



Lloyd's Register
LRQA

Stage 1 & 2 Verification Report

Report for:

AvalonBay Communities Inc.

LRQA reference:	UQA00000422
Verification dates:	April - June, 2018
Verification location:	Arlington, VA
Verification criteria:	WRI/WBCSD GHG Protocol (reporting), ISO 14064-3 & LRQA's Verification Approach (verification)
Verification team:	Derek Markolf – Lead Verifier
LRQA Client Facing Office:	Houston

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Attachments
N/A

This report was presented to and accepted by:
Name: Mark Delisi
Job Title: Sr. Director of Corporate Responsibility

1. Executive report

Verification outcome:

LRQA, Inc. (LRQA), a member of the Lloyd's Register group of entities, was contracted by AvalonBay Communities Inc. (AvalonBay) to verify its Scope 1 (direct emission), Scope 2 (energy indirect emissions), and Scope 3 (other indirect) greenhouse gas (GHG) emissions; energy consumption for Scope 1 and Scope 2; waste generation and water consumption for calendar year 2017 (CY 2017). The Scope 3 emissions verified by LRQA were limited to emissions from business travel and employee commuting.

Water consumption and waste generation data verified by LRQA did not include data from AvalonBay construction operations. This is in alignment with the Global Real Estate Sustainability Benchmark (GRESB) Guidance document.

The verification was conducted to a limited level of assurance and at a materiality level based on the professional judgment of the verifier. The final quantities verified are as follows:

Item	Quantity	Units
Scope 1 Emissions	19,008	MT CO ₂ e
Scope 2 Emissions Location-Based	62,243	MT CO ₂ e
Scope 2 Emissions Market-Based	62,243	MT CO ₂ e
Total Scope 1 Energy	104,390	MWh
Total Scope 2 Energy	198,261	MWh
Scope 3 Emissions (business travel)	376	MT CO ₂ e
Scope 3 Emissions (employee commuting)	5,891	MT CO ₂ e
Water Consumption (Communities only) ¹	11,484,681	M ³
Subset of Waste Generated (Communities only) ^{2,3}	77,488	MT

1. Water consumption does not include water consumed by the AvalonBay construction division.
2. Waste generation does not include waste generated by the AvalonBay construction division.
3. Waste generation data is only representative of 91% of AvalonBay communities.

AvalonBay excluded refrigerant emissions from HVAC systems and combustion of diesel fuel in emergency generators.

Based on LRQA's approach, nothing has come to our attention that would cause us to believe that the total Scope 1, Scope 2, and Scope 3 GHG emissions, and Environmental Data disclosed by AvalonBay in the Reports for CY 2017, as summarized in Table 1 below, are not materially correct and that the GHG Emissions Inventory and Environmental Data Assertion have not been prepared in conformance with WRI/WBCSD GHG Protocol and AvalonBay environmental data management processes, except for the following qualification:

- There was an unexplainable variance in Scope 2 emissions and Scope 2 energy between LRQA estimates and the final data reported in AvalonBay's data management platform. This misstatement was not material.

LRQA confirms that the contents of this report, together with any evidence or notes taken during this verification will be treated in the strictest confidence and will not be disclosed to any third party, without the prior consent of the client, except as required by the accreditation authorities.



Areas for senior management attention:

- Consider expansion of the AvalonBay GHG Emissions and Environmental Data Inventory Management Plan to include coverage of:
 - Organizational boundaries (i.e. operational control or financial control),
 - Operational boundaries (i.e. Scope1, Scope2 and Scope 3 emissions sources to be included & excluded), and
 - Base year selection and re-calculation policies

2. Verification summary

Visit objective

This report records the outcome of the LRQA verification of Greenhouse Gas (GHG) emissions and environmental data parameters for AvalonBay conducted in April to June 2018.

Introduction

The verification activities were conducted by Derek Markolf, Lead Verifier for LRQA with assistance from other LRQA staff where appropriate. This report includes the outcome of LRQA verification activities for the following data:

- Scope 1 and 2 greenhouse gas (GHG) emissions
- Scope 3 GHG emissions from business travel and employee commuting
- Energy inventory – Scope 1 Total Energy (consumptions of natural gas, propane and fuel oil) and Scope 2 Total Energy (consumption of electricity and steam).
- Water consumption
- Waste generation

The reporting criteria used to evaluate the CY 2017 emissions report was the WBCSD/WRI Greenhouse Gas (GHG) Protocol and the 2017 GRESB Real Estate Reference Guide. LRQA used verification criteria from ISO 14064 Part 3:2006 for the GHG data and LRQA's verification approach for the environmental data to perform the verification.

