Data Management Plan

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Version 1

Table of Contents

1.0 Introduction

1.1 Project Description

ONFARM is a four-year, Canadian Agricultural Partnership funded initiative that was announced on December 5, 2019 by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). ONFARM is delivered by the Ontario Soil and Crop Improvement Association (OSCIA) with the support from various organizations including OMAFRA, Agriculture and Agri-Food Canada (AAFC), Environment and Climate Change Canada (ECCC), several Conservation Authorities and The Soil Resource Group (SRG). ONFARM is also supported by a network of ONFARM cooperators who are essential to the success of this program.

ONFARM builds on work completed under the Great Lakes Agricultural Stewardship Initiative's (GLASI) Priority Sub-watershed Project (PSP), supports Ontario's Soil Health and Conservation Strategy, and helps the industry meet commitments under the Great Lakes Water Quality Agreement. The three pillars of ONFARM that will benefit Ontario's agricultural industry are:

1. Continuation of the water quality monitoring and modelling established in the Priority Subwatersheds,
2. Establishment of on-farm paired trials in-field to identify soil health indicators and test the effectiveness of best management practices (BMPs) in cooperation with farmers,
3. Enhanced engagement opportunities with stakeholders and farmers to foster a network of demonstration farms.

1.2 Data Management Plan Objective

To achieve the objectives outlined above, OSCIA and ONFARM service providers will collect several types of data throughout the life of the program. Data will largely be collected from working farms across the province by several participating organizations. It will be used and shared by several project partners and a selection of data will be made available to the broader agricultural industry and the public. The objective of the ONFARM Data Management Plan (DMP) is to ensure that all ONFARM data is being collected, shared and used in a uniform and responsible manner. The ONFARM Data Management Plan (DMP) will:

- Identify key organizations and stakeholders involved in data storage, sharing, and management
- Outline the types of data collected and their collection methods
- Describe how data will be stored and by whom
- Govern how ONFARM will use and share data

1.3 Project Duration and Data Management Plan Updates

ONFARM data collection began in late 2019 and is scheduled to end in early 2023. Until then, the DMP will be considered a living document to be updated annually. The DMP will be publicly available and posted on the ONFARM project webpage by May 1st each year for the duration of the program. OSCIA will be responsible for posting and updating the DMP with guidance from the ONFARM Technical Working Group (TWG).

2.0 ONFARM Organizations

2.1 ONFARM Structure and Partners

As a collaborative effort across Ontario's agricultural sector, ONFARM will include many different individuals and organizations as part of the project. Participating organizations will have different levels of access to ONFARM project data depending on their level of involvement. The key organizations that will be responsible for collecting, storing, and managing ONFARM data are defined in Table 1. In addition to the major partners listed, it should also be noted that two working groups have been formed that will play a role in data management: The Technical Working Group (TWG) and the Stakeholder Engagement Working Group (SEWG). These working groups will access and use data in varying capacities which is also described in Table 1.

Table 1. Key ONFARM partners and organizations and their respective role in ONFARM as it pertains to data sharing and management.

Organization	Description and Role
OSCIA	OSCIA administers ONFARM and is responsible for overseeing all aspects of data sharing and management.
OMAFRA	OMAFRA administers funding for ONFARM through the Canadian Agricultural Partnership. OMAFRA staff members of the Environment Management Branch contribute non-voting representation on the technical working group and provide input on all project activities including data collection and management. OMAFRA is also a member of the SEWG. OSCIA reports on all activities to OMAFRA.
AAFC	AAFC provides technical input on ONFARM activities through their participation in the Technical Working Group.
ECCC	ECCC provides technical input on ONFARM activities through their participation in the Technical Working Group.
Service Providers	OSCIA has contracted several "service providers" to assist in delivering specific components or activities. The primary service providers who will be collecting, managing, and using ONFARM data are listed below: • SRG coordinates the BMP field trials and will collect and analyze soil health, pedology, agronomic and economic data from cooperating farms. • Wilton Consulting Group (WCG) will advise on outreach and engagement data collection. They will use and interpret collected data. • OSCIA will subcontract priority subwatershed modelling activities to a qualified third-party yet to be selected. • Additional service providers may be contracted as needed and will adhere to the guidelines of this DMP and other contractual obligations to OSCIA.
Conservation Authorities	Five separate conservation authorities are collecting data and contributing to the ONFARM project: Ausable Bayfield Conservation Authority, Essex Region Conservation Authority, Lower Thames Valley Conservation Authority, Maitland Valley Conservation Authority, and Upper Thames River Conservation Authority.

