



DISCOVERY FARMS MINNESOTA

SOP

STANDARD OPERATING PROCEDURES



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Acronyms and Abbreviations

cfs	Cubic Feet per Second (ft ³ /sec)
CoC	Chain of Custody
CSG	Crest Stage Gage
CST	Central Standard Time
degF	Degrees Fahrenheit
MAWRC	Minnesota Agricultural Water Resources Coalition
MDA	Minnesota Department of Agriculture
MS	Measured Stage
MVTL	Minnesota Valley Testing Laboratory
RP	Reference Point
SOP	Standard Operating Procedure
t-tube	Transparency Tube

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
- ii. Collect a measured stage reading
- iii. Fill out the site inspection document with all relevant information
- iv. Inspect equipment to make sure everything is in good working order
- v. Take site photos
- vi. Label bottles and collect samples (if applicable), place on ice
- vii. Replace used bottles with sanitized ones
- viii. **RESET** the automated sampler
- ix. Perform any necessary site maintenance
- x. Make sure enclosure box is locked

AT OFFICE:

- i. Fill out CoC form.
- ii. Ship samples on ice to MVTL.
- iii. Transfer field notes to excel spreadsheet, save as backup.

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PURPOSE

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

Discovery Farms Minnesota is modeled after the successful Wisconsin Discovery Farms program, which has been on the ground for nearly a decade and proven to be a reliable and accurate source for 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 is great. It is the hope that we will all continue to build a strong relationship across state lines, which will likely increase the impact and value of both programs.

This SOP was tailored exclusively for Discovery Farms Minnesota. It is meant to serve as a basic step-by-step guide for collecting quantitative data from agricultural runoff (including both overland flow and subsurface tile drainage).

1.0 DATA COLLECTION

1.1 SITE INSPECTION & FIELD NOTES

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.

A site inspection worksheet has been created specifically for Discovery Farm Minnesota stations, which outlines the necessary data collection information to ensure understanding of specific site conditions as well as to warrant data accuracy. This worksheet is to be filled out on site. An electronic version will also be provided to the project partners in a Microsoft Excel spreadsheet. Once a site inspection has been completed in the field, the data must be transferred from the worksheet into Excel and saved as a backup. Minnesota Department of Agriculture (MDA) staff will request updated versions of this spreadsheet on occasion.

Upon arriving at the site, be observant of your surroundings. Take notes on the condition of the field, crop, equipment, water appearance and flow conditions, etc. Table 1 contains a checklist of items to consider for inclusion into notes when a site visit is being made. A completed example of the site inspection document is included in Appendix B.

Table 1. Information to include in field notes.

TYPE	INFORMATION NEEDED / SITE CHECKLIST
Basic Notes	<ul style="list-style-type: none"> ▪ Date and Time (CST, Central Standard Time) ▪ Site ID (for ID format, refer to Figure 6) ▪ Observer (first and last name)
Field Msmts.	<ul style="list-style-type: none"> ▪ Measured stage (MS) <ul style="list-style-type: none"> ○ <u>Flume</u>: staff gage reading (feet) <u>AgriDrain</u>: (RP – tapedown measurement) = MS (feet) ▪ Transparency Tube measurement (cm) ▪ Crest Stage Gage reading (feet) ▪ Manual Rain Gage reading (inches)
Datalogger Information	<ul style="list-style-type: none"> ▪ Datalogger time (CST) ▪ Battery Voltage (v) ▪ Stage reading (feet) <ul style="list-style-type: none"> ○ Area velocity flow meter (tile), pressure transducer (tile), bubbler (flume), ultrasonic transducer (flume backup sensor). ▪ Flow (cfs) ▪ Soil Temperature (deg F) ▪ Soil Moisture (%) ▪ Air Humidity (%) ▪ Air Temperature (deg F) ▪ Water Temperature (deg F) ▪ Download start/end dates, Memory -- % full
Auto Sampler info	<ul style="list-style-type: none"> ▪ Were samples collected? How many bottles completed? ▪ If currently sampling, what bottle is it on? What pulse # (out of 24) is it on? ▪ Sampler screen display message – any errors? ▪ Was the program resumed after sample collection?
Current site conditions	<ul style="list-style-type: none"> ▪ SUBSURFACE TILE <ul style="list-style-type: none"> ○ 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 <ul style="list-style-type: none"> ○ 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.
Current Weather Conditions	<ul style="list-style-type: none"> ▪ 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 high intensity rainfall? Low intensity? Long soaker rain? ▪ Wind speed and direction ▪ Current temperature ▪ <u>Example</u>: 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 forecast for the next 7 days.
Equipment Observations	<ul style="list-style-type: none"> ▪ Is the battery voltage sufficient? ▪ Is the rain gage unit level? Is the rain gage plugged? Was it unplugged and cleared of debris? Would the blockage have interfered with recent rainfall data? ▪ Manual rain gage – read water level if applicable and/or clean of debris. ▪ Desiccant status: New, Good, Bad, Needs to be changed ▪ Camera battery, camera SD card – downloaded? ▪ Solar panel: needs to be cleaned, cleaned (ok) ▪ Are mice a nuisance in the enclosure box? <ul style="list-style-type: none"> ○ If so, plug any obvious access holes into the box, purchase Decon/traps or a deterrent, remove any bedding or feces. Have they chewed through any of the cables or sampling tubing?

Table 1 (continued)

Current Agronomy Conditions	<ul style="list-style-type: none"> ▪ Was the crop recently planted, or harvested? ▪ Was the field recently treated 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 standing water present?
Maintenance Completion Notes	<ul style="list-style-type: none"> ▪ Was the desiccant replaced? Was the rain gage checked? Is the solar panel clean? ▪ Was the stage reset in the datalogger? Was the Crest Stage Gage reset? ▪ 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?

1.2 FIELD MEASUREMENTS

During significant runoff events, it is vital to get out to the site (even if the automated sampler has not completed its sampling round) to check on equipment, take notes, and to collect a measured stage reading, transparency tube measurement and site photos.

1.2.1 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. For contaminant loading calculations, the flow must be computed correctly and thus the stage record must also be accurate.

A measured stage reading should be collected during *every* site visit, regardless of the visit type (for sample collection, maintenance or just a checkup). On occasion, it may even be beneficial to collect two or more stage readings during a visit. **It is important to also record the date and time associated with the measured stage reading.**

FLUME (overland flow):

- A measured stage reading for overland flow inside of a standard H flume is fairly straight forward, as staff gages are mounted on the flume wall (see Figure 1). Simply read the water level on the staff gage to the **nearest 0.005 feet**. Double check the value and record it on the site inspection document.
- If no water or flow is present in the flume, record “**no flow**” in the site inspection document.

