

**Report on Futurepast's
Verification Engagement with
Manulife Investment Management
Relative to Its
Agricultural Greenhouse Gas Emissions
Inventory for 2022**

Report Date: 2023-04-26

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Addressee

This report is addressed to the management of Manulife Investment Management Timberland and Agriculture, 197 Clarendon St., C-08-99, Boston MA 02116.

Responsibilities

It was the responsibility of Manulife Investment Management (“Manulife”) to prepare its agricultural land management greenhouse gas (GHG) inventory statements in accordance with the WRI/WBCSD GHG Protocol Corporate Accounting and Reporting Standard. This responsibility includes designing, implementing and maintaining a data management system adequate for the preparation and fair presentation of the statements. Manulife is responsible for the fair presentation of its data and information and ensuring that these are free from material misstatements.

Based on the work we performed, it was the responsibility of Futurepast to express an opinion as to whether the agricultural land management GHG emissions as stated by Manulife were presented fairly in accordance with the agreed criteria.

Criteria

Manulife and Futurepast agreed that the criteria for the statements to be verified was the WRI/WBCSD GHG Protocol Corporate Accounting and Reporting Standard. Futurepast assessed the criteria and found them suitable, considering:

- a) the engagement’s scope and boundaries;
- b) the greenhouse gases and sources, sinks and reservoirs associated with Manulife’s facilities, physical infrastructure, activities, technologies, and processes;
- c) the quantification methods employed; and
- d) requirements for disclosures.

In accordance with the criteria, Manulife reported greenhouse gas emissions using the Global Warming Potentials (GWP) found in the IPCC’s 4th Assessment Report. In Futurepast’s opinion, the agreed criteria were relevant, complete, reliable and understandable.

Type of Engagement

This engagement included the following types of activities:

- ☒ Verification
- ☐ Validation
- ☒ Agreed-upon procedures

Objectives of the Verification

To provide limited assurance to Manulife that there is no evidence that the GHG Statements made by Manulife are not materially correct and are not in conformance with the stated criteria.

Manulife Investment Management seeks this verification for internal management purposes and for public disclosure of its GHG emissions.

Scope of the Verification

Facilities, physical infrastructure, activities, technologies, and processes	<p>GHG emissions from Manulife's network of agricultural properties (directly operated and leased) in the USA, Canada, and Australia.</p> <p>Manulife manages farmland and timberland portfolios through several investment structures for institutional investors, including public and private pension funds, foundations and endowments, high net-worth individuals, and Taft-Hartley plans.</p> <p>Manulife's agricultural businesses manages properties in the USA, Canada, and Australia. The portfolio includes a mix of both directly operated and leased properties. A wide range of crop types are farmed in the Manulife portfolio, including almonds, pistachios, rice, cotton, corn, soybeans, grapes, cranberries, and more.</p> <p>The Manulife GHG inventory includes emissions from energy combustion (fossil fuel, electricity) and other emissions specific to agricultural land management (N₂O release from fertilizer applications, CH₄ emissions from rice water management, CO₂ from lime/urea applications).</p> <p>Note that the following GHG sources were removed from the inventory boundary for the 2022 reporting year as they were deemed by Manulife not to be relevant:</p> <ul style="list-style-type: none"> • agriculture residue biomass combustion • fallow land and broadacre crop categories
Greenhouse gas sources, sinks, and reservoirs	<p>SCOPE 1 & SCOPE 2 GHG SOURCES (from directly operated properties):</p> <p><u>Scope 1:</u></p> <p>Fuel combustion (stationary and mobile sources), nitrogen application from fertilizers, lime and urea applications (CO₂ only)</p> <p><u>Scope 2:</u></p> <p>Electricity consumption</p>

	<u>SCOPE 3 SOURCES (from leased properties):</u> 1. All Scope 1 and Scope 2 GHG sources listed above occurring on leased properties 2. Methane (CH ₄) emissions from water management on leased rice properties
Types of greenhouse gases	Manulife's GHG inventory calculates and reports CO ₂ , CH ₄ , and N ₂ O emissions.
Time period	January 1, 2022 – December 31, 2022

Level of Assurance and Threshold of Materiality

Level of Assurance: Limited

Materiality Threshold: 10%

Summary of Manulife's Greenhouse Gas Statements

Manulife's 2022 GHG emissions from agricultural land management are presented in the table below (summarized from the Manulife GHG inventory spreadsheet "Ag GHG Emissions Calculator 2022 – For MFC.xls"):

