



# Data Management Plan

April 25, 2025

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## **1.0 Introduction**

### **1.1 Project Description**

ONFARM is a nine-year applied research initiative developed by the Ontario Ministry of Agriculture, Food and Agribusiness (OMAFRA) and currently funded by the Sustainable Canadian Agricultural Partnership. ONFARM is delivered by the Ontario Soil and Crop Improvement Association (OSCIA) with support from various organizations, including OMAFRA, Agriculture and Agri-Food Canada (AAFC), Ausable Bayfield Conservation Authority (ABCA), Lower Thames Valley Conservation Authority (LTVCA), and Upper Thames River Conservation Authority (UTRCA), and The Soil Resource Group (SRG). ONFARM is supported by a network of farmer 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. From 2019-2022, ONFARM was funded and delivered through the Canadian Agricultural Partnership, and was delivered with support from Maitland Valley Conservation Authority, Essex Region Conservation Authority, and the University of Guelph's Watershed Evaluation Group.

### **1.2 Data Management Plan Objective**

To achieve the program's goals, OSCIA and ONFARM service providers will collect data from working farms across the province. Data will be used and shared by project partners and a selection of data will be made available to the broader agricultural industry and the public. The objective of this document, 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 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**

Through the program's first iteration, ONFARM data collection began in 2019 and was collected to 2022; the second iteration of the program will have data collection continue from 2023 through 2027. The DMP will be publicly available and posted on the ONFARM project webpage. Any necessary updates will be posted publicly by May 1<sup>st</sup> 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 includes many different individuals and organizations as part of the project. Participating organizations will have different levels of access to ONFARM 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.

**Table 1.** ONFARM partners and their respective role in ONFARM pertaining to data sharing and management.

| Organization                                                            | Description and Role                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ontario Soil and Crop Improvement Association (OSCIA)</b>            | OSCIA administers ONFARM and is responsible for overseeing all aspects of data sharing and management.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFA)</b> | OMAFA administers funding for ONFARM through the Sustainable Canadian Agricultural Partnership. OMAFA staff members of the Environment Management Branch contribute non-voting representation on the TWG and provide input on all project activities including data collection and management. OSCIA reports on all activities to OMAFA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Agriculture and Agri-food Canada (AAFC)</b>                          | AAFC provides technical input on ONFARM activities through their participation in the TWG.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Service Providers</b>                                                | <p>OSCIA has contracted several “service providers” to deliver specific components or activities. The primary service providers who will be collecting, managing, and using ONFARM data are listed below:</p> <ul style="list-style-type: none"> <li>• SRG coordinates the Soil Health field trials and will collect and analyze soil health, pedology, agronomic, and economic data from cooperating farms.</li> <li>• Three conservation authorities (CAs) are collecting data and contributing to the ONFARM project: Ausable Bayfield Conservation Authority, Lower Thames Valley Conservation Authority, and Upper Thames River Conservation Authority. These three organizations are working with farmers in their respective geographies to collect Edge of Field water quality and quantity information.</li> <li>• Wilton Consulting Group (WCG) will support Forum delivery.</li> <li>• TerraNova UAV collects multispectral imagery from select sites for NDVI and LiDAR and support data interpretation.</li> <li>• Moose Ag delivers profit mapping for selected ONFARM Soil Health Trial sites.</li> <li>• Fieldwalker Agronomy supports the implementation of SWAT WATER within select Edge-of-Field trial sites</li> <li>• Caleb Niemeyer supports the analysis of select ONFARM Soil Health Trial sites with novel statistical testing for unreplicated strip trials.</li> <li>• Additional service providers may be contracted as needed and will adhere to the guidelines of this DMP and other contractual obligations to OSCIA.</li> </ul> |
| <b>Technical Working Group (TWG)</b>                                    | The TWG acts as a technical/scientific advisory and coordination group to provide guidance on all soil health and water monitoring activities including methodology, data collection, data management and reporting. The TWG is chaired by OSCIA and includes representatives from each participating CA, OMAFA , AAFC, and SRG.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## 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 | OMAF | Service Providers | TWG |
|-----------------------------------------------|-------|------|-------------------|-----|
| Create and update data management plan        | R, A  | C    | C                 | C   |
| Advise on soil and water data collection      | R, A  | R    | R                 | R   |
| Collect ONFARM soil and water data            | A     | C    | R                 | C   |
| Collect outreach and engagement data          | R, A  | C    | R, I              | I   |
| Communicate project results                   | R, A  | I    | R                 | I   |
| Create project reports                        | R, A  | I    | C                 | C   |
| Manage ONFARM website and public data         | R, A  | I    | I                 | I   |
| Manage agreements with all applicable parties | R, A  | C    | C                 | C   |
| Facilitate data sharing requests              | R, A  | C    | C                 | C   |