AGRI DRAIN (subsurface tile):

- Agri Drain structures are typically used for conservation drainage projects but are valuable for Discovery Farms because they allow easy access to the subsurface drainage water. Stop logs can be placed in the Agri Drain at variable heights to hold back tile water in the field. For Discovery Farm sites, stop logs will be

placed to a height so that the tile remains full when water is present in the line. The stage of interest will be the height of water that is pouring over the stop logs. A submersible pressure transducer or area velocity sensor will be mounted stationary in the upstream pooled water.

- To collect a measured stage, a Reference Point (RP) with an assigned value will be needed. The purpose will be to measure the distance between the known RP and the surface of the water, which is called a “tapedown.” The “tapedown” value will then be subtracted from the RP to calculate the height of water over the stop logs. Figure 2 shows a view into an Agri Drain. For an example of how to calculate the Measured Stage for tile water in an Agri Drain, see Table 2.
- For sites equipped with an Area Velocity Flow Meter, the sensor will be mounted inside of the tile line itself; therefore, stage values should remain very consistent due to the pipe always being full except for in extreme dry conditions.

Table 2. Calculation of the Measured Stage in an Agri Drain structure.

KNOWN INFORMATION		MEASURED STAGE
Total distance from top lip of Agri Drain to the bottom:	7.90 ft	(6.90 – 6.635) =
Height of stop logs (5” + 7”)	1.00 ft	
Reference Point (total distance minus height of stop logs)	6.90 ft	0.265 feet
Tapedown measurement (RP to water surface)	6.635 ft	



Figure 1. Flume staff gage.

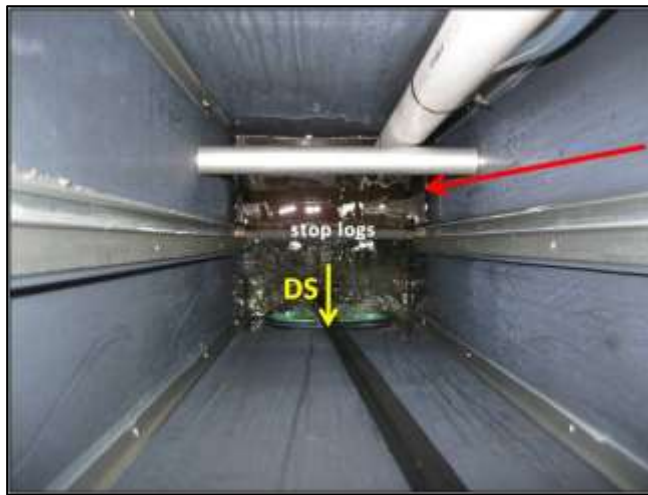


Figure 2. View into Agri Drain. Red arrow indicates where tape measure should hit the water.

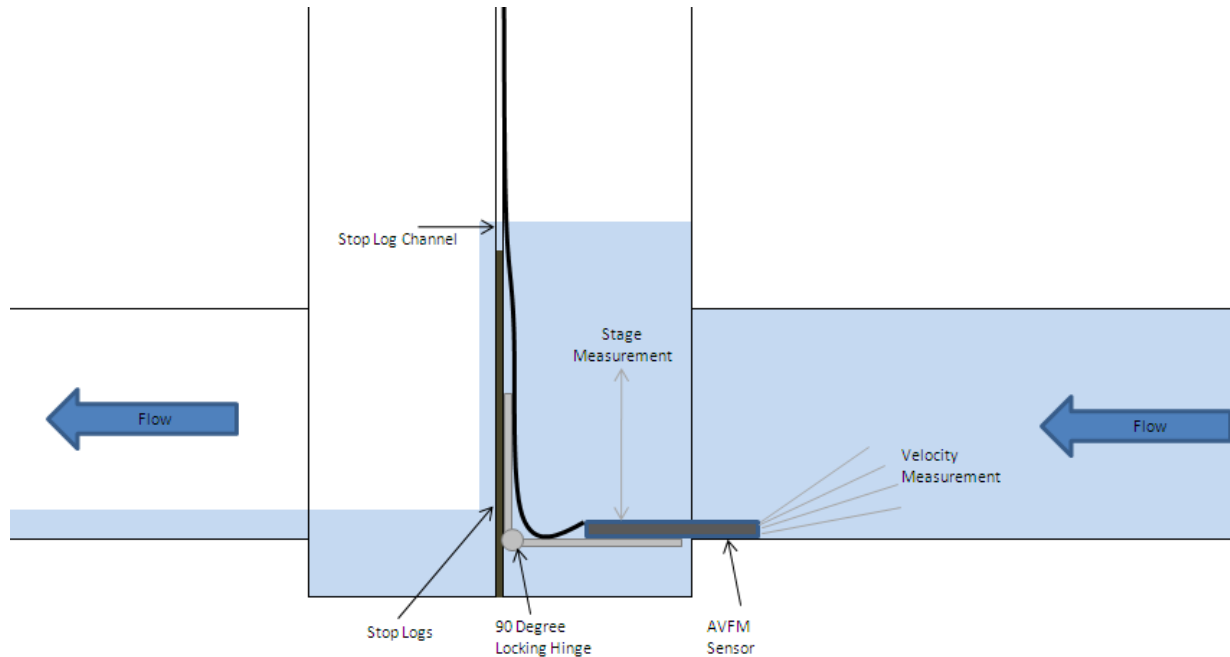


Figure 3. Profile view of gauged subsurface tile through an Agri Drain.

1.2.2 TRANSPARENCY TUBE

Transparency tube (t-tube) readings are a quick and effective way to get a general sense of the instantaneous water clarity. It would be highly beneficial to have a t-tube handy on site (60 or 100cm) to collect a reading whenever the flume is flowing. Prior to collecting a reading, make sure the t-tube is rinsed clean of any residual sediment from a previous measurement. **Remember to remove sunglasses and keep your back to the sun.** Do not allow water to sit in the t-tube as particulates may begin to settle out; take the reading immediately. 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.

Before dumping the runoff water out of the t-tube, snap a few 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 runoff channel or flume so field conditions can also be seen in the background. Figure 4 shows an example.



Figure 4. Transparency tube photos during runoff.

1.2.3 SITE PHOTOS

Field cameras are installed at each of the Discovery Farm sites and are programmed to take a photo each day and during runoff events (see Section 2.9 for further description). These cameras are stationary and will be installed downstream from the flume. Stationary photos are excellent for showing the changes in the 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* picture. Although photos are being collected on a daily basis, it is strongly recommended that photos be collected by the observer during site visits; the more the better. Table 3 provides of list for potential photos of interest.

SITE PHOTOS
<ul style="list-style-type: none"> ▪ Upstream Field ▪ Downstream channel ▪ Overview of flume ▪ View of entire flume with water exiting ▪ Overview of entire monitoring site ▪ Equipment photo ▪ Photo of full sample bottles (mixed well) ▪ T-tube photo with flume in the background ▪ Tile runoff / Agri Drain ▪ Crest Stage Gage pictures ▪ Before and after photo of flume cleaning or vegetation removal



Table 3. Photos of interest to collect during site visits.