The Stage 1 verification activities included:

- Initial review and discussions – to confirm scope, objectives, criteria, level of assurance, materiality and their appropriateness for the verification
- Review of the GHG Inventory and systems in place for its derivation
- Strategic Analysis and Risk Analysis
- Verification Planning for Stage 2

The Stage 2 verification activities included:

- Assessment of Criteria Conformance
- Implementation of the data review based on the LRQA sampling plan
- Verification of Data and Information for GHG emissions sources and environmental data sets
- Development of issues log and findings

This report includes a discussion of the items listed above, together with the Verification Schedule, the Verification Plan, and the findings and their resolution.

Grading of Findings

The following definitions apply to the grading of findings in this report:

<p>Misstatement (MIS)</p>	<p>A misstatement (omissions, misrepresentations and errors) in an assertion, data or information that, in the professional judgment of the verifier, is unlikely to affect the decision of the intended user. If such a finding is outstanding at the end of the verification, a positive Assurance Statement will be possible, although qualifications, limitations, and/or recommendations may be included in the Assurance Statement.</p>
<p>Material Misstatement (MMIS)</p>	<p>A misstatement, (omissions, misrepresentations</p>



	<p>and errors) in an assertion, data, or information that, in the professional judgment of the verifier, could affect the decision of the intended user. If such a finding is left outstanding at the end of the verification then the misstatement must be corrected or a positive Assurance Statement will not be possible.</p>
Non-conformity (NCN)	<p>A nonconformity with the requirements of the assurance criteria (including the terms of engagement) that, in the professional judgment of the verifier, is unlikely to affect the decision of the intended user. If such a finding is outstanding at the end of the verification, a positive Assurance Statement will be possible, although qualifications, limitations, and/or recommendations may be included in the Assurance Statement.</p>
Material Non-conformity (MNCN)	<p>A nonconformity with the requirements of the assurance criteria (including the terms of engagement) that, in the professional judgment of the verifier, could affect the decision of the intended user. If such a finding is left outstanding at the end of the verification then the nonconformity must be corrected or a positive Assurance Statement with regard to the assurance criteria will not be possible.</p>
Opportunity for Improvement (OFI)	<p>An opportunity for improvement is a suggestion from the verifier to improve the operator's performance in monitoring and reporting.</p>
LRQA	<p>A 'follow up' item for the LRQA Verifier to track ongoing issues within the Findings Log where required.</p>

3. Findings Log

1. Grading of the finding *	2. New, Open, Closed	3. Description of the LRQA finding	4. Review by LRQA	5. Process, aspect, department or theme
6. Date of the finding	7. YYMM<Initials>seq.#	8. Clause of the applicable standard		
* MIS = Misstatement MMIS = Material Misstatement NCN = Nonconformity MNCN = Material Nonconformity OFI = Opportunity for Improvement xLRQA = LRQA Follow Up				

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MIS	Closed	The WA024 property does not have any reported energy or water data in Measurabl for 2017, although it is stated to be active for part of the year (sold or lease terminated on 6/9/2017).	This was corrected in updated version.	Completeness	5/21/20 18	1805AS02	Accuracy
MIS	Closed	Need final decision and explanation regarding the large negative electric usage in the North Station entry (MA846) in "2017 Construction Utilities" spreadsheet. If AvalonBay keeps the negative value in the report, please provide a written explanation for why this is done and how the value was derived.	This error was corrected.	Electricity	5/21/20 18	1805AS04	
MIS	Closed	LRQA estimated total electric usage for the following sampled sites using billing data from Cass did not match with the totals from the "2017 Electric Data" spreadsheet, and the variation seems too large to be due to differences in allocation. The billing data that LRQA used for the calculation was from the "Electricity" service type only, and did not include the "Vacancy Electric" services as this was presumed to be included in the Vacant Data totals. - MD007 (14% different) - CA002 (4% different)	AvalonBay indicated that the difference for the CA002 facility was due to incorrect data in Cass for select months; reported values were adjusted to match bills. MD007 is financially paired with MD006, and the energy data is split outside of CASS. LRQA checked that the total estimated usage for those sites combined in CASS is similar to the data in the "2017 Electric Data v2" spreadsheet. AvalonBay provided updated data with MD007 electric usage based on CASS data - LRQA confirmed match when same allocation method is used.	Electricity	5/21/20 18	1805AS05	Accuracy
MIS	Closed	The reported fuel usage for the "Construction Data" line item in Measurabl is not consistent with the value reported in the "2017 Construction Utilities" spreadsheet.	Date in EnergyStar was wrong – this was fixed	Gas	5/21/20 18	1805AS08	Accuracy

