Report on Futurepast's Verification Engagement with

Manulife Investment Management

Relative to Its

Annual estimates of GHG emissions and carbon storage at timberland investments

Report Date: 2023-06-12

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Contents

Addressee

This report is addressed to the management of Manulife Investment Management (Manulife), 197 Clarendon St., Boston, MA 02116 USA.

Responsibilities

It was the responsibility of Manulife, to prepare its timberland business greenhouse gas inventory statements in accordance with the *Greenhouse Gas Protocol Corporate Accounting and Reporting Standard, revised edition (2004)*, and its subsequent updates. 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 greenhouse gas 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 were the *Greenhouse Gas Protocol Corporate Accounting and Reporting Standard, revised edition (2004)*, and its subsequent updates. 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 Assessment Report 4 Global Warming Potentials. 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

The objective of this engagement is to verify the 2022 emissions year (1 January 2022 to 31 December 2022) of Manulife's GHG inventory and to confirm that the emissions are

- free of material misstatements within the percent threshold of materiality, and
- that the inventory conformed to the requirements of the criteria for verification.

Manulife seeks this verification for internal management purposes and for public GHG emissions disclosure.

Scope of the Verification

Facilities, physical infrastructure, activities, technologies, and processes	Manulife directly operates forest lands in six countries: Australia, Canada, Chile, New Zealand, Brazil, and the United States.
Greenhouse gas sources, sinks, and reservoirs	**Scope 1 ("Direct")** • Scope 1 emissions and removals from forest lands • CO2, CH4, and N2O emissions from fuel used in equipment and vehicles (land-based and aircraft) that are owned or directly controlled by Manulife • N2O emissions from fertilizer application • CH4 and N2O from prescribed burning (including slash burning) • These three gases were the only greenhouse gases reported. **Scope 2 ("Energy Indirect")** • Given the remote nature of timberlands, there are no relevant scope 2 emission sources. **Scope 3 ("Other Indirect")** • Emissions from fuel used in equipment and vehicles (land-based and aircraft) that are owned by 3rd-party contractors and used for forest management and related activities at Manulife-managed sites.
Types of greenhouse gases	CO2, CH4 and N2O. These three gases were the only greenhouse gases reported.
Time period	2022 emissions year (1 January 2022 to 31 December 2022)

Level of Assurance and Threshold of Materiality

Manulife Investment Management has requested verification services be performed at the limited level of assurance.

Summary of Manulife Investment Management's Greenhouse Gas Statements for activities of its subsidiary Manulife

	2021	2022
(a) Emissions - Fuel Combustion from MIM TA Owned Vehicles / Equipment (MtCO2e)*	2,879	3,102
(b) Emissions - Fuel Combustion from Contractor Owned Vehicles / Equipment (MtCO2e)	195,330	482,445
(c) Total Direct and Indirect N2O Emissions (MtCO2e)	21,199	8,642
(d) CH4 and N2O Emission from Managed Fire (MtCO2e)	52,318	37,489
Total Scope 1 (MtCO2e, (a+c+d))	76,396	49,050
Total Scope 3 (MtCO2e, (b))	195,330	482,445
Total Non Biological Emissions (MtCO2e)	271,726	531,496 (1)
Removals (Net Biological Change MtCO2e)	3,179,520	-1,339,974 (2)
Storage (Carbon stocks MtCO2e)		
Forests	615,204,003	638,506,302
Resource Change		-24,642,273
Wood products	2,943,228	2,557,633 (3)
Total Net GHG Profile (2+3-1)		**686,164**

Source: Manulife Calculator Dashboard2022 version 3 May 5, 2023/Dashboard Total Adjustments (Resource Change) are made to adjust 2022 values to be comparable to 2021. These include property exchanges, and changes to the inventory methods.
*** Metric tons of carbon dioxide emissions equivalent**

As shown in the table above, forest carbon stores increased by approximately 23.3 million MtCO2e from the previous year. This was offset by a negative 24.6 million MtCO2e Resource Change adjustments for property exchanges and changes in inventory methods (so as to compare like with like). This resulted in a net negative 1.34 million (i.e., decrease) in forest carbon stores. Carbon stored in wood products was calculated to be 2.56 million MtCO2e. The wood products storage

(2.56), net biological decrease (-1.34) in the forest carbon, and the non-biological emissions (-0.53) summed to a net greenhouse gas profile of 0.69 million MtCO2e of removals for 2022.

