Production Facility & Output Audit Report

For Puro.Earth

CO_2 Removal Supplier	Earthcare, LLC
Removal Method	Biochar
Production Facility	Riverview Farms
Production Facility Address	1505 East County Rd. 500 N. Orleans, IN, USA 47452 *38.6274968,-86.4322177*
Net Volume of CO_2 Removal	268.88 CORCs
Removal Period	October 3, 2022 – December 15, 2023
Auditors	350Solutions Lily Schacht
Version	V2.0

Issued: November 14, 2024

Contents

PRODUCTION FACILITY & OUTPUT AUDIT REPORT		
Company: Earthcare, LLC	Company Contacts: Mike McGolden (Earthcare) Melissa Leung (GECA)	Audit Team: Lily Schacht* Kyann Hadife Tim Hansen
Removal Method: Biochar		
Report Date: November 14, 2024		
Document No: 350VR-VG-PU2302		
Rev: 2.0		

** primary contact/lead author*

1. Introduction

350Solutions was contracted to perform an audit and validation of the production facility as well as verification of carbon dioxide removal credit (CORC) claims for Earthcare biochar production and utilization at Riverview Farms. Earthcare gasifies poultry litter produced at Riverview Farms to make biochar that is spread on farm fields, pastures, and orchards, including those owned by Riverview Farms.

350Solutions conducted an audit of the process, lifecycle CO_2 emissions assessment (LCA), and other administrative details to verify compliance with the requirements of the Puro.Earth Puro Standard General Rules v3.1 [1] and Biochar Methodology (Edition 2022 Version 3) [2]. The audit and verification began with a document review and followed with a site visit and detailed data audit on August 22, 2024.

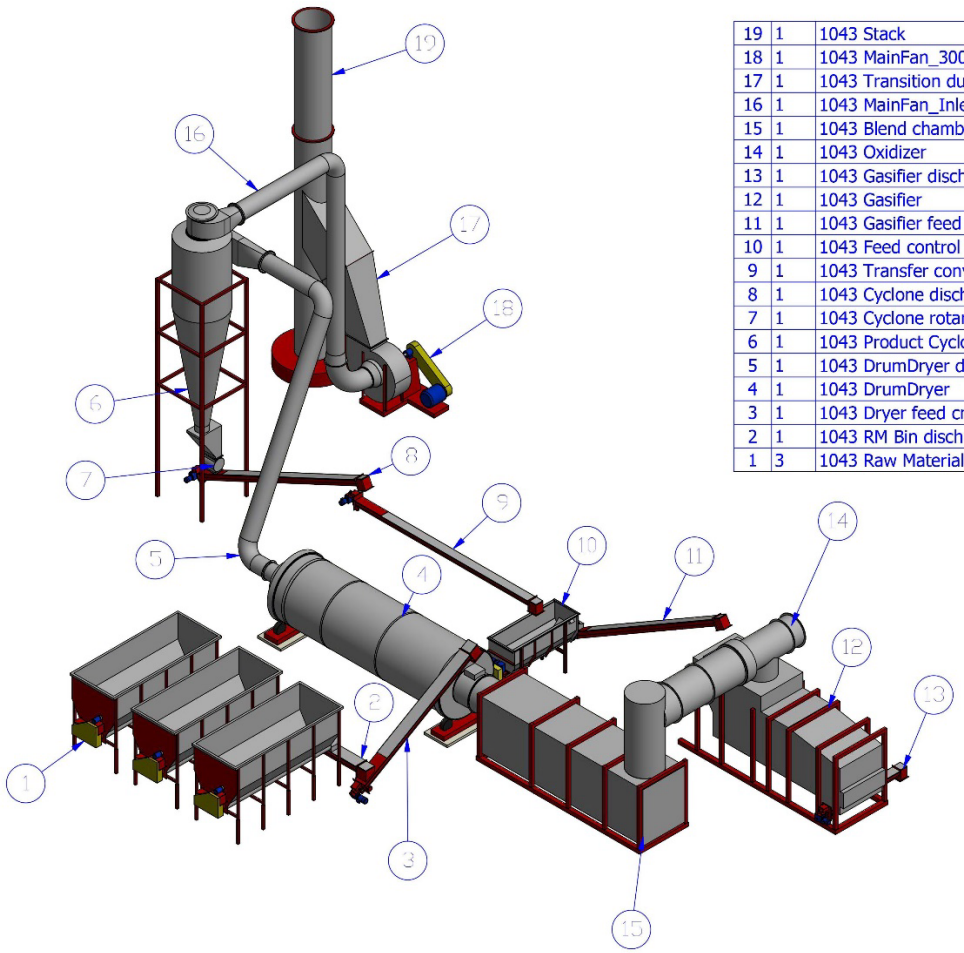
Table 1. Earthcare – Riverview Farms Verification Summary

Verification Summary	
CO_2 Removal Supplier	Earthcare, LLC
Removal Method	Biochar
Verification Type	Combined Production Facility Audit and Output Audit for Puro.Earth, including on-site visit and facility audit; Puro Standard General Rules (v3.1) and Biochar Methodology (v3)
Production Facility Name	Riverview Farms (Facility ID: 715141)
Production Facility Location	1505 East County Rd. 500 N. Orleans, IN, USA 47452 38.6274968, -86.4322177
Verified CORC Factor	0.807 t CO_2-eq/t biochar
Verified CORCs	268.88
Site Visit Date	August 22, 2024
Audit Report Date	November 14, 2024

2. Technology Description

Earthcare gasifies poultry litter from Riverview Farms' nearby pullet barns to produce biochar. Poultry litter is delivered daily with enough litter stockpiled at any time to operate the gasifier for three days. The flow of material ensures that no poultry litter sits for more than a few days,

preventing any decomposition while stockpiled. The poultry litter entering the production facility is typically around 50% moisture, but the moisture content varies throughout the year.



19	1	1043 Stack
18	1	1043 MainFan_300HP
17	1	1043 Transition duct
16	1	1043 MainFan_Inlet pipe
15	1	1043 Blend chamber
14	1	1043 Oxidizer
13	1	1043 Gasifier disch. cnvr
12	1	1043 Gasifier
11	1	1043 Gasifier feed cnvr
10	1	1043 Feed control bin
9	1	1043 Transfer conveyor 1
8	1	1043 Cyclone disch. cnvr
7	1	1043 Cyclone rotary valve
6	1	1043 Product Cyclone
5	1	1043 DrumDryer disch.
4	1	1043 DrumDryer
3	1	1043 Dryer feed cnvr
2	1	1043 RM Bin disch. cnvr
1	3	1043 Raw Material Bin

Figure 1. Components in Earthcare facilities. Note that the layout is different from Riverview Farms. Riverview Farms also has a packed bed scrubber that was not originally part of the system design and is not shown in this diagram.

