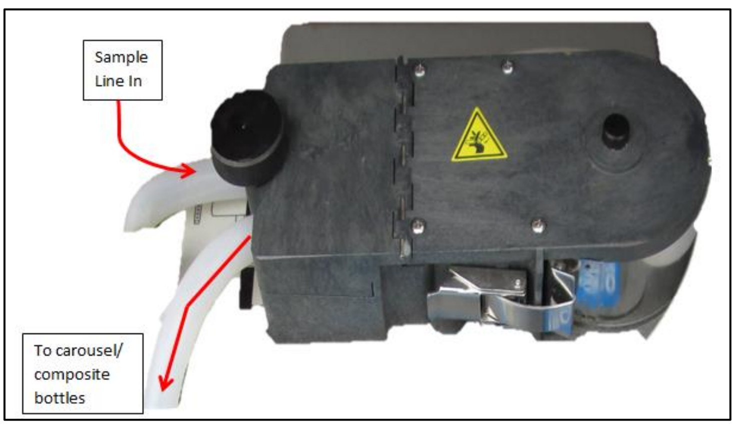


Figure 28. Correct orientation of pump tubing to the sample line and the carousel.

2.7. Desiccant

Desiccant is used to maintain dryness in a sealed container for equipment that is sensitive to moisture. Because moisture can damage expensive equipment, it is necessary to check the desiccant during each site visit to make sure that it is not compromised. Desiccant that needs replacing will typically change colors from the original state.

ISCO 6712 autocampler

A humidity indicator is located on the ISCO 6712 auto sampler face (Figure 29). Blue color in all three pies indicates that the sampler control box is dry and clear of excess moisture. If moisture does build up within the sealed control box, the indicator will begin to turn pink (or white) beginning with the "20" pie. This means that the relative humidity inside of the box is at 20%. The 30 and 40 pies will turn pink next indicating 30 and 40% relative humidity. Once the 30 turns pink, the desiccant should be replaced by opening the controller case (Figure 30). Contact MDA Discovery Farms staff immediately if the 30 is pink.

Figure 29. Location of humidity indicator card on the ISCO 6712 autosampler.

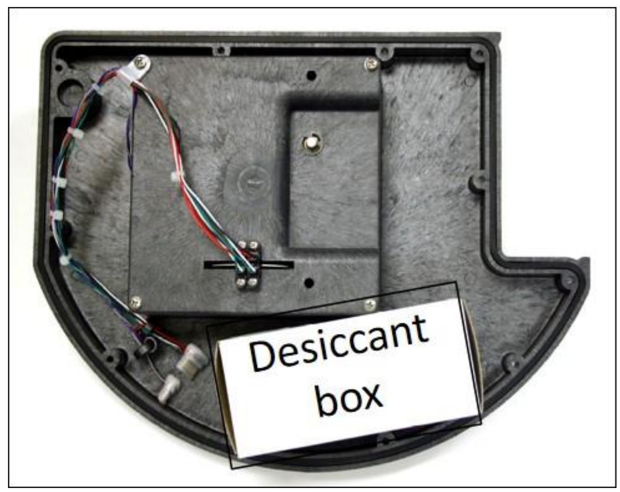


Figure 30. Location of desiccant box under the ISCO 6712 autosampler head.

ISCO 2150 area velocity module

The ISCO 2150 area velocity (AV) module desiccant needs to be replaced when the desiccant color changes from orange to dark green (approximately 1-2 times per year). The desiccant is contained in a cartridge located on the left side of the AV module (Figure 31). To remove the cartridge, unscrew the collar and slide the cartridge out of the AV module. The clear tube reveals the silica gel desiccant inside.

Figure 31. Location of ISCO 2100 series desiccant cartridge.

To replace the silica gel desiccant:

1. Hold the cartridge upright with the collar at the top.
2. Push the collar off the cartridge.
3. Empty the saturated silica gel beads or granules.
4. Fill the tube with new silica gel desiccant.
5. Press the collar onto the tube.
6. Slide the cartridge into the AV Module. Tighten the collar to seal the cartridge in place.

2.8. Flume levelness

Determining the levelness of the flume is critical to acquiring accurate stage measurements. Flumes must be level from front to back and side to side, however, this can be difficult to maintain with the freeze-thaw cycles of Minnesota winters. The Wisconsin Discovery Farms program has found that a tilt of just 0.02 feet from front to back can cause discharge measurements to be underestimated by 10 percent.

Figure 32. *Checking flume levelness.*

Small levels (Figure 32) will be stored inside each equipment enclosure box and are to be used during each site visit (regardless of the visit type). Flume levelness will be determined from front to back and side to side.

On an as-needed basis, an attempt will be made to level un-level flumes as best as possible by tightening or loosening turnbuckles attached to the wingwall and 4x4 posts supporting the flume. The time period for data collected with an un-level flume will be corrected using an equation developed by the Wisconsin United States Geological Survey to adjust for flume tilt.

2.9. Padlocks

Each enclosure box will be locked with a standard four-number combination padlock. Although most sites are in remote locations not easily accessible to the general public, the enclosure boxes house expensive equipment. Appropriate precautions must be taken regarding security. Ensure each padlock is locked tight before departing from a site. The padlock will not lock securely if the correct combination remains in the display (at least one number must be altered).

Due to snow, rain and temperature fluctuations, the locks can stick and become hard to operate at times. Spray a lubricant (graphite, silicone, WD40) into both the combination area as well as where the lock clicks into place to resolve sticky locks.

2.10. Field cameras

Stationary time-lapse cameras are installed at each site (Figure 33). The field time-lapse camera is set to collect a photo every three hours during the daylight period. During snowmelt time periods, it can be beneficial to increase the time interval from three hours to every one hour for finer resolution. The camera is housed in a weatherproof enclosure and positioned to collect photos with a view of the upstream field. Discovery Farms with surface flumes will also have a second time-lapse camera installed and positioned to take a photo of the staff gauge within the flume. The flume cameras will be set to collect a photo every 30 minutes, 24 hours a day. These photos assist in ensuring the stage being read by the sensors are accurate. During each field visit, make sure that the camera enclosure viewing glass' are cleaned of dust, dirt and water droplets that may interfere with the clarity of the photos.

The cameras are equipped with a 12V solar power panel and six C (or AA batteries for newer models). The solar power panel has a digital display which provides the internal charge of the battery. If the charge value drops below "90", notify MDA field staff, as repositioning of the solar panel may be necessary. AA or C batteries should be replaced once per year.

When not in use, the cameras are in standby mode; the screen will be clear. If the power button is quickly depressed, the camera status will be displayed for 10 seconds (Figure 34). Frequently check the camera status to assure adequate storage volume remains on the SD card and that the battery charge indicator is above 90%. The cameras are mounted on a support that is static. Although these supports should not move, check to make sure the cameras are still pointing in the target direction and the supports are secure.