Futurepast's Lead Verifier and Forestry Expert reviewed the initial Manulife Timberland Calculator Dashboard 2022 between April 7th and April 12th. The results of our findings were reviewed with a Manulife representative on April 13th. An updated Timberland Calculator Dashboard 2022_v3 was provided on May 5, 2023. This updated dashboard and earlier versions were reviewed along with the requested source spreadsheets between April 14th and May 10, 2023. Three versions of Futurepast's list of findings were provided to Manulife. Manulife provided responses that were subsequently reviewed and accepted.

Description of Data and Information Management Systems

Manulife described their methods for establishing its greenhouse gas inventory in a Greenhouse Gas Methodology Manual, prepared April 13, 2023, by the Delphi Group with support from Finite Carbon. This is a document that describes the base year, their sources/sinks/pools, and the quantification methods. They also describe the uncertainty assessment, their monitoring, data quality management, and GHG reporting. Their appendices provide details on the equations used and the citations for their sources.

The quantification and reporting process is centralized and performed via GHG calculator (MS Excel) that tracks input data, processes it to carbon values and outputs to summary tables. The calculator has been tested against earlier summary methods for consistency and errors. The document describes a number of QA/QC tests conducted by Manulife and Finite staff. These tests included forest area checks, conformance by forest type, age class distribution, and merchantable stocking, conversion of units, visually examining the year-to-year changes in datasets and that growth was within expected bounds. The calculator outputs inventory to formats to WRI GHG Protocol conformance.

The carbon calculations for the forest storage are based on estimates of forest volumes that are annually estimated by Manulife regional managers." Cursory information is given on the methods for collecting forest inventory information via conventional plots and by LiDAR methods. Manulife is switching over to the LiDAR methods and the accuracy of the LiDAR results was requested by Futurepast but was not provided. The volume estimate methods were not reviewed by the verification team and the volumes were used "as is". The verification focused on the calculation of the forest carbon stores, wood products, and estimates of production of greenhouse gases by scope 1 and scope 3 activities.

Discussion of Verification Team's Risk Assessment

Reporting activity	Inherent	Control	Non-Detection
GHG sources	High for forest volume	Low as their measurement	Low as forest volume measure

	measures; field inventories can have errors of up to 10 %. Volumes are provided "as is."	systems appear to be sophisticated.	are well established and errors are known.
Boundaries	Medium: boundaries may not be precisely known.	Survey and GPS/GIS data are generally accurate.	Low as Hancock appears to have an accurate management system.
Data management	High as data is coming in from a variety of regions in different formats and there are numerous calculations to be made.	Low as Manulife demonstrated a careful attention to details in their methods document.	Low as there are ways to cross check the data against other regions and against expected bounds.
Management controls	Medium as controls are only as good as the procedures are implemented. We relied on Hancock to institute data management.	Low as Manulife appears to be well organized and communications with the regions look adequate.	Low as Hancock details QA checks and appears to be aware of sources of error.

Description of Evidence-Gathering Procedures

Direct Emissions and Removals

We reviewed the harvested wood products (HWP) calculations in detail and confirmed the source of the values reported in the dashboard "Timberland Calculator Dashboard2022" (referred to as the "Dashboard"). We confirmed that the Dashboard values source data from the "Carbon Summary by Property2022" tab in the Dashboard workbook, which in turn source data from the "XXX_fulldata.xlsx" workbooks (where XXX is the name of the region/country).

We reviewed the Dashboard values source data from the Brazil2022Fulldata. Several cells were found to be incorrectly linked and this information was provided to Manulife in our list of findings. Some of these issues were corrected in Dashboard v2, and some were corrected in Dashboard v3. We reviewed the mean annual increment by property in Brazil which ranged between 15.56 m^3/ha to 41.69 m^3/ha averaging 26.5 m^3/ha and found this to be within expected ranges although somewhat on the high end. We checked Standing Live and Debris calculations in Brazil2002Fulldata tracing back to the formulas in the Delphi document and all the formulas were found to be correctly implemented. We reviewed the area values (hectares and acres) in Brazil2022Fulldata and found that some properties that had not been inventoried were not included in the calculations. While they should not have a Standing Live carbon value, they should have a Debris calculation based on when that property was last harvested. We reviewed the calculation of Harvested Wood Products from Brazil2022Fulldata and found that the Paper CO2e was abnormally high. After tracing this it was found to be looking up the wrong value on the pivot table.