GHG Emission Category	Metric Tonnes of CO ₂ e			
	CO ₂	CH ₄	N ₂ O	TOTAL
SCOPE 1 (Direct GHG emissions)	20,456	36	12,639	33,131
SCOPE 2 (Indirect GHG emissions from imported energy)	15,106	25	39	18,935*
SCOPE 3 (Indirect GHG emissions from other sources)	39,036	70,023	79,044	193,092*
TOTAL	74,598	70,084	91,722	245,159*

*total CO₂e value does not equal sum of listed greenhouse gas totals due to a lack of specific component greenhouse gas information in Australian emission factors for imported electricity

Manulife's reported Scope 1 and Scope 2 emissions are a result of farm management practices that occur on properties that are directly operated by Manulife. At these properties Manulife has operational control over the properties and has access to verifiable input data on the farm management practices and consumption of energy and fertilizers. Futurepast's verification opinion applies to the Scope 1 and Scope 2 emissions from directly-operated properties.

Manulife's reported Scope 3 emissions are a result of farm management practices that occur on properties that Manulife leases to farmers. A significant amount of the GHG emissions on leased properties are estimated using methodological approaches that have been applied by Manulife in the absence of actual property-specific input data. Futurepast has used verification techniques within agreed-upon-procedures to report factual findings concerning Manulife's Scope 3 emissions given the paucity of verifiable input data for leased properties. The findings of Futurepast's agreed-upon-procedures investigation are presented as an annex to this verification report. Assurance is not provided on factual findings that result from the application of agreed-upon procedures.

Description of Data and Information Management Systems

The data management system for the Manulife agricultural GHG inventory is a function of the parties described below:

Manulife Investment Management Sustainability Team

Overall coordination of the agricultural GHG inventory project including:

- decision-making on inventory parameters,
- scheduling and initiation of annual farm survey data request to managers of directly-operated properties
- review of reasonableness of data reported by farm property managers
- engagement with property managers regarding the importance of data accuracy, consistency, and completeness
- engagement with property managers to confirm potential issues observed with reported data
- on-going management and updating of GHG methodology document and GHG inventory spreadsheet
- processing and analysis of completed data collection surveys filled out by managers of directly-operated properties

Managers of Farm Properties

- management, collection, and reporting of GHG inventory activity data (fuel consumption, electricity consumption, N applications, etc.) through the annual farm data surveys circulated by Manulife

- quality control procedures including review and reconciliation by multiple levels of administration (e.g. Farm Manager, Operations Manager, Regional Manager)

Manulife Corporate Sustainability Team

- roll-up of agricultural GHG inventory data to the Manulife corporate level
- analysis of reasonableness of the agricultural GHG inventory data
- oversight of third-party verification of Manulife's corporate GHG inventory

Discussion of Verification Team's Risk Assessment

Futurepast performs a risk assessment to identify inherent risks, control risks, and detection risks that could result in material misstatements. The steps in the risk assessment process included:

- Reviewing the GHG Statement and other available documentation specific to the Statement (Inventory methodology document, Manulife 2022 agriculture GHG inventory calculation spreadsheet; Manulife agriculture GHG emissions from prior reporting years);
- Assessing the likelihood that a material discrepancy might exist in the GHG Statement, if no controls were used to prevent discrepancies in the GHG Statement (inherent risk);
- Assessing the control environment and the corporate governance process (control risk);
- Reviewing each emissions source identified in the Statement and evaluating the contribution of each source to the GHG Statement and the associated potential risk of material discrepancy for each.

Detection risk is a measure of the risk that the verification procedures will fail to detect material discrepancies (if any exist). Futurepast's verification procedures were developed to address inherent and control risks, while ensuring the level of detection risk is sufficiently low to reach a verification conclusion at a limited level of assurance. The results of the risk assessment are provided in the table below, including Futurepast's procedure for addressing each identified inherent and control risk.