Each camera contains a four or eight gigabyte memory card. A spare memory card is provided for each site. Each month, the camera card should be switched out with the spare card. Images from the memory card should be downloaded to a desktop or laptop computer. Pictures will be transferred to the online Discovery Farms photo database, which is housed at Dropbox.com. Dropbox is an online file synchronization/backup cloud service. Cameras must be powered off when removing the SD card out. **Remember to power the camera back on after inserting a new SD card.**

It is important not only that the date and time on the camera are set correctly, but that the camera time matches the datalogger time (to within one minute) so that correlations can be made between photos and the raw data. The camera time (along with the datalogger and autosampler) should also be set to Central Standard Time. Additionally, the camera name (should be set to each Discovery Farm ID), date and time should be imprinted on the photos themselves. This is an option under the setup functions. **A camera manual can be viewed and downloaded from <u>www.wingscapes.com</u> which will highlight all functions and procedures related to this camera.** Please contact MDA if you have trouble accessing the manual.

Log into Dropbox at **Dropbox.com** using the username and password provided below:

User name: **DiscoveryFarmsMN@gmail.com**
Password: **MAWRCmawrc2016**

Images can be uploaded to Dropbox using the following procedure:

1.) Select “Photos”
2.) Select “Discovery Farms Minnesota”
3.) Select “Farms”
4.) Specify the proper farm location.
5.) Select “Field Camera” or “Flume Camera”
6.) Select the Year (i.e. – “2019”)
7.) Select the “Upload” icon 
    a. If necessary, create a separate folder by selecting the “new folder” icon. 
    b. If all images are put into one single folder for the year, make sure each image has the date and time imprinted on the photo.
8.) Browse for the files and select the images for uploading. Multiple images can be selected at once by holding down the “shift” key. Select “Open”.
9.) Select “Start upload”
10.) Images will be transferred at this point. Transfer rate will depend on internet connection speed. Notify MDA staff with problems regarding file uploading.

Figure 33. *Time-lapse field camera.*

Figure 34. *Time-lapse camera status display. "TL countdown" indicates the time to next photo collection. "Battery" indicates the amount of battery life remaining. "Estimated days" shows the number of days that photos will be collected with the remaining space on*

2.11. Vegetation maintenance

During the growing season, vegetation or debris immediately upstream and downstream from the flume (Figure 35) could interfere with runoff leaving the monitoring station and could cause turbulent flow or backwater (submergence) issues. It is necessary to maintain vegetation upstream and downstream of the flume so that there are no flow restrictions (Figure 36 and Figure 37). In addition, vegetation that is currently or may obstruct the view of the flume (and runoff) from the time-lapse cameras should also be removed. Furthermore, keeping vegetation maintained around the monitoring station will cut down on potential tick encounters.

Figure 35. *Looking downstream (left) towards a flume dominated by thick ragweed. On the right, is the same site (looking upstream) after vegetation removal.*

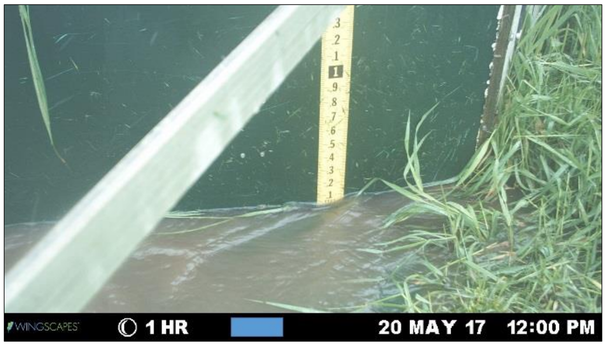


Figure 36. *Example showing the need for vegetation removal upstream from the flume. Runoff water can push grasses into the flume during a runoff event, which can cause turbulent conditions for the stage sensors to read.*

Figure 37. *Example showing the need for vegetation removal and cleanup from the flume following trimmer work upstream from the flume. Grassy debris could clog sampler and bubbler orifice lines during the next runoff event.*

2.12. Electronic tipping bucket rain gauge maintenance

During each field visit, the rain gauge should be closely inspected to make sure that debris has not clogged the collector lid. Wind-driven debris such as leaves, and small twigs or needles can end up blocking the collector. More frequently, birds roosting on the edge of the lid can defecate within the collector. Small bugs can also clog the opening. If debris is present, it should be immediately cleared out and noted in the electronic site inspection notes. The rainfall data totals will need to be closely inspected and compared with nearby stations to evaluate the period that may have been affected by the plugged rain gauge. If roosting birds becomes a frequent issue, thin spikes can be taped around the outer perimeter of the collection lid to deter birds from roosting.

Rain gauge levelness should also be checked on a frequent basis. Automatic tipping bucket rain gauges are calibrated while level. To prevent erroneous tipping, it is important that the rain gauge is level so that water lands on the internal tipping mechanism correctly.

2.13. Manual rain gauges

Manual rain gauges will be installed at each Discovery Farm near electronic tipping bucket rain gauges. The cylindrical plastic rain gauges (Figure 38) have a capacity to measure one inch of rain (to the nearest 0.01 inches) in the main cylinder and up to 11 inches in the outer cylinder which is designed to hold any water in excess of one inch.

Figure 38. *Manual rain gauge.*

Rainfalls of less than one inch can be read directly from the interior measuring tube. If rainfall exceeds one inch, the excess will accumulate in the outer cylinder and will need to be manually tallied. Carefully remove the inner tube and dump out the water. Then, pour the excess water slowly into the inner tube taking care to not spill any of the rainwater. This process can be repeated until the entire rain fall amount has been calculated (*do not forget to add on the rainwater that has already been dumped out*). If possible, collect all rain water into a secondary holding device so that measurements can be repeated to assure accuracy.

Manual rain gauges should be checked during each field visit, especially following rain events. Like the tipping bucket rain gauges, they should be cleared of any dirt or debris and should be periodically checked for levelness. Manual rain gauges should be removed from the site over the cold winter months to avoid potential cracking of the inner plastic cylinder with the freeze-thaw cycle.

3. Sample processing and data management

After samples are collected in the field, they must be transported back to the collector's office to store in a refrigerated unit until they are ready to be shipped or delivered directly to the laboratory. Before the samples can be delivered to the laboratory, a chain of custody form must be filled out and transported with the samples every step of the way.

3.1. Sample processing and shipping procedures

To retain data consistency among the many Discovery Farm locations in Minnesota, only one water quality testing laboratory will be utilized. Minnesota Valley Testing Laboratory (MVTL), a state contract laboratory located in New Ulm, Minnesota, will conduct all laboratory analyses for the project. MVTL will provide the appropriate sample bottles, coolers and chain of custody forms. The same suite of seven analytes (Table 6) will be run for each sample collected with adequate water volume.

Efforts should be made get samples to the laboratory within 48 hours to abide by holding times. **<u>Samples must be shipped on ice to the address below along with the completed CoC form</u>**. Once MVTL receives a shipment of samples, they will send the cooler along with a clean set of sample bottles back to the project partner.