We reviewed the proportion of CO2e in Long Term Storage as a proportion of Standing Live. Several properties showed unusually high numbers. We reviewed the amount of Debris compared to Total Onsite carbon. Several properties had Debris numbers that made up more than 50% of Onsite carbon. We also reviewed Harvest Volume as a proportion of Standing Live. Several properties had unusually high harvest volumes compared to standing live. This was especially noticeable in Brazil

– Bandeirante, which was identified as a linkage issue between the Dashboard and Brazill2002Fulldata. Other very high harvest volume numbers were found on Leesville, Piedmont, Tupelo, Salt Creek, and St. Helens.

We spot checked data between several spreadsheets. Comox showed up as both Canada and NZ in various places. A graph on Dashboard-Total was missing the Brazil data. The conversion factor for HWST_CDS and HWPW_CDS were the same as SWST_CDS and SWPW_CDS but many jurisdictions in the US use a higher factor for hardwood. We reviewed Aboveground Carbon in comparison to other data for each US property. There were 54 cases where Aboveground Carbon was zero, but age was valid and non-zero. These cases should have carbon tons.

We calculated average stem volume per acre values for each property in the "Carbon Summary by Property2022" tab in the Dashboard workbook as a check to ensure that the values are within expected ranges and generalized assumptions on the forest types and management regimes.

Direct emissions by fuel use, burning biomass, and fertilizer use were approximately 0.5 million Mt CO2e). Manulife provided summary data in the Dashboard Total and these were linked to tabs that aggregated and calculated the various sources. Each data cell in the Total tab could be linked back to another intermediate aggregating sheet, itself with links to still other data source sheets or another file the Non-biological Emissions Calculator. We selectively checked equations, factors, and reported raw data for their sources and for reasonableness.

Indirect Emissions and Removals from Imported Electricity, Steam, Heat, and Cooling
Scope 2 emissions were not included in the greenhouse gas inventory for Manulife's forest holdings as they reported there was no infrastructure on the forest properties. For this reason, scope 2 emissions in Manulife's GHG statements are quantified as "zero" and are omitted from the Emissions, Removals and Storage summary. Carbon accounting for the administrative management functions associated with Manulife's timberland business was not included in the scope of reporting subject to this verification engagement.

Indirect Emissions and Removals from Manulife's Supply Chain
Supply chain emissions were not included in this greenhouse gas inventory.

Indirect Emissions and Removals from the Use and End-of-Life Stages
Harvested wood from the forest was converted to mill deliveries and wood products. Manulife provided wood harvest volumes and carbon stored long-term products in the Timberland Calculator Dashboard. These summaries were linked back to the file XXFull data.xls. We requested the full data files and traced wood harvested volumes there. We checked factors and equations.

Indirect Emissions from Other Categories
No other categories of emissions associated with timber management not mentioned in this report were included in the greenhouse gas inventory of Manulife.

Base Year Adjustments

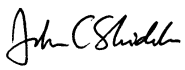
The Timberland Calculator Dashboard 2022 v3, Dashboard Total tab under the heading 2022 Net Change Summary shows a summation of the year-end stores for 2022 and 2021 and shows changes in CO2e emissions in year 2022 from the previous year 2021. An entry called "Resource Change" shows the change in CO2e as result of property divestitures and acquisitions, changes in estimation methods, and errors in calculations that occurred in year 2022. The Resource Change for 2022 summed to approximately an additional 24.6 million MTCO2e. This additional CO2e was then subtracted from the net GHG profile value for 2022 so as to make a corrected comparison to year 2021. The WRI GHG Protocol provides guidance on pages 37 and 38 that this adjustment should be made to the base year and not to the prior year (2021). However, this change of 24.6 million is less than the Forest Carbon Stores in the base year of 609 million MTCO2e and does not trigger a recalculation of the base year since the chosen threshold for recalculations as listed in the Greenhouse Gas Inventory Methodology Manual May 19, 2023, was a 10% change.

Improved data collection on fuel use by contractors (Scope 3 emissions) in 2022 resulted in a approximately three-fold increase in the estimates of CO2e emissions for scope 3 non-biological emissions when compared to the emissions reported in the base year 2020. This increase exceeded the threshold of 10% that would trigger a recalculation of the baseline emissions in accordance with the GHG Protocol, chapter 5.

Verification Criteria

Futurepast conducted its verification activities based on the requirements of ISO 14064 (2019) Greenhouse gases—Part 3: Specification with guidance for the verification and validation of greenhouse gas statements.

Verification Team Leader and Independent Reviewer Signatures

Verification Team Leader	 Kim Mattson, 2023-05-10
Independent Reviewer	 John C. Shideler 2023-06-12
This report is approved when signed and dated by the independent reviewer.	