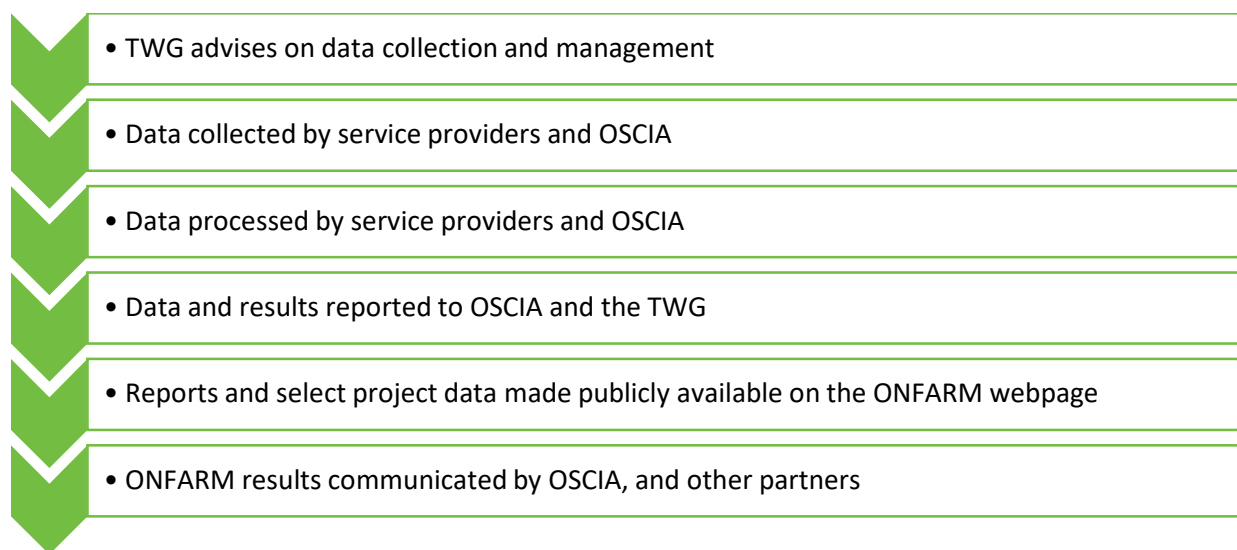
## 2.3 ONFARM Cooperators and Participants

ONFARM is supported by a network of farmers and industry stakeholders that are working with ONFARM to support its objectives. The term ONFARM cooperator is used to describe the farmers that have agreed to participate in the program by allowing applied research activities to be conducted on their farms. These cooperators form the foundation for this program and are essential to its success. The environmental data, business information, agronomic data and best management practice implementation conducted at each cooperator site constitute the dataset collected for ONFARM. In addition to ONFARM cooperators, other program participants may contribute data to the program that will be stored, analyzed, and shared, such as survey respondents or attendees of ONFARM events. Data is collected by OSCIA or service providers from 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 BMP Trials, Edge of Field Monitoring, 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 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 Soil Health BMP Trial Data

Twenty-five ONFARM cooperator sites have been established to study soil health in five regions of the province: Lake Erie West, Lake Erie East, Western, Central, Eastern Ontario, and North-Eastern Ontario. These 25 sites are focused on BMP implementation 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 soil health BMP trials are 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, and environmental data. A list of soil and soil health parameters being assessed can be found in Appendix A and agronomic parameters can be found in Appendix B.