Risk Number	Observed Potential Risk	Verification Procedure
INHERENT RISKS		
Inherent Risk 1	Consistency and accuracy of emission factors used.	Confirmed all emission factors used against cited sources.
Inherent Risk 2	Completeness of list of GHG SSRs included in reported GHG	Reviewed and assessed rationale for Manulife's exclusion of GHG emissions from biomass combustion in

	Statement.	<p>the 2021 GHG inventory.</p> <p>Reviewed the reasons for excluding soil carbon sequestration from reported GHG totals.</p>
Inherent Risk 3	Methodology for estimation of nitrogen inputs and energy consumption for leased properties is reasonable and is being applied consistently and accurately.	<p>Reviewed the appropriateness and accurate application of the methodologies used for estimation of nitrogen inputs and energy consumption for leased properties.</p> <p>Confirmed nitrogen application rate and energy consumption against cited source (e.g. USDA).</p> <p>Confirmed that the estimated nitrogen application rate and energy consumption is being properly applied based on crop type and region.</p>
Inherent Risk 4	GHG inventory spreadsheet input data and calculation accuracy (including year-to-year comparison)	<p>Reviewed Manulife GHG inventory spreadsheet to confirm the accuracy of all calculations used in the Statement through the following verification procedures:</p> <ol style="list-style-type: none"> 1. Tracing of GHG calculations within the GHG inventory spreadsheet 2. Comparison of 2022 GHG inventory to 2021 GHG inventory 3. Assessment of calculations against description provided in GHG methodology document
CONTROL RISKS		
Control Risk 1	Lack of version control and documentation of updates in GHG inventory methodology document and spreadsheet calculation tool.	Data management system was reviewed by Futurepast through interviews with Manulife staff.
Control Risk 2	Appropriate procedures are in place for quality control of GHG inventory.	<p>Data management system was reviewed by Futurepast through:</p> <ol style="list-style-type: none"> 1. interviews with Manulife staff 2. inspection of evidence of data quality and management process being implemented
Control Risk 3	GHG inventory methodology document is not being updated on an annual basis.	1. Assessment of data sources and assumptions used in calculations to confirm they continue to be an accurate representation of the reported GHG inventory.

Description of Evidence-Gathering Procedures

Due to the limited level of assurance, there was a reduced emphasis on analysis and assessment of source data (e.g. consumption invoices, farm operator surveys) in the verification. The verification focused on the reasonableness of methodologies and assumptions and accuracy of calculation tools used in the GHG inventory.

Scope 1 (Direct Emissions)

Scope 1 (direct emissions) represent 13.5% (33,131 tonnes CO₂e) of Manulife's 2022 agricultural GHG inventory. The following sources contribute to Manulife's direct GHG emissions:

- Fuel combustion (53%)
- Synthetic fertilizer nitrogen applications to soil (38%)
- Urea and lime applications to soil (9%)

Fuel Combustion

In its GHG inventory Manulife includes fuel combustion in agricultural equipment (diesel, gasoline, propane) and fuel combustion in agricultural buildings (natural gas). For directly-operated properties consumption data is obtained from fuel purchase invoices or surveys completed by the Manulife farm managers.

Futurepast reviewed the following information in its assessment of fuel combustion values used in Manulife's Scope 1 calculations:

1. Emission factor accuracy for all types of fuels and all geographic regions were checked against the cited source documents.
2. Total consumption of each fuel type for directly-operated properties was compared to the 2021 total consumption as a test of reasonableness of the 2022 data, aggregated by crop type.

Synthetic Fertilizer Nitrogen Applications to Soil

Manulife includes nitrogen applications to soil from several types of synthetic fertilizers in its GHG inventory. For directly-operated properties the nitrogen application data is obtained from surveys completed by the Manulife farm managers.

Futurepast reviewed the following information in its assessment of nitrogen application values used in Manulife's Scope 1 calculations:

1. Emission factor accuracy for all GHG emissions from nitrogen fertilizer applications (direct emissions, indirect emissions from atmospheric deposition, indirect emissions from leaching and runoff, indirect emissions from nitrogen volatilization) were checked against the cited source documents.

2. Total nitrogen applications by crop type for direct-operated properties was compared to the 2021 values as a test of reasonableness of the 2022 data.

Urea and Lime Applications to Soil

Futurepast reviewed the following information in its assessment of urea and lime application values used in Manulife's GHG inventory calculations:

1. We checked emission factor accuracy for CO₂ emissions from urea and lime applications against the cited source documents.
2. Total urea and lime applications in 2022 was compared to the 2021 values as a test of reasonableness of the 2022 data.

Scope 2 (Indirect emissions from imported energy)

Scope 2 (indirect emissions from imported energy) represent 7% (18,935 tonnes CO₂e) of Manulife's 2022 GHG inventory. For directly-operated properties the consumption data is obtained from electricity utility invoices or surveys completed by the Manulife farm managers

Futurepast reviewed the following information in its assessment of electricity consumption values used in Manulife's GHG inventory calculations:

1. Emission factor accuracy for all geographic regions were checked against the cited source documents.
2. Total consumption of electricity for directly-operated properties was compared to the 2021 total consumption as a test of reasonableness of the 2022 data, aggregated by crop type.