Verification-Validation Workbook: Verification Plan

CLIENT	Manulife Investment Management Timberland and Agriculture, Inc.	**CONTACT:**	Brandon Lewis		
			Email:	blewis@manulife.com	
ENGAGEMENT	Verification of 2022 carbon inventory at limited level	**Phone:**	[609-375-7545]		
			Lead verifier	Kim Mattson	(530) 925 5943
			Technical expert	Bruce Carroll	(843)270-2648

PLAN APPROVED BY:	kgm	**PLAN DATE:**	6-Apr-2023	**PLAN REV.:**	10-May-2023
LEVEL OF ASSURANCE:	Limited	**ENGAGEMENT TYPE:**	Verification		

OBJECTIVES

inventory and emissions are free of material misstatements within the percent threshold of materiality

that the inventory conformed to the requirements of the criteria for verification

[Enter objective 3 here]

SCOPE

Entries are required for all scope elements a-f.

a) GHG sources, sinks and reservoirs

Forest Carbon pools, harvested wood, emissions of Scope 1 and 3.

b) Boundaries

Operational control of five regions in millions of acres: Australia 1.4, Chile 0.2, New Zealand 0.6, North America (US 3.2 and Canada 0.05)

c) Physical infrastructure, activities, technologies and processes within the scope
Forest holdings, fuel use by machinery, fertilization with N, biomass burning. No electricity use.

d) Data management details
Limited engagement assumes client has adequate data management controls

e) Management controls
Limited engagement assumes client has adequate management controls

f) Time periods
Calendar year 2022

IDENTITY AND ROLES OF VERIFICATION TEAM MEMBERS

NAME:	Kim Mattson	**ROLE:** Team Leader	*530 925 5943*
NAME:	Bruce Carroll	**ROLE:** Technical Expert	*843 270 2464*

VERIFICATION CRITERIA:	ISO 14064-3	**MATERIALITY THRESHOLD (%):**	10
VERIFICATION CRITERIA:	Secondary criteria	**PERFORMANCE MATERIALITY (%):**	*N/A*
		DATE PLAN SENT TO RESPONSIBLE PARTY:	6-Apr-2023

REASON(S) FOR PLAN REVISION: Changes to schedule as List of findings was revised twice and resubmitted.

SCHEDULE FOR SITE VISITS

DAY	DATE	ACTIVITY	TEAM MEMBER
Tuesday	4-Apr-2023	Receipt of data sheets	KM BC
Thursday	6-Apr-2023	Kickoff call	KM BC
Wednesday	5-Apr-2023	Notification letter	KM

Wednesday	12-Apr-2023	Conference call with Manulife re calc sheets	KM BC
Thursday	13-Apr-2023	Continue verification work	KM BC
Tuesday	20-Apr-2023	List of findings	KM
Friday	27-Apr-2023	Response to List of findings	KM BC
Monday	28-Apr-2023	Follow-up call on List of findings	KM BC
Tuesday	May 1-2023	Version 2 of list of findings	KM BC
Tuesday	8-May-2923	Version 3 of list of findings	KM BC
Friday	10-May-2023	Response to Version 3 of List of findings	KM BC
Friday	10-May-2023	Draft report	KM
Mon-Fri	15-19-May 2023	Additional time added	KM, BC
Monday	22-May-2023	Independent review and draft to client	JS

Annex B: List of Findings

Futurepast
We count carbon.

Verification-Validation Workbook: List of Findings

Client Name:	Manulife Investment Management Timberland and Agriculture, Inc.
Lead Verifier:	Kim Mattson

Instructions to Verifiers

In executing the validation/verification, validators/verifiers shall undertake the following activities:
a) collection of sufficient objective evidence on original data/information, ensuring its traceability through the data/information management process, any further analysis and calculation;
b) identification of misstatements and consideration of their materiality;
c) assessment of conformity with specified requirements, considering the validation/ verification program.

Record findings of **Nonconformity (NC)** and **Clarification Requests (CR)** on this form. Findings of **Immaterial Nonconformity (INC)** may be listed (or, where a GHG program requires their reporting, shall be listed). **Forward Action Requests (FAR)** and **Recommendations (R)** may also be included as items on this form.
Finding/Clarification: State the requirement that was not met or ask for clarification of information related to audit objectives.
Reference (Ref.): Cite a relevant requirement in a protocol, standard or procedure; or cite information provided by the Responsible Party in a monitoring plan, report or other document.
Audit Evidence: Cite evidence that supports the finding of nonconformity, or (optionally) a reason for requesting clarification.
Responsible Party Action: Summarize the response provided by the Responsible Party with respect to the Finding or Clarification Request.
Lead Verifier Conclusion: State if the response has been accepted, and the disposition of the finding (closed, rewritten as a new NC, etc.).
NOTE: If a matter comes to the verifier's/validator's attention that causes the verifier/validator to believe in the existence of intentional misstatement or noncompliance by the responsible party with laws and regulations, the verifier/validator shall communicate the matter to the appropriate parties as soon as practicable. Intentional misstatements include the possibility of fraud.