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MIS	Closed	The reported Total Fuel Use in Measurabl for several sampled sites does not match with the data from "2017 Gas Data with Updated Propane" spreadsheet when therms of gas are converted to kWh. The sampled sites that are affected include: CA022_AVA Burbank CA055_Eaves Creekside CA082_Avalon Union City CA573_Toluca Hills Apartments by Avalon CA574_eaves Woodland Hills DC518_AVA Van Ness DC519_Avalon First and M DC520_AVA NoMa NY012_Avalon at Glen Cove NY015_Avalon Bowery Place NY021_Avalon Bowery Place II NY029_West Chelsea NY525_Avalon Midtown West VA031_Avalon Mosaic District VA559_Avalon Ballston Square	AvalonBay response: Reviewed data and updated EnergyStar where applicable Update: LRQA confirmed updated data is consistent for listed sites when comparing the total 2017 consumption from the "17 Data (Common Area)" tab as directed. There only outstanding inconsistency between the most recent spreadsheet data with the Measurabl report from 6/18/2018 was fuel use for the NY021 facility, which is explained by the additional oil consumption. AvalonBay noted this is the only facility with oil usage in 2017. Finding closed (AS, 6/18/18).	Gas	5/21/2018	1805AS11	Accuracy, Consistency
MIS	Closed	The natural gas total natural gas therms for Property NY029 in "2017 Gas Data with Updated Propane" is very different from the total based on billing data in CASS.	Based on response from AvalonBay, the CASS data for that facility is incorrect it is a shared building with NY034 (but financially separate). Data w/ these two buildings is split in the EDW based on SqFT allocation.	Gas	5/21/2018	1805AS12	Accuracy
MIS	Closed	There is a minor difference (<1%) in LRQA calculated emission factors using stated reference sources for natural gas and US electricity. LRQA calculations assume IPCC AR4 GWP values are used. For natural gas, the LRQA calculations use US average CO2 emission factors from TCR table 12.1, and CH4 and N2O emission factors from table 12.9.2.	Measurabl provided conversion factors and clarified that they are using AR5 GWP factors. With these inputs, LRQA calculated emission factors for Natural Gas match the provided values. However, a small (<1%) discrepancy remained in the electricity emission factors using eGrid data for all locations checked. This was determined to be due to an issue with the unit conversions for CH4 and N2O factors. Update - Measurabl corrected egrid electric emissions factors and Scope 2 emissions. Finding closed (AS, 6/18/18).	Emission Factors	6/8/2018	1806AS15	Accuracy

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MIS	Open	The CDP Report data differs from the verified Measurabl totals for electricity consumption and Scope 2 emissions included in the file entitled Data Quality Report 2016–17. The differences are 2.2% and 3.4%, respectively.	There were multiple efforts to correct for this, but in the end the final changes made in the Measurabl system left a variance between LRQA estimates and Measurabl data of 1.3%.	CDP Report: Electricity	6/18/20 18	1806AS16	Consistency, Accuracy
MIS	Closed	There is a small difference in the water consumption data in the GRESB Report as compared to the verified total value in the Measurable Data Quality Report 2016–17 (total water consumption, less construction). The difference is less than 1%.	This issue was clarified and resolved within the Measurabl system.	GRESB Report: Water	6/18/20 18	1806AS17	Consistency, Accuracy
MIS	Closed	The Employee Commute data in the CDP report, Section C6.5, Scope 3 Details table (2nd and 3rd columns), has not been updated to reflect the latest verified data presented in the AvalonBay file entitled "Commuting Scope 3 Calculation AVB 2017 - v3".	This issue was resolved within the Measurabl system.	CDP Report: Scope 3 Emissions	6/18/20 18	1806DM1 8	Consistency, Accuracy
MIS	Closed	Total Non-hazardous Waste data in Section PI4.1 of the GRESB report (77,429 MT) does not match the verified value in the Measurable Data Quality Report 2016–17 (78,526 MT). The variance is 1.4%.	This issue was clarified and resolved within the Measurabl system.	GRESB Report: Waste	6/18/20 18	1806DM1 9	Consistency, Accuracy
OFI	Open	This is a carry over OFI from CY 2016 verification activities: The AvalonBay GHG Emissions and Environmental Data Inventory Management Plan does a good job of describing responsible parties and the process for gathering and reporting data and information. Another common function of IMPs is to document the Organizational Boundaries (i.e. Operation Control, or Financial Control), Operational Boundaries (i.e. Scope 1, Scope 2 and Scope 3 emissions source categories to be included and/or excluded), and Base Year selection and re-calculation policies. LRQA recommends the expansion of this document to include the definition of AvalonBay boundaries mentioned above (GHGs and Environmental Data), and merging the existing Base Year selection and re-calculation policy into this document.		Inventory Management Plan	5/26/17	1806DM2 0	GHG Protocol Chapters 3, 4 and 5