Poultry litter is fed onto a conveyer with a screw auger which is controlled using a variable frequency drive (VFD) to maintain the gasifier temperature (Figure A2-1). The material is then fed to a triple pass rotary drum dryer that is heated by flue gas blended with ambient air.

Warm biomass leaving the dryer is held in a feed control bin. This feed bin is controlled by a rotary paddle level sensor to ensure there is enough material to keep the gasifier fueled. The biomass then enters on the upper stage of the two-stage gasifier and is moved by four parallel screw augers (Figure A2-2). Several temperature sensors monitor the temperature throughout the gasifier. The range of temperatures observed during the site visit was 1078 °F near the biomass inlet to 1472 °F just before the biochar is quenched (Figure A2-3). During startup, natural gas is burned to heat the gasifier, but as the temperature increases, the natural gas flowrate is decreased until the reaction is self-sustaining.

The biochar is quenched using spray nozzles on solenoid valves, resulting in a product at approximately 130 °F and 20% moisture. The incoming water (from Riverview Farms' well) easily clogs the nozzles, so a filter has been installed to reduce the particulate matter that gets into the line. The biochar is fed via screw auger into the staging room, where it can be loaded into the outdoor stockpile, loaded into trucks for spreading, or packaged in supersacks. The biochar to be put in supersacks is dumped into the port at the back of the room (Figure 2) where it is dispensed into a supersack hanging on a stand with a load cell. If the biochar is going to be used at Riverview Farms, it is not packed into supersacks. Riverview Farms have a weigh station for trucks that is used to determine how much biochar was loaded into the truck. This may mean the biochar is sitting stockpiled for some time before being weighed. This delay is typically under one month, depending on the availability of fields for spreading. The biochar may dry out while stockpiled, but because the moisture is analyzed directly after production, Earthcare may be underestimating the biochar produced and thus undercounting potential CORCs.

Figure 2. Biochar dispensed into staging room from screw auger.

The syngas produced within the gasifier is burned in the thermal oxidizer directly attached to the gasifier. The gasifier maintains a slight negative pressure to prevent gas from escaping through

other openings. The thermal oxidizer has a minimum temperature of 1700 °F during operation, ensuring any methane and other volatile organic compounds (VOCs) are destroyed.

The gas then passes through a blend chamber where ambient air is mixed with the flue gas before entering the dryer. Any residual particulate matter (ash) falls out in the blend chamber. The blend chamber is cleaned out every three months.

After passing through the dryer, the gas stream is pulled through a venturi scrubber then a packed bed to remove any VOCs that entered the gas in the drying process from the raw biomass (Figure A2-4). The packed bed was installed in 2020 due to complaints from neighbors about the smell. The complaints occurred in 2018 and the facility shut down for two years until a solution was implemented. The wastewater produced during the wet scrubbing process goes to a tank to be spread on fields as fertilizer.

2.1. Process Inputs & Outputs

The inputs to Earthcare's facility at Riverview Farms are biomass, water, natural gas, and electricity (Table 2). The biomass is all poultry litter from pullet barns operated by Riverview Farms. (Initially, other eligible sources of poultry litter and compost were used, but Riverview Farms has transitioned to only using pullet litter.) Without biochar production, the poultry litter would be spread on farm fields, where it would decompose, releasing any stored carbon.

Natural gas is used to start the gasifier but is not used once the reaction is self-sustaining. During this initial monitoring period, the gasifier was not running continuously. This led to more natural gas use as the cold start-up process happened more frequently relative to the amount of biochar produced than it will in future monitoring periods. The gasifier is currently operating 24 hours per day, 5 days per week. When the gasifier is shut down on Friday and restarted on Monday morning, the gasifier still has some residual heat and less natural gas is needed for start-up.

Water is used for quenching the biochar and wet scrubbing. The cumulative water use was not monitored. The water comes from the on-site private well. The electricity for operating the well pump is included in the electricity demand.

Electricity is used to power all operations other than the gasifier heat. This includes the rotating drum dryer, screw augers, well pump, and the PLCs controlling gasification and material transport.

The outputs from the process are biochar, nutrient-rich wastewater, and flue gas.

Table 2. Verified Production Facility Inputs & Outputs

Input or Output	Item	Verified Amount Over Monitoring Period	Notes (Specifications, source, etc.)
Input	Poultry litter	897.78 tonnes	15% moisture Weighed before delivery
Input	Natural gas	1,509,300 cu ft = 15,571 Therms = 456,230 kWh	Natural gas bills
Input	Electricity	759,000 kWh	Electricity bills
Input	Water*	---	Private well water

Output	Total biochar produced	1230.7 tonnes, dry weight	Bagged weight log
Output	Biochar used**	897.8 tonnes, dry weight	Invoice log
Output	Nutrient-rich wastewater***	---	---

* Cumulative water use is not monitored. Water comes from on-site private well. Electricity required to operate pump is included in electricity use.
** The difference between the biochar produced and biochar used is the increase in stockpile over the monitoring period. The CDR associated with the stockpiled biochar is not part of the CORC claim for this output audit.
*** The total nutrient-rich wastewater produced is not monitored. There is a tank that collects the water and periodically fills a truck to transport the water to a field where it is spread.

3. Audit Summary

3.1. Audit Approach

A planned series of audit activities were conducted by 350Solutions to independently validate and verify the production facility, its operations, production and output data, and CORC claims. The audit was conducted following the specifications of Puro General Rules (v3.1) and the Biochar Methodology (v3). Specific audit activities conducted are summarized in Table 3. Audit Activities. A completed Puro Biochar Methodology Compliance Checklist used during the verification is attached to this report as Appendix 1. Verifier qualifications are attached as Appendix 3.