#	Type	Issue/Clarification	Ref.	Audit Evidence	Responsible Party Action	Lead Verifier Conclusion

1	CR	Dashboard Carbon Summary data entries	HTRG Calculator Dashboard2022 - Carbon Summary 2021-2022 Change	Cells in row 11 (HVP) in the Carbon Summary 2021-2022 Change are hand entered rather than lookups from a source document. Can you confirm the accuracy of these numbers or provide the source document.	Manulife confirmed that these numbers are correct and will provide a source spreadsheet for our review.	Accepted.
2	CR	Dashboard Carbon Summary 2021-2022 Change data entries	HTRG Calculator Dashboard2022 - Carbon Summary 2021-2022 Change	Cells in row 15-17 (Brule River, Great Lakes Forests 1, Great Lakes Forests 2) columns Y to AC in the Carbon Summary 2021-2022 Change are blank rather than lookups into a source document. Can you confirm that these should be zero.	Manulife confirmed that these fields should be zero since these did not use the new LiDAR process.	Accepted.
3	CR	Dashboard Total harvests	HTRG Calculator Dashboard2022 - Dashboard Total	We show lower harvest in 2022 but much higher Carbon Stored Long Term on average over 100 years in Products In Use in 2022. Please confirm calculations. [Note: may be caused by #4 below]	Partial explanation is from #4 below, we will re-review the data.	Accepted. Wood products appear to be calculated based on average lifetime instead of 100-yr lifetime. Also see Issue 5 below.
4	CR	Dashboard Carbon summary by property 2022 Harvests Brazil appear high	HTRG Calculator Dashboard2022 - Carbon Summary by Property2022	Harvest in Bandeirante seems abnormally high compared to standing inventory implying a harvest of approximately 67% of original standing volume (m3).	Two fields were reversed in the Carbon Summary by Property2022 - cells :1-8 and M109. Manulife will correct and send a new copy of the Dashboard/	Accepted.
5	CR	Dashboard Carbon Summary by property other high harvests	HTRG Calculator Dashboard2022 - Carbon Summary by Property2022	Harvest on several other properties (Leesville, Piedmont, Tupelo, Salt Creek, St. Helens) seem high compared to standing inventory (m3). Please verify/explain these higher harvests.	As our inventory team explained to me the harvest volumes might be delayed entering the system and thus, the volumes for 2022 might include late records from 2021. For some properties the harvested volumes are higher in 2022 to capture the higher timber prices.	Accepted. Harvest on these properties still seem high but this error is not thought to be material.
6	CR	Dashboard Carbon Summary by property debris appear high	HTRG Calculator Dashboard2022 - Carbon Summary by Property2022	Debris numbers seem high with some carbon debris being more than 50% of total onsite carbon.	Debris calculations did not change from last year. PNW properties often have large debris carbon pools.	Accepted.

7	CR	Comox property appears to be inadvertently repeated	HTRG Calculator Dashboard2022 - Carbon Summary by Client2022	Comox shows up as both Canada and NZ in Carbon Summary by Client2022. Not sure if this oversight is affecting any downstream calculations by region.	Corrected in Dashboard. Manulife will send a new copy.	Accepted.
8	CR	Dashboard total graph for Brazil	HTRG Calculator Dashboard2022 - Dashboard Total	Graph on Dashboard Total is missing Brazil.	Corrected in Dashboard. Manulife will send a new copy.	Accepted.
9	CR	Emissions data	HTRG Calculator Dashboard2022 - Emission Summary byProperty2022	Please provide a copy of HTRG Non-Biological Emissions Calculator spreadsheet so that we may review source documents for Emission Summary byProperty2022	The copy was provided on 04/12/2023.	Accepted.
10	CR	Conversion factors	North America 20212022 full data Conversion Factor	Review Conversion Factors for HWST_CDS, HWPW_CDS. Many sources use 80 cubic feet per cord for hardwood.	The conversion factors were supplied by the developer and did not change year over year.	Accepted.
11	CR	Aboveground C calculations	North America 20212022 full data US_Inventory 2022	There are 54 cases where Live Aboveground CO2e is Zero. In 50 of these cases the Age is valid (non-zero, non-null)	Reviewed: 1) Out of those 54 records, 30 are premerch or clearcut/non-forested strata that does not have volumes. 2) The total area of the rest of the strata (24 records) is ~530 acres. 3) The majority of these 24 records correspond to non-commercial species on the PNW. That is a gap in the inventory, but we are collecting LiDAR data on these properties and will update these strata next year.	Accepted.