Verifier: Derek Markolf and Ali Schmidt
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Verification of:	Terms of Engagement - Contract Conditions Confirmation	Auditee(s):	Mark Delisi and Kevin Mulcahy
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Audit trails and sources of evidence:

Contract Condition Confirmation

Evaluation and conclusions:

Scope: Data Verification of the following items:

- Scope 1 (direct) GHG emissions: natural gas, fuel oil, and propane (operational control)
- Scope 2 (indirect) GHG emissions: purchased electricity and steam (operational control)
- Scope 3 (Other indirect) GHG emissions: business travel
- Scope 3 (other indirect) GHG emissions: employee commuting
- Energy Consumption:
 - Scope 1: total MWh (operational control)
 - Scope 2: total MWh (operational control)
- Water consumption (financial control)
- Waste generation (financial control)

Objectives: Verification of AvalonBay's GHG emissions, energy consumption, water consumption and waste generation for CY2017. The verification is intended to provide AvalonBay with an independent opinion on the completeness and accuracy of the data provided.

Criteria:

- World Resource Institute / World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol;
- 2017 GRESB Real Estate Reference Guide;
- Verification protocol follows ISO 14064-3: Specification with guidance for validation and verification of greenhouse gas assertions and LRQA verification approach
- AvalonBay GHG Emissions and Environmental Data Inventory Management Plan v5, and supporting policies and procedures

Level of Assurance: Limited Assurance

Materiality: Qualitative materiality based on the professional judgment of the verifier

Changes to Terms of Engagement: None

In completing this report, the LRQA verifiers confirm their independence from the client and that there was no known conflict of interest during the engagement.

Verification of:	Strategic Analysis and Risk Analysis (SARA)	Auditee(s):	Mark Delisi, and Kevin Mulcahy
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Strategic Analysis:

Through the Strategic Analysis, the Verifier determined the significance of the items of information and data to be verified. This judgement of significance is based on the nature and scale of the information and data as they relate to the scheme requirements.

Information or Data Source	Significance	Basis of Significance
Natural gas	M	Accounts for ~22% of Scope 1&2 GHG emissions
Fuel oil	L	Accounts for <1% of Scope 1&2 GHG emissions
Propane	L	Accounts for <1% of Scope 1&2 GHG emissions
Electricity	H	Accounts for ~76% of Scope 1&2 GHG emissions
Steam	L	Accounts for 1% of Scope 1&2 GHG emissions
Scope 3 business travel - air	M	Accounts for 5% of Scope 3 GHG emissions
Scope 3 business travel - car	L	Accounts for <1% of Scope 3 GHG emissions
Scope 3 business travel - hotel	L	Accounts for <1% of Scope 3 GHG emissions
Scope 3 employee commuting	H	Accounts for 94% of Scope 3 GHG emissions

NOTE: Much of the environmental data to be verified are activity data for the GHG emissions quantification, so the above Strategic Analysis is also applicable to this data.

Each of the environmental data parameters included in the Environmental Data Assertion was assessed separately for materiality.

Information or Data Source	Significance	Basis of Significance
Total Scope 1 Energy	H	Separate materiality for each environmental data parameter leads to each being highly significant.
Total Scope 2 Energy	H	Separate materiality for each environmental data parameter leads to each being highly significant.
Water Consumption	H	Separate materiality for each environmental data parameter leads to each being highly significant.
Waste Generation	H	Separate materiality for each environmental data parameter leads to each being highly significant.

Risk Analysis:

Through the Risk Analysis, the Verifier determined the potential risk of an omission, misrepresentation or error in relation to information and data sources. This determination included, but was not necessarily limited to, a judgement based on:

- the inherent risk associated with the data / information management
- the level of control applied to the data / information management
- the control of monitoring and metering used to gather data
- the number of personnel involved in the data management, their competence, attitude, and commitment.

Information or Data Source	Significance	Data Gathering	Measuring Equipment	People	OVERALL RISK
Natural gas	M	L	L	L	M
Fuel oil	L	L	M	L	L
Propane	L	L	M	L	L
Electricity	H	L	L	L	M
Steam	L	M	L	L	L
Scope 3 business travel - air	M	M	L	L	M
Scope 3 business travel - car	L	M	L	L	L
Scope 3 business travel - hotel	L	M	L	L	L
Scope 3 employee commuting	H	M	M	L	M

NOTE: The energy data to be verified are activity data for the GHG emissions quantification, so the above Risk Analysis is also applicable to this data.