Table 3. Audit Activities

Date(s)	Verification Activity	Verification Tasks	Documents Reviewed
August 13 – 19, 2024	Introductory Document Review	- Review of LCA - Review of Puro CORC calculations - Review of facility registries and permits	Audit Document Index - Biochar - Review 2.xlsx Contact information to auditor.xlsx README - Instructions.html signed registration-1.pdf _Company documents.txt Earthcare Articles of Organization.pdf Earthcare Certificate of Organization.pdf _Additionality assessment.txt Financial Additionality with Scenario Analysis_draft EarthCare.xlsx Puro additionality questions to suppliers v1.8.pdf GECA_Riverview Air Permit.pdf NRCS Community letter.pdf _Biomass types and origins.txt Biomass types and origins list.xlsx Biochar production equipment questionnaire.xlsx GECA Riverview safety training.pdf Mass and energy balance of production process.xlsx Operations Manual EarthcareLLC.docx ecochar usage and marketing statement.pdf GECA Earthcare LLC Branding statement.pdf Statement of understanding of physical-product decoupling.docx

			buyer letter.pdf Char Use Letter.pdf ecochar end use.pdf End use letter Mowery.pdf GECA Earthcare LLC Branding statement.pdf GECA invoice1.pdf GECA_RiverviewBOL_invoices.pdf _Calibration certificates for measuring devices.txt _Protocol applied for biochar sampling and testing frequency.txt _Protocol applied to calculate the dry mass of biochar produced.txt _Soil temperature selection methods.txt GECA_Riverview_StackTest_12.15.22.pdf Guidance_Determining the dry mass of biochar produced and delivered.pdf Guidance_Most common biochar test methods.pdf HR83-BA-e-11780514B.pdf GECA_RiverviewScaleCert.pdf Dry biochar calculation.xlsx Soil temperature calculation and justification.xlsx _Life cycle assessment for Facility Audit.txt LCA Model Earth Care - Riverview Farms.xlsx LCA report - Earth Care RVF - Updated - 07.11.24.pdf LCA Model Earth Care - Riverview Farms V3 - October.xlsx LCA report - Earth Care RVF - 03.27.24.pdf GECA Riverview Feedstock Deliveries.xlsx GECA Biochar Riverview Analysis.pdf GECA Riverview Biochar Production.xlsx GECA Riverview Raw production data.xlsx GECA_RiverviewScaleCert.pdf buyer letter.pdf Char Use Letter (1).docx ecochar end use.doc End use letter Mowery.pdf GECA invoice1.pdf Photos of packaging and storage.pdf LCA Model Earth Care - Riverview Farms V6.xlsx
August 19 – 30, 2024	Data Review	- Review of waste biomass sources and sustainability - Review of system inputs and outputs - Review evidence of product output - Review of biochar properties - Review of biochar end use - Review of financial additionality	*Review Above* + Site visit follow up 3.pdf 1160-WDA-EARTHCARE-001.pdf Layout and Legend (1).jpg ProcessFlowDiagram.docx 20240823_134742.jpg 20240823_134753.jpg GECA Riverview Farms Complaint Process.docx records production Earthcare.xlsx RV MMP.pdf
August 22, 2024	On-site Visit	- Process walkthrough - Witness of operations, measurement points, and instrumentation - Review of equipment and calibrations - Review of intake and production data collection	*No additional documents reviewed on-site*

		- Confirmation of company and facility administrative details - Confirmation of facility environmental and social safeguards	
August 30 – September 4, 2024	Report Writing	- Compose Validation and Verification Report - Internal quality control	*No additional documents reviewed following data review*
September 4 – November 14, 2024	Report Edits	- Edit report per Puro's clarifications on testing requirements - Add mention of Stakeholder Engagement Report	Stakeholder Engagement Report – EarthCare-1.docx

3.2. Verified Output & CORCs

Table 4 includes the specific CORCs claimed by Earthcare for the Riverview Farms facility, as well as the level verified by 350Solutions during the on-site audit and data review.

Table 2. Verified CORCs for Earthcare's Riverview Farms facility

Performance Metric Name / Description	Claimed Value	Verified Value	Monitoring Period
CORC Factor (tCO_2e/t biochar)	0.807*	0.299	October 3, 2022 – December 15, 2023
Biochar Production	897.78	897.78	
Total CORCs	724*	268.88	

* The claimed CORC factor and total CORCs from Earthcare's registration form did not account for process emissions. The values accurately reflected the permanence of the biochar but the emissions have been accounted for in the verified values column.

4. Audit Findings

4.1. Summary of Audit Findings

350Solutions has reviewed and audited the documentation of the technology, the instrumentation, the procedures, performance and collected data and has found that the data presented in the Puro Audit Package and during the site visit and follow up:

☐ ***Meets the requirements of the Puro General Rules V3.1 and Biochar Methodology V3***

☒ ***Meets the requirements of the Puro General Rules V3.1 and Biochar Methodology V3 with minor modifications***

☐ ***Does Not Meet the requirements of the Puro General Rules V3.1 and Biochar Methodology V3***

A summary of specific findings associated with each requirement of the Puro Standard and Biochar Methodology and any identified issues with the audit are summarized below.

Table 5. Audit Findings

Biochar Method.	

Section Ref.	Audit Verification Topic	Findings
1.1.2 5.2.1	Sustainable Feedstock	**Acceptable.** The biomass feedstock is poultry litter, which otherwise would be spread on fields and decompose, releasing stored carbon as CO_2. The poultry litter is collected from nearby barns and delivered to the facility, traveling an average of 4.2 km.
1.1.1 5.4.2	Biochar Use	**Acceptable.** The biochar is spread on fields as a soil amendment, which prevents decomposition. Biochar buyers attest to not burning the biochar to use as an energy source.
1.1.3 5.2.2 5.3.3 5.4.1	Net-Negative LCA	**Acceptable.** Input values to the LCA are based on empirical measurements, literature emissions factors, and where needed, conservative assumptions. The sum of emissions, as CO_2eq, is less than the amount of CO_2 stored.
1.1.4	Prohibition of Fossil fuel use for process heat	**Acceptable.** Natural gas only used for gasifier start-up and is tapered off as the gasifier approaches the desired temperature.
1.1.5	Negligible methane emissions	**Acceptable.** The thermal oxidizer is directly attached to the gasifier outlet and is operated at >1700 °F, which is sufficient to destroy methane.
1.1.6 5.3.4	Molar H:C Ratio < 0.7	**Acceptable.** Biochar test results show an H:C ratio of 0.55. Only one sample had been tested.
1.1.8	Safe Environment & Biochar Handling	**Acceptable with minor modifications.** Biochar is not handled directly. However, the production facility is missing engineering controls to prevent accidental pinch and burn injuries.
1.1.7 1.2.2	Environmental & Social Safeguards	**Acceptable.** The air quality permit is acceptable and the NRCS supports biochar use on fields. Complaints have been handled quickly, when possible. If not possible to remedy quickly, operations have stopped until a solution was put in place (e.g., packed bed filter).
1.2.3	Demonstrated Additionality	**Acceptable.** While the facility was built in 2016, there was not significant biochar production until manure became an eligible biomass feedstock in 2022. Without biochar production, the poultry litter would decompose on fields.
1.2.4 5.3.1 5.3.2	Biochar Quantification	**Acceptable.** For this monitoring period, all biochar was bagged and was weighed as it was loaded into bags. For future monitoring periods, the biochar for local use will be loaded into dump trucks that have been weighed on a calibrated truck scale before and after loading. Moisture content is measured directly after production, which is a suitable alternative to measuring total water input (Section 5.3.2 of Biochar methodology).
1.2.5	Verified Production Facility standing data	**Acceptable.** Standing data was confirmed and matched registration form.