Description of Agreed-Upon-Procedures (Scope 3)

Scope 3 (Indirect emissions from other sources)

Scope 3 (indirect emissions from other sources) represent 78.7% (193,902 tonnes CO₂e) of Manulife's 2022 GHG inventory. The following sources contribute to Manulife's Scope 3 GHG emissions:

- Synthetic fertilizer nitrogen applications to soil on leased properties (42%)
- Rice crop floodwater management on leased properties (37%)
- Fuel combustion on leased properties (11%)
- Electricity consumption on leased properties (9%)
- Urea and lime applications to soil on leased properties (1%)

Synthetic Fertilizer Nitrogen Applications to Soil on Leased Properties

Nitrogen application data for the majority of Manulife's leased properties is estimated using one of two methodologies: a) average of the nitrogen application rate for all direct-operated properties of

the same crop type, or b) use of published average nitrogen application rates by crop type reported by independent sources (e.g. USDA).

See Annex D for additional detail about the agreed-upon procedures that Futurepast used with respect to Manulife's Scope 3 GHG calculations of nitrogen application values.

Rice Crop Floodwater Management on Leased Properties

In its GHG inventory Manulife includes methane emissions from the anaerobic decomposition of organic materials during rice cropping that is influenced by the floodwater management approach utilized. All Manulife rice farms are leased properties. For most properties, input data needed for the methane emissions calculations from this source is obtained from surveys completed by the farm managers.

See Annex D for additional detail about the agreed-upon procedures that Futurepast used with respect to Manulife's Scope 3 emissions related to rice crop floodwater management.

Fuel Combustion on Leased Properties

Fuel consumption data for Manulife's leased properties is reported by the farm managers or is estimated using one of two methodologies: a) average of the fuel consumption rate for all direct-operated properties of the same crop type, or b) use of published average fuel consumption rates by crop type reported by independent sources (e.g. USDA).

See Annex D for additional detail about the agreed-upon procedures that Futurepast used with respect to fuel combustion values used in Manulife's Scope 3 emission calculations.

Electricity Consumption on Leased Properties

Electricity consumption data for Manulife's leased properties is reported by the farm managers or is estimated using one of two methodologies: a) average of the electricity consumption rate for all direct-operated properties of the same crop type, or b) use of published average electricity consumption rates by crop type reported by independent sources (e.g. USDA).

See Annex D for additional detail about the agreed-upon procedures that Futurepast used with respect to electricity consumption values reported by Manulife as Scope 3 emissions.



Urea and Lime Applications on Leased Properties

See Annex D for additional detail about the agreed-upon procedures that Futurepast used with respect to urea and lime application on leased properties.


Verification Criteria

Futurepast conducted its verification activities based on the requirements of ISO 14064-3:2019, *Specification with guidance for the verification and validation of greenhouse gas statements*.

Verification Team Leader and Independent Reviewer Signatures

Verification Team Leader	 Stephen Boles, 30 April 2023
Independent Reviewer	 John C. Shideler, 30 April 2023
<i>This report is approved when signed and dated by the independent reviewer.</i>	

Annex A: Verification Plan

		Verification-Validation Workbook: Verification Plan			
CLIENT	Manulife Investment Management Timberland and Agriculture			CONTACT:	Brandon Lewis
				Email:	blewis@manulife.com
ENGAGEMENT	2022 Agricultural GHG inventory verification			Phone:	609-375-7545
PLAN APPROVED BY:		PLAN DATE:	11-Apr-2023	PLAN REV.:	
LEVEL OF ASSURANCE:	Limited	ENGAGEMENT TYPE:	Verif. + AUP		
OBJECTIVES	To provide limited assurance to the stakeholders of Manulife Investment Management Timberland and Agriculture ("Manulife") that there is no evidence that the GHG Statement made by Manulife is not materially correct and is not in conformance with the stated criteria				
SCOPE					
	a) GHG sources, sinks and reservoirs				
	SCOPE 1 & SCOPE 2 GHG SOURCES (from direct-operated properties): Scope 1: 1. Fuel combustion (stationary and mobile sources) 2. Nitrogen application from fertilizers 3. Lime and urea applications (CO2 only) Scope 2: 1. Electricity consumption SCOPE 3 SOURCES (from leased properties): 1. All Scope 1 and Scope 2 GHG sources listed above occurring on leased properties 2. Methane (CH4) emissions from water management on leased rice properties				
	b) Boundaries				
	GHG emissions from Manulife's network of agricultural properties (direct-operated and leased) in the USA, Canada, and Australia				
	c) Physical infrastructure, activities, technologies and processes within the scope				
	Manulife manages farmland and timberland portfolios through several investment structures for institutional investors, including public and private pension funds, foundations and endowments, high net-worth individuals, and Taft-Hartley plans. Manulife's agriculture businesses manages agricultural properties in USA, Canada, and Australia. The portfolio includes a mix of both direct-operated and leased properties. A wide range of crop types are farmed in the Manulife portfolio, including almonds, pistachios, rice, cotton, corn, soybeans, grapes, cranberries, and more.				
	d) Data management details				
	Manulife's agricultural GHG inventory is a spreadsheet-based product. Manulife's process and controls for data aggregation, consolidation and reporting (including the management of data from direct-owned vs leased properties) is described in the Manulife corporate GHG inventory methodology document. Note that opportunities have been identified by Futurepast (and recommended to Manulife in the 2021 inventory verification report) for improved data management and quality control.				