Minnesota Valley Testing Laboratory
1126 North Front Street
New Ulm, Minnesota 56073

Phone: (507) 354-8517 <u>or</u> (800) 782-3557

Discovery Farms Minnesota MVTL Account #: **005238**

3.1.1. Chain of Custody form

A Chain of Custody (CoC) form is critical documentation for both the laboratory and Discovery Farms program. It is *the* legal paper trail for water quality samples and is required for each round of samples delivered to the lab. The CoC contains important information such as the contract account number, sample dates/times, sample IDs, parameters to analyze and contact information. CoC forms in a specific format are provided from the lab. A completed example CoC form is included in Appendix D. MVTL provides the formatted CoC document, which is then customized for each county or local partner. The blank form can be saved in a Microsoft Excel format and then filled out and printed as necessary. Enter the sample ID, sample type, start and end dates and times and select the bottles being submitted. **<u>IMPORTANT</u>: The sample IDs, dates and times on the bottle labels and the CoC form *MUST* be identical. Please double check all records for transcription errors before shipping samples to the lab.** Ensuring accurate sample information saves a significant amount of time at the end of the water year correcting errors.

Once the CoC is completed, the completed Excel file should be saved following the naming convention described below. Electronic CoC forms should be emailed to MDA staff.

CoC naming format: YYYY_MM_DD_*SiteID*_CoC
(*i.e.,* 2021_08_23_WR1_CoC.xlxs)

3.1.2. Cooler packing tips

These guidelines should be used for all shipments to MVTL. Immediately following collection, samples must be placed in coolers containing ice or ice substitutes. While transporting samples back to the office or directly to MVTL, coolers should be cooled to a temperature of 4 degrees Celsius if possible. A general rule of thumb is "the cooler the better." Samples arriving at the lab above 6 degrees Celsius are flagged for exceeding MVTL's temperature acceptance criteria.

1) Properly refrigerate samples prior to preparing shipment to MVTL. Shipping samples at ambient temperatures (especially during the summer months) will quickly melt the ice in the cooler and may affect the acceptance of samples at MVTL.
2) Line the bottom of the cooler with bulk bubble wrap.
3) Ensure that sample bottle lids are tight so that they do not come loose during shipment.
4) Place bottles in the cooler upright (never lie them down on their side).
5) Surround the bottles with wet ice, ice packs or frozen water bottles. Frozen water bottles are the preferred method since they are affordable, reusable and will not make a large mess as they melt. Make sure that the frozen bottles are covering the tops of the sample bottles as well. The cooler should lack any void areas where the bottles could shift during shipment and be 100% full with the sample bottles and frozen water bottles or ice.
6) Place bubble wrap on top of samples and frozen water bottles (or ice). Bubble wrap will help insulate the cooler, protect the bottle lids and will also assist with filling the voids so that there is no vertical movement of bottles. The goal is that if the cooler were dropped or tipped upside down, the contents inside would not shift around or be damaged.
7) Place the Chain of Custody form inside a Ziploc bag. Tape the Ziploc bag with the CoC to the underside of the cooler lid.
8) Seal the cooler with clear packaging tape. Tape completely around the cooler in two locations preventing the cooler lid from opening during transport.
9) Keep the prepared and packed cooler in a climate controlled, well-shaded location prior to sample pick-up.

3.1.3. Procedure for shipping samples via Spee Dee Delivery

Shipment method will be at the discretion of the project partner, however, for ease an account has been set up via Spee Dee Delivery Service through the Minnesota Agricultural Water Resources Center (MAWRC). MVTL also runs a weekly pickup route where they will pick up samples on a certain day and time each week for a minimal fee. This can be inquired about by calling MVTL directly.

Requests for sample pick-up should NOT be made for Friday pick-ups. The cooler could potentially sit on a delivery truck or in a warehouse over the weekend and would not be delivered to MVTL until Monday. It is unlikely that the ice pack would be able to maintain the appropriate temperatures as if they were stored in a refrigerator. If samples are collected on a Friday, a request for a Monday pick-up should be made. Additionally, if samples are collected on a Thursday, the user should request a pick-up for later that same day. If a Thursday pick-up cannot be arranged, the samples should be stored in a refrigerator until they can be shipped to the lab on Monday. The procedure for shipping via Spee Dee is outlined below:

1) Collect samples, store in a refrigerator until pickup day
2) By <u>4:30pm</u> for next day pick-up, call **1-800-862-5578 (ext. 504)** or email **<u>oncall@speedeedelivery.com</u>** to schedule your pick-up!
3) Specify the following in the email or on the phone:
   a) SpeeDee account shipper number: **14906**
   b) Your office address for pickup
   c) Destination address: Minnesota Valley Testing Laboratory, 1126 North Front Street, New Ulm, MN 56073
   d) Approximate weight and size of the item being shipped (specify that it's a cooler)
4) Fill out your chain of custody form with sample IDs, start and stop dates/times, etc.
   a) Print and place in a Ziploc bag
5) Morning of pickup, pack your cooler with samples
   a) Make sure all bottle lids are securely tightened
   b) Place sample bottles upright in the cooler and pack with frozen water bottles, wet ice, or freezer packs so that sample bottles are secure and will not tip over during transport. Make sure the samples are surrounded by ice/freezer packs on all sides (including on top)
   c) Tape Ziploc bag with the chain of custody to the underside of the cooler lid
   d) Use clear packaging tape and wrap it around the entire cooler a few times to make sure that the lid will not open during transport
6) While waiting for pickup, store cooler in a shady location (i.e. – not outside in the direct sun)
7) Figure 39 provides an example of an email sent to Spee Dee requesting a pick-up.

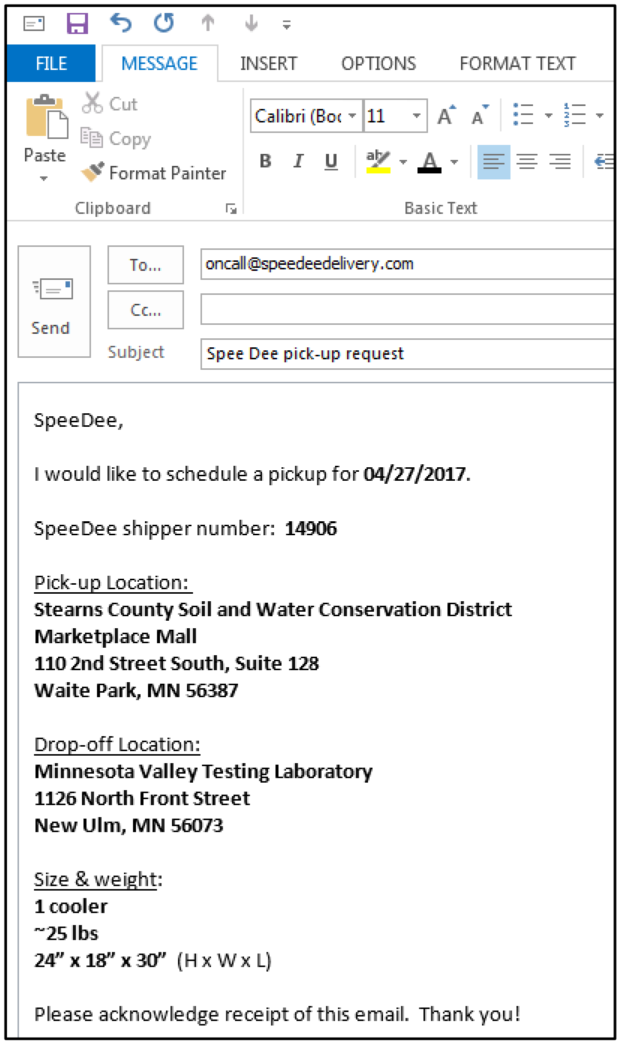


Figure 39. *Example email requesting a Spee Dee pickup for sample shipment to MVTL.*