5.2.1	Feedstock Sustainability Proof	**Acceptable.** Riverview Farms only uses poultry litter, primarily from pullet barns, to produce biochar. This is a waste product that would otherwise be spread on fields. Documentation of nutrient management plan showing poultry litter application was reviewed.
5.4.3	Justification of Soil Temperature	**Acceptable.** The average temperature where the production facility is located is 13.2 °C. Some of the biochar is shipped to Ohio and Pennsylvania, which are colder, so the biochar is more stable there. Using 13.2 °C for all biochar used is the conservative assumption.
5.5.2	Statement re: Double Counting	**Acceptable.** Riverview Farms and Earthcare have demonstrated that they do not use climate-positive marketing when selling biochar.
5.5.3	Marketing / Branding Restrictions on end-user	**Acceptable.** The documentation of product sales and shipment were reviewed and verified. End-use was specified in attestations from customers stating that they would not burn the biochar.

Additional details regarding audit activities, documents reviewed, and observations during the audit process are summarized in Appendix 1.

4.2. Ongoing Issuance

Puro.earth are currently transitioning to use the 4.0 version of the Puro General Rules. Although this Production Facility and Output Audit was conducted using version 3.1 of the General Rules, certain rules described in the updated version of the document (v4.0), such as the Ongoing Issuance Right, are applicable to all projects currently registered or in the process of getting registered on the registry. Specifically, Appendix A of the updated rules dictates that “the evaluation of the Ongoing Issuance Right is done in the performance verification by the 3rd party Auditor as part of the Output Audit” (A.4.1) and that "This evaluation can be done when a Production Facility has demonstrated regular industrial operation and successfully completed performance verification for the previous Monitoring Period with a minimum of 3 months of output” (A.4.2).

350Solutions confirms that the Riverview Farms facility is eligible for Ongoing issuance because they have successfully demonstrated regular industrial operation for over 3 months. It is recommended that Earthcare demonstrate that they have fixed Audit Issue 1 before additional CORCs are issued.

4.3. Audit Issues

1. Earthcare’s Riverview Farms facility complies with Puro General Rules V3.1 and Biochar Methodology V3. Section 1.1.8 in the Biochar Methodology states measures must be taken to ensure a safe working environment. We acknowledge that the workers are well-trained and extra steps are being taken to ensure training is available in their native language, so the facility is generally in compliance with the requirement. However, there are a few concerns that would improve the safety of the work environment and must be addressed prior to the next output audit. In particular,

1.1. Moving belts and chains should be covered with chain guards. If the guard is damaged, signage and physical barriers should alert people to the hazard. Moving parts labels (example) should be clearly visible near the hazard.
1.2. Equipment that is hot when in operation should be labeled with hot surface labels (example).
1.3. Yellow floor tape should direct foot traffic around machinery and define hazard boundaries.

All signage should be present in English and Spanish.

4.4. Recommendations for Improvement

350Solutions recommends the following to improve the data quality and operations of Earthcare's Riverview Farms facility. These recommendations are *not* requirements for future output audits.

1. Consider ways to decrease natural gas use at start-up (e.g., a way to store waste heat so that it can be used at start-up).
2. According to Section 1.1.7 in the Biochar Methodology, in places where there are no regulations related to biochar application on fields, the International Biochar Initiative (IBI) or European Biochar Certificate (EBC) standard defines the required testing. Puro has clarified that USDA Code 336: NRCS Conservation Practice Standard for Soil Carbon Amendments is a relevant regulation and thus prevails over IBI and EBC requirements, if the biochar is used as a soil amendment, not as animal feed or in other applications. Polycyclic Aromatic Hydrocarbons (PAHs) testing was not completed before this audit and is required under IBI and EBC but not USDA Code 336. However, it is recommended that PAH and other IBI Type B testing is completed in case the biochar is used in other applications and as general environmental risk prevention.
3. Review OSHA requirements and implement any relevant and practical requirements. While the facility is not technically subject to OSHA regulations, OSHA regulations constitute best practices for a safe industrial facility. As the first of Earthcare's facilities to be verified as a production facility, it is likely that Riverview farms will have many visitors on tours that have not been thoroughly trained. It is important that visitors are aware of potential hazards.
4. Increase sampling frequency for moisture content and H:C ratio to gauge stability over time. There may be annual variation in pullet manure as the birds grow, which should be captured empirically. Moisture content and H:C ratio are major factors in the CORC calculation and should have an associated empirical uncertainty to determine how conservative the CORC claim is. Ideal minimum testing frequencies are:
    a. Moisture: monthly
    b. IBI Type A tests: quarterly
    c. IBI Type B tests: every three years

5. Revision History

Version	Date Issued	Noted Changes
V1.0	September 4, 2024	Initial Draft
V1.1	September 11, 2024	Added PAH testing requirement
V1.2	October 9, 2024	Removed PAH testing requirement
V2.0	October 17, 2024	Fixed version number, Added ongoing issuance statement, Added clarification to number of verified CORCs
V2.1	November 14, 2024	Added report writing and edits to Table 3, Mentioned Stakeholder Engagement Report

6. Auditor Signatures

Lily Schacht (Lead Auditor)
Carbon Removal Verification Engineer
350Solutions, Inc.