	These five organizations are working with farmers in their respective geographies to collect Edge of Field water quality and quantity information and land-use management data in several priority subwatersheds.
Technical Working Group (TWG)	The TWG acts as a technical/scientific advisory and coordination group to provide guidance on all soil health and priority subwatershed activities including methodology, data collection, data management and reporting. The TWG is chaired by OSCIA and includes representatives from each participating conservation authority, OMAFRA, ECCC, AAFC, and SRG.
Stakeholder Engagement Working Group (SEWG)	The SEWG directs the development and implementation of engagement and communication activities, including building industry support for the establishment of a network of long-term applied research demonstration sites. OSCIA, with the contracted support of WCG, coordinates the SEWG which is comprised of of individuals representing organizations with a strong network in Ontario's agricultural community. More information about the SEWG and the organizations involved can be found in the Outreach and Engagement Strategy.

2.2 Roles and Responsibilities

To further illustrate the role each organization has in the ONFARM project, Table 2 describes the varying level of involvement and responsibilities each organization has in relation to collecting, managing, and sharing ONFARM data as a Responsibility Assignment Matrix (RAM). Definitions as they pertain to the RAM are defined in the glossary (Section 6.0).

Table 2. Responsibility Assignment Matrix for key ONFARM tasks and deliverables concerning data collection, management, and display. Definitions of responsible, accountable, consulted, and informed are defined in the glossary.

Task / Deliverable	OSCIA	OMAFRA	Service Providers	Conservation Authorities	TWG	SEWG
Create and update data management plan	R, A	C	C	C	C	I
Advise on soil and water data collection	R, A	R	R	R	R	I
Collect ONFARM soil and water data	A	C	R	R	C	I
Collect outreach and engagement data	R, A	C	R, I	R, I	I	R
Communicate project results	R, A	I	R	R	I	R
Create project reports	R, A	I	C	C	C	C
Manage ONFARM website and public data	R, A	I	I	I	I	I
Manage agreements with all applicable parties	R, A	C	C	C	C	I
Facilitate data sharing requests	R, A	C	C	C	C	I

R = Responsible, A = Accountable, C = Consulted, I = Informed

2.3 ONFARM Cooperators and Participants

ONFARM is supported by a network of farmers and industry stakeholders that are working with ONFARM to support its objectives. These cooperating farmers and program participants form the foundation for this program and are essential to its success. The term "ONFARM cooperator" is used to describe the 33 farmers that have agreed to participate in the program by allowing applied research activities to be conducted on their farms. The environmental data, business information, agronomic data and best

management practice implementation conducted at each ONFARM cooperator site will constitute the data collected throughout this program. In addition to ONFARM cooperators, several other program participants may contribute data to the program that will be stored, analyzed, and shared. This may include survey respondents or attendees of ONFARM events. Data will be collected by OSCIA, conservation authorities, or service providers about individuals who agree to participate in surveys and events to inform project results and ONFARM engagement success.

3.0 Data Collection, Processing and Reporting

3.1 Overview

Section 3.0 discusses the collection methods and types of data being collected for ONFARM for each major project activity: Soil Health Paired BMP Trials, Edge of Field Monitoring, Priority Subwatershed Modelling, and Outreach and Engagement. It will also briefly describe each project activity and the reporting schedule for ONFARM data. In general, the data processed for ONFARM follows the format shown in Figure 1 where, data is collected by conservation authorities and service providers, processed, reported, and then communicated.

Figure 1. Sequential description of the data collection, reporting and sharing process in the ONFARM program.