3.2. Post-sampling (or site visit) procedures

Once samples have been processed and shipped, or a site visit has been completed, a few more steps must be taken to complete the process:

1. Review electronic surveys for thoroughness and accuracy. Add in any additional notes that may have been forgotten to document while at site. Submit completed surveys once connected to Wi-Fi.
2. Complete the laboratory chain of custody form based on Survey123 data (sample ID, date, time). Review the log-in against the sample bottles labels for accuracy.
3. Request a SpeeDee shipping request via e-mail.
4. Ship samples (next day) on ice to the MVTL Laboratory.
5. Sanitize sample bottles as necessary.
6. Send a summary email to MDA personnel of tasks completed including:

a. Maintenance completed, or what is needed, outstanding issues or equipment problems.
b. Summary of sample collection and how many samples were collected.
c. General site observations.
d. E-mail the finalized Chain of Custody form to MDA staff.

4. Quality assurance and quality control

4.1. Field duplicate

Duplicate samples are collected simultaneously with a sample from the same source under identical conditions into separate sample containers. A duplicate will assess if the autosampler bottles are being properly mixed prior to pouring into laboratory bottles. A duplicate is also a quality control measure with the laboratory.

i. A separate sample number, typically the following sequential sample number for that station, will be assigned to each duplicate (i.e. BE1-F-14014 would be the duplicate of BE1-F-14013).
ii. Duplicates will be submitted blind to the laboratory. Once collected, a duplicate sample is treated independently of its counterpart in order to assess laboratory performance through comparison of the results.
iii. The entire suite of parameters listed in Table 5 for which a standard sample is analyzed will also be evaluated with duplicate samples.
iv. Duplicates will be preserved, stored, transported and submitted in the same manner as other water samples.
v. It must be noted in the site inspection document when a field duplicate sample is collected. The sample IDs for the duplicates and their respective counterparts will also be written in the document.
vi. The first sample collected for the water year should be run as a duplicate if water volume allows. A duplicate should be collected every 10th composite sample. As a general guideline, at least **10 percent** of composite samples submitted to MVTL should be duplicates.

4.2. Equipment blank

Equipment blanks will be collected to evaluate whether contaminants have been introduced into the samples during the sampling process via the sampler tubing and collection bottles. Deionized (DI) water will be pumped from the sampler intake into the composite sample bottle using the same rinse and purge cycle used for standard runoff-event samples. The water is then poured into a laboratory bottle for analysis.

i. A separate sample number, typically the following sequential sample number for that station, will be assigned to each field blank.
ii. Equipment Blanks will be submitted blind to the laboratory.
iii. The entire suite of parameters listed in Table 6 for which a standard sample is analyzed will also be evaluated with equipment blank samples.
iv. Equipment Blanks will be preserved, stored, transported and submitted in the same manner as other water samples.
v. The sample ID for the equipment blank will be entered into the electronic site inspection form like a regular collected sample.
vi. As a general guideline, one equipment blank per year will be collected at each sampling setup (flume and tile). MDA staff will be responsible for the

collection of equipment blanks.

4.3. Equipment assessments / calibration

Monitoring equipment needs to be checked on a frequent basis to ensure sensors are accurately reading or collecting data at proper intervals. This section describes equipment assessments that should be completed on a routine basis.

4.3.1. ISCO autosampler

When the datalogger sends a signal to the ISCO autosampler to collect a sample, the ISCO autosampler runs through its cycle of purging and collecting a sample of water. The ISCO is programmed by the user to collect a specified volume of water (*i.e.*, one pulse of water) and deposit the pulse into the collection bucket to collect a single composite sample. The process outlined below describes how to calibrate the volume of water collected with each pulse of water.

i. Items needed: DI water, extra sample bottle, 500 or 1,000 mL graduated cylinder,
ii. Press the (stop) button on the sampler head to put the sampler into a manual pause.
iii. Disconnect the sampler tubing coming out of the sampler head into the sampler carousel. The graduated cylinder will be held up to capture and measure the water volume leaving the pump tubing.
iv. Make sure the bottom half of sample line is free in the flume by removing tape or fasteners securing it to the wall of the flume.
    a. Place the end of the sample line into an extra sample bottle filled with at least 500 mL of DI water.
v. On the sampler head navigate to: OTHER FUNCTIONS > MANUAL FUNCTIONS > CALIBRATE VOLUME.
    a. The user will be prompted to enter a sample volume that is desired to be collected. Use the keypad to enter the volume of water in milliliters (use 125 mL).
vi. With the pump tubing coming out of the sampler head in the graduated cylinder, press (enter). This will tell the sampler to run through its sampling procedure and collect a single pulse.
vii. When the pumping has stopped, the sampler will prompt for the volume delivered. Using the keypad, enter the volume of water that was pumped into the graduated cylinder. The sampler will recalibrate itself based on the amount of water that was received.
viii. Repeat steps v – vii to ensure that the correct volume was pumped into the graduated cylinder. If a different volume was pumped than what was requested by the user (after calibration), notify MDA personnel as this may indicate an issue with the ISCO autosampler.
ix. Reconnect the pump tubing going from the sampler head to the sample collection carousel (bottom portion of the ISCO autosampler).
x. If the sample line was removed from inside the flume, reconnect the sample line in the flume and make sure the sample line is secured close to the bottom of the flume.

Autosamplers should be calibrated at least twice per year, if pump tubing is replaced or if sample lines are replaced.

5. Data management and analysis

Data management involves the process of data collection and storage, correcting and reviewing data, converting stage data to flow and reviewing water chemistry data. Once these steps have taken place the constituent loads, yields and flow weighted mean concentrations (FWMC) will be calculated along with the total runoff, water volume and precipitation totals.

Surface and subsurface stage data will be corrected using Autocaller (formerly Stream Trac) software available through Forest Technology Systems (FTS). Finalized data will be stored in the WISKI database utilized by the Minnesota Pollution Control Agency, Minnesota Department of Natural Resources and the MDA. Data will be assigned a quality code based on estimated accuracy. Finalized flow and water quality data are public and may be requested by anyone.

