SCOTTISH WATER

Water Industry Commission for Scotland (WICS) ANNUAL RETURN 2023/24

Section C – Carbon Emissions and Net Zero

Contents

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1 Table C0 – Summary

1.1 Overview

Scottish Water has been reporting its annual operational Carbon Footprint (CFP) within its annual reports and sustainability reports since 2006-07, and directly to the Scottish Government since 2014, in line with obligations on public bodies under Scotland's Climate Change Act. The data have been included in the Annual Return since AR22.

The operational CFP reports the greenhouse gas emissions associated with the day-to-day delivery of water and wastewater services. It also includes regulated services delivered on Scottish Water's behalf through the PFI concessions.

Carbon is expressed as "tonnes Carbon Dioxide equivalents" (tCO2e), which includes non-CO2 emissions (e.g. methane and nitrous oxide from wastewater treatment). The information in the tables provides a detailed breakdown of our operational carbon emission data and renewable energy generation.

With respect to emissions on Scottish Water's landholdings, AR22 reported the breakdown of the types of landholdings owned by Scottish Water and noted that work was ongoing to finalise the baseline carbon inventory. In AR23 we reported the carbon associated with the landholdings, due to the completion of initial baseline work during this period. In AR24 we continue to report values based on the original baseline, adjusted to reflect improved intelligence from field surveys. There is significant uncertainty in this area as it is an emerging science, and we will continue to work to improve our understanding in order to increase confidence in the figures reported. Scottish Water is currently working with external experts to update its carbon inventory for reporting in AR25.

Emissions Embodied in the Asset Base is a new area of carbon assessment and AR24 is the third year of reporting. It is noted that, as this is a newer area there continues to be a big focus on improving the data and tools used to assess and report carbon.

Tables C2, C3 and C4 have been audited by Binnies. Table C1 was audited by Achilles, as described in the commentary for Table C1.

Queries were raised during assurance audit and the Annual Return queries process that led to Scottish Water re-assessing two of the input numbers to the 2022-23 carbon footprint, which identified the omission of some data. This has now been addressed and AR24 presents the AR23 numbers adjusted to correct the omissions. Improvements in data processing have been identified to avoid these errors recurring, and we will draw it to the attention of our external auditor that these errors were missed during their audit.

The overall effect is that the 2022/23 regulated business carbon footprint was underreported by 1.92% (4,159 tCO2e). Table 1 details the lines that have changed:

Table 1: List of corrected carbon emission values (Table C0).

Line Reference	Original value reported in AR23 (tCO2e)	Corrected 2022/23 value reported in AR24 (tCO2e)
C0.2	-13,962	-9,803
C0.4	216,840	220,999
C0.9	219,356	223,516

1.2 Performance Trends

1.2.1 Lines C0.1-C0.4 – Operational Emissions

These lines refer to information detailed in C1 tables.

C0.1 Net operational emissions in previous year (opening)

Reported as 220,999 tCO2e, taken from AR23 tables **Line C1.29.**

C0.2 Change in Scope 1 to 3 emissions in the report year

Reported as 4,231 tCO2e. As shown in Table 1 above, the AR23 number has been changed to reflect the inclusion of previously omitted data. All elements associated with operational emissions are detailed in **Lines C1.1-C1.29**. Changes for each scope are detailed in the memo **Lines C1.37-C1.39**.

C0.3 Change in renewable electricity generated and exported in the year

Reported as -250 tCO2e, as detailed in **Lines C1.41-C1.43.**

C0.4 Net operational emissions in reporting year (closing)

Reported as 224,979 tCO2e, as presented in **Line C1.29**. This is a 1.9% increase from AR23. As in previous years, this is influenced by emissions associated with grid electricity. However, unlike previous years these emissions have increased in the AR24 period, resulting in an increase in scope 2 emissions and scope 3 emissions from PFIs in AR24. Further trends are detailed in C1 commentary. As shown in Table 1 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

Net operational emissions refer to emissions arising from the day-to-day operation of Scottish Water and includes emissions from the regulated water and wastewater operations (including PFIs), but not from the wider Scottish Water Group. Emissions sources include direct emissions from burning of fossil fuels on sites and in vehicles (scope 1), direct emissions in the form of nitrous oxide and methane from wastewater and sludge treatment (scope 1), indirect emissions from consumption of grid electricity (scope 2), indirect emissions from outsourced activities and business travel (scope 3). The term “net emissions” refers to the netting off of emissions from exports of renewable electricity to the grid. Emissions are calculated and reported using the Carbon Accounting Workbook (CAW) Version 18, a standard tool for the UK Water Industry.

1.2.2 Lines C0.5-C0.7 Emissions from landholdings

The initial baseline carbon inventory by the James Hutton Institute (JHI) (using national data sets and methods as outlined in Section 5.4 below) adjusted by the findings of peatland condition surveys (outlined in the commentary for **Line C4.6**) forms the basis of the calculations for these figures.

It is important to note that the numbers reported in the Annual Return are the mid-point of a broad range of land-based carbon capture/emissions. The range reflects the level of uncertainty around land-based emissions and will improve as we gather more data on Scottish Water's peatlands and woodlands via on-the-ground surveys. This work is ongoing and will feed into the 3-yearly inventory update to be reported in AR25.

The AR24 position is that Scottish Water's landholdings may be sequestering 5,844 tCO2e per annum. This falls within the original JHI range of -19,800 tonnes carbon capture per annum and 38,000 tonnes emitted per annum.

We expect significant movement in the Table C4 figures in AR25 as field data confirming site conditions for both peatland and woodland are fed into the inventory update, and uncertainty is reduced. Longer term, we expect these figures begin to reflect the benefits of land improvements.

1.2.3 Lines C0.8-C0.9 Net operational emissions net of insetting and offsetting (opening & closing)

These lines are calculated from other data within the table and AR24 is the second year of reporting these figures.

The outturn position in AR24 is that the net operational emissions (net of insetting and offsetting from the landbank) is 219,135tCO2e reflecting both the increase in the operational footprint and the improvement in the position of the landbank. As shown in Table 1 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

1.2.4 Lines C0.10-C0.13 Emissions embodied in the asset base

This section follows the same methodology as AR23.

Scottish Water has developed tools that enable understanding and accounting for carbon within the current investment programme. These tools draw from UK water industry guidance and adopt known carbon factors for materials from standard sources such as the Bath University/Institution of Civil Engineers embodied carbon database.

Scottish Water has a significant asset base that represents decades of investment and associated emissions. Historical embodied emissions are likely to be higher than they would be if the same investment was carried out today, owing to the greater carbon intensity of production and the reliance on coal and other fossil fuels in the power sector.

The tools that were developed have enabled Scottish Water to begin to understand the current carbon intensity of investment, and to identify major sources of emissions within the capital programme. These tools have been adopted by our supply chain and enabled the identification of opportunities to reduce carbon intensity.

This remains a developing area and we continue to improve the tools we use and their coverage within the programme, but we have already seen positive moves towards adopting lower carbon solutions such as low carbon concrete and steel, offsite fabrication, the adoption of sustainable fuels and nature-based solutions.

It may be desirable to consider overall embodied carbon as a “carbon MEAV” (Modern Equivalent Asset Valuation) to assess the carbon efficiency of asset replacement, which would seek to apply the latest investment carbon intensity factors across the asset base.

C0.10 Embodied carbon in overall asset base (previous year)

This is estimated as a Low and High range and is detailed in **Lines C2.10 and C2.11.**

C0.11 Increase in embodied carbon in the year (e.g. due to capital investment)

This is estimated as a Low and High range and is detailed in **Lines C2.4 and C2.5**. In terms of performance, embodied carbon, **Line C0.11**, has increased in relation to AR23This is due to our investment program growing quicker than inflation.

C0.12 Other changes in the year

No changes in the period covered by AR24.

C0.13 Embodied carbon in overall asset base (closing)

This is estimated as a Low and High range and is detailed in **Lines C2.10 and C2.11.** The overall embodied carbon figures have increased in line with the additional embodied carbon emitted by Scottish Water.

1.3 Investment

Emissions management is supported by a range of activities carried out across the business. Much is not directly connected to management approaches or specific investment needs for carbon but is delivered through changes in operational or investment delivery practices. For example - investment in data and systems such as the development of reporting for electric vehicles or creating embodied emissions functionality within costing systems. Similarly, promoting greener measures within capital investment projects (adoption of low emission fuels or use of low emission materials) would be integrated within projects.

1.4 Data

Greenhouse gas emission and energy data are reported for operational activities, capital investment and land-based emissions. Of these, electricity use and generation have the greatest level of confidence at A2, reflecting corporate energy data and billing systems. Operational emissions are C4 reflecting the wider range of data sources and methods of calculation, along with uncertainty in areas such as modelled process emissions.
Capital Investment emissions are C5, and carbon embodied in the asset base is D5/6 reflecting the lower maturity of these data and the assumptions made to generate a figure for overall carbon embodied in the asset base.

Land based emissions are assigned C5, which reflects that the landholdings data are based on corporate GIS and national data sets to which assumptions and models are applied to assess greenhouse gas emissions/capture.

A full overview of the data sources, methodology, assumptions, and confidence grades is covered in the Commentary for Tables C1 to C4.

See the corresponding table commentary for details of data improvement programmes.

2 Table C1 – Operational emissions

2.1 Overview

All figures within this table refer to the measurement of the annual operational Greenhouse Gas (GHG) emissions of the regulated business (Scottish Water operated sites, and PFI sites). Unless otherwise stated it does not include emissions from the wider (non-regulated) Scottish Water Group. Emissions are reported in line with Global, UK and Scottish reporting protocols and guidance, and calculated using UK Water Industry Research's Carbon Accounting Workbook (CAWv18) used by all UK water companies. This is updated annually to reflect the latest UK Government Department for Energy, Security and Net Zero (DESNZ) carbon conversion factors, boundaries, guidance, and methods. Prior to publication, Scottish Water's operational carbon footprint is audited externally by Achilles, carbon specialists, in line with ISO 14064-1.