Figure 5. Examples of site photos.

MDA staff will request copies of all relevant photos periodically. Please save photos under the following format: **Date_SiteID_Type**. The date should be in the format mm-dd-yy. The photo “type” should include a descriptive comment (“SnowmeltRunoff”, “US” (upstream), or “DS” (downstream), “RainEvent”, “Field”, “Flume”, etc). If multiple photos (>5) exist for one field visit, use the format **Date_SiteID** for simplicity and then number the photos according to the time they were taken.

For example:

- 03-15-11_GO1_SnowmeltRunoff.jpg
- 05-14-11_BE1_RainEvent_US.jpg
- 05-14-11_BE1_RainEvent_US1.jpg
- 08-09-11_CH1_RainEvent_Ttube.jpg
- Multiple photos: 03-15-11_GO1 (1).jpg to 03-15-11_GO1 (12).jpg

1.3 SAMPLE COLLECTION AND PROCESSING

1.3.1 SAMPLE ID LABELING

Individual samples will be labeled following the format in Figure 6.

Each unique ID will specify the Station ID, water type (whether obtained from subsurface tile flow or overland flow through the flume), year and sample number for the specified year.

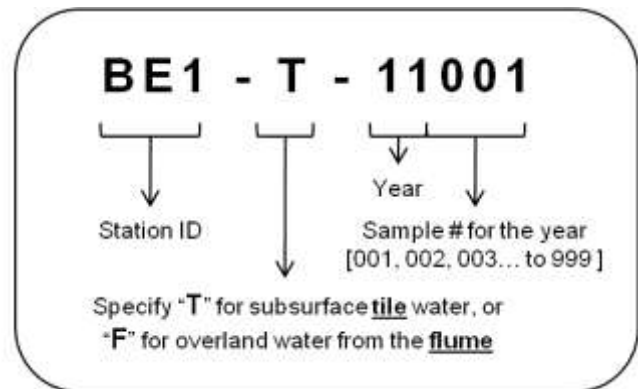


Figure 6. Description of Site ID labeling.

1.3.2 SAMPLE BOTTLE LABELING

Each sample bottle must contain a descriptive label before it is submitted to the lab. All labels must include the sample ID, date and time (central standard time). Record both the START and END times for each bottle on the site inspection document, but *only* the END date and time on the label and Chain of Custody.

DISCOVERY FARMS MINNESOTA

Sample ID: **BE2 - F - 11001**

END Date: 05/17/11 END Time: 16:05

MVT Account #: 005238

Figure 7. Example of sample bottle labels.

1.3.3 SAMPLER KEYPAD BASICS

ISCO 6712 Automatic Samplers will be used for the collection of water quality samples. Figure 8 shows the 6712 keypad and Table 4 highlights the functions. This can be found in the 6702 Portable Sampler Installation and Operation Guide.

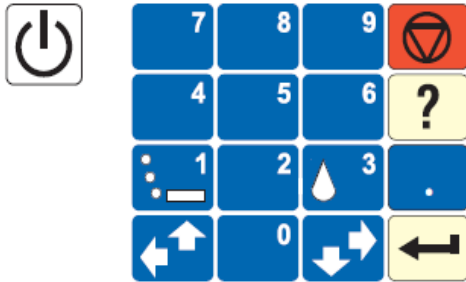


Figure 8. Autosampler Keypad

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.
	Numbers	Types a number.
	Decimal Point	Types a decimal point.
	Pump Reverse	Press when at the main menu to run the pump in reverse.
	Pump Forward	Press when at the main menu to run the pump forward.

Table 4. Description of ISCO Automatic Sampler keypad.

1.3.4 SAMPLE COLLECTION FOR RUNOFF EVENTS

The ISCO 6712 autosampler configuration will consist of four polyethylene one gallon bottles. Samples will be collected on an equal-flow increment composite basis. Once the flume or tile system reaches a predetermined level (0.01ft in the Agri Drain and 0.02ft in the flume), sampling will commence. The amount of flow in the flume or tile system will dictate how fast the composite bottle is filled. After the cumulative flow threshold is reached, the sampler will trigger one pulse of 125 ml into the first bottle. The cumulative flow counter will then start over, counting up from zero. When the threshold is reached again, another pulse of 125 ml will be collected into the bottle. Each one gallon bottle will be a flow-composited sample with 24 pulses totaling 3 liters (0.80 gallons). Once a bottle contains all 24 pulses, the sampler distributor arm will move to the next consecutive bottle. This process will continue either until the fourth bottle is full or flow subsides.

Once the automatic sampler has completed filling bottles following a rain event or snowmelt runoff, 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. Holding times are also critical for Dissolved Ortho Phosphorus and Total Suspended Sediment. Refer to Table 5 for associated holding times.

STEPS FOR RUNOFF SAMPLE COLLECTION:




- i. Record the display message on the autosampler head in the field notes. 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 error messages are displayed, troubleshoot the equipment to fix the error. Call an MDA Discovery Farms representative 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 start and stop times for each of the 24 pulses for bottles 1, 2, 3 and 4. The arrow keys can be used to toggle back and forth if a day or time is missed.
 - a. Document any errors that occur for each pulse, such as “no liquid detected” with the associated date and time.
- v. RECORD the start/stop date/time for each pulse and bottle.
 - a. “1, Bottle 1” and “24, Bottle 1”
 - b. “1, Bottle 2” and “24, Bottle 2”
 - c. “1, Bottle 3” and “24, Bottle 3”
 - d. “1, Bottle 4” and “24, Bottle 4”



Figure 9. Pulse #, Bottle #, and sample date and time readout of the ISCO 6712 Automatic Sampler. The two images above represent the start and stop times for bottle #1.

- 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 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. 500mL (preserved with H₂SO₄)
- 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. Unfasten the latches and place the sampler head back up inside the enclosure box.
- ix. Make sure to identify which bottle is which -- 1, 2, 3 and 4.
- x. Nitrile or protective gloves should be worn when handling water quality samples.
- 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 have been evenly distributed.
- xii. Upon shaking, immediately pour the representative sample into the appropriate labeled 500ml and 1L bottles.
- xiii. Once the appropriate 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 strong concentrated cleaning solution before being used again. A second full set of one gallon sample bottles should be provided for each monitoring station to allow for swapping out sanitized/dirty bottles. Please refer to Section 2.2 for the bottle washing procedure.
- xv. **IMPORTANT:** To prepare the sampler for the next runoff event, it will need to be reset (or resumed) 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.


- 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 10 shows the default screen readout when the sampler has been resumed and is ready for the next runoff event.