12	CR	Linkages between Dashboard and Brazil full data spreadsheets	HTRG Calculator Dashboard 2022 Carbon Summary by Property 2022 and Brazil 2022 full data PivotTable	Several cells are incorrectly linked from Dashboard to Brazil2022fulldata. Example: TSV for Brazil links to column labeled TSV in PivotTable tab, but this cell links to Net_ForType_Hectares in the pivot table	Corrected.	Accepted.
13	CR	Property area, forested property area, and managed forested area for Brazil	Brazil2022fulldata - PivotTable	Various values for hectares exist in Brazil2022fulldata. Prop Hectares, For Hectares, Mgnt_For_Hectares do not match between pivot tables because some are sourced from BrazilInventory2021 or BrazilInventory2021raw versus being source from Brazil_ Property Activity 2021. Brazil Property Activity2021 has several Property ID's that do not exist on the other tabs. Please confirm which area values are correct. If these extra properties are owned but not yet old enough for inventory they should be included so that Debris is calculated for them.	Corrected. Please see Brazil2022 fulldata.xlsx	Accepted. We found that 14 of the 20 properties were fixed. The remaining 6 being unfixed is a small conservative error.
14	R	Year assigned to some data files or tabs in excel files have not been updated to reflect the current year (2022). We recommend you review and fix.		1) App A2 Delphi methods document have references to full data excel tables dated 2019 2020. The current year is 2021 2022. 2) HTRG Dashboard Pivot tab Carbon Summary by Property 2022, column H refers to North America 2021 2022 tab PivotTable 2021. This table correctly sums 2022 data, but the tab is labeled PivotTable 2021.	The original document is not edited for annual calculator updates.The tab is not updated to avoid broken links in the dashboard.	Accepted
15	CR	Conversion factors BEF	NorthAmerica 2021 2022 Tab Conversion Factors	If these factors are being used in calculations, please provide sources for BEFs listed in rows 54, 55, and 57. Also row 57 ratios appears to be reversed. That is, it appears to be TOTSL to TOTSLAG. (No dependent cells appear to be associated with these factors, which may make this issue moot.)	None of those coefficients are used in the calculations.	Accepted

16	NC	Equation for living biomass North America	NA full data Tab US Inv 2022 Column AD Living Biomass	The equation in spreadsheet does not appear to match Eqn 22 in Delphi Methods doc. Coefficient A in Eqn 22 is negative. Appears to be positive in spreadsheet. Please check and either explain or revise calculations.	Same as last year	Accepted. Dashboard for 2022 volumes were corrected. But see Issue 21 below.
17	CR	Dashboard Carbon summary by property 2022	Column O total C Mt CO2e	Two properties have been removed from the total C summation: Salish and Tomanamus. These removals reduced total C by 16.4 million Mt or 4 %. Is the removal correct?	Yes, we have never included these properties into a carbon report because they have a special status.	Accepted
18	CR	Delphi Methods doc 2023	References to year updates	Several references to years of data appear to need updates for 2022.	Addressed in #14.	Accepted
19	R	Repeated US as country code in emission factors	Non-Biological Emissions Calculator tab Emission Factors column D (D44 D45)	Lookup command from tab Fuel Emission Calc uses county code to lookup the factor (CO2eq, Column H). With two County codes for US in the Emission Factors, the second factor will not be looked up. The two factors are very similar and likely not material.	The two different coefficients are used in Scope 1 and Scope 3 calculations.	Accepted
20	CR	Dashboard Carbon Summary 2021-2022 Change	Last three columns AK-AM	These columns appear to summarize the 2021 carbon profile. That is, columns AK and AL summarize carbon from the 2021 sheet not the 2022 sheet. Please verify that this is what was intended or if the 2022 profile was intended.	Corrected	Accepted
21	CR	Correction to NA volumes noted in Issue 16 above	Issue 16 above	The equation change (to add the minus sign) from issue 16 caused a very large change in End of 2022 Forest Carbon Stores. Should this have caused a recalculation of the End of 2021 Forest Carbon Stores.	Corrected both 2022 and 2021 calculations. The adjustments were made in the North America 20212022.xlsx submitted on May 5, 2023.	Accepted. However, an email from Svetlana Schroder on May 10, 2023, indicated that the corrections were embedded in the adjustment value.
22	CR	Available information about volume method changes and accuracy assessment.	See last two tabs to the right	The overall change in carbon (CO2e) caused by the change to LiDAR inventory from conventional inventory in the US South totaled an additional 6.086 million tons or 3.54% of the US South inventory. Please provide more details on the LiDAR inventory method and accuracy. For example - would you please provide any available details on recall, precision, f-score, producer accuracy, users accuracy overall accuracy or other relevant measures, preferably on standing volume.	Table submitted by Svetlana Schroder on May 10, 2023, contained goals for the LiDAR scans but not the resulting accuracies. See tabs attached to this file.	Accepted. Estimates of forest volumes were accepted "as is" with no evaluation of accuracy.