e) Management controls							
For the 2020 calendar year the Manulife agricultural GHG inventory was developed and managed by a third-party GHG consulting firm. For the 2021 calendar year Manulife assumed responsibility for the on-going maintenance of the agricultural GHG inventory, although the third-party consultant was still involved on an as-needed basis. For the 2022 calendar year Manulife has complete responsibility for the agricultural GHG inventory (no involvement of third-party consultant).							
f) Time periods							
Calendar year 2022 (January 1 - December 31, 2022)							
IDENTITY AND ROLES OF VERIFICATION TEAM MEMBERS							
NAME: Stephen Boles				ROLE: Team Leader			
NAME: Alexander Scott				ROLE: Observer			
VERIFICATION CRITERIA: ISO 14064-3				MATERIALITY THRESHOLD (%): 10			
VERIFICATION CRITERIA: Secondary criteria				PERFORMANCE MATERIALITY (%):			
				DATE PLAN SENT TO RESPONSIBLE PARTY: 11-Apr-2023			
REASON(S) FOR PLAN REVISION:							
SCHEDULE FOR SITE VISITS							
DAY	DATE	TIME	ACTIVITY	TEAM MEMBER			
Wednesday	19-Apr-2023	11:00 EDT	Verification Audit	SB, AS			
PROPOSED VERIFICATION PROCEDURES							
1. Detailed comparison of 2021 to 2022 GHG emissions and calculation input parameters by region, crop type							
2. Review of accuracy and relevancy of GHG emission factors and conversion equations used in calculations							
3. Assess the appropriateness and accuracy of sources of data used for key input parameters (e.g. industry reports, government reports) used in estimated GHG calculations							
4. Review the accuracy and proper functioning of the Manulife agriculture GHG inventory spreadsheet tool							
5. Assess the reason for significant decrease in Scope 1 emissions compared to previous year							
<u>NOTE:</u> Additional supporting evidence (e.g. surveys, energy invoices) will only be requested if the proposed verification procedures reveal issues that demand further investigation by the verifier							
TENTATIVE SCHEDULE							
05-Apr-23		Kick-off Meeting					
April 6 - 11, 2023		Document Review					
12-Apr-23		Verification Plan sent to client					
19-Apr-23		Verification Audit (virtual)					
24-Apr-23		Preparation of Draft Verification Report and Statement					
April 26 - 27, 2023		Independent Review					
28-Apr-23		Delivery of draft verification report and statement to client					

Annex B: List of Findings

#	Type	Issue/Clarification	Ref.	Audit Evidence	Responsible Party Action	Lead Verifier Conclusion
1	INC	<p>CH₄ and N₂O emission factors for US-based diesel, gasoline, and propane combustion have not been sourced from the most recent version of the US EPA "Emission Factors for GHG Inventories" released on April 1, 2022.</p> <p>Result of the INC is a 231 tonne CO₂e understatement of reported Scope 1 GHG emissions.</p>	GHG Protocol Corporate Reporting Standard (Section 6)	"4.4 Energy EFs Input" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's fuel emission factors.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.
2	INC	<p>CO₂e location-based emission factors for electricity consumption in Ontario and Quebec have not been sourced from the most recent version of the Canadian National Inventory Report (released April 2022).</p> <p>CO₂e location-based emission factors for electricity consumption in Australia have not been sourced from the most recent version of the Australian National GHG Factors (released Feb 2023).</p>	GHG Protocol Corporate Reporting Standard (Section 6)	"4.4 Energy EFs Input" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's Ontario, Quebec, and Australia electricity emission factors.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.