Information or Data Source	Significance	Data Gathering	Measuring Equipment	People	OVERALL RISK
Water Consumption	H	L	L	L	M
Waste Generation	H	M	M	L	M

Client note: Generally, the outputs of the Risk Analysis influence the Verification Plan to manage the risk of LRQA detecting omissions, misrepresentations and errors in the following way:

High Overall Risk – detailed verification and data sampling

Medium Overall Risk – verification and data sampling to a lesser extent than High Overall Risk

Low Overall Risk – limited verification, simple checks only.

The Verifier will manage the degree of sampling through their Data and Information Sampling Plan.

Verification Planning:

As a result of the completion of the Strategic Analysis and Risk Analysis, a Verification Plan was developed. The Verification Plan, included in Section 5, defines the key elements of the verification and when those elements will be covered. The Verification Plan is supported by a Data / Information Sampling Plan which defines all the specific items of data and information which the Verification Team has identified as relevant and the depth to which relevant data is to be verified.

The following changes to the original Verification Plan / Data and Information Sampling Plan took place:

The original schedule for the verification plan was delayed due to time necessary for AvalonBay to finalize the GHG and environmental data for verification.

Verification of:	Criteria Conformance	Auditee(s):	Mark Delisi Kevin Mulcahy Sondra Tosky (Measurabl) Brianna Jackson (Measurabl)
<p>Audit trails and sources of evidence:</p> <p>Discussions with corporate representatives Discussions with Measurabl representative overseeing AvalonBay data management within Measurabl platform. Overview of AvalonBay utility bill management through their third party services (Cass) Careful review of reporting boundaries with AvalonBay representatives GHG Emissions and Environmental Data Inventory Management Plan v5</p> <p>Evaluation and conclusions:</p> <p>No findings were raised related to conformance with criteria.</p> <p>One opportunity for improvement was added, which was a carry-over from CY 2016 verification activities, related to suggested improvements to the GHG Emissions and Environmental Data Inventory Management Plan v5. Refer to item 1806DM20 in the findings log for more details.</p>			

Verification of:	Data & Information Verification	Auditee(s):	Mark Delisi Kevin Mulcahy Sondra Tosky (Measurabl) Brianna Jackson (Measurabl)
<p>Audit trails and sources of evidence:</p> <p>Measurabl CDP and GRESB reports with final data to be verified Measurabl Data Quality Report 2016–17 Scope of activity data, references for EFs and GWPs, conversion factors, and calculation methodologies within Measurabl software. Utility bill (NG, electricity and water) data downloads from Cass Avalon Bay WM 2017 Data Request - 4.24.2018.xls 2017 Electric Data.xls 2017 Gas Data with Updated Propane.xls 2017 Water Data.xls AvalonBay Scope 3 Travel & Commuting Emissions Data Summary (30_May_2018)_ALL DATA Commuting Scope 3 Calculation AVB 2017 - v3 Distance to Work - - Summary.xls Copy of Data Quality Report 201617__AVB Assurance Proof of Calcs__06-19-2018 facilityscope2 AvalonBay_CDP 2018 Data Quality Report 2016–17 - 06-19-18 v3-AS</p>			

Evaluation and conclusions:

The revised Verification Plan and Data Sampling / Evidence Gathering Plan were followed to completion.

AvalonBay utilised a cloud based climate change and sustainability data management and reporting platform called Measurabl who caters primarily to the real estate sector. The two reports generated by Measurabl for AvalonBay are the CDP report and the GRESB report, both of which are intended to be uploaded directly to the CDP and GRESB in the form of completed questionnaires.

AvalonBay populates energy and water data for each of their 280 communities in the US EPA Energy Star platform. Measurabl is then populated by a direct automated transfer of data from Energy Star to Measurabl. For waste data, AvalonBay enters the data directly into Measurabl.

Scope 1, Scope 2 and Scope 3 GHG Emissions:

A high level review of Measurabl energy data and GHG emissions data reported to CDP and GRESB was performed to identify areas where the data differs. LRQA noted numerous differences and was then informed of the unique reporting criteria that GRESB has and how it differs from standard GHG emissions accounting principles.

The raw utility bill data for natural gas and electricity was checked against final data reported in Measurabl for a representative sample of facilities. During this check the emissions factors for natural gas combustion and electricity grid factors were checked for accuracy.

Three findings were raised related to natural gas combustion. All three were closed. See the findings log for details and resolution.

AvalonBay reported both location-based and market-based Scope 2 emissions. For market-based emissions, AvalonBay has opted to utilise the lowest tier on the GHG Protocol Scope 2 Guidance market-based hierarchy, which results in the same Scope 2 emissions data being reported for both location-based and market-based methods. See the sampling plan for details of the analysis performed on the Scope 2 data.