**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                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Farm layout</li> <li>• Nutrient management information</li> <li>• Cost of production</li> </ul> | <ul style="list-style-type: none"> <li>• Planting and harvesting dates</li> <li>• Yield data</li> <li>• Planting data</li> <li>• Fertilizer use and application rates</li> <li>• Organic amendment use, application rates and nutrient analysis</li> </ul> | <ul style="list-style-type: none"> <li>• Tillage practices</li> <li>• Field boundaries</li> <li>• Field topography</li> <li>• GPS data</li> <li>• Soil physical, chemical, and biological properties</li> <li>• Soil drainage data</li> </ul> |

*\*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**

Edge of Field (EOF) monitoring sites have been established to examine key soil health indicators and monitor the impact that different BMPs have on nutrient loading and water quality in the surface water leaving the field. These efforts build upon work completed under GLASI and will also be conducted on working farms coordinated by the local conservation authorities. A list of parameters being collected at EOF sites is outlined in Appendix C. SRG collects soil health and agronomic data at the EOF sites as described in section 3.2. At each of the EOF sites, conservation authority staff collect water quality and quantity data, and work with the cooperators to track operational data.

### **3.4 Outreach and Engagement Data**

Data is collected about outreach and engagement activities throughout the ONFARM project. Data includes but is not limited to, event participation surveys, X/Twitter analytics, website data, photographs, videos, and other media. This information is used to track project engagement successes and communicate project results. OSCIA will be the primary collector of outreach and engagement data.

### **3.5 Data Reporting**

Service providers 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 occur quarterly, and additionally on an as-needed basis. This ensures 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 are prepared annually and posted to [the ONFARM website](#) by March 31<sup>st</sup> each year.

### **3.6 Additional Analysis through LEEAAP**

In the 2024-2025 program year, OSCIA secured additional support for the analysis of data generated through ONFARM sites funded by the Canadian Water Agency's Great Lakes Freshwater Ecosystem Initiative's Lake Erie Innovation Substream. The Lake Erie Enhanced Analysis of Agricultural Practices will support a range of activities from in-field monitoring, to producing documentation as a standard for data processing, and will enhance ONFARM's analysis of EOF datasets to better inform agricultural practice recommendations.

## **4.0 Storage and Retention**

### **4.1 Database Storage**

Each service provider 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. Water quantity and quality data will be stored in the Kisters Water Information System (WISKI) database previously used in GLASI and maintained by the UTRCA. OSCIA has established a database with support from SRG to store soil health data, manage data requests, assist in reporting, and facilitate public access.