Figure 10. Autosampler default display screen for a resumed/restarted program. This shows that when triggered again from the datalogger, the sampler will begin with 1 of 24 pulses on bottle #1.


1.3.5 SAMPLE COLLECTION FOR SUBSURFACE TILE BASEFLOW

It is important to not only collect runoff samples for subsurface tile, but also to collect samples under low flow or baseflow conditions. If runoff samples were analyzed alone, the loading calculations would be biased and likely over estimated.

Baseflow samples should be collected every **two** weeks on average. An attempt should be made to collect at least one baseflow sample between runoff events. To collect a baseflow sample from the tile via the automatic sampler, a “grab” sample will need to be collected.

STEPS FOR BASEFLOW GRAB SAMPLE COLLECTION:

- i-a. If there is no program currently running; select **OTHER FUNCTIONS** from the main screen on the autosampler.
- i-b. 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.
 - a. 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. Place the tube over the one gallon bottle.
- 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.
- v. The sampler will 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. Once the sample is collected, reconnect the pump tube to the bulkhead fitting.
- 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, H₂SO₄)
- viii. Screw the lid tightly onto the one gallon sample bottle. Aggressively shake the bottle for 30 seconds to agitate the sample.
- ix. Upon shaking, immediately pour the representative sample into the 500ml and 1L MVTL bottles.
- x. Once the grab sample has been collected, immediately place the labeled bottle into a cooler, on ice.
- xi. The used one gallon sample bottle must be properly sanitized before it is used again. Refer to Section 2.2 for the bottle washing procedure.

1.3.6 CREST STAGE GAUGE

Crest Stage Gauges (CSG) are installed at each site as a verification of the event-maximum stage that the bubbler (pressure transducer) records in the flume. The CSG is a 3 foot long wooden dowel or PVC pipe with a small cup attached to the bottom. The small cup is filled with granulated cork and the dowel or PVC is housed in a 3 foot long, 2" diameter PVC pipe capped on both ends (one side permanently). The CSG is mounted using U brackets to the upstream wing wall near the flume (Figure 11). On the bottom few inches, several holes are drilled to allow water movement into the housing. When a runoff event occurs, the cork will float up through the enclosed unit and adhere to the wood or PVC as the water recedes. The level of the cork can then be measured

with a tape measure following a rain event and recorded to the **nearest 0.01 feet** in the site inspection document.

Once a measurement has been gathered, it is suggested to take a photo of the CSG with cork (see Figure 11). Once done, brush off the granulated cork from the dowel or PVC and make sure there is adequate cork remaining in the small cup. A small plastic jar of granulated cork will be kept at each site for refills.

The bottom of the CSG will be surveyed in with the bottom of the flume, and an offset will be applied to compare the CSG measurement with the peak bubbler measurement.



Figure 11. CSG location on upstream wingwall and cork measurements following a runoff event.



Figure 12. Manual rain gauge.

1.3.7 MANUAL RAIN GAUGES

Manual rain gauges will be installed at each Discovery Farm in close proximity to electronic tipping bucket rain gauges. The cylindrical plastic rain gauges have a capacity to measure 1" of rain (to the nearest 0.01") in the main cylinder and up to 11" in the outer cylinder which is designed to hold any water in excess of 1".

Rainfalls of less than 1" can be read directly from the 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.

1.3.8 CHAIN OF CUSTODY

A Chain of Custody (CoC) form is critical documentation for both the laboratory and Discovery Farms program. It is *the* legal paper trail and is required for each round of samples coming into 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 are provided from the lab. A completed example CoC form is included in Appendix D.

Under the date and time sampled for the CoC form, **enter only the END date and time for each sample**. The lab does not record the start dates/times; however, they still need to be recorded in the site inspection document.

1.3.9 SAMPLE PROCESSING

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. A list of analytes is included in Table 5. The same suite of analytes will be run for each sample collected.

Table 5. Laboratory analytes, holding times, minimum detection levels, analytical method numbers and accuracy for Minnesota Discovery Farms parameters.

Analyte	Holding Time	Minimum Detection Level	Method #	Accuracy
Total Suspended Solids (TSS)	7 days	2 mg/L	USGS 1-3765-85	+/- 0.1135 mg/L
Ammonia-N (NH ₃)	28 days	0.16 mg/L	SM 4500NH3, B, E	+/- 0.0209 mg/L
Nitrate+Nitrite (NO ₂ +NO ₃)	28 days	0.2 mg/L	EPA 353.2	+/- 0.0640 mg/L
Total Kjeldahl Nitrogen (TKN)	28 days	0.2 mg/L	SM 4500NorgB, NH3, E	+/- 0.0128 mg/L
Total Phosphorus (TP)	28 days	0.005 mg/L	EPA 365.1	+/- 0.0338 mg/L
Dissolved Ortho-Phosphorus (DOP)	48 hours	0.005 mg/L	EPA 365.1	+/- 0.0629 mg/L
Chloride (Cl ⁻)	28 days	3 mg/L	SM 4500 Cl, E	+/- 0.0426 mg/L

Immediately following collection, samples must be placed in ice chests (coolers) containing ice or ice substitutes. While transporting samples, ice chests should be cooled to a temperature of four degrees Celsius if possible. A general rule of thumb is “the cooler the better.” During winter months ice or ice substitutes may be unnecessary if the ice chest and vehicle temperatures remain low.

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 Coalition (MAWRC).

Efforts should be made get samples to the laboratory within 48 hours to abide by holding times. Samples must be shipped to the address below along with the completed CoC form. The form should be placed in a sealed Ziploc bag during transport to make certain that it does not get wet and lids to the coolers ought to be secured with packaging tape. 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 or (800) 782-3557

2.0 SITE MAINTENANCE

2.1 CALIBRATION OF STAGE

As previously mentioned in Section 1.2.3, frequent site visits are important to ensure that the equipment is providing accurate data measurements. Measured Stage (MS) values collected during site visits are crucial for correcting raw data from the bubbler or pressure transducer (via the datalogger). It is possible for a stage sensor to “drift” over time. Drift essentially means that the stage output has slowly *drifted* from the true value and is reading slightly off. The datalogger is set to calculate flow based on provided equations for the flume and AgriDrain. These equations are heavily reliant on the stage measurements in a calculated area and because of this, 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 greater than **0.02 feet**, the datalogger stage should be reset to what the current MS is. Prior to resetting any equipment, please verify that your MS value is accurate by taking one or more follow-up measurements. ***Always include notes in the site inspection document if the datalogger stage has been altered.***

If the equipment is showing drift repeatedly after being corrected during previous site visits, there may be a bigger issue. Please contact a MDA Discovery Farms representative to discuss these issues.