Independent Opinion on the Statements of

Manulife Investment Management

Relative to Its

Annual estimates of GHG emissions and carbon storage at timberland investments

Opinion Date: 2023-06-12

To the Management of:	MANULIFE INVESTMENT MANAGEMENT, TIMBERLAND AND AGRICULTURE 197 Clarendon St., Boston, MA 02116 USA
Independent Verification Opinion of:	Futurepast, Inc. 2111 Wilson Boulevard, Suite 700 Arlington, Virginia 22201 USA
Subject Matter:	Annual emissions of GHG emissions and carbon storage
For the Period:	1 January 2022 to 31 December 2022

Details Pertaining to the Statements

Responsible Party, if Different from Addressee	N/A
Statement of Responsibility:	It was the responsibility of MANULIFE INVESTMENT MANAGEMENT TIMBER AND AGRICULTURE (Manulife) to prepare its ANNUAL GHG EMISSIONS AND CARBON STORAGE statements in accordance with the World Resources Institute/ World Business Council for Sustainable Development's *"The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard – Revised Edition" (March 2004)* as amended in 2013 and 2015 (GHG Protocol). This responsibility includes designing, implementing, and maintaining a data management system relevant to 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.

Intended User and Limitation of Liability

Intended User:	This report has been prepared for the management of Manulife for both internal use and for public disclosure.
Limitation of Liability:	Manulife is solely responsible for the preparation and presentation of the information it has submitted to Futurepast for verification. Our role is limited to expressing a conclusion as to whether the greenhouse gas emissions and carbon storage as

stated by Manulife are presented fairly in accordance with the GHG Protocol. In doing so, we do not assume any duty, liability, or responsibility of Manulife or of any third party. Our duties in relation to the opinions expressed are owed solely to Manulife. As such, we do not accept any responsibility for any loss allegedly occasioned by any third party acting or refraining from action because of our expressed opinions.

Details Pertaining to the Validation/Verification Body

Futurepast's Role:	Futurepast is an impartial third-party validation/verification body.

Declaration of Impartiality

Evaluation of Actual or Potential Conflicts-of-Interest	Futurepast, and the verification team members and independent reviewer, have evaluated their potential for compromised impartiality and found no actual or potential threats to impartiality with respect to the performance of this engagement.

Details Pertaining to the Verification Team and Independent Reviewer

Verification Team Leader:	This verification was led by Kim Mattson.
Verification Team Members:	Bruce Carroll assisted the team leader in the execution of this verification as a technical expert.
Independent Reviewer:	This verification was independently reviewed by John Shideler.

Details Pertaining to the Verification

Type(s) of Engagement:	Verification
Objectives of the Verification:	To verify the 2022 GHG inventory of Manulife's timberland business and to confirm that emissions and reported removals are free of material misstatements within the agreed level of assurance and that the inventory conformed to the requirements

	of the criteria.
Scope of the Verification:	Manulife directly operates forest lands in six countries: Australia, Canada, Chile, New Zealand, Brazil, and the United States.
Level of Assurance:	Limited
Threshold of Materiality:	10 %
Verification Criteria:	Futurepast performed this verification in accordance with the requirements of ISO 14064-3:2019.