Emissions are recorded in tonnes of carbon dioxide equivalent (tCO2e) to account for the different potential each GHG has for global warming. **Lines C1.5 to C1.8** split out the tCO2e into each of the main GHGs: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O). The table is split according to "emissions scopes" in line with Global GHG reporting protocols (see descriptions in Section 2.2, Performance Trends, below).

There have been three major changes in reporting since AR23. The first is that the grid electricity emissions factor, which has historically decreased year on year, has increased. This accounts for the majority of the rise in our overall carbon footprint, as explained in more detail in **Line C1.9** Purchased Electricity and **Line C1.20** Purchased electricity - transmission and distribution.

The second major change is the impact of the PFI concessions that concluded during the previous reporting year – Highland PFI (Allanfearn and Fort William Wastewater Treatment Works [WwTW]) in May 2022 and Grampian PFI (Nigg, Fraserburgh, Persley and Peterhead WwTWs, along with associated sewer pumping stations) in October 2022. This does not impact the total emissions, but it does mean that the scope breakdown of the emissions has changed. In line with the global Greenhouse Gas Protocol, PFI emissions are considered third party "supply chain" emissions and reported as Scope 3. When they revert to Scottish Water control the emissions are classed as either Scope 1 (direct emissions - e.g. on-site fuel, process emissions) or Scope 2 (indirect emissions e.g. electricity). Whereas in AR23 these sites' contribution to emissions was split between Scope 3 and Scope 1 and 2, they are now apportioned to Scope 1 and 2 only.

The third major change is an update to the Global Warming Potentials used in CAWv18 compared to CAWv17. The Global Warming Potential (GWP) takes into account the different potential each GHG has for global warming. Carbon dioxide is given a GWP of 1 and all other gases are compared against this. The update has been made to align with DESNZ conversion factors for 2023. These moved from IPPC AR4 to IPPC AR5 GWPs. The GWP for methane has increased slightly (25 to 28) and the GWP for nitrous oxide has decreased more significantly (298 to 265). This impact is seen in an overall decrease in our process emissions from nitrous oxide, as explained in more detail in **Lines C1.2, C1.6 and C1.7**.

The net operational Carbon Footprint (CFP) reported by Scottish Water for water and wastewater services in AR24 is reported in **Line C1.29** as 224,979, an increase of 1.9% from the AR23 figure. Within the Annual Performance and Prospects report the CFP is rounded to 225,000 tCO2e.

Queries were raised during assurance audit and the Annual Return queries process that led to Scottish Water re-assessing two of the input numbers to the 2022-23 carbon footprint, which identified the omission of some data. This has now been addressed and AR24 presents the AR23 numbers adjusted to correct the omissions. Improvements in data processing have been identified to avoid these errors recurring, and we will draw it to the attention of our external auditor that these errors were missed during their audit.

The overall effect is that the 2022/23 operational carbon footprint was underreported by 1.92% (4,159 tCO2e). Table 2 details the lines that have changed:

Table 2: List of corrected carbon emissions values (Table C1)

Line Reference	Original value reported in AR23 (tCO2e)	Original CG (if changed)	Corrected 2022/23 value reported in AR24 (tCO2e)	Updated CG (if changed)
C1.18a	81,817		84,540	
C1.19	1,525	B3	2,961	C4
C1.22	92,606		96,765	
C1.23	58,515		62,621	
C1.24	11,684		11,696	
C1.25	22,407		22,448	
C1.27	220,962		225,121	
C1.29	216,840		220,999	
C1.34	52%		51%	
C1.35	53%		52%	
C1.39	-11,065		-6,906	
C1.40	220,962		225,121	

2.2 Performance Trends

2.2.1 Lines C1.1-C1.8 Scope 1 Emissions

Scope 1 refers to emissions arising directly from the burning of fossil fuels or other direct release of GHGs such as CH4 or N2O.

Line C1.1 Direct emissions from burning fossil fuels (including CHP generated on site
This is reported as 4,305 tCO2e for AR24, increasing from 3,236 tCO2e for AR23. This covers all activities that release emissions from fossil fuels in the course of delivering water and wastewater services, including natural gas used in heating and diesel and other fuels used in generators on site.

These emissions can vary depending on operational practices and in-year demands (e.g. standby generator use). While natural gas use has fallen, diesel and kerosene use has increased. This also now includes the full year of fuels used at two large ex-PFI sites (Nigg

and Allanfearn), which would previously have been included in Scope 3. While this is one of the higher consumptions we have seen in recent years, it is within the range we have seen over the last 10 years, as per Table 3 below:

Table 3: Historic annual emissions (tCO2e) from direct burning of fossil fuels

2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
4,012	4,374	2,856	3,585	4,468	3,667	3,184	2,360	3,734	3,236	4,305

We continue to use HVOs (Hydrogenated Vegetable Oils) to power air curtains at two reservoirs whilst a permanent power supply is installed. HVO emits up to 90% less CO2e than diesel. (In calculating the AR table value a DESNZ supplied emissions factor is used in calculations) In year, this avoided diesel emissions of 56 tCO2e. We are investigating opportunities to use HVOs across more sites and we anticipate this will support a reduction in emissions in the future. We are also working with operational and finance teams to improve the granularity of reporting that will help us to better track the penetration of fuels such as HVO in the future.

Line C1.2 Process and fugitive emissions

Reported as 23,974 tCO2e for AR24, decreasing from 25,004 tCO2e for AR23. This consists of direct release of GHGs such as CH4 and N2O from the natural processes of wastewater and sludge management.

Process emissions are estimated based on the quantity of sludge processed and the population equivalent of WwTWs using the agreed methodology set in the UK Water Sector's Carbon Accounting Workbook. While these vary slightly year on year, the main reason for the change from AR23 is updated Global Warming Potentials used in CAWv18.

The Global Warming Potential (GWP) accounts for the different potential each GHG has for global warming. Carbon dioxide is given a GWP of 1 and all other gases are compared against this. The update has been made to align with DESNZ conversion factors for 2023 which moved from IPPC AR4 to IPPC AR5 GWPs. The GWP for methane has increased slightly (25 to 28) and the GWP for nitrous oxide has decreased more significantly (298 to 265), meaning there is an overall decrease in tCO2e.

C1.3 Transport: company owned and leased vehicles

Reported as 11,541 tCO2e for AR24, with little change from the 11,276 tCO2e reported for AR23. This includes emissions from Scottish Water-owned fleet and long-term leased vehicles. It does not include emissions from business travel in private vehicles, which is included under scope 3. Whilst the emissions in this category are proportional to fleet milage and customer activity, the continued transition of the van fleet to electric vehicles will also lead to reductions in this line.

C1.4 Total scope 1 emissions

Reported as 39,821 tCO2e for AR24, increasing slightly from 39,517 tCO2e for AR23. This presents the total Scope 1 emissions (a sum of **Lines C1.1, C1.2 and C1.3**), which comprises all emissions released directly from Scottish Water assets (including vehicles). The increase in fuel use (**C1.1**) is balanced by the decrease in process emissions (**C1.3**), with Scope 1 transport staying largely consistent from last AR23. Please refer to items **C1.1 – C1.3** for detailed explanations.

2.2.2 Lines C1.5-C1.8 break down Scope 1 emissions into their constituent GHGs – carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and other GHGs

Generally, trace refrigerant gases of which there are none to report for AR24, as stated in **Line C1.8**. Nitrous oxide (N2O) from wastewater treatment is the largest contributor to scope 1 emissions.

There is a discrepancy between **Line C1.4** Total scope 1 emissions 39,820.76 and the sum of the constituent GHGs in **C1.5-C1.8** is 39,819.52 as detailed in Table 4. This difference is mainly due to the UK Government DESNZ 2023 conversion factors (which are used in the CAWv18) not having a breakdown of emissions by GHG for Hydrogenated Vegetable Oils (HVOs), and so these emissions are only available in tCO2e, detailed in Table 5.

There is also a small amount of discrepancy attributed to other DESNZ conversion factors - specifically, the factors for the different GHGs broken down by type (methane, nitrous oxide, carbon dioxide etc.) have slight discrepancies in how they add up to the CO2 equivalent. It is not currently possible to fully reconcile the figures. This impacts all UK Water companies that use the CAW to report their figures.

Table 4: Total Scope 1 Emissions – Discrepancy attributed to DESNZ conversion factors

	tCO_2e
C1.4 Total scope 1 emissions	39,820.76
Scope 1 emissions - CO_2	15,652.05
Scope 1 emissions - CH_4	4,675.58
Scope 1 emissions - N_2O	19,491.89
Scope 1 emissions - other GHGs	-
Sum of C1.5-C1.8	39,819.52
Difference	1.24

Table 5: Items not included in constituent GHG breakdown

Items not included in constituent GHG breakdown (C1.5-C1.8)	tCO_2e	Comments
HVO fuel consumption	1.23	The 2023 UK government DESNZ 2023 emission factor does not provide a breakdown for constituent GHGs.
Other	0.01	Discrepancies arising when DESNZ 2023 conversion factors for individual GHGs are summed to CO_2 equivalent

TOTAL	1.24	

C 1.5 Scope 1 emissions – CO2

Reported as 15,652 tCO2e for AR24, increasing from 14,307 tCO2e for AR23. This is due to the increase in diesel and kerosene on operational sites, as per C1.1.

C1.6 Scope 1 emissions – CH4

Reported as 4,676 tCO2e for AR24, increasing from 3,955 tCO2e for AR23.

This is largely made up of methane emissions from the wastewater and sludge treatment process. These emissions are calculated based on the volume of sludge treated and the Population Equivalent (PE) of our WwTWs.