STEPS TO CHANGING THE DATALOGGER STAGE FOR SUBSURFACE TILE:

- i. From the main home screen on the datalogger, select **SENSORS**
- ii. Select “**Stage_PT**”
- iii. Hit the “SET” button
- iv. Enter the current stage value to the nearest 0.005 feet, and click “OK”
- v. Confirm the stage settings by clicking “YES”

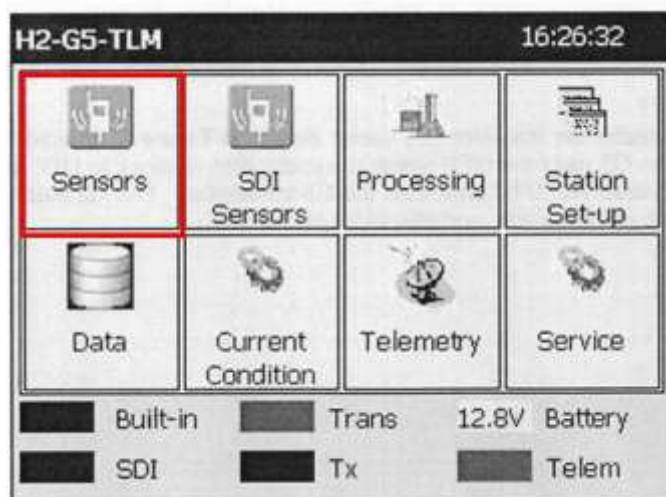


Figure 13. Main screen for FTS H2 datalogger

2.2 BOTTLE CLEANING

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

Supplies needed:

- Non-phosphate soap (Extran, a commercial cleaner)
 - * **CAUTION:** Extran is a strong base and can be corrosive. Caution must be used in handling this product, including eye and skin protection.
 - * Extran Material Safety Data Sheet (MSDS): <https://www.vwrsp.com/msds/10/EM-/EM-EX0996-2.pdf>
- Distilled/De-ionized (DI) water
- Cleaning brushes (plastic)
- Cleaning basin (plastic, stainless steel or glass)
- Nitrile gloves
- Protective eyewear

Bottles

- i. Prepare 1-2% solution of Extran inside of each one gallon sample bottle. 1% solution is equal to approximately 38 ml of Extran, with the rest being water.
- ii. Allow the solution to soak for at least 10 minutes.
- iii. Use a bottle brush to mechanically remove any particles attached to the bottle.
- iv. Rinse at least three times with hot tap water, followed by triple rinsing with de-ionized water.
- v. Allow bottles 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 (see below).

Lids

- i. Soak caps in 1-2% Extran solution for at least 10 minutes.
- ii. Mechanically remove any particulate matter.
- iii. Rinse three times with hot tap water, followed by triple rinsing with de-ionized water.
- iv. Allow caps to air dry the place on a clean bottle.

2.3 WINTER MAINTENANCE

Winter runoff in Minnesota is infrequent, but it is imperative to keep a keen eye on the weather throughout the winter months and especially prior to snowmelt runoff in early spring. Generally, during winter months it will take a few consecutive days of above-freezing temperatures to generate any runoff. If these conditions are foreseen, it should be 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 even layers of snow and

ice). Ice buildup blocks the sampler and bubbler lines causing them to freeze and read erroneously high potentially causing the automated sampler to falsely trigger. Prior to any winter runoff events, the flume will need to be cleared of snow and ice (Figure 14).



Figure 14. Progression of flume cleaning. 1) Shovel and remove excess snow. 2) Carefully melt and chip out any ice. 3) Clear upstream and downstream flow paths.

Unless properly supported, flumes are not constructed to withstand significant weight. Take care and try not to stand inside of the flume if possible. 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 15). 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 causing the stage to be inaccurately high. This also slows the water velocity considerably making flow calculations incorrect.

On the upstream side of the flume, snow must be cleared out of at least a three to six foot cone (Figure 16). 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 times, 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 15. Snow removal area downstream from flume.



Figure 16. Snow removal area upstream of flume.

2.4 FLUME CLEANING

After a runoff event, sediment and debris will likely remain on the floor of the flume (Figure 17). This residual sediment must be properly cleaned to prevent contamination of sample water during the *next* runoff event. 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.

Note in the site inspection document 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 17. Flume before and after cleaning.

2.5 PUMP TUBING REPLACEMENT

New silicone sampler tubing will be installed annually or on an as-needed basis by the Minnesota Department of Agriculture staff. Only sampler tubing made specifically for ISCO 6712 autosamplers will be used. Tubing will 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. Field blanks (see Section 3.2) 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.

2.6 DESICCANT

A humidity indicator is located on the ISCO 6712 auto sampler face (see Figure 18). 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 (see Figure 19). Contact a MDA Discovery Farms representative immediately if the 30 is pink.



Figure 18. Location of humidity indicator card on the ISCO 6712 autosampler.

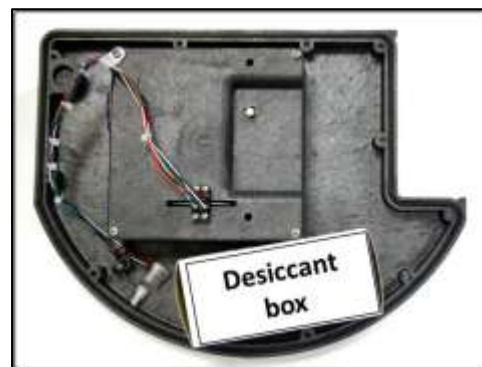


Figure 19. Location of desiccant box under the ISCO 6712 autosampler head.

2.7 FLUME LEVELNESS

Determining the levelness of the flume is critical to acquiring accurate stage measurements and subsequently flow calculations. Flumes must be level from front to back and side to side, however, this can be difficult to maintain with the freeze-thaw characteristics of winter in Minnesota. The Wisconsin Discovery Farms program has found that a tilt of just 0.02 feet from front to



Figure 20. Checking flume levelness.

back can cause discharge measurements to be underestimated by 10 percent.

Small levels (Figure 20) 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. Bubbles will be drawn in the field notes to maintain consistent level readings.

On an as needed basis, an attempt will be made to level unlevel flumes as best as possible by tightening or loosening turn buckles attached to the wingwall and 4x4s supporting the flume.

2.8 PADLOCKS

Each enclosure box will be locked with a standard four number combination padlock. Although most sites are located 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.

2.9 FIELD CAMERAS

As previously mentioned in Section 1.2.3, a stationary field camera is installed at each site. These cameras will be set to collect one photo each day at 12:00 CST. The cameras will also trigger during runoff events. One photo will be collected with each pulse the automated sampler collects (24 pulses per bottle). An event that fills all four one gallon bottles should ideally collect 96 photos throughout the duration of the runoff event. Cameras are housed in weatherproof enclosures and will be positioned to collect photos with a view of the upstream field and flume.