5.1. Data collection and storage

Data collected by the various instruments at each Discovery Farm will be recorded in the datalogger which has an internal memory of 4-6 months at current logging intervals. Each site will be instrumented with a cellular modem which allows for remote acquisition of the logger data by way of a static IP address and the Autocaller software. Raw data are downloaded on an hourly schedule and pushed to an FTP site where they are then available to the general public from the Discovery Farms Minnesota website (under Real-Time Data). Logger data will be reviewed weekly to ensure all instruments are functioning properly and evaluated to look for any inconsistencies, such as outliers or missing values.

Once raw data have been compiled at the end of the year, stage values must be reviewed, verified and corrected if necessary.

5.2. Water quality analysis

Surface Runoff Sites

Surface runoff sites consist of standard H flumes which are instrumented with dual stage measurement devices, an OTT brand cbs bubbler (primary) and an APG brand ultrasonic transducer (secondary). In addition, stand-alone Solinst Leveloggers are also deployed as a third stage measurement during the non-winter months. Detailed field notes are of critical importance for accurate raw data corrections. Stage data will be verified in the field by comparing bubbler and ultrasonic transducer output values with a measured stage reading. The "measured stage" will be obtained from a staff gauge mounted within the flume during site visits.

Dual stage measurement devices will be highly beneficial for correcting data. In situations where one instrument is tracking poorly (clogged bubbler intake, cracked bubbler line, etc.) the second instrument can be used to fill the gap for missing or erroneous stage readings (and subsequently used to calculate flow). When examining stage data, both datasets will be compared closely to assess if one dataset can be used to help adjust the other.

Using the combination of the field notes, measured stage values, dual sensor measurements, weather conditions (such as rainfall and air temperature) and site visit and timelapse camera images, the raw stage data will be corrected at the conclusion of the water year monitoring season. Data corrections and finalization will occur from October through December.

Finalized stage data will be converted to flow based on existing stage-to-flow rating equations (specific to the flume size) that have been developed by the H-flume manufacturer (see Table 10).

Table 10. *H flume equations, by height.*

FLUME HEIGHT (feet)	**FLOW EQUATION** Q=Flow (cubic feet per second) H=Head (feet)
1.5	$Q=2.11*(H^{2.31})$
2.0	$Q=0.000787-0.01082*H^{0.05}+0.745962*H^{1.5}+1.511207*H^{2.6}$
2.5	$Q=0.001499-0.01992*H^{0.4}+0.727294*H^{1.4}+1.698273*H^{2.5}$
3.0	$Q=0.00036-0.00228*H^{0.4}+0.95356*H^{1.5}+1.877055*H^{2.5}$

Sub-surface Tile Sites

Sub-surface tile sites are instrumented with ISCO area velocity flow meters. These probes measure both the level and velocity of water through the tile. Stoplogs are placed in the Agri Drain structure to a height that completely submerges the incoming tile (Figure 40). The top stoplog has a machine cut v-notch weir cut into the face. To calculate flow, stage through the v-notch weir is converted via a rating equation. Stage-discharge rating equations were developed at Saint Anthony Falls Laboratory in St. Paul, Minnesota in July 2014. Rating equations for 8 inch and 12 inch Agri Drain structures are provided in Table 11. When surcharge or backwater conditions occur, flow is calculated as the area of the submerged tile multiplied by the velocity measurement from the ISCO 2150 meter.

Table 11. *Flow equation for 8" tile over stop logs within an Agri Drain.*

TILE DIAMETER (inches)	**STOPLOG WIDTH*** (feet)	**HEAD** (feet)	**FLOW EQUATION** Q=Flow (cubic feet per second) H=Head (feet)
8	0.867	< 0.35	$Q = 0.8045 * H^2 + 0.0115 * H$
8	0.867	>/= 0.35	$Q = 1.1137 * H^{2.2562}$
12	1.201	< 0.529	$Q = 0.8346 * H^3 + 0.3431 + H^2 + 0.0619 * H$
12	1.201	>/= 0.529	$Q = -4.2897 * H^3 + 11.33 * H^2 - 6.707 * H + 1.2659$

* Width as measured between stoplog channel in Agri Drain structure.