Three findings were raised related to Scope 2 emissions. Two of the three were closed. The remaining one was left open and resulted in a qualification within the assurance statement. See the findings log for details and resolution.

AvalonBay uses a third party travel service to book all travel and one of the services provided by the booking company is to track Scope 3 GHG emissions for AvalonBay and provide reports of the emissions upon request. AvalonBay received a report for CY2017 Scope 3 emissions from air travel, car travel and hotel room occupancy. LRQA sampled the data Scope 3 air travel data per the sampling plan. No errors were noted in the execution of the functions in the travel services database.

Scope 3 GHG emissions from employee commuting was reported per the AvalonBay Commuting Scope 3 Calculation methodology provided to LRQA in a word document. LRQA confirmed the databases and calculations used for derivation of employee numbers and their distance from workplace were appropriate. Also, the assumptions made for emissions calculations were checked and considered appropriate.

There was one finding raised related to the reporting of employee commuting emissions in Measurabl. This finding was closed. See the findings log for details and resolution.

Verification of environmental data parameters included in Environmental Data Assertion:

The energy data reported by AvalonBay are closely related to GHG activity data. LRQA performed checks against the Measurabl GHG emissions reports to confirm all environmental data being verified was consistent with verified GHG emissions activity data.

For the other environmental data parameters related to water consumption and waste generation, LRQA gained an understanding of the processes and procedures in place through interviews with AvalonBay personnel whom oversee the respective data management systems. Key files from the system were sampled, and data was tracked from source to sink (Measurabl).

LRQA was only contracted to verify waste generation related to a subset of the AvalonBay communities (91%). LRQA verified the percentage of communities represented and will include clear documentation of the scope of the verification in the assurance statement. Also, the boundaries for AvalonBay waste and water data exclude waste and water data related to construction activities. This is in alignment with the GRESB reporting guidelines.

One finding was raised related to water and one related to waste data. Both findings were closed. See the findings log for details and resolution.

Verification of:	Errors and Corrections	Auditee(s):	Mark Delisi Kevin Mulcahy Sondra Tosky (Measurabl) Brianna Jackson (Measurabl)
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Audit trails and sources of evidence:

2018-06-20_AvalonBay Communities_2018-CDP-Response-v1
 2018-06-20_AvalonBay Communities_2018-GRESB-Response-v1
 Data Quality Report 2016–17 - 06-19-18 v3-AS
 Copy of Data Quality Report 201617__AVB Assurance Proof of Calcs__06-19-2018
 AvalonBay Scope 3 Travel & Commuting Emissions Data Summary (30_May_2018)_ALL DATA
 Commuting Scope 3 Calculation AVB 2017 - v3
 AvalonBay - CY17 Workbook

Evaluation and conclusions:

During the verification activities AvalonBay provided clarification regarding discrepancies noted by LRQA between various data sources. LRQA confirmed that appropriate amendments were made to the GHG emissions inventory and the environmental data assertion.

Verification of:	Materiality Conclusion	Auditee(s):	Mark Delisi Kevin Mulcahy Sondra Tosky (Measurabl) Brianna Jackson (Measurabl)
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Audit trails and sources of evidence:

2018-06-20_AvalonBay Communities_2018-CDP-Response-v1
 2018-06-20_AvalonBay Communities_2018-GRESB-Response-v1
 Data Quality Report 2016–17 - 06-19-18 v3-AS
 Copy of Data Quality Report 201617__AVB Assurance Proof of Calcs__06-19-2018
 AvalonBay Scope 3 Travel & Commuting Emissions Data Summary (30_May_2018)_ALL DATA
 Commuting Scope 3 Calculation AVB 2017 - v3
 AvalonBay - CY17 Workbook

Evaluation and conclusions:

Based on LRQA's approach, nothing has come to our attention that would cause us to believe that the total Scope 1, Scope 2, and Scope 3 GHG emissions, and Environmental Data disclosed by AvalonBay in the Reports for CY 2017 are not materially correct and that the GHG Emissions Inventory and Environmental Data Assertion have not been prepared in conformance with WRI/WBCSD GHG Protocol, the 2017 GRESB Real Estate Reference Guide, and AvalonBay environmental data management processes, except for the following qualifications:

- There was an unexplainable variance in Scope 2 emissions and Scope 2 energy between LRQA estimates and the final data reported in AvalonBay's data management platform. This misstatement was not material.