The digital cameras are loaded with a 4GB memory card which should only need to be downloaded a few times throughout the year. Minnesota Department of Agriculture staff will be responsible for downloading the SD cards and replacing rechargeable batteries on an as needed basis.

During each field visit, make sure that the camera enclosure viewing glass is cleaned of dust, dirt and water droplets that may interfere with the clarity of the photos.

3.0 QUALITY ASSURANCE AND QUALITY CONTROL

3.1 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-11014 would be the duplicate of BE1-F-11013).
- 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. As a general guideline, at least **10%** of composite samples submitted to MVTL should be duplicates.

3.2 FIELD BLANK

Field 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. 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. Field Blanks will be submitted blind to the laboratory.
- iii. The entire suite of parameters listed in Table 5 for which a standard sample is analyzed will also be evaluated with field blank samples.
- iv. Field Blanks 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 blank is collected. The sample IDs for the field blank must also be written in the document.
- vi. As a general guideline, at least **5%** of samples submitted to MVTL should be field blanks.

3.3 RAIN GAUGE CALIBRATION

Rain gauge calibration will be conducted once every three years by the manufacturing company, Forest Technology Systems (FTS). Rain gauges will be shipped to FTS who will then replace bearings and recalibrate the tipping mechanism.

During each field visit, the rain gauge should be closely inspected to make sure that debris has not clogged the water intake. If debris is present, it should be immediately cleared out and noted on the site inspection document. Gauge levelness should also be checked on a frequent basis.

4.0 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.

Surface and sub-surface stage data will be corrected using Stream Trac software available through Forest Technology Systems (FTS). Data will be assigned a quality code based on estimated accuracy and finalized flow data will be stored in a MDA database and made available through the Discovery Farms Minnesota webpage.

4.1 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 Stream Trac software. Raw data will be downloaded by MDA staff daily and backed up monthly on a secured MDA network server. 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.

4.2 WATER QUANTITY 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 measurements) and an APG brand ultrasonic transducer (secondary). Detailed field notes are of crucial 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 gage mounted within the flume (Section 1.2.1). Crest Stage Gauges (see Section 1.3.6) will also be installed at each surface runoff site as a backup measurement for a peak runoff stage.

Dual stage measurement devices will be highly beneficial for correcting data. In situations where one instrument is tracking poorly (clogged bubbler intake, 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 stages, crest gauge field readings and dual sensor measurements, the raw stage data will be corrected at the conclusion of the calendar year. Data corrections and finalization will occur from January through March.

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 6).

Table 6. 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	$Q=0.000787-0.01082*H^{0.05}+0.0745962*H^{1.5}+1.511207*H^{2.6}$
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 Greyline or Starflow area velocity flow modules. These probes measure both the level and velocity of water through the tile. Two stop logs, at a total height of 12” are installed within the Agri Drain structure in order to fully submerge the inlet tile (Figure 2 and Figure 3). To calculate flow, the velocity through the pipe will be multiplied by the area of the submerged tile.

A 2nd method to calculate flow involves measuring the level of water over the top stop log. Flow can be calculated by inputting the level (or height of water) into a rating equation developed by Dr. Richard Cooke, Associate Professor of Agriculture Engineering at the University of Illinois. As with the flume, a “measured stage” is measured and calculated from a known reference point during each site visit to ensure the area velocity probe is properly tracking stage. This second flow calculation method can be used as long as the tile is not in a state of surcharged flow or backwater conditions.

Table 7. Flow equation for 8” tile over stop logs within an Agri Drain.

TILE DIAMETER (inches)	FLOW EQUATION Q=Flow (cubic feet per second) H=Head (feet)
8	$Q=1.5114*(H^{1.2087})$

4.3 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 to verify that all data are present and no typos exist.

4.4 WATER QUALITY ANALYSIS

Water quality and quantity (flow) data will be combined to calculate constituent loads, yields and flow weighted mean concentrations. As described in Section 1.3.4, 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. Each one gallon sample has a specific start and stop time, which is recorded by the datalogger. The sample results are applied to the flow period the sample was collected. For periods between samples when no water chemistry results are available, the concentration is extrapolated based on the surrounding samples. For sub-surface tile sites, baseflow sample concentrations are applied to the baseflow periods. Loads, yields, and FWMC's will be tabulated by specific storm events, months and year. Monthly values will be used to tabulate seasonal values.

4.5 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.

4.6 SOIL MOISTURE AND TEMPERATURE DATA

A Campbell Scientific Soil Water Content Reflectometer will be installed at each site to measure the soil volumetric water content (soil moisture), bulk electrical conductivity

and temperature. A Microcom Soil Temperature probe will also be instrumented at each site to measure soil temperature at four depths; 5, 10, 30 and 60cm.

All meteorological and soils data will be appended and correlated with the appropriate stage, flow and water chemistry data and periodically backed up and saved in an Excel spreadsheet on a secured MDA network drive.

4.7 DATA STORAGE AND SUBMITTAL

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

Discovery Farms will utilize EQulS 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 EQulS specified templates and submit to MPCA staff for inclusion into the EQulS database on a quarterly basis, or more/less frequently as the need permits.

APPENDIX

A. PROJECT CONTACT INFORMATION

MINNESOTA DEPARTMENT OF AGRICULTURE	STAFF	ADDRESS	CONTACT INFORMATION
	1 Scott Matteson , Hydrologist	MN Dept. of Agriculture 12 Civic Center Plz, Ste 2165 Mankato, MN 56001	Office: 507.344.5261 Cell: 507.216.2299 Email: scott.matteson@state.mn.us
	2 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
	3 Adam Birr, PhD. Impaired Waters Technical Coord.	MN Dept. of Agriculture 2300 Silver Creek Road Rochester, MN 55906	Office: 507.206.2881 Cell: 507.696.5624 Email: adam.birr@state.mn.us
	4 Heather Johnson , MDA Monitoring Unit Supervisor	MN Dept. of Agriculture 625 Robert Street North St. Paul, MN 55155	Office: 651.201.6098 Email: heather.johnson@state.mn.us

MINNESOTA AGRICULTURAL WATER RESOURCES COALITION	STAFF	ADDRESS	CONTACT INFORMATION
	1 Tim Radatz , Research Specialist	MAWRC 3080 Eagandale Place Eagan, MN 55121	Office: 651.768.2106 Cell: 608.443.6587 Email: radatz@mawrc.org
	2 George Rehm , Discovery Farms Coordinator	MAWRC 3080 Eagandale Place Eagan, MN 55121	Office: 651.768.2106 Cell: 507.263.9127 Email: rehm001@umn.edu
	3 Warren Formo , Executive Director	MAWRC 3080 Eagandale Place Eagan, MN 55121	Office: 651.768.2106 Email: warren@mawrc.org

Numbers indicate order to call, by agency.