### **4.2 Retention and Backup**

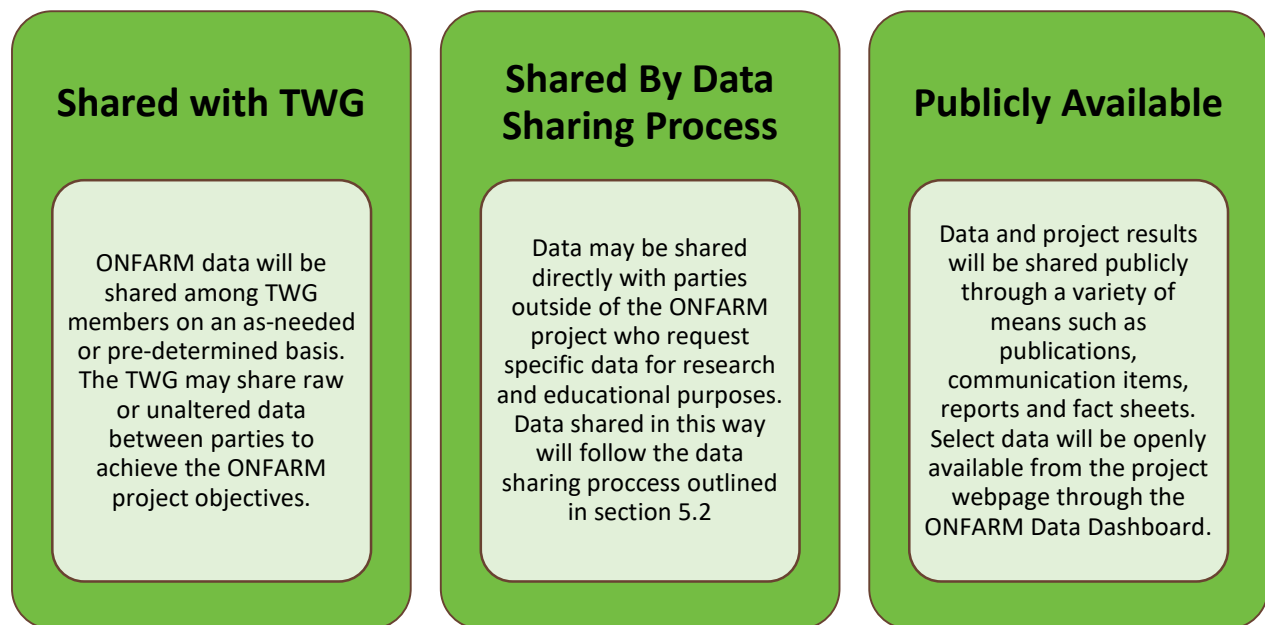
Each data collector for ONFARM is responsible for adequately backing up the project data in their possession. Each organization will ensure that data back-ups occur at least weekly. Backup files can be

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 2035. 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.

## 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 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](mailto:ONFARM@ontariosoilcrop.org). Requests must clearly identify:

- A description of the data requested;
- Who is receiving the data;
- What will the data be used for, emphasizing the research or educational element of the request;
- 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 and attributed 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, OMAFA, 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.

If an ONFARM 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 service provider can choose to make the request directly to OSCIA and act as an intermediary.

### **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 is shared beyond the members of the TWG, it will be anonymized 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.

A key objective of the ONFARM program is to share program results and successes with the agricultural community, and this may require hosting events or highlighting specific program achievements made by specific people or at a specific location. Where personal information is revealed or where personal identifiers cannot be removed, ONFARM seeks 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.

### **5.4 Publicly Available Data**

OSCIA makes 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 webpage is administered by OSCIA. ONFARM reports are posted annually and include any updates to the DMP, and technical reports for soil and water data. The portion of ONFARM data made publicly available on the project webpage is 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.

OSCIA will continue to explore methods for improving the accessibility of ONFARM data, including adding more parameters to the publicly accessible dataset, and updating tools to enhance the user experience.

### **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 OMAFA for all data shared, published, or otherwise used:

*“The On-Farm Applied Research and Monitoring (ONFARM) program is a nine-year, applied research initiative delivered by OSCIA on behalf of OMAFA to support soil health and water quality research across farms in Ontario. This program is funded by the Sustainable 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.

## **5.6 Data Sharing Agreements**

OSCIA establishes agreements with all partnering organizations and any current or future service providers. They 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 are 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 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 they 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.