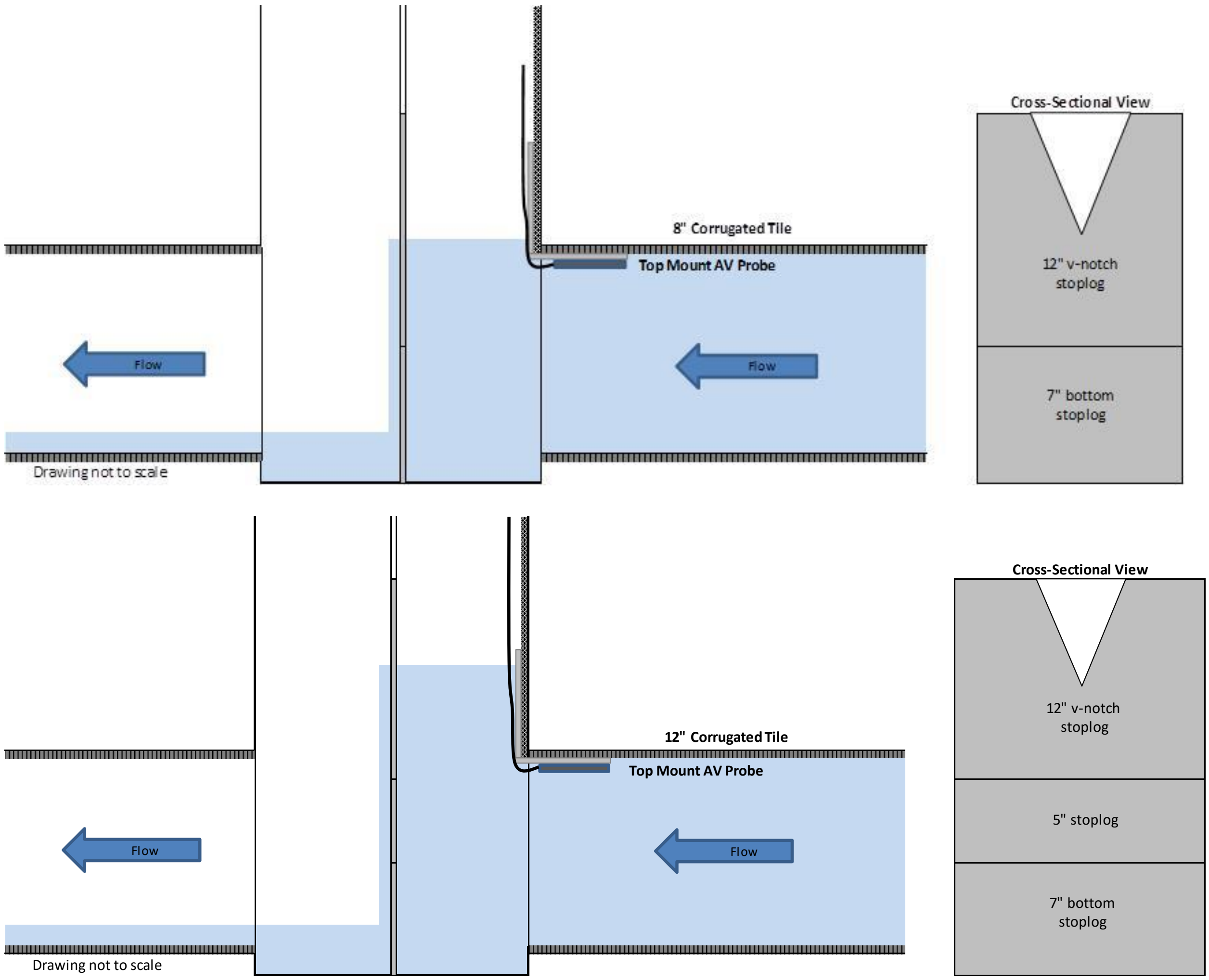


Figure 40. *Cross sectional view of Agri Drain subsurface tile monitoring set up for 8 inch (top) and 12 inch (bottom) incoming tile drains.*

5.3. Water quality data

Upon receiving finalized water quality results from Minnesota Valley Testing Laboratory, results will be checked thoroughly for potential lab errors or typos. Original samples will be kept for up to 30 days, and retests will be requested for any questionable values.

Approved laboratory results will be transcribed into a formatted Excel spreadsheet by Discovery Farm site ID and date. The spreadsheet will also contain the start and stop times associated with each sample and any information recorded in the field notes related to the sample (such as if subsamples were missed due to ice or clogged intake). Hard and electronic copies of the laboratory results will be filed for backup on a secured MDA network server.

Prior to working up any analysis of the water quality data, all results will be thoroughly reviewed against electronic survey entries and sampler logs to verify that sample IDs and sample dates and times are correct.

5.4. Water quality analysis

Water quality and quantity (flow) data will be combined to calculate constituent loads, yields and flow-weighted mean concentrations. Flow composited samples will be collected during snowmelt and storm runoff periods. Each individual sample consists of up to 24 discrete 125 ml sub-samples in a one-gallon jug (or 6 discrete 500 ml sub-samples in the first bottle of the flume sampler, only). Each one-gallon sample bottle has a specific start and stop time, which is recorded by the datalogger. Sample results will be applied to the flow period for which that sample represents. For periods between samples when no water chemistry results are available, the concentration will be extended to the midpoint between that sample and the next one. For sub-surface tile sites, baseflow sample concentrations are applied to the baseflow period between runoff events. Loads, yields, and FWMC's will be tabulated annually, monthly and by specific storm events.

5.5. Meteorological data

Meteorological data collected at each site will include precipitation (FTS tipping bucket rain gauge), air temperature and humidity (FTS Temperature and Humidity Sensor). These data will be stored in 15-minute increments by the datalogger. Fifteen-minute rainfall will be a total rainfall value over the previous 15-minute period. Sites will also be instrumented with a manual rain gauges which will be emptied and recorded by monitoring partners after field visits that follow rain events. The manual rain gauge values will be compared to the electronic tipping bucket rain gauge to verify accuracy.

5.6. Soil moisture and temperature data

A Stevens Water Hydraprobe will be installed at each site to measures both soil volumetric water content (percent moisture) and soil temperature at two different depths: 6 inches and 24 inches.

All meteorological and soils data will be appended and correlated with the appropriate stage, flow and water chemistry data and saved in the Autocaller export included in individual site and water year load calculation spreadsheets which will be housed on a secure MDA network.

5.7. Data storage and submittal

The Minnesota Pollution Control Agency (MPCA) manages EQuIS (Environmental Quality Information System). This database houses water quality data from sampling locations across the state of Minnesota. The new program (implemented in 2011) replaces the older STORET and will be significantly more functional.

DFM will utilize EQuIS to maintain storage of all finalized and reviewed water quality data. Data housed in the system will include all water quality parameters analyzed; total suspended sediment, ammonia, nitrate+nitrite, total kjeldahl nitrogen, total phosphorus, dissolved ortho-phosphorus and chloride.

Data will be compiled into EQuIS specified templates and submit to MPCA staff for inclusion into the EQuIS database on an annual basis, or more frequently as the need permits.

Appendix

A. Project staff contact information

MN DEPARTMENT OF AGRICULTURE	STAFF	ADDRESS	CONTACT INFORMATION
	Scott Matteson Hydrologist	MN Dept. of Agriculture 422 Belgrade Ave, Suite 104 North Mankato, MN 56003	**Office**: 507-344-3201 **Cell**: 507-340-4048 **Email**: scott.matteson@state.mn.us
	Katie Rassmussen Hydrologist	MN Dept. of Agriculture 625 Robert Street North St. Paul, MN 55155	**Office**: 651-201-6331 **Cell**: 218-343-4159 **Email**: katie.rassmussen@state.mn.us

MN AGRICULTURAL WATER RESOURCES CENTER	STAFF	ADDRESS	CONTACT INFORMATION
	Tim Radatz Discovery Farms Coordinator	MAWRC 3080 Eagandale Place Eagan, MN 55121	**Office**: 651-768-2106 **Cell**: 608-443-6587 **Email**: radatz@mawrc.org
	Warren Formo Executive Director	MAWRC 3080 Eagandale Place Eagan, MN 55121	**Office**: 651-768-2106 **Email**: warren@mawrc.org