Whilst the PE and sludge treated has increased slightly from AR23 due to the inclusion of ex-PFI sites (which were previously included in Scope 3), the main increase in emissions is due to the change in Global Warming Potential of methane used in the CAW v18 from 25 to 28. As explained in C1.2 this change was made to align with the GWPs used in the 2023 DESNZ conversion factors.

C1.7 Scope 1 emissions – N2O

Reported as 19,492 tCO2e for AR24, decreasing from 21,223 tCO2e for AR23. This is nitrous oxide emissions from the wastewater treatment process, which is calculated based on the Population Equivalent (PE) of our WwTWs. Whilst this has gone up slightly from AR23 due to the inclusion of ex-PFI sites, the overall decrease is due to the change in Global Warming Potential of nitrous oxide used in the CAW v18.

As noted in **C1.2** above, the Global Warming Potential (GWP) accounts for the different potential each GHG has for global warming. Carbon dioxide is given a GWP of 1 and all other gases are compared against this. The update has been made to align with DESNZ conversion factors for 2023 which moved from IPPC AR4 to IPPC AR5 GWPs. The GWP for nitrous oxide has decreased from 298 to 265, meaning there is an overall decrease in tCO2e.

C1.8 Scope 1 emissions - other GHGs

Reported as 0 tCO2e for AR24, decreasing from the 20 tCO2e reported for AR23. This is based on refrigerant gases used to service air conditioning units, the service records of which show no known refrigerant gases have leaked in year.

2.2.3 Lines C1.9-C1.16 Scope 2 emissions

Scope 2 refers to emissions associated with the purchase of electricity and specifically the generation of electricity within the national grid. It is important to note that this does not include the carbon impact from transmission and distribution of electricity across the grid – which is accounted for as a Scope 3 emission.

Note that in line with guidance from the Scottish Government, Scottish Water uses the location- based method for accounting, where emissions are associated with where the electricity is generated and consumed. Some water companies in the rest of the UK may report their emissions using the market-based method, which allows grid electricity purchase to be reported as zero emissions when green tariffs are in place.

C1.9 Purchased Electricity

Reported as 97,614 tCO2e for AR24, increasing from 88,822 tCO2e for AR23.

These emissions are associated with purchased electricity from the national grid and are calculated from the annual electricity purchased and the DESNZ grid emissions factor. At present grid electricity use comprises the major element of Scottish Water's carbon footprint.

Line C1.9 only covers Scottish Water electricity use, which represents 43.5% of the carbon footprint. This line excludes both Scope 3 transmission and distribution losses and PFI electricity, which come within Scope 3, **Line C1.20** and in part of **Line C1.18a**, respectively. With these two elements included, electricity emissions represent 57% of the carbon footprint. In the Annual Report all electricity is reported together regardless of Scottish Water or PFI use.

Scope 2 electricity consumption has increased as per **C3.1b** Grid Electricity consumption (Scottish Water regulated). This is due to the electricity consumption at Scottish Water Grampian being fully reflected in Scottish Water's purchased electricity in AR24 (as opposed to partly accounted for in PFI Scope 3 in AR23). 73% of the increase in Scope 2 emissions was due to the change in grid emissions factor; 14% to the inclusion of the PFI sites; the remainder is due to increased operational demand. In addition, there has been increased operational demand, particularly for raw water and sewage pumping.

However, the major increase in emissions is due to the higher emissions associated with each kWh (i.e. the grid emissions factor) as published by UK Govt DESNZ. This has increased by 7% from 0.1934kgCO2e/kWh to 0.2071kgCO2e/kWh.

C1.10 Electric vehicles

Reported as 52tCO2e for AR24, increasing from 16 tCO2e for AR23.

This reflects the increase in EVs used in our leased fleet and private vehicles and covers emissions from all electricity used to charge electric vehicles (EVs), regardless of where the vehicle was charged.

C1.11 Removal of electricity to charge electric vehicles at site

This line refers to the amount of electricity used to charge EVs at Scottish Water sites.

As stated in AR23 commentary and queries, at present this data is unavailable due to the need to establish a new reporting framework and platform for the developing charging infrastructure. A digital project has now taken place to improve and streamline reporting from these different sources and we are on schedule to report this data for AR25.

We have taken the decision to report emissions from EV's in **Line C1.10**, accepting that there will be a small amount of double counting as we are currently unable to remove the proportion associated with charging on Scottish Water sites – consumption which will already be accounted for under **Line C1.9** Purchased Electricity.

C1.12 Total Scope 2 emissions

Reported as 97,667 tCO2e for AR24, increasing from 88,839 tCO2e for AR23. Electricity emissions remain the major element of the operational footprint. The increase was attributed to an increase in grid electricity consumption and in the carbon intensity of grid electricity per the explanation in **Line C1.9**.

2.2.4 Lines C1.13-C1.16 Breakdown of Scope 2 emissions into their constituent GHGs

C1.13 Scope 2 emissions – CO2

Reported as 95,477 tCO2e for AR24, increasing from 86,941 tCO2e for AR23. CO2 is the main constituent of scope 2 emissions from purchased grid electricity (See explanation for increase in **Line C1.9**).

C1.14 Scope 2 emissions – CH4

Reported as 1,622 tCO2e for AR24, an increase from 1,275 tCO2e for AR23.

This is largely from electricity Scottish Water purchases from Scottish Water Horizons natural gas CHPs at Stirling and Dalmarnock. This increase is a direct result of increased generation at Dalmarnock.

C1.15 Scope 2 emissions – N2O

Reported as 568 tCO2e for AR24, a slight decrease from 623 tCO2e for AR23.

C1.16 Scope 2 emissions - other GHGs

Reported as zero tCO2e for AR24, as it was in AR23. There are no other constituent GHGs that make up scope 2 emissions.

2.2.5 Lines C1.17-C1.26 Scope 3 emissions

Scope 3 emissions refer to our indirect emissions from activities that do not fit with Scope 1 or 2 or are emitted by others on our behalf (e.g. public transport, outsourced activities).

C1.17 Business travel by public transport and private vehicles used for company business

Reported as 672 tCO2e for AR24, an increase from 359 tCO2e for AR23. This has continued to increase post-pandemic as the business has moved to a hybrid working pattern, with a further return to office working and face-to-face meetings.

C1.18 Outsourced activities - PFI within the Scottish Water Group (e.g. SW Grampian)
Reported as 0 tCO2e for AR24. With the incorporation of SW Grampian PFI sites into Scottish Water core operations in AR23, there are no sites and so no emissions in this category.

C1.18a Outsourced activities – PFI outside the Scottish Water group
Reported as 78,790 tCO2e for AR24, decreasing from 84,540 tCO2e for AR23.

The decrease from AR23 is mainly due to the conclusion of two PFI concessions – Highland PFI in May 2022 and Grampian PFI in October 2022. The full year of emissions are now reported under Scope 1 (direct emissions) or Scope 2 (indirect emissions i.e. electricity). Whereas in AR23 for the period they were under PFI operation they were reported in this category. Other changes reflect expected year to year variation in consumption at PFI sites.

C1.19 Outsourced activities – other
Reported as 2,977 tCO2e for AR24, remaining consistent with 2,961 tCO_2e for AR23. This consists of sludge tankering carried out by third parties on our behalf.

As shown in Table 2 (page 9 above), the AR23 number has been changed to reflect the inclusion of previously omitted data. Reported in AR23 as 1,525 tCO_2e, further investigation highlighted that mileage reported in 2022-23 was an under-estimate due to the omission of third-party sludge tanker mileage for one of the sub-contracted service providers. In addition, the lead contractor identified that mileage from 20 of their own vehicles was omitted.

The missing data are not available. It is possible to estimate what the missing sub-contractor mileage may have been on the basis that they were contracted to deliver 500,000 miles of tanker journeys. The missing mileage from the lead contractor's vehicles can be estimated by applying average vehicle mileage from their wider tanker fleet to the missing 20 vehicles.

Adding these estimates to the reported third-party tankering changes the AR23 reported value from 1,525 tCO2e to 2,961 tCO2e, a value more consistent with the AR24 reported number.

As the mileage in AR23 cannot be reported from measured values but is instead a mix of measured mileage and estimates based on average values, we have reduced the confidence grade for 2022/23 from B3 to C4.

C1.20 Purchased electricity - transmission and distribution
Reported as 8,341 tCO2e for AR24, increasing slightly from 8,042 tCO2e for AR23. These are emissions associated with electricity lost in the electrical transmission and distribution system. The trend follows scope 2 electricity emissions and has increased due to an increase in grid electricity consumption and a modest 1% increase in the transmission and distribution grid emissions factor published by DESNZ.

C1.21 Disposal of water and wastewater treatment waste to landfill
Reported as 1,084 tCO2e for AR23, increasing from 864 tCO2e for AR23. This is within the variation expected from previous years (as shown in Table 6) and reflects quantity of waste to landfill on several islands where no recycling outlets are available.

Table 6: Disposal of water and wastewater treatment waste to landfill.

	AR24	AR23	AR22	AR21	AR20	AR19
Disposal of water and wastewater treatment waste to landfill (tCO_2e)	1,084	864	1,123	1,214	923	898

Note that this is not a required part of Ofwat reporting by water companies in England & Wales but has been included in Scottish Water's operational carbon footprint for more than a decade.

C1.22 Total scope 3 emissions.

Reported as 91,864 tCO2e for AR24, decreasing from 96,765 tCO2e for AR23. As shown in Table 2 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

The majority of this is made up of emissions from PFI operators acting on Scottish Water's behalf, as reported in **Line C1.18a**. The decrease in this category masks increases in Scope 3 transport and waste to landfill.