Kyann Hadife (Quality Assurance)
Carbon Removal Verification Engineer
350Solutions, Inc.

7. References

[1] Puro.Earth, Puro Standard General Rules, Version 3.1. https://puro.earth/documents/

[2] Puro.Earth, Biochar Methodology, Edition 2022 V3, Feb 2024.
https://puro.earth/methodologies/

Appendix 1: Puro.Earth Biochar Methodology Audit Checklist

Guideline Ref	Requirement	Requirement Met Y/N	Verification Remarks Insert auditors comments	Evidence Document Insert evidence used to verify requirement
1.2.5	A certified trade registry extract for the CO2 Removal Supplier	Y	Earthcare provided their articles and certificate of organization effective November 16, 2017	Earthcare Articles of Organization Earthcare Certificate of Organization
	CO2 Removal Supplier registering Production Facitily	Y	Earthcare registered the Production Facility at Riverview Farms with Puro, requested March 27, 2024	signed registration-1
	Evidence of the location of the Production Facility	Y	1505 E Co Rd 500 N Orleans, IN 47452	signed registration-1
	Evidence of the Volume of Output for the full calendar year prior to registration	Y	Data provided for October 3, 2022 - December 15, 2023, which is the monitoring period specified	LCA Model Earth Care - Riverview Farms
	Evidence of the Removal Method(s) for which the plant is eligible to receive CORCs	Y	Biochar production from waste poultry and swine manure is an accetable removal method for receipt of CORCs	Biochar production equipment questionnaire
	Evidence of the date on which the Production Facility became eligible to receive CORCs	N/A	Production Facility is not currently eligible to receive CORCs	N/A
	If the Production Facility has benefited from public support, evidence to show this	Y	No benefit from public support	N/A
	Documentation on Environmental and Social Safeguards imposed	Y	Air quality permit from the state of Indiana and documentation in support of biochar from NRCS were provided.	GECA_Riverview Air Permit NRCS Community letter
5	Proof of sustainability of raw material for forest biomass (FSC, SFI, PEFC, other certifications)	N/A	N/A	N/A
	Proof of sustainability of raw material for waste biomass	Y	Poultry litter from nearby pullet barns is the only biomass used.	Puro additionality questions to suppliers v1.8
	LCA data for biomass and biochar production, supply and use, including climate change impact and the contribution of each life cycle stages.	Y	LCA is complete with Estored, Ebiomass, Eprod, and Euse calculated separately. No CH4 or N2O emissions expected. Emissions factors used include non-CO2 greenhouse gases to determine CO2-eq	LCA Model Earth Care - Riverview Farms V6 LCA report - Earth Care RVF - Updated - 07.11.24
	Proof of product quality: laboratory analysis of total organic carbon content, hydrogen content and H/Corg	Y	Control Labs is a widely used biochar analysis lab	GECA Biochar Riverview Analysis

	Proof of production volume: documentation for the whole period and methodology applied to calculate the dry mass of biochar produced.	Y	All material was bagged during this monitoring period. Each bag was weighed using a loadcell under the rack that holds the supersack	LCA Model Earth Care - Riverview Farms V6
	For mobile units or carbonizer operator: proof of load cell measurement of the biochar for the whole period, and water input measurement.	N/A		
	Proof of end use of biochar: offtake agreement, shipment, and other records indicating the intended use of biochar.	Y	Biochar is used either for application on farm fields or for bioretention ponds, Customers submitted letters stating they would not burn the material.	buyer letter Char Use letter ecochar end use End use letter Mowery GECA Earthcare LLC Branding statement
	Justification on the soil temperature selected for the calculation of the biochar sequestration.	Y	Biochar is mostly used in region around Riverview farms or in slightly colder climates so using the average soil temperature in Orleans, IN is a conservative assumption. The average temperature over one year is 13.2 degrees C. Linear interpolation used to calculate Woolf constants at 13.2 C.	Soil temperature calculation and justification
	Proof of no double-counting	Y	No C-negative branding used by Earthcare and no attempts to monetize the carbon credits except through Puro	Ecochar usage and marketing statement GECA Earthcare LLC Branding statement
	Proof of sales	Y	Scans of invoices provided	GECA invoice1
1.1.1	Biochar is used in applications other than energy.	Y	Biochar applied to fields or used for retention ponds	Ecochar usage and marketing statement
1.1.2	Biochar is produced from sustainable forest or waste biomass raw materials (consult list of raw materials).	Y	Biochar is produced from manure that would otherwise decompose	Puro additionality questions to suppliers v1.8

1.1.3	LCA shows:- carbon footprint of the biomass production and supply- emissions from the biochar production process- carbon footprint of the biochar end use- cradle to grave	Y	Biomass is a waste material and is appropriately placed outside the system boundary;Biomass transportation is accounted for using an average distance traveled (4.2 km);Biochar production emissions from natural gas and electricity consumption is conservative;Emissions from packaging material (supersacks) production are included;Infrastructure and equipment manufacturing are accounted for	LCA Model Earth Care - Riverview Farms V6
1.1.4	Pyrolysis reactor input fuel for heating is not a fossil fuel. Unless only used for ignition/pre heating or in a mobile unit and the emissions are fully included in the LCA. The use of waste heat from other industrial processess (eg. Biodigesters, cement production) is permitted.	Y	Natural gas is only used for cold start-up and is accounted for in the LCA	LCA report - Earth Care RVF - Updated - 07.11.24
1.1.5	Pyrolysis gases are combusted or recovered. Bio-oil and pyrolysis gases can be stored for later use as renewable energy or materials.	Y	Produced gases are combusted in thermal oxidizer attached to gasifier.	LCA report - Earth Care RVF - Updated - 07.11.24 Site visit observation
1.1.6	The molar H/Corg ratio is less than 0.7.	Y	0.55	GECA Biochar Riverview Analysis
1.1.8	Evidence of safe handling and transport is provided and adequate for the production facility.	Y	Biochar itself is handled safely. It is moved using heavy equipment, not manually	Site visit
1.1.7	Biochar products meet the product quality requirements existing in the jurisdiction where biochar is used and for the specific applications considered.	Y	Puro considers USDA Code 336: Conservation Practice Standard for Soil Carbon Amendments a regulation for the US and thus prevails over IBI or EBC benchmarks. Code 336 does not require PAH testing so Earthcare is not required to test the biochar for PAHs if it is only used as a soil amendment.	NRCS Community letter GECA Biochar Riverview Analysis
6.6 in General Rules	The SDG outcome meets the claims below: Specific: must refer to a specific individual outcome rather than being overly broad or abstract. Cause-and-effect relationship: must establish a direct and inherently clear cause and-effect relationship between the carbon removal activity and the impact, i.e., the impact should be additional and attributable to the CO2 Removal activity. Quantitative metric: Numeric measurement allows for objective assessment and comparison as per Section 4 of SDG assessment requirements Accuracy: can be determined without relying heavily on input assumptions. Manageable monitoring, reporting and verification (MRV): Pragmatic MRV processes limit the costs of data collection.	Y	Biochar production at Riverview Farms is only possible with carbon finance and was not in frequent operation until manure became an acceptable biomass feedstock. Few input assumptions are needed to quantify CDR, rather empirical measurements are used.	Puro additionality questions to suppliers v1.8 LCA report - Earth Care RVF - Updated - 07.11.24