Evidence list:

 2018-06-20_AvalonBay Communities_2018-CDP-Response-v1	6/20/2018 10:20 AM	Microsoft Word D...	2,597 KB
 2018-06-20_AvalonBay Communities_2018-GRESB-Response-v1	6/20/2018 10:18 AM	Microsoft Word D...	2,648 KB
 Bill_Analysis_Electricity-Cass Export	5/21/2018 4:31 PM	Microsoft Excel W...	3,179 KB
 Bill_Analysis-Gas-Cass Export	5/22/2018 4:43 PM	Microsoft Excel W...	1,271 KB
 Bill_Analysis-Water-Cass Export	5/21/2018 9:00 AM	Microsoft Excel W...	1,212 KB



EF Reference Sources	6/13/2018 5:43 PM
Employee Commuting	6/20/2018 11:17 AM
Waste	6/20/2018 11:23 AM
2017 Construction Utilities v2-AS	6/19/2018 1:12 PM
2017 Electric Data v2-6-13-18_AS	6/13/2018 5:49 PM
2017 Electric Data v2-AS	6/8/2018 3:06 PM
2017 Electric Data-AS	6/13/2018 4:56 PM
2017 Electric Data-LR2	5/4/2018 12:39 PM
2017 Gas Data with Updated Propane v2-AS	6/13/2018 7:42 PM
2017 Gas Data with Updated Propane-AS	6/8/2018 1:57 PM
2017 Vacant Data_AS	5/21/2018 3:19 PM
2017 Water Data_AS	5/21/2018 9:35 AM
AvalonBay Scope 3 Travel & Commuting Emissions Data Summary (30_May_2018)_ALL DATA-DM	6/8/2018 3:38 PM
Bill_Analysis_Electricity-Cass Export v2-AS	6/13/2018 5:17 PM
Bill_Analysis-Gas-Cass Export-AS	6/8/2018 2:32 PM
Data Quality Report 2016-17 - 05-04-18-AS	6/13/2018 4:57 PM
Data Quality Report 2016-17 - 06-08-18-AS	6/13/2018 7:49 PM
Data Quality Report 2016-17 - 06-18-18-AS	6/19/2018 1:14 PM
Data Quality Report 2016-17 - 06-18-18-AS-DMWaste	6/18/2018 7:44 PM
Data Quality Report 2016-17 - 06-19-18 v2-AS	6/19/2018 4:17 PM
Data Quality Report 2016-17 - 06-19-18 v3-AS	6/20/2018 11:06 AM
Data Quality Report 2016-17 - 06-20-18	6/20/2018 10:23 AM
facilityscope2 AvalonBay_CDP 2018	6/20/2018 10:40 AM
Measurabl CDP Emissions Factors Methodology_revised 13June2018-AS	6/18/2018 10:00 AM
Measurabl Emissions Factors 2018-AS	6/18/2018 10:00 AM
Re AVB Findings - Please Update	6/20/2018 11:11 AM
Estimate of employee distance travelled	6/8/2018 9:09 AM
Distance to Work - - Summary	6/12/2018 4:40 AM
Commuting Scope 3 Calculation AVB 2017 - v3	6/12/2018 6:34 AM
RE CSR Data Compilation - 2017 v2	6/12/2018 4:40 PM
RE Estimate of employee distance travelled-v3	6/12/2018 4:40 PM
Re Estimate of employee distance travelled-Sondra	6/12/2018 4:43 PM
AvalonBay Scope 3 Travel & Commuting Emissions Data Summary (30_May_2018)_ALL DATA-LR	6/18/2018 9:31 PM
2017 AvalonBay Waste Data FINAL for LRQA Review v2-DM	6/8/2018 4:32 PM
2018-06-19_AvalonBay Communities_2018-GRESB-Response-v1	6/19/2018 1:25 PM
Avalon Bay WM 2017 Data Request - 4.24.2018-LR	6/18/2018 7:58 PM
Copy of Data Quality Report 201617_AVB Assurance Proof of Calcs_06-19-2018-7pm	6/19/2018 7:11 PM
Data Quality Report 2016-17-Waste-06-08-18	6/18/2018 9:29 PM