3.2 Paired Soil Health BMP Data

25 ONFARM cooperator sites have been established to study soil health in five regions of the province: Lake Erie West, Lake Erie East, Western, Central, and Eastern Ontario. These 25 sites are focused on paired soil health BMP trials to identify soil health indicators and test the effectiveness of BMPs such as cover crops, organic amendments, and reduced tillage across a variety of soil types and farm types. Data from the paired soil health BMP sites will be collected by SRG through various methods including but not limited to interviews, consultations, in-field surveys, roadside observations, soil sample collection, remote sensing and accessing existing data sources. Data will include farm business data, agronomic data, land and field data, as well as environmental, weather and climate data. Examples of data under each category are shown in Table 3. A more specific list of soil and soil health parameters being assessed can be found in Appendix A.

Table 3. Examples of data that may be gathered as part of the ONFARM program*

Farm Management and Business Data	Agronomic Data	Land and Field Data	Environmental, Weather and Climate Data
• Farm layout • Nutrient management information • Cost of production • Commodity prices • Machinery, equipment and implements • Crop protection costs (herbicide, pesticide, fungicide)	• Planting / harvesting dates • Yield data • Planting data • Fertilizer use and application rates • Organic Amendment use, application rates and nutrient analyses • Soil test / fertility data	• Tillage practices • Crop rotation • Field boundaries • Field topography • GPS data • Soil physical, chemical, and biological properties • Soil drainage data	• Precipitation • Temperature • Wind speed • Relative humidity • Soil temperature

**The table above is not exhaustive and is meant to provide examples of the data that may be collected during the ONFARM program.*

3.3 Edge Of Field Data

In addition to the 25 paired soil health research sites, seven Edge of Field (EOF) monitoring sites have been established in six priority subwatersheds of the Lake Erie and Lake Huron Basins. These seven EOF sites will examine key soil health indicators and monitor the impact that different BMPs and agricultural practices have on nutrient loading and water quality in the surface water leaving the field. These efforts will build upon work completed under GLASI and will also be conducted on working farms coordinated by the local conservation authorities. A full list of parameters being collected at EOF sites is outlined in Appendix B.

SRG will work to collect and manage soil health data at the EOF sites as described in section 3.2. In addition to soil health data, water quality and quantity data will also be collected and managed by the local conservation authority. At each of the EOF sites, conservation authorities will collect water quality and quantity data. Data will be collected both manually by staff and automatically by in-stream sampling equipment installed at the site.

3.4 Priority Subwatershed Surveys and Profitability Mapping

In each PSP soil, water quantity, and water quality measurements will also be complemented with additional assessments to describe the land-use practices. Windshield surveys, land management surveys, and profitability mapping of select acreage will all be conducted within each PSP. This information will ultimately be used to inform subwatershed models described in section 3.5.

Conservation authorities will conduct windshield surveys by visually assessing land-use information from the roadside. Profitability maps and land management surveys will be conducted with farmers in each subwatershed and will include the collection of farm management data, business data, agronomic data, land data, and field management data. These activities will be conducted with both the ONFARM cooperators and additional farmers throughout each subwatershed. Each survey participant will be required to provide consent for ONFARM to collect and use the data they provide.

3.5 Modelling and Cost-Benefit Analysis Data

Soil health, water quality, water quantity, and survey data collected for ONFARM will be used to generate both subwatershed models and analyze the cost-effectiveness of best management practices. Specific methods for completing these activities have not been determined but will result in a secondary source of data to inform project results. This generated data will be a key output of ONFARM and should be highlighted as a unique source of project data. Descriptions of the data and the methods for generating the models will be included in subsequent version of the DMP once modelling activities are initiated. When modelling is initiated, public technical reports on the modeling will be posted to the ONFARM website.

3.6 Outreach and Engagement Data

Data will also be collected about outreach and engagement activities throughout the ONFARM project. Data will include but is not limited to, event participation surveys, Twitter analytics, website data, photographs, videos and other media. This information will be used to both track project engagement successes and communicate project results. Additional details on outreach and engagement activities can be found in the Outreach and Engagement Strategy. OSCIA will be the primary collector of outreach and engagement data. Outreach and engagement activities will be advised by the SEWG.

3.7 Data Reporting

High-level program data and results will be reported to OSCIA four times per year. Conservation authorities and service providers will submit quarterly updates to OSCIA outlining results and progress on deliverables. Discussions on methodology, data storage, collection, and use will be discussed during TWG meetings which will occur at least four times per year and on an as-needed basis. This will ensure that data is being collected, shared, and used responsibly in a uniform manner across the program. ONFARM Technical Reports outlining key soil and water quality results will be prepared annually and posted to the ONFARM website by March 31st each year.