B. **Project partners** (farm information shaded in gray and strikethrough are no longer active).

DISCOVERY FARM	AGENCY	ADDRESS	CONTACT INFORMATION
~~**BE1**~~	~~**Minnesota Department of Agriculture**~~	~~**Scott Matteson**~~ ~~Hydrologist~~ ~~422 Belgrade Ave, Suite 104~~ ~~North Mankato, MN 56003~~	~~**Office**: 507-344-3201~~ ~~**Cell**: 507-340-4048~~ ~~**Email**: scott.matteson@state.mn.us~~
~~**CH1**~~	~~**Chisago County SWCD**~~	~~**Craig Mell**~~ ~~District Administrator~~ ~~38814 Third Avenue~~ ~~North Branch, MN 55056~~	~~**Office**: 651-674-2333~~ ~~**Email**: craig.mell@mn.nacdnet.net~~
~~**DO1**~~	~~**Dodge County SWCD**~~	~~**Jessica Bakken**~~ ~~916 2nd Street SE~~ ~~Dodge Center, MN 55927~~	~~**Email:** jessica.bakken@dodgeswcd.org~~ ~~**Office:** 507-374-6364, ext. 117~~
~~**GO1**~~	~~**Goodhue County SWCD**~~	~~**Beau Kennedy**~~ ~~Water Planner/Wetland Adm~~ ~~104 E 3rd Ave, PO Box 335~~ ~~Goodhue, MN 55027~~	~~**Office**: 651-923-5286~~ ~~**Email**: bkennedy@goodhueswcd.org~~
MC1	**Hawk Creek Watershed Project**	**Jordan Austin** Water Quality/Outreach Technician Renville County Courthouse 500 East DePue Avenue Olivia, MN 56277	**Office:** 320-523-3673 **Email:** jordan@hawkcreekwatershed.org
~~**NO1**~~	~~**Norman County SWCD**~~	~~**Mark Christianson / Lori Thronson**~~ ~~100 Main Avenue East~~ ~~Twin Valley, MN 56584~~	~~**Office:** 218-584-5169 (Norman SWCD)~~ ~~**Email**: markc@arvig.net / lorit@arvig.net~~
~~**RE1**~~	~~**Hawk Creek Watershed Project**~~	~~**Jordan Austin**~~ ~~Water Quality/Outreach Tech.~~ ~~Renville County Courthouse~~ ~~500 East DePue Avenue~~ ~~Olivia, MN 56277~~	~~**Office:** 320-523-3673~~ ~~**Email:** jordan@hawkcreekwatershed.org~~
~~**RO1**~~	~~**Rock County SWCD**~~	~~**Arlyn Gehrke**~~ ~~Engineering Technician~~ ~~311 West Gabrielson Road~~ ~~Luverne, MN 56156~~	~~**Office:** 507-283-8862 ext 3~~ ~~**Email:** arlyn.gehrke@co.rock.mn.us~~
RW1N **RW1S**	**Redwood Cottonwood Rivers Control Area**	**Shawn Wohnoutka** GIS/Outreach Watershed Technician 1424 E. College Drive, Suite 300 Marshall, MN 56258	**Office:** 507-532-1325 **Email:** shawn.wohnoutka@rcrca.com
~~**ST1**~~	~~**Stearns County SWCD**~~	~~**Mark Lefebvre**~~ ~~Nutrient Management Spec.~~ ~~110 2nd St. So., Suite 128~~ ~~Waite Park, MN 56387~~	~~**Office**: 320-251-7800, ext 3~~ ~~**Email**: mark.lefebvre@mn.nacdnet.net~~
~~**WI1**~~	~~**Wilkin County SWCD**~~	~~**Kim Melton**~~ ~~District Technician~~ ~~1150 Highway 75 North~~ ~~Breckenridge, MN 56520~~	~~**Office**: 218-643-2933~~ ~~**Email**: dbajumpaa@co.wilkin.mn.us~~
WR1	**Wright County SWCD**	**Alicia O'Hare** Water Management Specialist 311 Brighton Avenue S, Suite C Buffalo, MN 55313	**Office:** 763-682-1970 **Email:** alicia.ohare@mn.nacdnet.net

C. Autosampler data sheet (example)

BOTTLE: 1 | 2 | 3 | 4 TILE or FLUME
SAMPLE ID: BE1-F-14003

PULSE	DATE	TIME	COMMENTS
1	3/15/14	14:13	Start date/time for Bottle #1
2			
3			
4			
5			
6			
7			
8			No errors
9			detected
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20	3/15/14	23:31	
21	3/16/14	00:09	
22			
23			
24	3/16/14	1:07	End time

BOTTLE: 1 | 2 | 3 | 4 TILE or FLUME
SAMPLE ID: BE1-F-14004

PULSE	DATE	TIME	COMMENTS
1	3/16/14	1:38	Start bottle #2
2		2:00	
3		2:41	
4		3:52	
5		4:16	
6		4:59	NLD-no liquid det.
7		5:19	NLD
8		6:00	NLD
9		7:07	NLD
10		7:45	
11		8:16	
12		8:53	
13		9:14	
14		9:41	
15		10:15	
16		10:22	
17		10:29	
18		10:37	
19		10:50	
20		11:17	
21		11:28	
22		11:44	
23		12:15	
24	3/16/14	12:31	end bottle #2

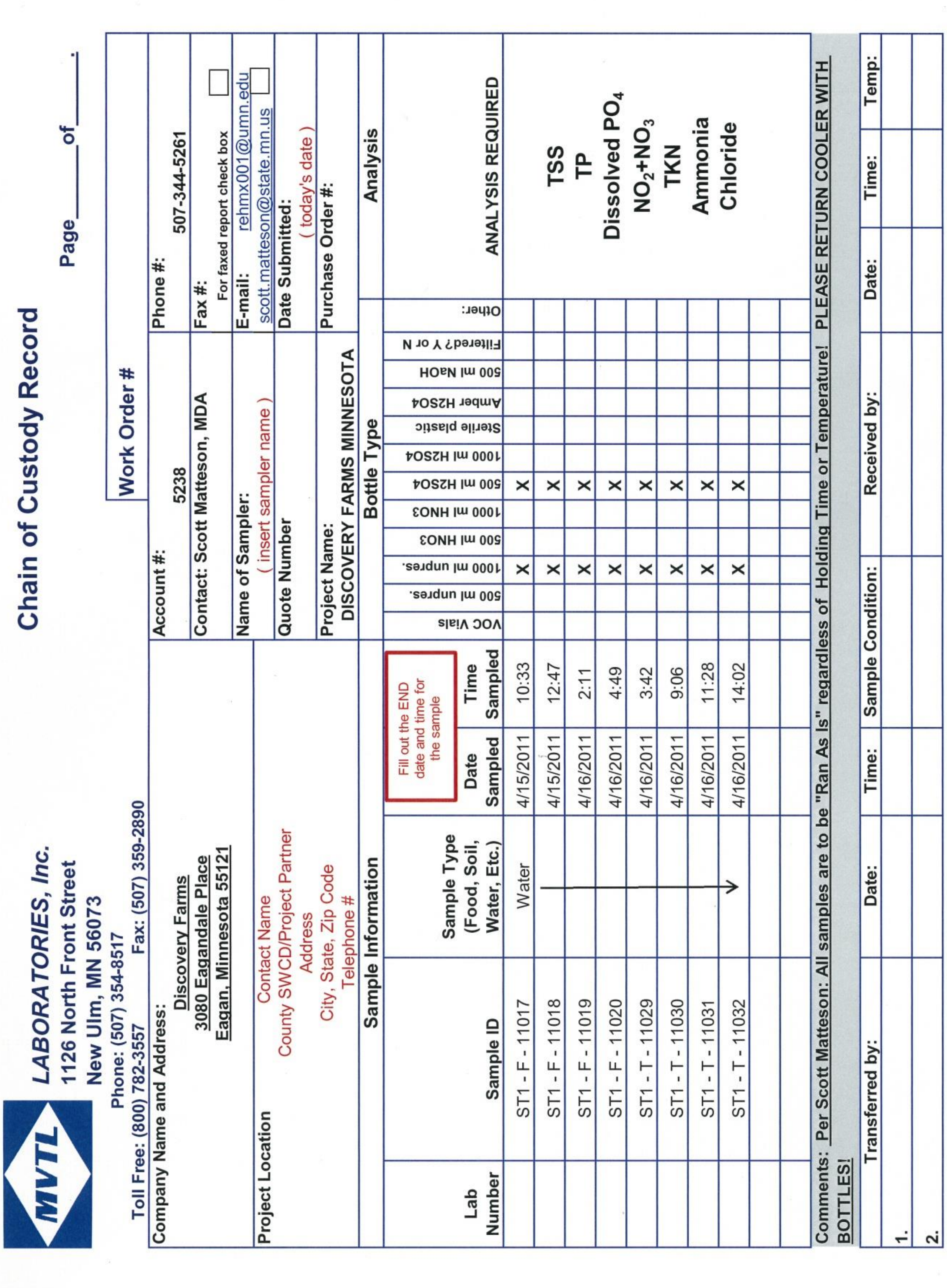
BOTTLE: 1 | 2 | 3 | 4 TILE or FLUME
SAMPLE ID: BE1-F-14005