1.2.1	Evidence of Production Facility eligibility under the general rules of Puro Standard.	Y	See Standing Data Confirmation section, above	Puro additionality questions to suppliers v1.8
1.2.2	The Production Facility demonstrate Environmental and Social Safeguards.	Y	See Standing Data Confirmation section, above	GECA_Riverview Air Permit NRCS Community letter
1.2.3	CO2 Removal Supplier shall be able to demonstrate additionality, meaning that the project must convincingly demonstrate that the CO2 removals are a result of carbon finance. Even with substantial non-carbon finance support, projects can be additional if investment is required, risk is present, and/or human capital must be developed. To demonstrate additionality, CO2 removal Supplier must provide full project financials and counterfactual analysis based on Baselines that shall be project-specific, conservative and periodically updated. Suppliers must also show that the project is not required by existing laws, regulations, or other binding obligations.	Y	Facility was built in 2016 but was not operated continuously until manure became an acceptable feedstock for biochar CORCs in 2020.	Biochar production equipment questionnaire records production Earthcare
1.2.4	The Production Facility's documentation system is accurate and reliable	Y	Followed example biomass and biochar delivery from input to database during site visit	Site visit
	The quantity of the biochar produced and sold is quantified and documented in a reliable manner	Y	Invoices provided; demonstrated invoice production during site visit	GECA invoice1
	Relevant meters are in place and they are calibrated;	Y	Truck scale certification provided. Electricity and natural gas usage based on utility bills.	GECA_RiverviewScaleCert
	The emissions from the cultivating, harvesting and transporting of the biomass are estimated and calculated in a reliable manner	Y	Biomass is a waste material so emissions associated with production are outside of the LCA scope. Transportation emissions are accounted for by using the tonnes of biomass delivered and the average delivery distance of 4.21 km	LCA Model Earth Care - Riverview Farms V6
	The energy use of the Production Facility can be quantified and the emissions from the process calculated	Y	Electricity and natural gas usage determined from utility bills. All energy use attributed to biochar production. EPA emissions factors used.	LCA Model Earth Care - Riverview Farms V6 LCA report - Earth Care RVF - Updated - 07.11.24
	The auditor goes through the Quantification of CO2 Removal requirements with the CO2 Removal Supplier, so that the Supplier is able to calculate the CO2 Removal independently in its Output Report	Y	GECA and Earthcare can independently calculate CORCs	Site visit
3.1	The CO2 Removal Supplier shall provide a life cycle assessment (LCA) for biochar activity including disaggregated information on the emissions arising at different stages. The system boundary is set cradle-to-grave and shall include emissions from	Y	Manure is a waste biomass and thus the production can be excluded from the LCA system boundary (Fig 2B in Methodology)	LCA report - Earth Care RVF - Updated - 07.11.24

	production and supply of the biomass, from biomass conversion to biochar, and from biochar distribution and use.			
3.2	Life cycle assessment (LCA) shall follow ISO standard, WRI GHG protocol or similar method.	Y	ISO 14040 and 14044, ISO 14067 used to develop LCA	LCA report - Earth Care RVF - Updated - 07.11.24
3.3	The default baseline emission scenario for the project activity feedstock is zero, which is a conservative assumption since it is not taking into account methane emissions derived from decay of manure or combustion of waste biomass.If a non-zero baseline presented, needs to be accepted by Puro.earth	Y	Baseline emission scenario is assumed to be zero	Puro additionality questions to suppliers v1.8
1.2.2	Environmental Safeguards are demonstrated through: Environmental Impact Assessment (EIA) Environmental permit Other documentation approved by the Issuing Body on the analysis and management of the environmental and social impacts	Y	Environmental safeguards are demonstrated through NRCS letter of support and Indiana Air permit	GECA_Riverview Air Permit NRCS Community letter
1.1.8	Safety measures include, but are not limited to, providing a Material Safety Data Sheet, post-production quenching and cooling of biochar, and appropriate flue gas treatment systems.	Y	Biochar is quenched to ~20% moisture after production and flue gas is treated using a thermal oxidizer and is ultimately released through a stack. Worker safeguards need improvement to prevent accidents. At minimum, pinch and burn risks should be clearly marked.	Biochar production equipment questionnaire
6.7.3.1 in General Rules	The risk estimation shall be quantitative, and the Overall Risk Effect shall be given in percentage of the Output volume. The Reversal risk estimation shall consider all material risks arising from: Nature-induced risks (e.g., flora, fauna, or climate conditions). Human-induced risks (e.g., design and construction faults, operational risks). Geopolitical risks (e.g., potential effects of the legal and political environment). Any additional factors mentioned in the applicable Methodology.	Y	No risk of reversal because biochar is applied on fields. Customer attestations that the biochar is not burned were provided.	buyer letter Char Use letter ecochar end use End use letter Mowery

Guideline Ref	Requirement	Requirement Met Y/N	Verification Remarks Insert auditors comments	Value	Units
4.2	Qbiochar = Quantity of biochar produced and sold to end user. (dry char)	Y		897.78	tonnes
	FpTHTs = c + m x H/Corg	Y		71.9%	N/A
	C Biochar = carbon content of biochar	Y		30.6%	N/A
	Estored = biochar carbon storage = Qbiochar x Cbiocharorg x FpTHTs x 44/12	Y		724.66	tonnes
4.3	Ebiomass = LCA emissions of production and supply of biomass: With allocation	Y	Allocation determined based on fraction of biochar used vs produced.	2.43	tonnes
4.4	Eproduction = LCA emissions from biochar manufacturing: With allocation	Y	Emissions factor must include natural gas production and distribution per ISO14040	384.80	tonnes
4.5	Euse = LCA emissions of the use of biochar, including distribution up to the point of final use: With allocation	Y		68.55	tonnes
4.1	CORCs = Estored - Ebiomass - Eproduction - Euse: with allocation	Y		268.88	tonnes
	Quantity of CORCs (in evidence).	Y		268.88	tonnes
	Confirm consistency.	Y			

Appendix 2: Site Visit Photos

Figure A2-1. Biomass intake bin (Item 1 in Figure 1 diagram)

Figure A2-2. Chains controlling screw augers in gasifier

Figure A2-3. Inspection port on lower stage of gasifier.