2.2.6 Lines C1.23-C1.26 break down Scope 3 emissions into their constituent GHGs

C1.23 Scope 3 emissions – CO2

Reported as 61,995 tCO2e for AR24, decreasing slightly from 62,621 tCO2e for AR23. As shown in Table 2 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

C1.24 Scope 3 emissions – CH4

Reported as 11,820 tCO2e for AR24, increasing slightly from 11,696 tCO2e for AR23. As shown in Table 2 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

This includes process emissions from PFI sites and will be impacted by both a decrease from the conclusion of PFI Grampian and Highland sites last year (which are now reported under Scope 1); an increase due to the increase in GWP of methane, as explained in C1.2 and 1.6.

C1.25 Scope 3 emissions – N2O

Reported as 18,050 tCO2e for AR24, decreasing from 22,448 tCO2e for AR23. As shown in Table 2 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

This includes process emissions from PFI sites will have decreased due to the conclusion of PFI Grampian and Highland concessions last year (which are now reported under Scope 1); and the fall in GWP of nitrous oxide, as explained in C1.2 and 1.7.

C1.26 Scope 3 emissions - other GHGs

Reported as 0 tCO2e. As in previous years all GHG emissions are in the form of CO2, CH4 or N2O, as reported in **Lines C1.23-1.25**.

C1.27 Gross operational emissions (scope 1, 2 and 3)

Reported as 229,351 tCO2e for AR24, increasing from 225,121 tCO2e for AR23. As shown in Table 2 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

This is a sum of scope 1, 2 and 3 emissions. The major impact is from the increase in Scope 2 emissions for purchased electricity due to the increase in the grid emissions factor. Please refer to previous line items for further detail.

C1.28 Renewable Electricity Generated and Exported

Reported as -4,372 tCO2e for AR24, increasing slightly from -4,122 tCO2e for AR23.

Electricity that is generated on site but not used on site is exported to the grid where suitable connections are available. Where the generation meets the Renewable Energy Guarantee of Origin (REGO) criteria, this is converted to carbon credit and netted off against the overall operational carbon footprint. Both the amount of electricity exported and the grid emissions factor have increased.

C1.29 Total net operational emissions

Reported as 224,979 tCO2e for AR24, increasing from 220,999 tCO2e for AR23. As shown in Table 2 above, the AR23 number has been changed to reflect the inclusion of previously omitted data.

Net operational emissions are the total of Scopes 1, 2 and 3 (C1.27 gross operational emissions) minus the carbon credit associated with exported renewable electricity (C1.28).

Net operational emissions are reported to the nearest kiloton (225,000) tCO2e in the Performance and Prospects report – due to the inherent uncertainty in reporting these figures. The rounding formula is not included in the revised WICS template and therefore the figures held within the table will not exactly match the figures quoted in other publications containing these data.

2.2.7 Lines C1.30-C1.31 Ratio values

The carbon intensity of water and wastewater services are figures we have calculated and published since 2006-07 to provide information to customers on the carbon intensity of their service, and to enable interested organisations to calculate emissions embodied in the water they use. Intensity is expressed in tCO2e per megalitre of water or wastewater service provided.

C1.30 Carbon Intensity, water (operational emissions)

Reported as 0.08 tCO2e/Ml of treated drinking water for AR24, consistent with 0.08 tCO2e/Ml in AR23.

C1.31 Carbon Intensity, wastewater (operational emissions)

Reported as 0.17 tCO2e/Ml of wastewater for AR24, consistent with 0.17 tCO2e/Ml in AR23.

2.2.8 Lines C1.32-C1.35 Comparison to 2006-07 baseline

In AR24 we report that our net operational carbon footprint has fallen by 51% to 224,979 tCO2e compared with our 2006-07 baseline of 462,000 tCO2e. As shown in Table 2 above, the AR23 numbers for C1.34 and C1.35 have been changed due to the inclusion of previously omitted data for 2022/23.

2.2.9 Lines C1.36-C1.43 Memo lines

These are for comparison with the previous year and commentary on key differences is contained in relevant lines above. These lines can be considered duplication now that a previous year column has been added to the AR template. As shown in Table 2 above, the AR23 numbers for C1.39 and C1.40 have been changed to reflect the inclusion of previously omitted data.

2.2.10 Lines C1.44-C1.45 Scottish Water Group

These lines refer to emissions from Scottish Water Group subsidiaries that are not included in the regulated operational footprint above.

C1.44 Scottish Water Horizons net operational emissions in report year

Reported as 982 tCO2e for AR24, decreasing from 2,931 tCO2e for AR23.

Horizons emissions were significantly lower than AR23 due to a number of factors. Predominantly due to reduced total electricity consumption (as reported in **Line C3.1a**) for Scottish Water Horizons reduced by 0.275GWh (-15%) thanks to the grid consumption returning to a similar level seen in financial year 2021-22. It should be noted that financial year 2022-23 was atypical given the operational issues the Deerdykes Centre suffered that year.

C1.45 Scottish Water Business Stream net operational emissions in report year

Reported as 473tCO2e for AR24, increasing from 166 tCO2e for AR23.

This increase was due to an issue in their server room when a cable started to smoulder and caused the release of a fire suppressant gas (as happened in AR22 when emissions were reported as 417 tCO2e). Their new office does not have the same system in place, and they have moved storage to the cloud so that will not be a risk again. This shows the volatility of emissions reporting, particularly where novel gases are concerned – 1kg of HFC227a used in fire extinguisher is equivalent to 3,500kg CO2e.

2.3 Investment

During AR24,5.68GWh annual equivalent energy efficiency was delivered in wastewater through adoption of lower energy equipment and by the Exemplar Wastewater Treatment (further detail is contained in section 4.3, investment related to table C3 – Energy).

2.4 Data

2.4.1 Data sources and confidence grades

There are two main types of data involved in calculating the operational carbon footprint – consumption data from Scottish Water and emission conversion factors from the CAW. There are inherent uncertainties in both, that must be considered in assigning confidence grades. Consumption data is gathered from teams across the business from a variety of sources including meter readings, invoices, internal and regulatory reporting. Much of this is held in corporate systems and input follows an auditable process that is set out within Scottish Water's management system so can be assigned a high confidence grade. For example, electricity consumption (which is the largest single contributor to our footprint – 57%) is taken from verified meter readings, and fleet fuel usage is based on purchase information from vehicle fuel cards.

Some consumption data is not available in the correct units to allow a direct conversion into associated emissions and so some estimation is involved. For example, on site fuel consumption and travel on public transport are gathered in £ sterling. However, in order to be entered into the CAW, these need to be converted into litres of fuel and kilometres travelled respectively based on Scottish Water reference sites (on site fuel use), Department for Transport information etc., such entries will therefore be assigned a lower confidence grade.

Emission factors in the CAW are updated annually in line with latest UK government's BEIS carbon conversion factors, boundaries, guidance and methods. The main uncertainty recognised by the water industry is with regards to process emissions from wastewater and sludge treatment. Emissions are based on fixed factors applied to the population equivalent served and tonnes sludge treated. This does not take into account the varying nitrogen load of sewage entering the works, or the method of treatment or operation of the works. The water industry in the UK is collectively reviewing its methods around this and we expect the methodology to change in the next few years. This is reflected in the assigned confidence grade – i.e. we are confident in the figure we are reporting but expect this will change when the methodology changes.

Going forward, due to the greening of the grid, we expect electricity to make up a smaller proportion of our carbon footprint. As components become more or less significant, the confidence grade of our overall footprint may change.

2.4.2 Data improvement programmes

Annually, the operational carbon footprint of the regulated business is verified externally in line with ISO 14064-1 and informs continual improvement actions.

We are working with the wider water sector and through on-site monitoring programmes to better understand our process emissions and how they may be accounted for in the future.

The water industry in the UK works collaboratively each year to review and improve the CAW, including footprint boundaries, emissions factors and methods of calculation.

2.4.3 Assumptions used for forecast data

The C1 Table does not include forecasts.

3 Table C2 – Investment emissions

3.1 Overview

The following section explains Scottish Water's approach to investment carbon, detailing the progress we have made to date, and sets out the data improvement we have put in place during the year. Carbon is an emerging area, and it is challenging to develop approaches where there is currently little or no guidance and no historic knowledge. Some of these challenges are set out in the section 3.5 Future Data improvement programmes.

We have continued to consolidate our tools and to use them throughout the project lifecycle. These tools are now deployed across the capital programme. Some of our key successes in the year have been:

- The implementation and operation of the carbon dashboard used for managerial reporting of carbon within CILT, it is expected that the dashboard will be used to complete these Annual Return tables in 2024/25.
- Non Complex Service Delivery (NSCD) app producing carbon values for small value projects with a combined value of approximately £150m and feeding the results directly into P3M.
- The introduction of a carbon target for all investment projects.

During 2024-25 Scottish Water will seek certification to PAS2080: Reducing Carbon in Infrastructure accreditation which is a quality assurance standard that provides a framework for managing and reducing carbon.

3.1.1 Carbon Tools and Data Improvements

Scottish Water is using the same tools as described in the AR23 commentary to estimate investment carbon and during the year Scottish Water has continued to develop these tools to improve their accuracy and performance. These improvements are described below:

Capital Carbon Assessment Tool (CCAT) – During the year we updated the operational data within CCAT to be aligned with the Operational Carbon Calculator. This is part of a wider program to ensure that carbon data is consistent across all tools within Scottish Water.

The Operational Carbon Calculator is used to estimate future operational carbon emissions for interventions. It is considered the master feed to other tools using similar operational data such as the NPCC, and Embodied carbon calculator.

Additional data relating to different material types was added to CCAT to align the information with the embodied carbon calculator.

The next upgrade will be to feed CCAT with emission data directly from the Benchmarking Estimating System (BES) so that these tools are better aligned and provide closer results. This will be carried out after the emissions data in BES is improved, which is forecast for 2024/25 delivery.

Benchmark Estimating System (BES) – this is Scottish Water's project investment costing tool. It uses a "bill of quantities" approach to produce a cost and a carbon value for a project.