AvalonBay - CY17 Workbook	6/20/2018 11:29 AM Microsoft Excel W... 830 KB

4. Verification plan

AvalonBay Communities, Inc. Greenhouse Gas Emissions Inventory & Environmental Data, CY 2017 Verification Plan 3/20/2018	
Verification Objectives:	To provide AvalonBay Communities, Inc. (Avalon Bay) with an independent opinion on the completeness of the data and information being submitted to CDP & GRESB.
Verification Criteria:	
Protocols and Standards:	WRI/WBCSD GHG Protocol AvalonBay's Environmental Data Management Processes ISO 14064-3 (GHG Verification standard) LRQA Verification Approach - (Environmental data)
Verification Scope:	
Description of Industry/Sources:	REIT which owns, operates, develops and re-develops multi-family communities.
Geographic Boundaries:	North America
Reporting Period:	CY 2017
Greenhouse Gas Verified:	CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ , Energy use, Water use, Waste generated
Scopes covered:	Scope 1, 2 and 3. Scope 3 includes business travel and employee commuting only.
Reporting Basis:	Operational Control: GHG Emissions & Energy Financial Control: Water Consumption & Waste Generated
Level of Assurance:	Limited
Materiality Threshold:	
	Professional judgement of the verifier
LRQA Verification Team:	
Lead Verifier:	Derek Markolf
Verifier:	Ali Schmidt
Technical Reviewer (QA/QC):	Heather Moore
Verification Activities and Schedules:	
Scheduled for week of:	Task
March 19, 2018	Kick-Off Meeting
April 9, 2018	Delivery of Scope 3 Business Travel and Employee Commute Reported GHG Emissions and Supporting Spreadsheets
April 23, 2018	Delivery of GHG Inventory, Key Supporting Spreadsheets & Environmental data plan
April 23, 2018	Strategic Review / Risk Assessment
April 30, 2018	Screen Share Meeting & Initial Data Request
May 7, 2018	Initial Data submitted to LRQA
May 14, 2018	LRQA data verification
May 21, 2018	LRQA Final Review
May 21, 2018	Delivery of Final List of Findings
May 28 & June 4, 2018	Client to address Findings
June 11, 2018	LRQA to conduct internal Technical Review and Assurance Statement Review
June 11, 2018	Delivery of Final Verification Report and Verification Statement

Verification Plan approval:

Name:	Derek Markolf
Date:	March 19, 2018
Revision Date:	March 20, 2018
Revision Date:	

*Plan must be approved by the Lead Verifier

5. Data and Information Sampling Plan

Sampling Code #	Item to be Sampled	Data and Information Requirement (evidence gathering plan)	Lead Verifier Reasoning
01	Scope 2 GHG Emissions & Electricity Use	Check total CY 2017 elect. utility bill data against Measurabl GHG emissions for 30 communities. Divide Measurabl Scope 2 GHG emissions by utility bill electricity use and confirm results in correct eGRID EF. Check raw utility bill data for 3 communities.	This will check revenue metered data from utility bills (first tier of data aggregation) against final data in Measurabl used for reporting total GHG emissions (final tier of data aggregation). Will also confirm correct EFs used.
02	Scope 1 GHG Emissions from NG combustion.	Check total CY 2017 NG utility bill data against Measurabl GHG emissions for 30 communities. Divide Measurabl Scope 1 GHG emissions by NG consumption and confirm results in correct EF for NG combustion. Check raw utility bill data for 3 communities.	This will check revenue metered data from utility bills (first tier of data aggregation) against final data in Measurabl used for reporting total GHG emissions (final tier of data aggregation). Will also confirm correct EFs used.
03	Scope 3 GHG emissions from business travel (Air, car and hotel)	Obtain copy of calculation methodology for travel emissions and check the line item air travel records against the calculation method to confirm accurate execution of calculations.	Air travel accounts for 5% of the Scope 3 emissions.
04	Scope 3 GHG emissions from employee commutes	Obtain copy of estimation/calculation methodology for employee commute emissions and check pertinent employee records against the calculation method to confirm accurate execution of calculations.	Employee commuting accounts for 94% of Scope 3 emissions, and this is the first year they're reporting these emissions

05	Water Data	Check total CY 2017 water utility bill data against Measurabl water consumption for 30 communities. Check raw utility bill data for 3 communities.	This will check revenue metered data from utility bills (first tier of data aggregation) against final data in Measurabl used for reporting.
06	Total GHG Emissions calculated in Measurabl	Confirm all GHG emissions source categories are included in Measurabl calculated GHG emissions. Also, check reasoning for all properties with >100% year on year change between Cy2016 and CY2017.	High level check of aggregate Scope 1 and Scope 2 activity data against aggregate GHG emissions calculated in Measurabl. YOY change may indicate missing properties.
07	Waste	(1) Confirm Waste Management uploads to Measurabl are complete and accurate through interviews with Measurabl teams and sampling of Waste Management files. (2) Confirm percent coverage of the waste data in Measurabl is accurately calculated.	Waste measured and billed by haulers is relatively straightforward, as the data is straight from the Waste Management billing system.
08	Boundaries	Confirm operational control (GHG emissions) and financial control (water & waste) are accurately applied throughout all communities.	There was some confusion during the CY2015 site visit about application of boundaries. For the most part the boundaries have been straightened out, but still need close attention.