| Soil Health Indicator Measurements           | Description of Measurement                                                                                                                                                                     |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Physical</b>                              |                                                                                                                                                                                                |
| Bulk Density (BD)                            | Density ( $\text{g cm}^{-3}$ ) of a known soil volume. Samples were taken from the top 5 cm of soil, oven dried and weighed. High bulk density numbers can be an indicator of soil compaction. |
| Soil Hardness                                | Penetration resistance of a soil by depth (soil compaction) was measured using a field penetrometer.                                                                                           |
| Aggregate Stability (AggStab)                | Resistance of soil aggregates to break apart following rapid wetting and agitation. Soils with low aggregate stability are prone to crusting and wind and water erosion.                       |
| Moisture Content                             | Moisture content of the soil. The bulk density samples were weighed, oven dried and re-weighed to determine soil moisture.                                                                     |
| Temperature                                  | Temperature of the surface soil. Soil temperatures were taken at a 7.5 cm depth.                                                                                                               |
| <b>Chemical</b>                              |                                                                                                                                                                                                |
| Fertility Levels                             | Measure of plant available nutrients (phosphorus, potassium, calcium, magnesium, zinc, manganese).                                                                                             |
| pH                                           | A measure of soil acidity.                                                                                                                                                                     |
| <b>Biological</b>                            |                                                                                                                                                                                                |
| Soil Organic Matter (SOM)                    | A measure of organic carbon (living and dead plant and animal materials) in the soil.                                                                                                          |
| Active Carbon (AC)                           | An indicator of the fraction of soil organic matter that is readily available as a food source for soil life; also referred to as Permanganate Oxidizable Carbon (POxC).                       |
| Solvita CO <sub>2</sub> Burst                | The CO <sub>2</sub> burst is a rapid measure of microbial biomass respiration and reflects the size and activity of the microbial biomass.                                                     |
| Potentially Mineralizable Nitrogen (PMN)     | PMN measures the ability of the microbial population to mineralize (convert) organic nitrogen into plant available nitrogen.                                                                   |
| Solvita Labile Amino Nitrogen (SLAN)         | SLAN estimates organic nitrogen reserves present by measuring readily mineralizable amino-sugars in soil.                                                                                      |
| Autoclaved Citrate Extractable (ACE) Protein | An indicator of the amount of protein like substances that are present in the soil organic matter (organically bound nitrogen in the soil organic matter).                                     |

## Appendix B – Agronomic Data Collected

The table below shows the scope of the agronomic 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.

| Data/Information                                                                                                                                                                   | Potential Source(s)                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Fertilizer Application (form, time, method, rate)                                                                                                                                  | Producer interviews                               |
| Manure Application (form, time, method, rate)                                                                                                                                      | Producer interviews, in field data collection     |
| Tillage (time, implement type, depth of operation, direction of travel, # of passes)                                                                                               | Producer interviews                               |
| Planting (crop type or cover crop type, plant date, row spacing)                                                                                                                   | Producer interviews                               |
| Crop performance including yield                                                                                                                                                   | In field data collection, producer yield monitors |
| 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                     |
| Cover crop implementation (planting date, rate, type, termination)                                                                                                                 | Producer interviews, in field data collection     |

## Appendix C – Water Quality and Quantity Data Collected at Edge of Field Sites

The table below shows the scope of the water quantity and water quality data being collected for ONFARM Edge of Field sites .

Any changes to the Edge-of-Field (EOF) monitoring criteria outlined here in Appendix A will need to be discussed and approved by the Technical Working Group (TWG).

### Required for all EOF Sites: Monitoring and Survey Data

| Data/Information Need                                                                | Potential Source(s)                                    | Frequency of Data Collection                                                                              | Density of Data Collection                                                                                                         |
|--------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Weather:</b>                                                                      |                                                        |                                                                                                           |                                                                                                                                    |
| Rainfall                                                                             | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF Site or Paired site if paired sites deemed close enough to each other                                                    |
| Snowfall or snow transect surveys (see below)                                        | Dedicated weather station                              | Calculating/weighing type precipitation gauge                                                             | 1 per EOF Site or Paired site if paired sites deemed close enough to each other                                                    |
| Total Precipitation                                                                  | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF Site or Paired site if paired sites deemed close enough to each other                                                    |
| Air Temperature                                                                      | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF Site or Paired site if paired sites deemed close enough to each other                                                    |
| Relative Humidity                                                                    | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF Site or Paired site if paired sites deemed close enough to each other                                                    |
| Wind Speed                                                                           | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF Site or Paired site if paired sites deemed close enough to each other                                                    |
| Solar Radiation                                                                      | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF Site or Paired site if paired sites deemed close enough to each other                                                    |
| Ground Temperature 5 cm                                                              | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF site                                                                                                                     |
| Ground Temperature 15 cm                                                             | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF site                                                                                                                     |
| Ground Temperature 30 cm                                                             | Dedicated weather station                              | 15 minute                                                                                                 | 1 per EOF site                                                                                                                     |
| Periodic snow transect surveys                                                       | Survey                                                 | Monthly and prior to melt events                                                                          |                                                                                                                                    |
| <b>Field Activities Information:</b>                                                 |                                                        |                                                                                                           |                                                                                                                                    |
| Fertilizer Application (form, time, method, rate)                                    | Producer interviews, crop input supplier interviews    | Interview/collect data every year of Study at a time of year mutually convenient for all EOF participants | By field (Note: a field is defined as a unique crop) and any field area that falls within the boundaries of the EOF watershed area |
| Manure Application (form, time, method, rate)                                        | Producer interviews, crop input supplier interviews    | Interview/collect data every year of Study at a time of year mutually convenient for all EOF participants | By field                                                                                                                           |
| Tillage (time, implement type, depth of operation, direction of travel, # of passes) | Producer interviews, in field/roadside data collection | Interview/collect data every year of Study at a time of year mutually convenient for all EOF participants | By field                                                                                                                           |