4.0 Storage and Retention

4.1 Database Storage

Each service provider and participating conservation authority will be responsible for storing ONFARM data for the duration of the project. OSCIA, service providers and conservation authorities will store ONFARM data on their institution's previously established servers and file systems. ONFARM will also use several other data storage platforms to amalgamate and store specific types of data. Water quantity and quality data will be stored in the Kisters Water Information System (WISKI) database previously used in GLASI and maintained by Upper Thames Valley Conservation Authority. In addition, land management survey data collected by conservation authorities will be collected and stored on the Survey 1,2,3 platform lead by Essex Region Conservation Authority. SRG has established methods to store and analyze soil health data within their own organization. In addition, OSCIA will establish its own soil health data repository to store soil health data, manage data requests, assist in reporting, and facilitate public access. OSCIA will also explore avenues for retaining data long-term and methods for accessing project data across all platforms to further facilitate any data sharing requests. More information about data retention and data sharing can be found in section 4.2 and 5.2, respectively.

4.2 Retention and Backup

Each data collector for ONFARM will be responsible for adequately backing up the project data in their possession. Each organization will ensure that data back-ups occur at least weekly. Backup files can be stored in either third-party servers (such as cloud-based) or in-house data storage systems. All data for the program will be retained until at least June 2023, the current end of the ONFARM program. OSCIA will work with the TWG to develop a data retention policy to ensure that ONFARM data is stored beyond the life of the program. The data retention policy will include the types of data to be stored, the location of storage, and metadata requirements for interpreting the data. Specifics of the data retention policy will be outlined in subsequent versions of the ONFARM DMP.

4.3 Folder and File Management

Each data collection partner is responsible for organizing files, folders, and databases under their control. Conservation authorities inputting data into WIKSI will follow established protocols with the WISKI database managers. Once OSCIA has developed a data repository for storing ONFARM soil health data, OSCIA will specify how files are to be formatted, named, and revised for consistency. These specifications will be provided in subsequent versions of the ONFARM DMP.

5.0 Accessibility, Sharing, Protection and Use

5.1 Overview of Data Sharing and Accessibility

ONFARM data will be shared, used and distributed through three key avenues depicted in Figure 2.