Figure A2-4. Venturi scrubbers (sides) and exhaust stack (middle)

Appendix 3: Verifier Qualifications

Supporting documentation, including verifier resumes, and verifier or corporate accreditations are also included in this appendix.

Company Name:	**Earthcare, LLC**
Date:	**9/11/2024**

Verifier Name:	**Lily Schacht**
Company Name (where applicable):	**350Solutions**
Verifier Contact Information:	lily@350solutions.com, 203-554-2957
Verifier Address:	**1053 E. Whitaker Mill Rd. Suite 115, Raleigh, NC 27604**
Verifier Scope of Activities:	**Verification through observation and review of key technology components and documentation.**

Verifier Qualifications	**Criteria Met?**	**Evidence / Notes** *(note how the criteria was met, specific documents - resume/CV, publications, certifications, etc.).*
Verifier has relevant technical knowledge of the type of technology being evaluated and carbon removal processes in general		
A) Does Verifier have:		
1. An in-depth technical knowledge of the technology type under verification;	☑	350Solutions is accredited to ISO/IEC 17020:2012 and ISO 14034 Environmental Technology Verification (ETV) as a Type A (third party) Inspection Body (ANAB Certificate Number: AI-2618). The technical scope of 350's accreditation includes verification of performance and environmental impact as it relates to design, materials, equipment, installation and operations of technologies in the categories of Energy, Clean Production and Process, and Air Pollution Monitoring and Abatement. As documented in 350Solutions' ETV Standard Operating Procedure (ETV QPM 350-223-03), and Quality Systems Procedures for verifier qualifications (QSP-350-005-02), 350Solutions conforms to the requirements of ISO 17020 Annex A with respect to verifier qualifications and procedures relevant to the Puro.Earth General Standard. 350 staff have participated in the evaluation and development of small scale biomass gasification and biofuels technologies. 350 also served as lead verifier for the Carbon XPrize competition and contributed to the development of procedures and processes for verification of relevant calculations, modeling, and statistical methods in order to assess team results and calculations of performance metrics and uncertainty. 350 has demonstrated knowledge of data quality and data validation approaches and execution in supporting verification of performance claims and results.
2. Knowledge of specific risk areas associated with performance of such technologies (i.e. common failure points, performance issues, barriers to scaleup);	☑	
3. Knowledge of the environmental implications related to the use of the technology from a life cycle perspective, such as impact of the technology on lifecycle CO2 emissions and carbon removal;	☑	
4. Knowledge of relevant applicable test methods and standards for evaluating performance or impact of the technology;	☑	
5. Knowledge of relevant calculation, modeling, and statistical methods in order to assess test results and calculations of performance metrics and uncertainty, as applicable;	☑	
6. Knowledge of data quality and data validation approaches, including QA/QC procedures, for example.		

	☑	
Verifier is a credible independent 3rd party		
B) Is Verifier:		
1. third-party body independent of the team registered for the Puro Earth CORCs;	☑	350Solutions is accredited to ISO/IEC 17020:2012 and ISO 14034 ETV as a Type A (third party) Inspection Body. As documented in 350Solutions ETV Policy Manual (ETV QPM 350-200-03), 350Solutions conforms to the requirements of ISO 17020 Annex A with respect to impartiality for Type A inspections, pursuant to ISO 14034 activities. These procedures and quality management programs are generally relevant to verification under the Puro.Earth General Standard. Note that verifications completed for Puro.Earth are not equivalent to ISO 14034 verifications.
2. Not directly involved in the design, manufacture or construction, marketing, installation, use or maintenance of the specific technologies submitted to Puro.Earth for verification, or represent the parties engaged in those activities.	☑	
3. Not part of a legal entity that is engaged in design, manufacture, supply, installation, purchase, ownership, use or maintenance of the items inspected.	☑	

Lily Schacht
Carbon Removal Verification Engineer, 350Solutions

EDUCATION:
MS, Environmental Engineering, University of Wisconsin – Madison, 2019
BS, Chemical, Energy, and Environmental Engineering, Washington University in St. Louis, 2017

EXPERIENCE SUMMARY:
Lily Schacht is an Environmental and Chemical Engineer with experience in process engineering, environmental chemistry, analytical methods, and life cycle analysis (LCA). At 350Solutions, Lily works on verifying carbon dioxide removal (CDR) technologies, with a focus on mineralization-based pathways, including enhanced weathering, direct air capture, and ocean alkalinity enhancement. Previously, Lily led agronomic research at an enhanced weathering CDR supplier where she organized field trials across multiple states to quantify carbon removal and crop yield changes after rock application. Before that, Lily developed rapid prototyping instrumentation to optimize a biomineralization process in concrete production and aided in scaling up the process to pilot-scale. Lily also built environmental impact models for process variable sensitivity analysis of demo-scale manufacturing processes. These models were used to drive the direction of research and development to minimize product life cycle impacts. Throughout her career, Lily has developed analytical chemistry methodologies for both liquid- and solid-phase analyses.

RESEARCH AND PROFESSIONAL EXPERIENCE:
March 2024 – Present: Carbon Removal Verification Engineer, 350Solutions
Verify CDR technologies on behalf of registries and the XPRIZE Carbon Removal challenge. Specializes in mineralization pathways, including mineralization kinetics, measurement methods, and open-system modeling.

Nov 2022 – Feb 2024: Researcher, Lithos Carbon
Quantified carbon removal rates and agronomic impacts of enhanced weathering on cropland across six US states; Evaluated chemical analysis methods for precision relative to cost.