During the year BES data was improved through the use of new MEICA data and a comprehensive review of the existing data which identified areas for data improvement. These changes resulted in more than 20,000 data fields being updated. This has the benefit of increasing the number of defined values in BES and reducing the need for infill values.

The intensity factor used to infill items without direct carbon values was updated to reflect the impact of inflation.

A quality assurance system has been developed during the year which allows projects costed within BES to complete a quality audit before the carbon data is used by the project teams. The QA process looks at the projects carbon values and data completeness, highlighting areas of concern for the Estimator to review. This process has not only improved the quality of the outputs from BES but is used by Scottish Water to identify the next areas of data that require attention.

We are currently working with the developer of BES to specify and purchase an updated carbon module for BES. This will allow Scottish Water to better and more accurately understand and control our investment carbon for projects. We had hoped that this tool would be operational by summer (2024) however the development cycle has been frustratingly slow, and we are yet to agree a specification with our developer. We are investigating other options to provide the functionality required outside of BES.

Non-complex Service Delivery Application (NCSD) – This tool has been fully operational during the year with approximately £150m of expenditure passing through it. As with other tools where a detailed carbon value is not available an intensity value is used and during the year this was updated to adjust for the impact of inflation. NCSD data feeds directly into P3M.

High Level Pricing Tool (HLPT) – This tool is used for pricing and to provide carbon estimates for optioneering for projects, before detailed design information is available. This tool uses a mix of carbon curves driven by asset sizes and intensity infill values based on the estimated cost of each item. During the year, carbon curves were developed and added to the tool to improve the accuracy of the estimates. The intensity value used was adjusted in line with inflation.

Storing Investment Carbon Data – Data is stored within the P3M/Unifier tool as described in AR23. In addition to the functionality described in AR23 we have added the ability for project managers to provide a current view of the carbon assessment of a project other than at project gateways, a carbon version of the Latest Best Estimate of outturn cost (LBE).

Appraisal tools – The Net Present Cost and Carbon calculator (NPCC) is still our main appraisal tool, where cost and carbon are analysed together. The operational data was updated during the year to align with the Operational Carbon Calculator. During the current financial year, the tool will receive a refresh which will improve the operation carbon functionality.

Reporting – The Carbon Dashboard - a Power BI report - was operational during the year and provides detailed investment carbon reporting for Scottish Water and our delivery partners. The data is linked to the P3M system which holds the relevant carbon data at each delivery milestone (Gate) and the latest carbon estimate. There are a number of sub-reports within the report ranging from carbon values through to compliance with the process. Elements of this tool are available for our delivery partners to view. The data in these reports is produced automatically from P3M on a monthly basis.

We plan to use the information from this tool to complete this section of AR25.

Scottish Water sets an intensity target which is applied to all projects. The target is

published on our Carbon Dashboard and is visible to all Scottish Water staff and our

delivery vehicles, the target is reduced annually to follow the intensity glidepath towards net zero, the adjustment also accounts for the impact of inflation on the intensity value. The 2023/24 carbon target has been reduced to 125t CO2e per £m, is a reduction from the 2022/23 figure of 150t CO2e per £m.

3.2 Auditing

The C2 tables were audited externally by Binnies in AR24.

3.3 Performance Trends

3.3.1 Lines C2.1-C2.2 Carbon intensity of investment, low and high estimates

We continue to report a broad range of carbon intensity due to the relatively small data set, maturity of the process and complex data interactions leading to a degree of uncertainty.

Adjusting for inflation in AR23 we reported a range of 175-262 tCO2e per £m, these figures are now calculated as 165-248 tCO2e per £m for the period 2023/24.

We expect to use the data from the Carbon Dashboard report in 2024/25. This has been running as a shadow measure during the year, allowing us to build confidence in the data produced.

Line C2.3 Capital expenditure (figure brought forwards from capital tables)

The total figure provided is taken from **Line G1.83**. The calculation is detailed below in Table 7:

Table 7: Capital expenditure breakdown

		Water (£m)	**Waste (£m)**	**Total (£m)**
G1.66	Water	530.118		530.118
G1.67	Wastewater (combined)		435.805	435.805
	Percentage	55%	45%	
G1.70	General	32.283	26.540	58.823
G1.81	Water Reasonable Cost Contributions	8.071		8.071
G1.82	Wastewater Reasonable Cost Contributions		25.035	25.035
G1.83	**Total Investment including Reasonable Cost Contributions**	570.473	487.380	1057.853

3.3.2 Lines C2.4-C2.5 Carbon emissions from the capital investment programme

This is the estimated range for the total carbon footprint resulting from Investment activities and is calculated from intensity multiplied by the cost of the capital programme.

3.3.3 Lines C2.6-C2.9 Quadrant intensity figures

We are not able to update quadrant values due to the immaturity of our reporting system. The figures in AR24 reflect the baseline 2020/21 quadrant values adjusted for inflation as per **Line C2.1**. We will produce quadrant values in AR25 using the carbon reporting tools described above.

For consistency, Lines C2.1 C2.2 C2.6 C2.7 C2.8 C2.9 all follow the same calculation methodology. The original carbon intensity figures were calculated in 2020/21 and are used as the base year. Each annual return update adjusts for the impact of inflation. The inflation factors are the cost inflation figures line G10.2.

Line C2.10 Embodied carbon in overall asset base - low estimate

The figure is the carbon Modern Equivalent Asset Valuation (MEAV) from AR23 plus the 'low' carbon emissions from the Investment programme for AR24. If Scottish Water were to rebuild the full asset stock today, the resultant carbon would be approximately this value. This methodology has been retrospectively applied to AR23, resulting in a change in these figures.

Line C2.11 Embodied carbon in overall asset base - high estimate

This is an estimate of the total carbon produced by Scottish Water and its predecessors to build its asset stock over time. We have taken the 'high' carbon emissions from AR23 and added the high carbon emissions from the Investment programme for AR24. This methodology has been retrospectively applied to AR23, resulting in a change in these figures.

3.4 Data

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3.4.1 Data sources and confidence grades

Lines C2.1-C2.2 Carbon intensity of investment

Data based on an original assumption of a 200-300 tCO2e per £m range was set out in the net zero route map. We have applied the impact of inflation to these figures.

The embodied carbon in the overall asset base is expressed as a range reflecting the early maturity of work to establish the emissions intensity of investment, the relatively small data set, and the complex data interactions. Confidence in this data is low, although it should be

noted that this range is felt to reflect Scottish Water's current carbon performance. A confidence grade of C5 has been assigned.

Line C2.3 Capital Expenditure

Data supplied by capital investment team; data grade applied (A1) is the same as **Line G1.83**.

Lines C2.4-C2.5 Carbon emissions from the capital investment programme

This is a calculation based on the data above, the confidence grade (C5) reflects the confidence in **Line C2.1-C2.2**.

Lines C2.6-C2.9 Emissions by water/waste/infra/non-infra

This data is based on a limited dataset from multiple data sources. There is known to be high volatility in the data, due to the data feeding this data. Once we start reporting from the capital carbon dashboard, we will move to reporting from a single data source and the data confidence in this area will improve. Current confidence rating D6.

Lines C2.10-C2.11 Embodied carbon in overall asset base

Data from multiple data sources using the data from **Lines C2.6-C2.9** as the base. **Line C2.11** has additional extrapolation. Current confidence rating D5/D6.

3.5 Future Data improvement programmes

3.5.1 Lines C2.1-C2.2 Carbon intensity of investment

During AR23 we stated that Scottish Water would move to reporting directly from the capital carbon dashboard. Whilst we have the carbon dashboard in place and it has been operational during the year, we still lack confidence in the results as our data improvement plan has run slower than expected. Since January 2024 we have initiated a number of data improvement exercises as described in the BES section above. However these improvements are only just starting to feed through into the data.

We currently feel that the intensity figures reported within the carbon dashboard are lower than expected, and we are seeing large variations in intensity values for similar projects. There are several issues which are causing this:

1. The level of infill data from BES is still too high, for which there are two causes:
    - the number of items without actual carbon values which should have been rectified by the data improvement programme.
    - the operation of the BES tool, where it is possible for the user to mis-input the data in such a way that looks correct to the user but results in a BES tool not identifying an actual carbon value and using an infill intensity value. The QA process that has been put in place will start to tackle some of these systemic issues.
2. Procedural issues – projects using values developed in CCAT that should use

a BES value. We have been phasing out the use of CCAT and moving to BES or NCSD. There is an exception to this for some of our regional contractors who are responsible for lower value projects and do not have access to BES. However, we are still seeing a number of DV1 projects using CCAT values rather than the specified BES carbon values. There is currently no barrier within P3M to prevent the input of data from an incorrect source and we continue to educate our project managers on the correct procedure.

3. NCSD – since the tool became operational too much data is calculated using infill values i.e. approximately 90% uses infill values. The expectation was around 20% infill would be used. Work is underway to understand why so many projects are using infill values and to develop an approach to reduce this number.

It should be noted that the reported intensity is backward-looking and reports either gate 90 or 110 for each project. The consequence of this is a lag between data improvements being applied and the results being seen in the reported data.

3.5.2 Assumptions used for forecast data

The C2 Table does not include forecasts.

4 Table C3 - Energy

4.1 Overview

Table C3 provides information on electricity consumption, generation and export; and its associated financial information as well as other fossil fuels consumption. Scottish Water's operational electricity consumption comes from different sources. The predominant source is the grid, but we also use electricity generated by our own schemes and a small proportion comes from a Combined Heat and Power (CHP) process located at a farm adjacent to one of our treatment works and connected to it via a private wire.