3	INC	Estimated nitrogen application rate for grapes has not been updated.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's average nitrogen application rate value based on 2022 almond and pistachio primary data.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.
4	INC	Estimated nitrogen application rate for cranberry has not been updated.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's average nitrogen application rate value based on 2022 cranberry primary data.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.
5	INC	Estimated electricity consumption rate for apples and olives has not been updated.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's average electricity rate value based on 2022 apple primary data. It is noteworthy that 16 properties use all primary data, and 2 properties are sourcing from estimates.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.

6	INC	Estimated electricity consumption rate for corn has not been updated.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's average electricity rate value based on 2022 corn primary data.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.
7	INC	Estimated electricity consumption rate for grapes has not been updated.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's average electricity rate value for grapes, based on 2022 almond and pistachio primary data.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.
8	INC	Estimated electricity consumption rate for rice has not been updated.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's average electricity rate value based on 2022 rice primary data.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.

9	INC	Estimated fossil fuel combustion rate for rice has not been updated	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory's average fuel rate value based on 2022 rice primary data.</p> <p>In 2023 we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Response accepted - issue closed.
10	INC	Estimated fuel consumption rates are calculated for diesel fuel only, even when other fuel types are reported as primary fuel consumption data.		"2.1 Input Table" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Recognizing that diesel is the most utilized fuel in agriculture operations, when an estimate for diesel was needed, other primary fuel data (gasoline, propane, NG) was removed. This was done in recognition that the diesel estimates were intended to be comprehensive of all fuel used on a given property.</p> <p>In future, including estimates for the other fuels will be considered. However, due to the irregularity in which other fuel sources are used in agriculture, it may prove difficult to find reliable information.</p>	Response accepted - issue closed.
11	INC	Farm property "Jackson 74" is not being included in reported GHG emissions	New Results Tables worksheet of Manulife 2022 GHG inventory spreadsheet	New Results Tables worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Since this issue was categorized as immaterial, we will forgo updating the GHG inventory worksheet. This was a calculator function error that was not identified at the time of completion that we will address in the next carbon inventory.</p>	Response accepted - issue closed.

1	CR	<p>Nitrogen application rates for crop types with significant acreage in Manulife's portfolio (wheat, vegetables, potato) may be using outdated USDA statistics.</p> <p>Manulife requested to check reference USDA sources for updated N application rate values for wheat, vegetables, potato.</p>	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>The most recent update that we are aware of for fertilizer rates from the USDA is 10/30/2019.</p> <p>In 2023, we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Clarification accepted – issue closed
2	CR	Market-based Scope 2 calculations are not reported.	GHG Protocol Corporate Reporting Standard (Section 6)	"New Results Tables" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>Market-based Scope 2 emissions have not been provided separately from location-based Scope 2 emissions because in our case there is no difference between the two. We use grid factors to estimate emissions from electricity usage (in contrast to utility-specific factors), and we do not have any renewable power purchase agreements. While we do have some limited on-site solar capacity at a few of our California ranches, these do not need to be factored out of our electric usage (which we source from the provider); further, there are no emissions being generated from solar power production, anyways.</p>	<p>Response accepted.</p> <p>It is the opinion of the lead verifier that Futurepast's verification opinion does not need to be modified due to this issue.</p>

3	CR	<p>N application rate for vegetables used for Alberta is obtained from USDA stats for Florida and Wisconsin.</p> <p>Manulife requested to check availability of vegetable N application rate specific to Alberta.</p>	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>There is Alberta-specific fertilizer research from the province published in 2004 that we could reference. "Vegetables" as a category aren't given, but we could develop an average based on the individual crops provided. This data is similar to the N rate used in the calculator.</p> <p>In 2023, we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Clarification accepted – issue closed
4	CR	<p>Estimated N application rate for Washington state used for a Texas potato property (Hartley 998).</p> <p>Manulife requested to check whether a separate potato N application rate should be used for Texas properties.</p>	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>No state-specific academic information on fertilizer application was found after an initial internet scan for Texas potatoes. However, one non-academic source suggested a very similar value to what was used in the calculator.</p> <p>In 2023, we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator.</p>	Clarification accepted – issue closed