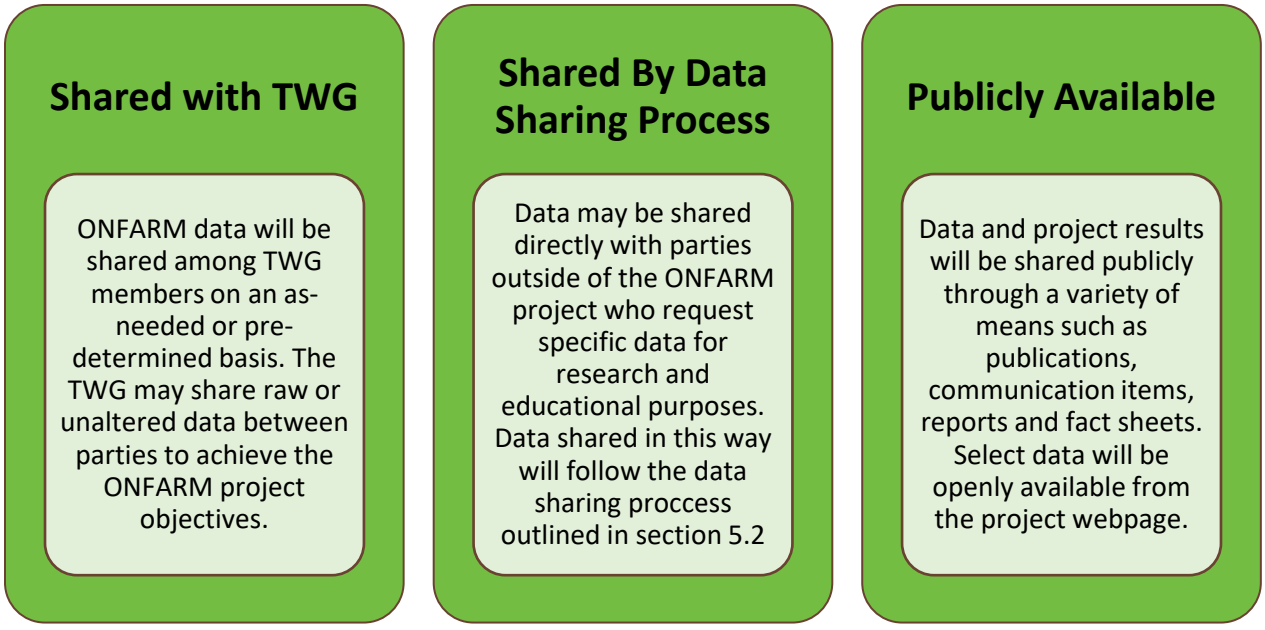

Figure 2. Three avenues of data sharing and use in the ONFARM project.

5.2 Data Sharing Process

ONFARM data may be made available to third party organizations and institutions not currently involved in ONFARM upon written request to OSCIA. Data requests can be made by emailing OSCIA at ONFARM@ontariosoilcrop.org. Requests must clearly identify:

- Who is receiving the data
- What the data will be used for
- Why the data is required
- How the user will provide attribution to ONFARM
- Who will be responsible for the data and ensure it is being used appropriately

Based on the information provided, OSCIA will choose to release all or part of the data requested. A written agreement signed by both parties will confirm the information provided and any data use restrictions OSCIA deems necessary. OSCIA may also choose not to release data in certain circumstances and reserves the right to deny such requests. Decisions will be made using the following criteria:

- Confidentiality and privacy of the ONFARM cooperators and program participants.
- Risks to businesses and partners involved including but not limited to OSCIA, OMAFRA, Conservation Authorities, SRG, and the ONFARM cooperators.
- Intent of the data use.
    - Data must only be used for research and educational purposes and cannot be used for commercial intent.
    - Data use must also align with the broader ONFARM program objectives.

The data sharing process will also apply to conservation authorities and subcontracted service providers who are storing and collecting ONFARM data. If the conservation authority or service provider would like to share ONFARM data or receives a data sharing request, they must direct the data sharing request to OSCIA for authorization. Alternatively, the conservation authority or service provider can choose to make the request directly to OSCIA and act as an intermediary. For data shared, priority will be given to accessible data formats such as .csv, .pdf, .xls, and .docx.

5.3 Anonymization and De-identification

ONFARM datasets may contain information that identifies the names, locations and business information of individuals and businesses participating in the program. Raw data may be shared among TWG members who must abide by the privacy guidelines stipulated in TWG terms of reference and any applicable data sharing agreements. If data will be shared beyond the members of the TWG, ONFARM will anonymize and de-identify data to protect the privacy of program participants where possible. This will be accomplished by removing or limiting the number of personal identifiers, aggregating data, and replacing personal information with alphanumeric codes.

It is also recognized that a key objective of the ONFARM program is to share program results and successes with the agricultural community. This may require hosting events or highlighting specific program achievements made by specific people or at a specific location. Where personal information will be revealed, or where personal identifiers cannot be removed, ONFARM will seek permission from the

relevant participants before sharing the data outside of the TWG. ONFARM may also choose to share collected data and enforce conditions of use by entering into voluntary data sharing agreements with ONFARM cooperators, partners, or participants. For example, ONFARM cooperators have all signed agreements acknowledging their participation in the program which outlines how their data will be used and shared.

5.4 Publicly Available Data

OSCIA will make ONFARM reports and a portion of the soil health data available on the project webpage for research and educational purposes (https://www.osciaresearch.org/onfarm-applied-research/). The ONFARM website will be administered by OSCIA and updated on an as-needed basis. ONFARM reports will be updated annually and include the DMP, a modelling report, an annual technical report for soil and water data, and the outreach and engagement strategy. Data to be made publicly available on the project webpage will be determined by OSCIA with guidance from the TWG. When making this determination, special consideration will be given to the privacy of the ONFARM cooperators and program participants from which the data has been generated, as described in section 5.3. Data made publicly available through the ONFARM website will use Creative Commons Licensing (CC BY-NC-SA 4.0).