Queries were raised during assurance audit that led to Scottish Water re-assessing one of the input numbers to the 2022-23 carbon footprint. It was identified that cell referencing errors had been made, leading to the omission of some data. This has now been addressed and AR24 presents the AR23 numbers adjusted to correct the mistake. An improvement in data processing has been identified to avoid this error recurring, and we will draw to the attention of our external auditor that this error was overlooked during their audit.

The overall effect, alongside the updated values for **Lines C0.2, C0.4** and **C0.9** previously stated on Page 4, is that the 2022/23 carbon footprint was underreported by 1.92% (4,159 tCO2e). See changes relating specifically to C3 Lines in Table 8 below:

Table 8: List of corrected energy consumption and carbon footprint values (C3 tables)

Line Reference	Previously Reported 2022/23 Value (GWh)	Corrected 2022/23 Value (GWh)
C3.1a - PFIs	112.290	125.194
C3.1a - Regulated Carbon Footprint Total	605.659	618.562

C3.1b PFIs	90.797	103.700
C3.1b - Regulated Carbon Footprint Total	549.269	562.172

4.2 Performance Trends

Electricity consumption, generation, and exports.

4.2.1 Lines C3.1a-C3.1c Electricity Consumption

Scottish Water Regulated - Total consumption for regulated operations was 503.070GWh (from the grid and self-supplied) for AR24 showing an increase of 17.971GWh compared to AR23.

Note that **Lines 3.1a, 3.1b and 3.1c** refer only to operational consumption of electricity, from each of the sources stated.

The predominant source of electricity consumed is the grid (464.353GWh) which was 9.668GWh higher than for AR23. The consumption of former Grampian PFI wastewater assets for a full financial year (compared to just a partial year before) explains 6.391GWh of the variance whereas 3.253GWh were an increase in water operations (primarily the pumping of raw and treated water).

The electricity we self-supply is mainly renewable with the exception of Stirling and Dalmarnock CHPs (included in **Line C3.1c**). The higher volume supplied via **Line C3.1c** (+3.115GWh) was due to Dalmarnock CHP whereas the variance shown on **Line C3.2b** (+5.187GWh) was the result of accounting for the Grampian PFI (Nigg WwTW) CHP output under the Regulated business for the full financial year (as opposed to just six months the year before when it was under PFI).

PFIs (Excluding those in Scottish Water Group) - Total electricity consumption for PFIs saw a small decrease since AR23 - 122.160GWh in AR24 compared to 125.194 GWh in AR23.

Scottish Water Grampian - The reduction in the generation figures is due to the conclusion of the PFI contract in October 2022 when the assets came back into the Scottish Water Regulated business and are reported under the Scottish Water Regulated section.

Scottish Water Horizons - Total electricity consumption (C3.1a) for Scottish Water Horizons reduced by 0.275GWh (-15%) thanks to the grid consumption returning to a similar level seen in financial year 2021-22. It should be noted that financial year 2022-23 was atypical given the operational issues the Deerdykes Centre suffered that year.

4.2.2 Lines C3.2a-C3.2c On-site renewable electricity generated, used and exported

C3.2a – On site renewable electricity generated

This is presented disaggregated by the owners of the schemes: Scottish Water Regulated, PFIs and Scottish Water Horizons. The PFI schemes benefit only their own assets whereas

the Horizons schemes are mostly embedded in Scottish Water regulated assets, contributing to displace grid consumption. Hence **Line C3.2b** - On-site renewable electricity used reflects the usage of renewable power by the Scottish Water Regulated assets regardless of ownership of the renewable scheme.

Scottish Water Regulated - The volume of renewable electricity self-supplied (**Line C3.2b**) for the use of regulated assets showed a variance of +5.187GWh. This was mainly the result of reporting the output of the Nigg WwTW CHP under the regulated business for a full financial year (as opposed to just six months the year before when it was still part of the PFI group). Another factor that contributed to the variance was an increase in new renewable assets generation (PVs).

As pointed out in previous years, the volume self-supplied does not match the difference between total generation (**Line C3.2a**) minus exports (**Line C3.2c**) for two reasons:

- The regulated sites also benefit from the volume supplied by renewable schemes owned by Scottish Water Horizons when these are located on regulated operational sites
- The hydro turbine at Daer WTW where, due to export connection constraints, 0.917GWh of the generation had to be diverted into heat dumps.

PFIs (excluding those in Scottish Water Group) - Overall renewable generation from biogas CHPs at PFIs has fallen from 23.728GWh in AR23 to 20.047 GWh in AR24

Scottish Water Grampian - The reduction in the generation figures is due to the conclusion of the PFI contract in October 2022 when the assets returned to Scottish Water Regulated business ownership and are now reported under the Scottish Water Regulated section.

Scottish Water Horizons - The total volume generated grew by 3.882GWh as a result of new PV schemes commissioned on Scottish Water Regulated sites (+1.980GWh) and a better performance of the Deerdykes CHP (which had operational issues the previous year).

C3.3 Renewable Electricity Capacity at end of year

Line C3.3 represents how much the existing renewable schemes could generate in a year as per the design output. It is not intended to express the capacity of the assets (usually expressed in MW) or the actual output in a given year, but rather how much the scheme is expected to generate in GWh based on its design and assumptions on operational conditions.

The source of this information varies. For older schemes it is based on historical output. For newer schemes it is based on the Acceptance Certificate (an internal document that shows the expected benefits of the project when delivered). For schemes owned by PFIs or third party-hosted on Scottish Water land, we rely on the information provided by these companies.

There is a net increase of 6.065GWh mainly from thirteen new renewable schemes: 12 PVs and one hydro turbine (the first one installed in a Scottish Water wastewater treatment works). These projects were delivered by Scottish Water Horizons and will mainly benefit Scottish Water regulated assets (one of them was installed at a PFI site (Newbridge WWTW PFI). Most of these were commissioned towards the end of the financial year so we will see the benefits of reducing reliance on the grid in the coming months.

There were other renewable minor schemes delivered by SW that also contributed to this; although modestly: Ardrishaig, Marchmount House (for which we don't have data available on the installed capacity), Bonnycraig and Shieldhall Workshops.

C3.4 Percentage of 2030 Renewable Target Reached

Line C3.4 is a calculated figure that tracks progress against our 1320GWh target. It compares **Line C3.3** in GWh to the 1320GWh objective.

4.2.3 Lines C3.5-C3.9 Renewable technologies

This section shows the volume of renewable electricity generated, split by technology and ownership.

Scottish Water Regulated - The largest contribution (68%) to on-site renewable generation in **Lines C3.5-C3.9** comes from hydro turbines (**Line C3.5**) and the total generation across **Lines C3.5-C3.9** showed a positive variance of 4.061GWh in AR24. This is predominantly because the generation from bioresources (**Line C3.8**) increased by 4.459GWh as a result of reporting the Nigg WwTW CHP for the full year (the year before it was reported half of the year under PFI).

There was little variance in the other technologies.

PFIs (excluding those in Scottish Water Group) - Overall renewable generation from biogas CHPs at PFIs has fallen from 23.728GWh in AR23 to 20.047 GWh in AR24

Scottish Water Grampian - The total generation shows a decrease because of the return of the Nigg WwTW CHP to the Scottish Water Regulated business.

Scottish Water Horizons – The two main contributors to the total generation are the Deerdykes CHP (which benefits the Scottish Water Horizons Deerdykes facility) and the solar PV schemes (which are embedded into regulated assets benefiting them). The increase in total generation (3.882GWh) came from a better performance of Deerdykes CHP (bioresource) and from the new PV schemes commissioned.

C3.10 Diesel consumption by Scottish Water fleet (transport by Scottish Water owned and leased fleet i.e. scope 1)

Note that this line represents diesel consumption from owned and leased fleet according to the boundaries outlined in the table and as below. ‘Scottish Water fleet’ is only relevant for the Scottish Water regulated number.

Scottish Water Regulated - Reported as 4,561,571 litres diesel for AR24, increasing from 4,382,520 litres diesel for AR23. This includes diesel used for by Scottish Water fleet (Scottish Water owned and leased vehicles i.e. scope 1).

The increase is due to travelling more miles to maintain service in AR24. We added a further 70 Electric Vehicles (EVs) to our fleet in AR24, which has reduced diesel consumption.

PFIs (Excluding those in Scottish Water Group) - Reported as 250,647 litres diesel for AR24 compared to 260,527 litres diesel for AR23.

This modest drop likely reflects normal year on year variation. As this is only the second year we have requested and reported this information we do not have historic trends.

Scottish Water Grampian - SW Grampian PFI concessions concluded in October 2022. Full year consumption and generation for AR24 is therefore included within Scottish Water regulated category.

Scottish Water Horizons - Reported as 5,974.590 litres diesel for AR24, down from 6,233.000 litres diesel for AR23.

C3.11 Other fuels (non-transport)

This includes fuels not used for transport, including natural gas for heating and on-site fuel use in generators. This is the equivalent of Line C1.1 but expressed in GWh rather than tCO2e.

Scottish Water Regulated - Scottish Water Regulated - Reported as 44.328GWh for AR24, increasing from 33.475GWh for AR23.

This also now includes the full year of fuels used at two large ex-PFI sites (Nigg and Allanfearn), which were split between Scottish Water Regulated and PFI operation in AR23. In terms of GWh the major change comes from biogas consumption at Nigg, with an extra 15GWh being included in this category that wasn't in AR23. This 15GWh represents the six months of biogas consumption within SW Regulated for AR24 that would have been reported in a different column if Nigg were still a PFI.

Other changes reflect changes in on site fuel consumption as stated in **Line C1.1**.

PFIs (Excluding those in Scottish Water Group) -PFIs (Excluding those in Scottish Water Group) - Reported as 193.073 GWh for AR24, decreasing from 216.155GWh for AR23, due to reduction in on-site fuel consumption of natural gas and biogas, within expected year to year variation. 1.390 GWh of this reduction is due to consumption at ex-PFI site Allanfearn that was included in this category last year up to May, before reverting to Scottish Water control and being included in Scottish Water Regulated category for the remainder of AR23 and the full year for AR24.