PULSE	DATE	TIME	COMMENTS
1	3/16/14	13:01	Start-bottle #3
2		13:59	
3		14:33	
4		15:05	
5		15:48	
6		16:49	
7		17:31	
8		18:19	
9		18:58	
10		19:50	
11		20:22	
12		21:32	
* 13	3/16/14	22:05	END-bottle #3
14		23:45	NML-no more liquid
15	3/17/14	1:19	NML
16		1:20	NLD - no liquid detected
17		1:21	NLD
18		1:22	NLD
19		1:23	NLD
20		1:25	
21		1:29	
22		1:35	
23		1:40	
24		1:42	

BOTTLE: 1 | 2 | 3 | 4 TILE or FLUME
SAMPLE ID: BE1-F-14006

PULSE	DATE	TIME	COMMENTS
1	3/18/14	9:02	start-bottle #4
2		9:33	
3		10:17	No errors
4		11:06	
5		11:33	
6	3/18/14	11:56	end-bottle #4
7			
8		Program stopped @ 11:58	
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

D. MVTL chain of custody form (example)



MVTL LABORATORIES, Inc.
1126 North Front Street
New Ulm, MN 56073
Phone: (507) 354-8517
Toll Free: (800) 782-3557 Fax: (507) 359-2890

Chain of Custody Record

Page______of______.

Work Order #

Company Name and Address: Discovery Farms, 3080 Eagandale Place, Eagan, Minnesota 55121	Account #: 5238	Phone #: 507-344-5261
	Contact: Scott Matteson, MDA	Fax #: For faxed report check box ☐
Project Location: Contact Name, County SWCD/Project Partner, Address, City, State, Zip Code, Telephone #	Name of Sampler: (insert sampler name)	E-mail: rehmx001@umn.edu scott.matteson@state.mn.us ☐
	Quote Number	Date Submitted: (today's date)
	Project Name: DISCOVERY FARMS MINNESOTA	Purchase Order #:

Fill out the END date and time for the sample

Sample Information					Bottle Type												Analysis
Lab Number	Sample ID	Sample Type (Food, Soil, Water, Etc.)	Date Sampled	Time Sampled	VOC Vials	500 ml unpres.	1000 ml unpres.	500 ml HNO3	1000 ml HNO3	500 ml H2SO4	1000 ml H2SO4	Sterile plastic	Amber H2SO4	500 ml NaOH	Filtered? Y or N	Other:	ANALYSIS REQUIRED
	ST1 - F - 11017	Water	4/15/2011	10:33			X			X							TSS TP Dissolved PO_4 NO_2+NO_3 TKN Ammonia Chloride
	ST1 - F - 11018		4/15/2011	12:47			X			X							
	ST1 - F - 11019		4/16/2011	2:11			X			X							
	ST1 - F - 11020		4/16/2011	4:49			X			X							
	ST1 - T - 11029		4/16/2011	3:42			X			X							
	ST1 - T - 11030		4/16/2011	9:06			X			X							
	ST1 - T - 11031		4/16/2011	11:28			X			X							
	ST1 - T - 11032		4/16/2011	14:02			X			X							

Comments: Per Scott Matteson: All samples are to be "Ran As Is" regardless of Holding Time or Temperature! PLEASE RETURN COOLER WITH BOTTLES!

Transferred by:	Date:	Time:	Sample Condition:	Received by:	Date:	Time:	Temp:
1.							
2.							

E. ISCO 6712 one-part programming for sampler pulsing (tile samplers)

Must be in **EXTENDED PROGRAMMING**. From the main menu, type **6712.2** to switch into extended mode.

PROGRAMMING:

1. Enter Program Name and Site Description, if desired. Program name could be DFM, and site description could be GO1 as an example.
2. Units Selected: **ft**
3. **30-minute** data interval
4. Enter bottle information
   - **4** bottles, **3.78** liter bottles
   - **X** ft suction line
   - **Auto section head**
   - **1** rinse, **1** retries (this is only available in extended mode)
5. Pacing: **Flow, Every 1 Pulses, No Sample at Start**
6. Distribution: **24 sample/bottle**
   a. **1** bottle per sample event
   b. Switch bottles on: **Number of samples**
   c. Switch bottles every **24 samples**
   d. Run continuously? **No.**
7. Volume: **125 mL samples**
8. Enable: **once enabled stay enabled, sample at enable**
9. Enable: **0 pause and resumes**
10. **No delay to start**
11. Run program now – **yes**

F. ISCO 6712 two-part programming for sampler pulsing (flume samplers)

Must be in **EXTENDED PROGRAMMING**. From the main menu, type **6712.2** to switch into extended mode.

PROGRAMMING:

12. Enter Program Name and Site Description, if desired. Program name could be DFM, and site description could be GO1 as an example.
13. Units Selected: **ft**
14. **30-minute** data interval
15. Enter bottle information
    - **4** bottles, **3.78** liter bottles
    - **X** ft suction line
    - **Auto section head**
    - **1** rinse, **1** retries (this is only available in extended mode)
16. Two-Part Program Bottle Assignments
    - **1-1 to 'A'**
    - **2-4 to 'B'**
17. 'A' Pacing: **Flow, Every 1 Pulses, No Sample at Start**
18. 'A' Composite: **6 samples/bottle**
    a. Run continuously: **No**
    b. Take **6** samples
19. 'A' Volume: **500 mL samples**
20. 'A' enable: **None programmed**
21. 'A' enable: **Once enabled, stay enabled, sample at enable**
22. 'A' enable: **0 pause & resumes**
23. 'B' pacing: **Flow, Every 1 pulses, no sample at start**
24. 'B' distribution: **24 sample/bottle**
    a. **1** bottle per sample event
    b. Switch bottles on: **Number of samples**
    c. Switch bottles every **24 samples**
    d. Run continuously? **No.**
25. 'B' volume: **125 ml samples**
26. 'B' enable: **when 'A' is done**
27. 'B' enable: **once enabled stay enabled, sample at enable**
28. 'B' enable: **0 pause and resumes**
29. **No delay to start**
30. Run program now – **yes**