5	CR	Corn, cotton, soybean and rice are using estimated N application rates based on prior year GHG inventory (no primary data was available in 2022 to update estimated application rates). Manulife to justify the appropriateness of using prior year average application rates instead of using published statistics from USDA.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	To our knowledge, USDA sources are most recent to 2019. Although we did not receive any usable primary data for corn, cotton, soybean, and rice crops for 2022, an average from the year prior was determined to be a reliable way to manage this information gap.	Clarification accepted – issue closed
6	CR	42 properties have no reported electricity consumption. Manulife to confirm that identified properties have no electricity consumption.	"2.1 Input Table" worksheet of Manulife 2022 GHG inventory spreadsheet	"2.1 Input Table" worksheet of Manulife 2022 GHG inventory spreadsheet	All of these properties did not have electricity consumption. These properties were all rain fed, thus not needing any electricity for irrigation. These property templates were either filled with a 0 or left blank. When any field was left blank, it was clarified with regional managers whether it was blank due to lack of data (needing an estimate) or due to no usage.	Clarification accepted – issue closed
7	CR	Corn property fossil fuel combustion is estimated using a methodology based on published statistics. Actual fuel combustion data available for several Manulife corn properties. Manulife to explain why actual fuel combustion from corn properties in Manulife portfolio are not used to generate average fuel combustion rates.	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	With the benefit of hindsight, it would be more accurate to use an average value per acre for fuel for corn, rather than a periodical source. The average of the 7 properties with primary fuel data for corn was 14 gal/ac, in comparison to the estimate of 7 gal/ac used. In 2023, we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates. This suggested strategy will be considered then.	Clarification accepted – issue closed

8	CR	<p>Cotton property electricity consumption is estimated using a methodology based on published statistics. Actual electricity consumption data is available for several Manulife cotton properties.</p> <p>Manulife to explain why actual electricity consumption from cotton properties in Manulife portfolio are not used to generate average electricity consumption rates.</p>	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	"4.1 Assumptions" worksheet of Manulife 2022 GHG inventory spreadsheet	<p>With the benefit of hindsight, it would be more accurate to use an average value per acre for electricity for cotton, rather than a periodical source. Notably, the average of the 12 properties with primary electricity data for cotton was 329 kWh/ac, in comparison to the estimate of 500 kWh/ac that was used.</p> <p>In 2023, we are planning to recalculate our agriculture portfolio baseline, which will involve a review and update of emission factors and estimates in the calculator. This suggested strategy will be considered then.</p>	Clarification accepted – issue closed
9	CR	<p>The following GHG types are not included in the GHG inventory: SF6, NF3, PFC, HFC.</p> <p>Manulife to confirm that SF6, NF3, PFC, HFC will not be reported.</p>	GHG Protocol Corporate Reporting Standard (Section 6)	GHG calculation worksheets of Manulife 2022 GHG inventory spreadsheet	<p>To our knowledge, our operations do not use any technologies, or follow any processes, that would generate material quantities of emissions of SF6, NF3, PFCs, or HFCs. The only real potential use case that would lead to emissions of any of these gases would be HFCs from refrigeration. Our refrigeration is limited, but where it occurs either ammonia or CO2 are used.</p>	<p>Response accepted - issue closed.</p> <p>A modified opinion will be issued due to the lack of reporting of SF6, NF3, HFC, and PFC in GHG inventory report.</p>

10	CR	<p>The majority of properties reported by Joseph Bell in the disclosure template form include detailed N applications.</p> <p>Manulife to explain why average values were used for N applications instead of actual reported values in Joseph Bell properties.</p>		2022 Property Disclosures - Joseph Bell.xls	<p>In some cases, data was given but it was not clear enough to warrant inclusion in the calculator, and an estimate was used instead. This decision was made with Analyst discretion. In the case of Joseph Bell's fertilizer data, there were a number of issues that forced us to defer to estimates:</p> <p>a) A single mass value was given for the use of multiple fertilizers.</p> <p>b) NPK ratios were not clear, or fertilizer names were not given.</p> <p>c) A single % urea was given for multiple fertilizers.</p> <p>Joseph is a manager of leased properties, so he doesn't have the same ease communicating with on-the-ground operations as a direct-operate manager. Because of this, follow-ups on this data were fruitless and the timeline pressure to complete the inventory caused us to use estimates even though we were close to having comprehensive primary data. In future, we will be more specific in the templates and instructions to ensure all applicable information for multiple fertilizers on one property is gathered in one ask.</p>	Clarification accepted – issue closed
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11	CR	<p>The property disclosure template form includes entries for both "fertilizer formulation" and "mass applied".</p> <p>Manulife to confirm whether the "Mass Applied" form field applies to total N applied OR total fertilizer applied.</p>		2022 Property Disclosures - Mike Bretl.xls	<p>The mass applied is for the total fertilizer applied. This was an input that was a source of confusion for those completing the template. Although this was always clarified with regional managers and operations reps., the template will be improved for next year with this in mind.</p>	Clarification accepted – issue closed
12	CR	<p>Diesel, gasoline, and NG decreased in 2022 on direct-operated almond properties with a corresponding significant increase in acreage.</p> <p>Manulife to explain the reductions observed.</p>			<p>Almond acreage in Australia was interpreted differently in 2021 vs. 2022. In 2021, the real acres of practice per crop was used, whereas in 2022 if there were multiple crops on a property, acreage was evenly distributed. This caused the calculator to show a significant increase in almond acreage year-over-year, when actual acquisitions and dispositions did not have a significant impact on the overall acreage.</p> <p>For fuel information, the major discrepancies are explained below:</p> <p>a.) In every case where there was a diesel estimate used in 2021, then primary data in 2022, the 2022 value was less than 2021 (this was 21% of cases for almonds).</p> <p>b.) The most significant year-over-year difference in diesel was at Lachlan Valley Farms. In 2022, less irrigation occurred due to it being a wet year. In addition, fuel for 2022 may have been purchased in late 2021. Most fuel calculations are based on invoices, potentially resulting in errors coming from carry-over into a new year.</p>	Clarification accepted – issue closed