Creative Commons Licensing will ensure the following:

Attribution: Users must give appropriate credit, provide a link to the license, and indicate if changes were made. Data users may do so in any reasonable manner, but not in any way that suggests that ONFARM endorses them or their use.

Users may not use the data for commercial purposes.

If data is remixed, transformed, or built upon, data users must distribute their contributions under the same license as the original. This will ensure data remains open and used in the same manner as specified for ONFARM.

OSCIA will also explore methods for making water quality and quantity data publicly available using established tools in the WISKI database with conservation authority partners. Future versions of the DMP will outline how water quality and quantity data will be made publicly available and the methods for doing so.

5.5 Notices, Credit, and Attribution

All data shared, used, published, or communicated as part of the ONFARM project must provide appropriate attribution to the ONFARM project, OSCIA, associated funding partners and any partners who have contributed to the dataset used (*e.g.,* SRG or a specific conservation authority). The following statement may be used in consultation with OSCIA and OMAFRA for all data shared, published, or otherwise used:

> "*The On-Farm Applied Research and Monitoring (ONFARM) program is a four-year, applied research initiative delivered by OSCIA on behalf of OMAFRA to support soil health and water quality research across farms in Ontario. This program is funded by the Canadian Agricultural Partnership, a federal-provincial-territorial initiative. ONFARM data has been collected with support from Ausable Bayfield Conservation Authority, Essex Region Conservation Authority, Lower Thames Conservation Authority, Maitland Valley Conservation Authority, Upper Thames River Conservation Authority and The Soil Resource Group*."

Specific names of each organization involved in data collection can be adjusted to reflect the data shared. Any data obtained publicly via the ONFARM website must follow the terms set out by the Creative Commons Licensing (CC BY-NC-SA 4.0) and include attribution to the appropriate parties. Public data hosted on the ONFARM website will list all parties involved in data collection.

5.6 Data Sharing Agreements

OSCIA will establish agreements with all partnering organizations and any current or future service providers. They will outline data collection procedures and minimum standards for data storage, data sharing and data use. Agreements will ensure data is being managed appropriately as highlighted throughout the ONFARM DMP. Agreements have been established with all ONFARM cooperators to ensure they understand how their data will be used and the expectations of participating in the program. OSCIA will also enter into data sharing agreements with all organizations or individuals with whom data is shared through the data sharing process outlined in section 5.2. Data sharing agreements will contain at a minimum the following:

- The specific types of data shared.
- File formats of the shared data and any associated meta data.
- The duration of the data sharing agreement.
- Conditions of use. For example, data must be used for research and education. It cannot be used for commercial purposes.
- Any requirements that must be made to ensure the privacy of ONFARM cooperators and program participants.
- Attribution or acknowledgement statements to ensure credit is given to appropriate parties.

6.0 Glossary

The terms below were defined as the pertain to the ONFARM program. Other definitions may be used for these terms, that do not apply to the program. Where applicable, definitions were created with assistance from the Oxford Learners Dictionary (https://www.oxfordlearnersdictionaries.com/us/)

Accountable (RAM): The organizations that will ensure the key deliverables of the task are met and are answerable for the completion of the task.

Aggregated Data: Data from multiple sources that has been summarized or compiled to identify higher level results or trends (*e.g.,* mean values).

Anonymize: The act or process of transforming data to mask who it belongs to or where it originated, such as removing personal identifying information or randomizing results.

Attribution: The act of providing credit or ascribing the work to the author, person, or organization.

Consulted (RAM): The organizations whose expert opinions will be sought to provide input on the completion of the task.

De-identification: The action or process of removing personal identifying information from a dataset such as name and address.

Informed (RAM): The organizations that will be kept up-to date on the progress or outcome of the activity or task.

Raw Data: Data that has not been processed since its collection and is unaltered.

Remixed Data: Data that has been altered from its original state by adding, removing, or changing information.

Remote Sensing: The use of satellites to search for and collect information about the earth. ONFARM examples include satellite imagery, GPS coordinates, and AAFC's annual crop inventory.

Responsible (RAM): The organizations that will undertake the work or complete the task.