Scottish Water Grampian - SW Grampian PFI concessions concluded in October 2022. Full year consumption and generation for AR24 is therefore included within Scottish Water regulated category.

Scottish Water Horizons - Reported as 31.244 GWh in AR24, largely consistent with 31.238GWh for AR23. This difference is within expected year to year variation

4.2.4 Lines C3.12-14 Income received from energy exports and decarbonisation payments

All values presented have been extracted from our general ledger which captures costs at an account level. With the exception of Scottish Water Horizons, **Line C3.12** is derived from amounts recorded as exported to grid. **Line C3.13** is derived from amounts recorded as Renewable Obligation Certificates (ROC) and Feed in Tariffs (FIT) income.

Scottish Water Horizons, **Line C3.12** has been populated using income recorded as sale of electricity and does not include the sale of electricity to the core business as this is included in **Line 3.17** detailed below.

Income from renewable electricity exported (**Line C3.12**) in Scottish Water regulated increased by £0.714m or 27% to £3.360m (2023: £2.646m). This has been driven partly from an increase in electricity generated and exported (as reported in **Lines C3.21 - C3.23**) with the main driver being price increases. Although prices have fallen during 2023/24 when compared to 2022/23, Scottish Water secured export prices for 2023/24 when prices were still relatively high.

Income from ROC and FITs (**Line 3.13**) in Scottish Water regulated increased by £0.821m or 19% to £5.213m (2023: £4.392m). The main driver for increases has been the price increase

of 12% when compared to prior year (2022/23 £49.71 per MWh) and FIT increases in line with inflation.

Income from renewable electricity exported (**Line 3.12**) in Scottish Water Horizons increased by £1.175m or 71% to £2.832m (2023: £1.657m). The increase in the year has been mainly driven by an increased export price at Deerdykes as well as a higher volume of generation and export at Deerdykes compared to the prior year. Generation at Deerdykes in 2022/23 was impacted by the engine being offline for part of the year for maintenance/replacement. This was partially offset by reduced export volumes at the Stirling Energy Centre.

Income from ROC and FITs within SW Grampian decreased by £0.234m or 94% to £0.016m (2023: £0.250m) reflecting the transfer of generation and income to Scottish Water regulated following the absorption of the North-East Scotland PFI scheme from 1 October 2022.

Electricity costs, recharges and hosting and export income have been extracted from our general ledger which captures costs at an account level. This data for PFIs is not available to us due to its commercially sensitive nature.

C3.15 Income from Hosting Renewable Electricity

There was an increase in the income received from our hosted renewables of c.£0.6m which came mainly from the two of the wind farms operating on our estate.

4.2.5 Lines C3.16-20 Electricity expenditure

All values presented have been extracted from our general ledger which captures costs at an account level. **Line 3.16** is derived from charges from Optima and also includes Power Purchase Agreements charges and other non-optima charges. The value reported for gross expenditure is net of offset benefits.

Recharges of electricity expenditure represents the sale of renewable electricity from Scottish Water Horizons to the core business. This is also reported within the N Tables.

Total electricity expenditure (**Line C3.16**) for Scottish Water regulated has increased £23.399m or 37% to £86.497m (2022/23: £63.098m). The increase in the year has been mainly driven by price increases which equate to approximately £21.4m with the balance of the increase due to increased consumption. In 2023/24, 53% of electricity costs were exposed to market prices. Before the start of the 2022/23 financial year Scottish Water forward purchased its electricity requirements. Given the electricity market conditions prior to the 2023/24 financial year, which were heavily influenced by the war in Ukraine, Scottish Water changed its electricity procurement strategy by moving to a combination of month ahead and day ahead purchases. As a consequence, electricity costs were significantly lower than would have been the case if they had been forward purchased at the start of the year.

Recharges of electricity expenditure in Scottish Water regulated have increased £0.902m or 44% to £2.938m (2023: £2.036m). The increase reflects the full year benefit from the Dalmarnock PPA which came online from September 2022 (c. £555k), and new PV assets coming online in the 2023/24 year (c. £337k). We have also seen an inflationary increase in price at other PPA's. At a group level the offset is shown on **Line C3.17** in the Scottish Water Horizons column. The majority of the PPAs mainly relate to Scottish Water Horizons PV assets which are located on Scottish Water regulated sites.

Total electricity expenditure in SW Grampian decreased by £0.649m or 100% to nil (2023: £0.649m) reflecting the transfer of expenditure to Scottish Water regulated following the absorption of the North-East Scotland PFI scheme into the regulated activities of Scottish Water on 1 October 2022.

During the year there has been no movement of income between companies in the Scottish Water group (**Line C3.19**).

Electricity costs, recharges and hosting and export income have been extracted from our general ledger which captures costs at an account level. This data for PFIs is not available to us due to its commercially sensitive nature.

4.2.6 Memo Lines C3.21-23

These are for comparison with the previous year and commentary on key differences is contained in relevant lines above. These lines can be considered duplication now that a previous year column has been added to the data tables.

4.3 Investment

To reduce emissions from electricity, Scottish Water is investing to improve energy efficiency and to increase renewable generation on its assets. Under MA027 - Energy efficiency, Scottish Water expect to replace electrical equipment with more modern energy efficient equipment including pump variable speed drives, blowers, aerators, lighting and will continue to introduce real time control technology. The criteria used is as follows:

- Energy efficiency projects which have positive NPV should be progressed in both water and wastewater service areas
- Positive NPV energy efficiency projects will be prioritised on the basis of quickest payback period first
- Projects with a payback period of <10 years can be progressed within the Investment Planning Scenario allocation
- Projects with payback periods of >10 years but which generate a return in the life of the asset (typically 20 years) can be progressed subject to additional governance checks

Under MA101 – Renewable Energy Enhancement, Scottish Water has adopted a strategic approach with a hierarchy of options and over the strategic review period 2021-2027 is selecting options for investment at each site. Projects include:

- Using renewables to displace power consumed from the grid
- Exploring the potential for including renewable generation in the scope of creating new assets if shown to be the lowest whole life cost
- Using renewables to displace power consumed from the grid and excess power generated stored using battery technology and consumed on site
- Purchasing renewable power via the grid generated by others on Scottish Water land along with Carbon Credits (e.g. hosted wind farms)
- Using renewables to displace onsite power use and export to private wire
- Using renewables to displace onsite power use and export to grid
- Using renewables, no onsite consumption and export to the grid/private wire

- Purchase renewable power generated by others on non-Scottish Water land via private wire

In addition to investment of Tier 2 funds on renewables, Scottish Water Horizons are making investments on renewables. The renewables investment hierarchy provides guidance on what investment should be Tier 2 or Horizons funded.

4.4 Data

The data for electricity consumption, generation and export comes from meter recordings and invoices from our electricity supplier.

The vast majority of our electricity import supplies, and renewable assets are fitted with smart meters that record and transmit data automatically. We have access to this data via a portal run by Scottish Power Dataserve (our meter operator).

The consumption and export data are also sent directly by Dataserve to our electricity supplier nPower for billing purposes and is subject to industry standard validation processes.

A small proportion of our import supplies are billed on estimated data when actuals are not available due to communication issues or lack of a manual meter reading and the estimation is done by our supplier following industry rules.

The meter data and the supplier's invoices feed our energy management system Optima from where we can obtain reports. Hence the degree of confidence in this data, as per WICS definitions, would be A2 (to allow for estimates).

The data relating to the "installed capacity at the end of year" comes from a mix of sources: historical records, internal documents and spreadsheets and information received from third parties; therefore, it has been graded B3.

The PFI consumption and generation data is gathered directly from each PFI company.

Electricity costs, recharges and hosting and export income have been extracted from our general ledger which captures costs at an account level. This data for PFIs is not available to us due to its commercially sensitive nature.

The data presented in Table C3 was audited by Binnies, with the exception of **Lines C.3.10 and C3.11** which were audited by Achilles. Achilles also audited the source data behind **Lines C3.1a to C3.9**.

4.4.1 Data improvement programmes

We continue to identify electricity supplies with analogue meters so that these can be replaced with smart meters capable of transmitting data automatically avoiding reliance on manual readings or estimates.

4.4.2 Assumptions used for forecast data

The C3 Table does not include forecasts.

5 Table C4 – Land and carbon inventory

5.1 Overview

Land is a key part of the Scottish Water asset base in supporting Net Zero. We need to understand, manage and enhance our landholdings as an asset for carbon sequestration and greenhouse gas emissions reductions; and to report credible data on the carbon balance of our landholdings.

In AR22, Scottish Water reported the initial inventory of landholdings in terms of the hectarage of key land classes. We reported the carbon inventory in AR23, reflecting the conclusion of initial baseline work and key learning from extensive peatland studies that year. The AR24 carbon inventory has been updated following the same approach.

The Scottish Water greenhouse gas baseline inventory for landholdings, undertaken by the James Hutton Institute (JHI), was based on spatially explicit national land cover data set; robust and referenced modelling approaches; and published emission factors. The methodology aligns with global and national principles for greenhouse gas accounting, and was strengthened by engagement with external stakeholders, including the Scottish Government and NatureScot. The method considers land cover, soil type, peatland condition, climate, topography, and land management.

The inventory adopts a “top-down” approach using national data sets. Thus, it reports carbon position as a range. This reflects the uncertainty around actual site condition when compared with the possible range of conditions in the national data sets. For the purposes of the Annual Return, a mid-range figure is reported in the data tables and any adjustments to the numbers (currently only peatland emissions) are made to that mid-point.

Sources of uncertainty include factors such as the actual extent and condition of peatland, the age and species composition of woodland, and the management practices on moorland and grassland. The full inventory is intended to be reproduced every three years to reflect land use change, improved site intelligence and the resultant impact on carbon performances. We have begun working with external experts (JHI) to update our inventory during 2024/25 and will report this in AR25.