13	CR	Gasoline, propane, and fertilizer decreased in 2022 on direct-operated apple properties with a corresponding increase in acreage. Manulife to explain the reductions observed.			Fertilizer information was inputted incorrectly for direct-operated apple properties in 2021. The value for the total mass of fertilizer was used where only the value for Nitrogen was needed. Upon recalculation, fertilizer use was similar year-over-year.	Clarification accepted – issue closed
14	CR	Electricity significantly decreased in 2022 on direct-operated citrus properties with a corresponding increase in acreage. Manulife to explain the reductions observed.			The major decrease in electricity at Kern Muller is because it was under redevelopment in 2022 and not in operation.	Clarification accepted – issue closed
15	CR	Electricity significantly decreased in 2022 on direct-operated cranberry properties with same acreage as previous year. Manulife to explain the reductions observed.			Electric sprinkler usage is tied to frost protection and irrigation on cranberry properties. The spring and fall of 2022 were mild, with minimal frost – this can vary significantly each year. In 2021 there were roughly 30 frost events, versus about three in 2022. In addition, summer of 2022 was cool with considerable precipitation, requiring significantly less irrigation.	Clarification accepted – issue closed
16	CR	Significant volume of propane consumption introduced in 2022 on direct-operated cranberry properties. Manulife to explain why propane consumed in 2022 and not in 2021.			In 2021, direct-operate cranberry propane consumption was not included due to a Sustainability Analyst error. There was propane usage in 2021 for all properties.	Clarification accepted – issue closed

17	CR	Natural gas combustion eliminated in 2022 at multiple direct-operated pistachio properties. Manulife to explain why NG not combusted in 2022.			Due to a Farm Operations Analyst error, pistachio natural gas for information was not reported in the 2022 inventory.	Clarification accepted – issue closed
18	CR	Natural gas combustion introduced in 2022 at Shasta Ash Creek walnut property. Manulife to explain why NG consumed in 2022 and not 2021.			Natural gas was used on Shasta Ash Creek in 2021, but it was not reported to the Sustainability team due to a Farm Operations Analyst error.	Clarification accepted – issue closed
19	CR	Manulife to describe their process for confirming that biomass combustion was not performed within their portfolio of properties in 2022.			In completing past carbon inventories, it was recognized that biomass combustion was de minimis, while also requiring significant effort to calculate, Therefore, it was not completed in the 2022 inventory.	Clarification accepted – issue closed

Recommendations:

RECOMMENDATION #	DESCRIPTION OF RECOMMENDATION
Recommendation #1	In the interest of improved transparency and efficiency of verifications, Manulife is encouraged to improve version control for documents, including the methodology document and the inventory spreadsheet.
Recommendation #2	Manulife is encouraged to prepare an updated version of its GHG methodology document on an annual basis.
Recommendation #3	Manulife is encouraged to review the effectiveness of its QA/QC procedures to reduce the occurrences of sustainability analyst error and farm operator error remaining undetected.
Recommendation #4	Manulife should ensure that all sources of emission factors and data sources used in GHG calculations are checked on an annual basis for updates.

Annex C: Verification Opinion

Annex D: Report of Factual Findings (If Applicable)