Processed Data: The transformation or manipulation of data into a usable or understandable format.

Appendix A – Soil Health Data Collected

The table below shows the scope of the soil health data being collected for ONFARM. It is not an exhaustive list of all information collected. Modifications to parameters may be made at the discretion of OSCIA and the TWG, collectively.

Data/Information	Potential Source(s)
Soil Fertility (nitrogen, potassium, phosphorus, etc.)	In-field data collection, producer interviews and historical data
Soil Organic Matter	In-field data collection, producer interviews and historical data
Soil pH	In-field data collection, producer interviews and historical data
Soil Cation Exchange Capacity	In-field data collection, producer interviews and historical data
Aggregate Stability	In-field data collection/lab analysis
Active Carbon	In-field data collection/lab analysis
Bulk Density	In-field data collection/lab analysis
Soil Texture Analysis	In-field data collection /lab analysis
Water Infiltration	In field data collection
Solvita CO_2 Burst	In-field data collection/lab analysis
Solvita Labile Amino Nitrogen	In-field data collection/lab analysis
Potentially Mineralizable Nitrogen	In-field data collection /lab analysis
Crop Yield	In field data collection
Soil Profile Data (depth to water table, pore-size discontinuity, horizons, mottles, gley colours, parent materials, soil health risk assessment, etc.)	In field data collection
Pedology Data (drainage class, soil series, etc.)	In-field data collection and historical data
Topography	In-field data collection and historical data

Appendix B – Water Quality and Quantity Data Collected in Priority Subwatersheds

The table below shows the scope of the water quantity and water quality data being collected for ONFARM Edge of Field and Subwatershed monitoring. It is not an exhaustive list of all information collected. Modifications to parameters may be made at the discretion of OSCIA and the TWG, collectively.

Data/Information	Potential Source(s)	Frequency of Data Collection
Weather:		
Rainfall	Dedicated weather station	15 minute
Snowfall	Dedicated weather station	15 minute
Total Precipitation	Dedicated weather station	15 minute
Air Temperature	Dedicated weather station	15 minute
Relative Humidity	Dedicated weather station	15 minute
Wind Speed	Dedicated weather station	15 minute
Solar Radiation	Dedicated weather station	15 minute
Ground Temperature 5 cm	Dedicated weather station	15 minute
Ground Temperature 15 cm	Dedicated weather station	15 minute
Ground Temperature 30 cm	Dedicated weather station	15 minute
Periodic snow transect surveys	Survey	Monthly and prior to melt events
Field Activities Information:		
Fertilizer Application (form, time, method, rate)	Producer interviews, crop input supplier interviews	Single Interview
Manure Application (form, time, method, rate)	Producer interviews, crop input supplier interviews	Single Interview
Tillage (time, implement type, depth of operation, direction of travel, # of passes)	Producer interviews, in field/roadside data collection	Single Interview
Surface residue cover (prior to freeze -up and post planting)	Roadside data collection	2 times/year
Planting (crop type or cover crop type, plant date, row spacing)	Producer interviews, in field/roadside data collection	Roadside collection is typically 1X/year but may be more if cover crops employed. Interviews Y3.
Visual evidence of erosion (Qualitative)	Field observations and/or assessments, air photo interpretation, producer interviews	Do field observations during seasonally significant hydrological events throughout study period

Crop performance including yield	Producer interviews	Single Interview
Use of BMPs and their financial implications (i.e. cost and crop performance relative to normal practice/before BMP implementation) to inform models and BMP cost benefit analyses	Producer interviews or survey	Single Interview
Water Quantity:		
Stream flow	Flowmeter, or water level with established rating curve, flow detect devices, or field/roadside observations and recordings (e.g. trail cams)	Minimum continuous at outlet. Monitoring of events at key points in watershed, such as key brand confluences with the main watershed
Stream Water Quality:		
Total suspended solids (TSS)	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.
Total Phosphorus (TP)	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.
Total Dissolved Phosphorus (TDP)	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.
Total organic P (orgP)	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.
Total nitrogen (TN)	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.
Nitrate-N	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.
Ammonia-N	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.
Organic-N	Water sampling/analysis	Runoff event based at outlet plus periodic baseflow through all seasons of year.