B. PROJECT PARTNERS

DISCOVERY FARM	AGENCY	ADDRESS	CONTACT INFORMATION
BE1	Minnesota Department of Agriculture	Scott Matteson, Hydrologist 12 Civic Center Plz, Ste 2165 Mankato, MN 56001	Office: 507.344.5261 Cell: 507.216.2299 Email: scott.matteson@state.mn.us
BE2	Minnesota Department of Agriculture	Scott Matteson, Hydrologist 12 Civic Center Plz, Ste 2165 Mankato, MN 56001	Office: 507.344.5261 Cell: 507.216.2299 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
		Casey Thiel, Water Resource Specialist 38814 Third Avenue North Branch, MN 55056	Office: 651.674.2333 Email: casey.thiel@mn.nacdnet.net
GO1	Goodhue County SWCD	Beau Kennedy, Water Planner/Wetland Adm 104 E 3 rd Ave, PO Box 335 Goodhue, MN 55027	Office: 651.923.5286 Email: bkennedy@goodhueswcd.org
ST1	Stearns County SWCD	Mark Lefebvre, Nutrient Management Spec. 110 2 nd St. So., Suite 128 Waite Park, MN 56387	Office: 320.251.7800, ext 3 Email: mark.lefebvre@mn.nacdnet.net
	Sauk River Watershed District	Heather Lehmkuhl, Monitoring Coordinator 524 Fourth Street South Sauke Centre, MN 56378	Office: 320.352.2231 Email: heather@srwdmn.org

C. SITE INSPECTION DOCUMENT (EXAMPLE)



MINNESOTA DEPARTMENT OF AGRICULTURE

DISCOVERY FARMS MINNESOTA



SITE NAME	DATE (mm/dd/yy)	TIME (CST)	STAFF
ST1	05/13/2011	16:40 CST	John Doe, MDA

FIELD MEASUREMENTS	FLUME Measured Stage (ft) [staff gage reading from flume]	TAPEDOWN MEASUREMENT [Measure of distance from HP to water surface]	SUBSURFACE TILE Measured Stage (ft) [RP - Sigedown]		
	0.435 ft	RP = 4.90 TD = 4.68 ft	4.90 - 4.68 = 0.22 ft		
	FLUME T-Tube (cm)	VISIT TYPE		Photos taken	Camera Battery Checked
6 cm	<input checked="" type="checkbox"/> Rain event <input type="checkbox"/> Snowmelt Runoff <input type="checkbox"/> Crest flow sampling <input type="checkbox"/> Site Maintenance/check up		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

DATALOGGER INFORMATION	TIME (military, CST)	Head_APG (stage for backup ultrasonic in flume)	WTemp (water temperature)	AHum (air humidity)	ATemp (air temperature)
	16:40	0.439 ft	43.5 degF	87 %	46 degF
	Stg_PT (stage for pressure transducer, tile)	T_flow (flow for tile)	VBatt (battery voltage)	SoilTemp (soil temperature)	SoilMoist (soil moisture)
	0.24 ft	0.213 cfs	13.1 volts	42 degF	91 %
	Head_ft (stage for flume)	F_flow (flow for flume)	DOWNLOAD START (date / time)	DOWNLOAD END (date / time)	Datalogger % Full
	0.441 ft	0.336 cfs	4/30/11 10:15	5/13/11 16:30	13 %
	Datalogger Capacity	Crest Stage Gauge Measurement	Datalogger notes		
231 days	0.65 ft	Difference for tile and flume were both less than 0.03 feet. No charges/offsets were made to the datalogger stage values.			

STAGE ACCURACY	DIFFERENCE (FLUME) [FLUME Measured Stage - datalogger Head_ft]	DIFFERENCE (TILE) [SUBSURFACE TILE Measured Stage - datalogger Stg_PT]
	0.435 - 0.441 =	-0.006 ft (good)

AUTOSAMPLER NOTES	FLUME AUTOSAMPLER				TILE AUTOSAMPLER			
	Bottle Completed? 1 2 3 <input checked="" type="checkbox"/> 4 Complete		CURRENT CONDITIONS: Bottle _____ Pulse# _____ / 24		Bottle Completed? 1 2 <input checked="" type="checkbox"/> 3 4 Complete		CURRENT CONDITIONS: Bottle 4 Pulse# 16 / 24	
	Bottle 1	START date / time 5/13/11 09:47	Bottle 2	START date / time 5/13/11 11:09	Bottle 1	START date / time 5/13/11 04:57	Bottle 2	START date / time 5/13/11 08:11
		END date / time 5/13/11 10:57		END date / time 5/13/11 11:39		END date / time 5/13/11 07:29		END date / time 5/13/11 11:47
	Bottle 3	START date / time 5/13/11 12:18	Bottle 4	START date / time 5/13/11 13:57	Bottle 3	START date / time 5/13/11 12:09	Bottle 4	START date / time 5/13/11 14:48
		END date / time 5/13/11 13:34		END date / time 5/13/11 14:46		END date / time 5/13/11 14:36		END date / time Pulse 16: 5/13/11 16:31
Notes: Sampler was full while flow was still present. Reset back to bottle 1 (will probably collect 1-2 more bottles)				Notes: Bottle 4 was not completed; collected bottle 4, and listed stop time as the stop time for pulse 16. Purged remaining samples, restarted sampler/program on bottle 1.				