Description of Work Performed

Description of the Basis for Our Conclusions and Opinion	Manulife provided a methods document describing how they followed the GHG Protocol for reporting emissions and a set of spreadsheets showing their calculations derived from timber volumes, timber harvests, land area, land exchanges, volume estimate changes, and Scope 1 and Scope 3 emissions reporting. Futurepast reviewed these documents using a risk-based approach where we focused on those data that posed the greatest risks to misstatement in their annual GHG report. Futurepast verified the consolidated total carbon stocks and emissions found in the tab “Dashboard Total” of the Manulife Calculator Dashboard 2022 v. 3 and many of the associated linked tabs. We reviewed the average stem volume per acre values for selected property in the "Carbon Summary by Property2022" tab in the Dashboard workbook as a check to ensure that the values were within expected ranges and generalized assumptions on the forest types and management regimes. We reviewed the other pools (standing dead, understory, debris) for reasonableness. We checked the actual calculations used and the emission factors to convert to CO2 equivalent. We checked the sources for these equations and emission factors. We reviewed emissions from fuel use, fertilizer use, and burning and how they were derived. Issues we encountered were assembled into a list of findings and were presented to the client for resolution. Manulife made corrections and the corrections were accepted. The data examined were historical in nature.

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Summary of the Responsible Party's Statements

	2021	2022
(a) Emissions - Fuel Combustion from MIM TA Owned Vehicles / Equipment (MtCO2e)*	2,879	3,102
* metric tons of CO2 equivalent		
(b) Emissions - Fuel Combustion from Contractor Owned Vehicles / Equipment (MtCO2e)	195,330	482,445
(c) Total Direct and Indirect N2O Emissions (MtCO2e)	21,199	8,642
(d) CH4 and N2O Emission from Managed Fire (MtCO2e)	52,318	37,489
Total Scope 1 (MtCO2e, (a+c+d))	76,396	49,050
Total Scope 3 (MtCO2e, (b))	195,330	482,445
Total Non Biological Emissions (MtCO2e)	271,726	531,496 (1)
Removals (Net Biological Change MtCO2e)	3,179,520	-1,339,974 (2)
Storage (Carbon stocks MtCO2e)		
Resource Change	615,204,003	638,506,302
Wood products		-24,642,273
	2,943,228	2,557,633 (3)
Total Net GHG Profile* (2+3-1)		**686,164**

Source: Manulife Calculator Dashboard2022 version 3 May 5, 2023/Dashboard Total
*** Adjustments (Resource Change) are made to adjust 2022 values to be comparable to 2021. These include property exchanges, and changes to inventory methods.**

As shown in the table above, forest carbon stores increased by approximately 23.3 million MtCO2e

from the previous year. This was offset by a negative 24.6 million MtCO2e Resource Change adjustments for property exchanges and changes in inventory methods (so as to compare like with like). This resulted in a net negative 1.34 million (i.e., decrease) in forest carbon stores. Carbon stored in wood products was calculated to be 2.56 million MtCO2e. The wood products storage (2.56), net biological decrease (-1.34) in the forest carbon, and the non-biological emissions (-0.53) summed to a net greenhouse gas profile of 0.69 million MtCO2e of removals for 2022.

Limitations, If Any

Manulife's largest stores of carbon are in the forest stands. Carbon estimates are based on volume estimates. Futurepast accepted the volume data "as is."

Scope 2 electricity emissions were not reported as no offices or infrastructure is located at the remote forest sites and electricity emissions were considered de minimus.

Modifications, If Any

Manulife's GHG inventory did not fulfil the requirement for public disclosure listed in the GHG Protocol, Chapter 9, "Reporting GHG Emissions" that emissions data for all seven GHGs (CO2, CH4, N2O, HFCs, PFCs, SF6, NF3) be separately reported in metric tonnes and in tonnes of CO2 equivalent.

Manulife's inventory base year (2020) was not recalculated as required by chapter 5 of the GHG Protocol.

Conclusions (Verification)

Except for the limitations and modifications described above, and based on our evaluation of the evidence, nothing comes to our attention which causes us to believe:

- That Manulife Investment Management*'s* inventory report for its timberland business for the period from 1 January 2022 to 31 December 2022 is not materially correct and is not a fair representation of its GHG data and information, and
- That Manulife Investment Management's inventory report for its timberland business for the period from 1 January 2022 to 31 December 2022 has not been prepared in accordance with the World Resources Institute/World Business Council for Sustainable Development's "*The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard – Revised Edition*" (March 2004) as amended in 2013 and 2015.

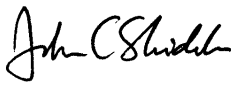
Approvals

Kim Mattson

Verification Team Leader: 

Date: 2023-05-10

John C. Shideler

Independent Reviewer: 

Date: 2023-05-21

Signature

Verification/Validation Body: Futurepast: Inc., Arlington, Virginia USA

Opinion Issued: 2023-06-12