|                                                                                                                                                                         |                                                                                                                                                |                                                                                                           |                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Surface residue cover (prior to freeze -up and post planting)                                                                                                           | Roadside data collection                                                                                                                       | 2 times/year prior to entering the winter post fall tillage and in spring post planting.                  | By field                                                                                                                                                                          |
| Planting (crop type or cover crop type, plant date, row spacing)                                                                                                        | Producer interviews, in field/roadside data collection                                                                                         | Interview/collect data every year of Study at a time of year mutually convenient for all EOF participants | By field                                                                                                                                                                          |
| Visual evidence of erosion (Qualitative)                                                                                                                                | Field observations and/or assessments, air photo interpretation, producer interviews                                                           | Do on-going field observations during seasonally significant hydrological events throughout study period. | By field                                                                                                                                                                          |
| Crop performance including yield                                                                                                                                        | Producer interviews                                                                                                                            | Interview/collect data every year of Study at a time of year mutually convenient for all EOF participants |                                                                                                                                                                                   |
| Use of BMPs and their financial implications (i.e. cost and crop performance relative to normal practice/before BMP implementation) to inform BMP cost benefit analyses | Producer interviews or survey                                                                                                                  | Interview/collect data every year of Study at a time of year mutually convenient for all EOF participants |                                                                                                                                                                                   |
| <b>Water Quantity:</b>                                                                                                                                                  |                                                                                                                                                |                                                                                                           |                                                                                                                                                                                   |
| Water Quantity - Tile (if exists) and Surface Water                                                                                                                     | Flowmeter, or water level with established rating curve, flow detect devices, or field/roadside observations and recordings (e.g., trail cams) | Continuous                                                                                                | Edge of field capturing a defined catchment area                                                                                                                                  |
| <b>EOF Water Quality:</b>                                                                                                                                               |                                                                                                                                                |                                                                                                           |                                                                                                                                                                                   |
| Total suspended solids (TSS)                                                                                                                                            | Water sampling/analysis                                                                                                                        | During all observed runoff events through all seasons of year.                                            | Located at water quantity monitoring station. For events, minimum 1 sample early into storm, one at hydrograph peak and one along falling limb. More, if needed to describe event |
| Total Phosphorus (TP)                                                                                                                                                   | Water sampling/analysis                                                                                                                        | During all observed runoff events through all seasons of year.                                            | Located at water quantity monitoring station. For events, minimum 1 sample early into storm, one at hydrograph peak and one along falling limb. More, if needed to describe event |
| Dissolved Reactive Phosphorus (DRP)                                                                                                                                     | Water sampling/analysis                                                                                                                        | During all observed runoff events through all seasons of year.                                            | Located at water quantity monitoring station. For events, minimum 1 sample early into storm, one at hydrograph peak and one along falling limb. More, if needed to describe event |

|                               |                         |                                              |                                                                                                                                                                                   |
|-------------------------------|-------------------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Total Kjeldahl nitrogen (TKN) | Water sampling/analysis | At storm events through all seasons of year. | Located at water quantity monitoring station. For events, minimum 1 sample early into storm, one at hydrograph peak and one along falling limb. More, if needed to describe event |
| Nitrate-N                     | Water sampling/analysis | At storm events through all seasons of year. | Located at water quantity monitoring station. For events, minimum 1 sample early into storm, one at hydrograph peak and one along falling limb. More, if needed to describe event |
| Ammonia-N                     | Water sampling/analysis | At storm events through all seasons of year. | Located at water quantity monitoring station. For events, minimum 1 sample early into storm, one at hydrograph peak and one along falling limb. More, if needed to describe event |