WATER QUALITY QA/QC	BOTTLES sanitized with Extran?	QA/QC sample collected	QA/QC Sample Label (specify associated bottle #, or grab sample)
	<input checked="" type="radio"/> Yes <input type="radio"/> No	<input checked="" type="radio"/> DUPLICATE <input type="radio"/> REPLICATE BLANK NONE	FLUME dup ID: ST1 - F - 11016 (duplicate for bottle #4)
WEATHER CONDITIONS	46 degF, mostly cloudy (80%), NE wind 15-20mph, gusts to 30mph. Significant rain event this morning (5/13) produced 2.5" of rain in the area, high intensity, short lived t-storms. 0.75" of rain also fell on 5/10. No rainfall for 2.5 weeks prior to 5/10 (dry conditions). <small>Temperature, % cloud cover, wind speed, recent weather conditions (Rain event? Dry?)</small>		
CURRENT AGRONOMY CONDITIONS	2011 = corn. With recent rain, corn is looking very green and lush, approximately 6-10" tall. Acetochlor applied 2 weeks ago. Grasses in the grassed waterway are approximately 1-2' high. Very saturated soil conditions, water is ponded in between some rows and in adjacent road ditches. <small>Crop and field conditions, crop height</small>		
FLUME & CHANNEL OBSERVATIONS	Moderate flow, fairly turbid, falling limb of hydrograph. Small debris flowing through flume; doesn't appear to be interfering w/flow. Flow is slightly turbulent DS. DS vegetation is becoming significant (maintenance needed soon). Overland flow will likely subside within the next hour. <small>Water clarity (clear, sediment, debris, etc), flow conditions</small>		
TILE OBSERVATIONS	Moderate flow. Rising limb (will likely peak sometime within the next 2-3 hours). Very clear water. Smooth flow over the stop logs. Free flow conditions, no backwater. <small>Water clarity (clear, sediment, debris, etc), flow conditions</small>		
MAINTENANCE COMPLETION or NEEDED NOTES	Notes: Desiccant was replaced under the sampler head 2 weeks ago (should be good for the rest of the monitoring season). A follow-up visit will be needed tomorrow to collect the next set of samples and to clear any residual sediment out of the flume. The rain gage was plugged with leaf debris (may have an effect on this morning's storm event totals). Data will need to be reviewed for that time period.		
	FLUME LEVELNESS: <input checked="" type="radio"/> Good <input type="radio"/> Needs to be leveled <input type="radio"/> Leveled	FLUME CLEANING: <input checked="" type="radio"/> Good <input type="radio"/> Cleared of sediment/debris <input checked="" type="radio"/> Will need cleaning	VEGETATION REMOVAL NEEDED: <input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Completed
	RAIN GAGE: <input type="radio"/> Clear <input checked="" type="radio"/> Plugged <input type="radio"/> Level <input checked="" type="radio"/> Cleaned	SOLAR PANEL: <input checked="" type="radio"/> Clean <input type="radio"/> Cleaned <input type="radio"/> Needs to be cleaned	DESICCANT: <input type="radio"/> New <input checked="" type="radio"/> Good <input type="radio"/> Bad <input type="radio"/> Needs to be changed
MISC. FIELD NOTES	<p>FLUME: 4 bottles collected, IDs ST1-F-11012 to ST1-F-11016 (includes one duplicate). Still flowing, reset.</p> <p>TILE: 4 bottles collected, IDs ST1-T-11020 to ST1-T-11023. Still flowing, reset.</p>		

D. AUTOSAMPLER DATA SHEET (EXAMPLE)



Automated Sampler
(circle one) | TILE / FLUME



BOTTLE 1				BOTTLE 2					
Pulse	Time	Date	Comment	Pulse	Time	Date	Comment		
1	17:43	5/17/11	START for Bottle #1	1	4:46	3/18/11	START for Bottle #2		
2	17:58	↓		2	5:02	↓			
3	18:09			3	5:17				
4	18:21		program stopped @ 18:34	4	5:49				
5	18:42			5	6:19				
6	19:00			6	6:32				
7	19:25			7	6:56				
8	19:59			8	7:07				
9	20:33			9	7:23				
10	20:51			10	7:46				
11	21:28			11	8:06				
12	22:03			12	8:41				
13	22:49			13	9:02				
14	23:58		↓	No liquid detected	14		9:33	↓	
15	1:01	5/18/11		15	10:17				
16	1:16	↓		16	11:06	END for Bottle #2			
17	1:39			17	Flow subsided, program stopped				
18	2:05		No liquid detected	18	3/18 at 11:09. No more samples.				
19	2:41			19					
20	2:59			20					
21	3:18			21					
22	3:44			22					
23	4:00			23					
24	4:22		↓	END for Bottle #1	24				
Sample ID Label			BE1 - F - 11012		Sample ID Label		BE1 - F - 11013		

E. MANUAL RAIN GAUGE – FIELD DATA SHEET (EXAMPLE)



DISCOVERY FARMS
MINNESOTA




MINNESOTA DEPARTMENT
OF AGRICULTURE

MANUAL RAIN GAGE DATA COLLECTION

DATE (mm/dd/yy)	TIME (Daylight Savings Time)	RAINFALL (Inches)	NOTES*
6/22/2011	14:50 DST	1.78"	Rainfall exceeded 1", poured off remaining water from overflow cylinder twice to verify measurement. 1.78" is the accumulated result from rains occurring between 6/21-6/22 which included 3-4 flashy runoff events with scattered thunderstorms.
EXAMPLE	EXAMPLE	EXAMPLE	EXAMPLE
3/11/2011	9:35 DST	0.33"	Overnight rainfall (low intensity), contributing to snowmelt runoff.
3/19/2011	10:40 DST	0.26"	High intensity rain burst between 8:30-9:00am DST this morning.
4/3/2011	14:20 DST	0.93"	Low intensity soaker rain lasting from approximately yesterday (4/2) in the morning to this morning (4/3).
4/21/2011	15:35 DST	2.29"	Exceeded 1", measured twice. High intensity, scattered and sporadic thunderstorms occurring from 4/19-4/21. Multiple storms and runoff events.
5/1/2011	11:05 DST	0.11"	Low intensity rainfall occurred in multiple scattered rain showers from 4/29-4/30.
5/2/2011	13:55 DST	0.08"	Low intensity rainfall occurred in one shower from approximately 5/2 @ 8:00am-10:00am.
5/13/2011	12:00 DST	1.09"	Rainfall exceeded 1", poured off overflow amount twice to verify reading. Rainfall occurred in one flashy t-storm (5/12), afternoon hours.

* **NOTES:** Please include any information pertaining to the storm event: date, time, duration, rainfall intensity (low, medium, high, flashy), and how many "events" are included in the rainfall manual measurement (one event, multiple small events from "May 15-May17th", etc)

F. CHAIN OF CUSTODY FORM (EXAMPLE)



LABORATORIES, Inc.
1126 North Front Street
New Ulm, MN 56073
Phone: (507) 354-8517 Fax: (507) 359-2890

Discovery Farms
3080 Eagandale Place
Eagan, Minnesota 55121

Contact Name: County SWCD/Project Partner
Address: _____
City, State, Zip Code: _____
Telephone #: _____

Page _____ of _____

Chain of Custody Record

Work Order # _____

Account #: 5238 Phone #: 507-344-5261

Contact: Scott Matteson, MDA Fax #: _____
For faxed report check box

Name of Sampler: _____ E-mail: rehmx001@umn.edu
(insert sampler name) scott.matteson@state.mn.us

Quote Number: _____ Date Submitted: _____
(today's date)

Project Name: DISCOVERY FARMS MINNESOTA Purchase Order #: _____

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
	ST1 - F - 11018	↓	4/15/2011	12:47		X				X							TP
	ST1 - F - 11019		4/16/2011	2:11		X				X							Dissolved PO ₄
	ST1 - F - 11020		4/16/2011	4:49		X				X							NO ₂ +NO ₃
	ST1 - T - 11029		4/16/2011	3:42		X				X							TKN
	ST1 - T - 11030		4/16/2011	9:06		X				X							Ammonia
	ST1 - T - 11031	↓	4/16/2011	11:28		X				X							Chloride
	ST1 - T - 11032		4/16/2011	14:02		X				X							

Fill out the END date and time for the sample

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

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

2. _____