Nov 2023 – Jan 2024: Independent Consultant, Keel Labs
Built an environmental impact model to evaluate potential material and process changes; Recommended areas for reducing material usage up to 80%

Dec 2020 – Oct 2022: Research Scientist II
Guided experimentation and data analysis throughout all R&D teams to inform techno-economic analysis (TEA) and LCA; built and led the carbonate biomineralization prototyping workstream for rapid iteration; developed real-time measurement techniques for critical process parameters in solid state

SELECTED PUBLICATIONS & PRESENTATIONS:

- **Schacht, L.**, Baum, M., Liu, H., & Yap, M. (2023) Scaling Enhanced Rock Weathering: Agronomic Impacts at Field-Scale [Abstract]. ASA, CSSA, SSSA International Annual Meeting, St. Louis, MO.
- **Schacht, L.** and Ginder-Vogel, M. Arsenite Depletion by Manganese Oxides: A Case Study on the Limitations of Observed First Order Rate Constants. *Soil Syst.* 2018, 2(3), 39. https://doi.org/10.3390/soilsystems2030039

Tim Hansen, P.E.
Founder and CEO, 350Solutions

EDUCATION:
B.S., Chemical Engineering, University of Virginia, 1993
M.S., Engineering Science, Thayer School of Engineering, Dartmouth College, 1995

EXPERIENCE SUMMARY:
Mr. Hansen has 26 years of experience in management of energy and environmental technology development and demonstration projects and programs, as well as multimedia environmental engineering efforts. These majority of his recent work has focused on the evaluation of innovative carbon capture, utilization, and removal technologies. Mr. Hansen has led the development and management of large technology evaluation programs in the advanced energy, transportation, and climate change areas.

RESEARCH AND PROFESSIONAL EXPERIENCE:
2019-Present Founder – CEO, 350Solutions, Inc.
Owns and operates a small cleantech engineering consulting business focused on the independent evaluation of new cleantech innovations and their impact on the environment and carbon emissions. Provides engineering consulting, testing and evaluation, techno-economic assessment, and other support to companies developing, using, or investing in new clean technology innovations. Manages administrative, business development, and project activities for 350Solutions.

2012-2019: Director - Energy and Environment, Southern Research
Manages scientific and technical staff performing research, development, and evaluation of innovative clean energy technologies. Projects range from $25,000 to $6million in size, and are funded by the US Department of Energy, Department of Defense, and commercial partners. Technical focus areas are conversion of biomass to fuels and chemicals, carbon capture and utilization, energy efficient building technologies and renewable energy generation.

2009-2012: Program Manager – Transportation & Climate Change Technology, Southern Research
2003-2009 Sr. Project Leader, Environmental Engineer, Southern Research
1996-2003 Environmental Engineer, Bensinger & Garrison Environmental

PROJECT EXPERIENCE:
Mr. Hansen has executed several independent technology performance verifications of emerging carbon, energy and transportation technologies, as CEO of 350Solutions, Director of Energy & Environment at Southern Research, and Director of the U.S. EPA's Greenhouse Gas Technology Center. Mr. Hansen has completed clean technology evaluations for the Department of Defense, state energy agencies, commercial clients, investors, and technology developers, involving evaluation of commercial feasibility, economic and environmental impacts, and technology performance. Mr. Hansen served as the Measurement and Verification Program Lead for the NRG COSIA Carbon XPrize – a $20M prize competition for technologies that capture and beneficially utilize CO_2. Mr. Hansen also served as U.S. Technical Expert for the development and implementation of ISO 14034 – Environmental Technology Verification, an international standard, issued in 2016

350Solutions, Inc. Corporate Experience

350Solutions serves as an independent expert in cleantech, low carbon, and environmental technologies. We provide an unbiased assessment of innovative technologies. 350Solutions is accredited through ANAB under ISO 17020 as an independent inspection body to provide independent technology evaluation services using the ISO 14034 ETV process. In addition, 350Solutions staff include a Certified Measurement and Verification Professional (CMVP for IPMVP) and a North Carolina Registered Professional Engineer (P.E.). 350Solutions ANAB Accreditation certificate is provided below.

ANAB
ANSI National Accreditation Board

CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

350Solutions, Inc.
1053 E. Whitaker Mill Rd., Suite 115
Raleigh, NC 27604

Fulfills the requirements of

ISO/IEC 17020:2012

and

ISO 14034:2016, Environmental Management - Environmental Technology Verification (ETV)

In the field of

INSPECTION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 25 September 2024
Certificate Number: AI-2618

ANAB
ANSI National Accreditation Board

ilac-MRA

An inspection body's fulfilment of the requirements of ISO/IEC 17020:2012 means the inspection body meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid inspection results (refer to joint ISO-ILAC-IAF Communiqué dated Sept 2013).

ANAB
ANSI National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17020:2012

and

ISO 14034:2016, Environmental Management - Environmental Technology Verification (ETV)

350Solutions, Inc.
1053 E. Whitaker Mill Rd., Suite 115
Raleigh, NC 27604
Tim Hansen tim@350Solutions.com
(919) 675-6432

INSPECTION
TYPE A (THIRD-PARTY) BODY

Valid to: **September 25, 2024** Certificate Number: **AI-2618**

General

Products Categories	Range	Stage	Methods and Procedures
Energy Technologies (ET):	Performance and Environmental impact as it relates to design, materials, equipment, installation and operations.	Operating	QSP-350-223-02 - *SOP ISO 14034 ETV*
Cleaner Production and Processes (CPP):	Performance and Environmental impact as it relates to design, materials, equipment, installation and operations.	Operating	QSP 350-223-02 - *SOP ISO 14034 ETV*
Air pollution monitoring and abatement (APP):	Performance and Environmental impact as it relates to design, materials, equipment, installation and operations.	Operating	QSP 350-223-02 - *SOP ISO 14034 ETV*
Water monitoring and treatment (WMT)	Performance and Environmental impact as it relates to design, materials, equipment, installation and operations.	Operating	QSP 350-223-02 - *SOP ISO 14034 ETV*

Note:
1. This scope is formatted as part of a single document including Certificate of Accreditation No. AI-2618.

R. Douglas Leonard Jr., VP, PILR SBU

Version 005 Issued: August 09, 2022 www.anab.org

Page 1 of 1