### Required for all EOF Sites: Data Layers

| Data/Information Need                                                           | Potential Source(s)                                                                                                                                                                                    | Frequency of Data Collection                                                        | Density of Data Collection                  |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------|
| <b>Topography and Soils:</b>                                                    |                                                                                                                                                                                                        |                                                                                     |                                             |
| Topography via Digital Elevation Model (2 to 5 cm vertical accuracy)            | Provincial LiDAR datasets and/or site specific remote aerial imagery data topographic mapping (e.g. drone)                                                                                             | 1 time unless changes made (e.g. Built WASCoB, changing flowpath)                   | 1 to 3 m grid                               |
| Detailed Soil Mapping (based on DEM and field truthing)                         | Past soil surveys, Enhancements to past surveys (e.g. SWEEP, Black Creek example in Lake Simcoe, etc.). LiDAR imaging will be supported by drone at the continuing EOF sites and other suitable sites. | 1 time                                                                              | 1: 10,000 scale preferred                   |
| <b>Hydrologic layers:</b>                                                       |                                                                                                                                                                                                        |                                                                                     |                                             |
| Reservoirs, Ponds                                                               | Land Information Ontario, MNRF, aerial photography, field truthed observations                                                                                                                         | 1 time unless changes made or occur through time (man-made or natural), then modify | Within EOF watershed boundary or at outlet* |
| Municipal drainage layer (closed) (include tile diameter and grades)            | Land Information Ontario, OMAFA, municipal township office (drain reports), in-field data collection/producer interviews                                                                               | 1 time unless changes made or occur through time (man-made), then modify            | Within EOF watershed boundary*              |
| Tile surface inlet locations (include type of inlet, inlet diameter/dimensions) | aerial photography interpretation, OMAFA, in-field data collection/producer interviews                                                                                                                 | 1 time unless changes made or occur through time (man-made), then modify            | Within EOF watershed boundary*              |

|                                                                                                           |                                                                           |                                                                                                          |                                 |
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| Subsurface tile drainage layer<br>(include tile diameter, depth, spacing)                                 | Aerial photography, in-field/roadside data collection/producer interviews | 1 time unless changes made or occur through time (man-made), then modify                                 | Within EOF watershed boundary*  |
| <i>*Recognize that conditions may change through time, necessitating updates to the hydrologic layers</i> |                                                                           |                                                                                                          |                                 |
| <b>Land use Layers:</b>                                                                                   |                                                                           |                                                                                                          |                                 |
| Non-agricultural land use boundaries/delineation                                                          | Aerial photography, in-field/roadside data collection/producer interviews | 1 time unless changes made or occur through time (man-made or natural), unless changes made, then modify | Within EOF watershed boundary** |
| Land-based BMP layer (e.g. grassed waterway, WASCoB, buffer, windbreak, other)                            | Aerial photography, in-field/roadside data collection/producer interviews | 1 time unless changes made or occur through time (man-made or natural), then modify                      | Within EOF watershed boundary** |
| Field Boundaries                                                                                          | Aerial photography, in-field/roadside data collection/producer interviews |                                                                                                          |                                 |
| Agricultural Land use by field, Crop type, cover crop type                                                | Aerial photography, in-field/roadside data collection/producer interviews | 1 time unless changes made or occur through time (man-made or natural), unless changes made, then modify | Within EOF watershed boundary   |
| <i>**Recognize that conditions may change through time, necessitating updates to the land use layers</i>  |                                                                           |                                                                                                          |                                 |