Scottish Water has been focusing on site level data improvement of peatland and woodland, to decrease uncertainty and help target activities for land improvement. Improvements to peatland data are quite straightforward because emissions factors are based only on the condition of the peat. We have therefore been able to report data improvements from on-the-ground condition surveys as reduced inventory emissions, following an approach agreed with JHI. Whilst we have improved data for much of our woodland, sequestration rates are far more complex to calculate. This will therefore be reflected in the next three-yearly inventory update rather than as an annual interim update.

The baseline inventory suggested that potentially significant carbon capture in woodland is exceeded by losses from peatland (using the mid-point of ranges). The on-the-ground condition surveys, as an overall picture, found there to be less peat and in better condition that the national datasets suggested, leading to a lower estimate of emissions. This leads, in AR24, to a modest net negative position for our landholdings (using the mid-point of ranges). This will be fully reviewed and updated in the three-yearly re-assessment of our inventory, employing the methods agreed with JHI and stakeholders, new data and intelligence gathered since our baseline, and reported in AR25. Work for this has now commenced.

The full inventory update to the baseline will need to identify all changes from the original baseline, for example:

- Changes because of improved intelligence (e.g. better land classification)
- Changes in land cover (e.g. grassland to woodland)
- Improvements (e.g. peatland restoration)
- Losses (e.g. wildfires)

It is important to reflect this because, unlike market-based schemes such as the Woodland Carbon Code where the risk of loss is built into the cost of the credit, the impact of the loss of carbon assets will need to be accounted for in Scottish Water's land inventory. If we lose carbon storing assets through events such as storm damage to trees or harvesting, this needs to be reflected in the carbon performance of our land.

As well as the baseline study undertaken by JHI, a separate form of land assessment exercise was undertaken by Natural Capital Research Ltd to establish a baseline of biodiversity and natural capital across our landholdings. The resultant data were used to report our first set of Natural Capital Accounts in our Biodiversity Report 2023. This is published on our website.

5.2 Performance Trends

Lines C4.1 to C4.27 are displayed as numbers with zero decimal places. Please see file "AR23 Template Change Log Final.xlsx", reference AR23-218. This is designed to create consistency, and to make the displayed values appropriate for the units specified. As we have only three years of data, the methodology for estimating carbon in this area is still evolving. The movement and measurement of carbon within landholdings is a slow natural process and trends are not yet visible. We are likely to require at least ten years of data before a meaningful trend begins to emerge.

Line C4.1 Total area of peatland

The reported value of 4,614 ha is based on the inventory assessment of our major landholdings, mostly those under agricultural tenancies or grazing lets, and excludes small areas of land associated with operational sites and assets, which were not part of our initial carbon assessment. As explained above the full baseline re-assessment will be repeated by external experts on a three-yearly basis.

Following on from surveys in the south of the catchment the previous year, detailed peatland survey work was completed within the remainder of Loch Katrine during 2023-24. Once again, significant differences were identified in the field compared with the national dataset/inventory. Extensive field sampling identified that for the remainder of Katrine the peatland is generally in better condition and is less extensive than expected.

We applied the same methodology as that used in AR23, where land formerly thought to be peat has been classed as “near natural” peatland. This classification means we conservatively assume that this land is losing small amounts of greenhouse gases whilst in reality, some of the land may be capturing carbon, depending on land cover. This has still to be established.

As an alternative land type has not yet been assigned to the areas found not to be peatland the number of hectares is unchanged from the number reported in AR23, although the emissions figure has been adjusted in **Line C4.6**. Further habitat surveys, to help us understand how best to categorise land no longer considered peatland, are required. However, our focus has remained on identifying peatland in poor condition to facilitate the development of restoration projects. It is envisaged that these areas of unknown land cover will be revised as part of the three-yearly inventory update.

Surveys in other catchments to establish peat condition are ongoing.

Line C4.2 Total area of woodland

The reported value of 3,808 ha is based on our major landholdings, mostly those under agricultural tenancies or grazing lets, and excludes small areas of land associated with operational sites and assets, which were not part of our initial carbon assessment.

A key principle of the method for assessing land and the impact of land use change is that we will not re-assign land to woodland until five years post-creation. This aligns with the Woodland Carbon Code and allows sufficient time to enable the planting to become established and for us to confidently report the new land cover type.

The baseline assessment will be repeated on a three-yearly basis and at this stage the number is unchanged from the number reported in AR23

Line C4.3 Total area of grassland

The reported value of 5,898 ha is based on our major landholdings, mostly those under agricultural tenancies or grazing lets, and excludes those small areas of land associated with, for example, operational sites and assets, which were not part of our initial carbon assessment.

Some areas of grassland have been planted as woodland in AR23 and AR24 but, as noted above, we will wait five years before representing this as an established land use change. Therefore, the number is unchanged from the number reported in AR23. This will be adjusted for each area planted once we are confident the new woodland has been established.

Line C4.4 Total area of other land cover types

The reported value of 8,899 ha is based on major landholdings, mostly those under agricultural tenancies or grazing lets, and excludes those small areas of land associated with, for example, operational sites and assets, which were not part of our initial carbon assessment.

This category includes Montane and Moorland areas, as well as Scottish Water’s only arable farm. Aside from updating a policy position to prevent Muirburn (the burning of the heath and stubble on a moor) on tenanted moorland (which will come into force at the conclusion of an existing tenancy), Scottish Water has not yet sought to proactively intervene and change land types in this category. Further study work is being scoped to help understand the steps we can take to improve the carbon status of these areas. The number of hectares is, therefore, unchanged from that reported in AR23.

Line C4.5 Total area of landholdings

The reported value of 23,219 ha is the sum of **Lines C4.1-C4.4**.

Line C4.6 CO2e emissions from peatland in year

The condition of peatland is the most important factor in determining associated emissions. JHI completed the initial baseline inventory in late 2022, using national datasets rather than specific site surveys. This suggested we are losing significant amounts of greenhouse gases from peatland in poor condition. The opening value for the inventory was 40,000 tCO2e which is the mid-point of a large range (28,000 – 52,000 tCO2e) given on pages 185-186 of the AR23 Commentary.

As a result of surveying the actual condition of peat in the remainder of the Loch Katrine catchment in 2023/24 we estimate, using Peatland Code factors but with low confidence, the mid-point has fallen to 24,956 tCO2e losses per annum. On the same basis of surveys completed in 2022/23, the number reported in AR23 was 33,317 tCO2e.

We discussed the method we used to update the inventory and the findings of our survey work with the JHI. They are supportive of the approach, but we note that this will be fully reviewed by them as part of the 3-yearly update to our land inventory, which will supersede all past assumptions. We would expect to report this in AR25.

Further data improvement will continue year on year both through peatland surveys for drinking water quality and specifically for carbon purposes.

Line C4.7 CO2e emissions from woodland in year

The inventory suggests we are capturing significant amounts of carbon in our woodland, making a strong contribution to net zero. The reported number of -39,000 tCO2e per annum is the mid-point of a large range (-24,000 to -54,000 tCO2e) set out in the inventory produced by JHI The number is unchanged because, as stated in the commentary at **Line C4.2**, newly created woodland will not be reflected in the inventory until five years after the trees have been planted.

There are several sources of uncertainty in the data that contribute to the range: tree age and species being the main unknown factors in our current dataset. We have undertaken an extensive ground-truthing exercise to collect these data. However, whereas emissions from peat are simply calculated based on condition, sequestration by woodland is a far more complex calculation with multiple factors. It is not appropriate to undertake such calculations and changes to our inventory emissions without review by experts. Therefore, the emissions number for woodland remains the same as previous years. The data from our surveys will inform the inventory update in AR25.

Line C4.8 CO2e emissions from grassland in year

The reported number of -6,250 tCO2e is the mid-point of the range (-7,800 to -4,700 tCO2e) given in the JHI report. Some areas of grassland have been planted as woodland in AR23 and AR24 but, as noted above, we will wait five years before representing this as an established land use change and reporting the associated change in emissions. Therefore, the number is unchanged from the number reported in AR23. This will be adjusted for each area planted once we are confident the new woodland has been established.

As with peatland and woodland, the confidence grade for grassland is low due to the nature of the source data. It includes both improved grassland (where there is carbon capture) and upland unimproved grazing land where carbon is being lost. It excludes the operational emissions of any land operator which are beyond the control of Scottish Water, and we will work with agricultural experts to better understand and manage these emissions in future years.

Line C4.9 CO2e emissions from other land cover types in year

The reported number of 14,450 tCO2e is the sum of other land types in the inventory prepared by JHI and is likewise the mid-point of the range given (14,000 to 14,900 tCO2e).

Line C4.10 Total CO2e emissions from landholdings in year

The reported value of -5,844 tCO2e is the sum of **Lines C4.6-C4.9**. This has fallen from the AR23 figure of 2,517 tCO2e and suggests we may now have a net negative carbon position for our landholdings as a whole. Bearing in mind the numbers are the mid-points of large ranges, this net negative position is indicative and will be updated in AR25 following the full inventory update. However, the direction of travel is genuine and the fall in AR24 is due to the peatland condition surveys described in **Lines C4.1 and C4.6**, which provide more accurate input data.

5.2.1 Lines C4.11-C4.19 Carbon sequestration – progress

Line C4.11 Peatland restored in year

The reported value in **Line C4.11** of 193 ha was confirmed by the Catchment Liaison Officer as the area restored at one site – Afton. This area includes a 50m buffer zone where applicable, which is standard practice amongst peatland restoration organisations to account for the rewetting of adjacent peat due to the restoration work. Restoration of two other planned sites have been deferred to 2024/25, but more peat than originally planned was restored at Afton.

This line reports restoration on Scottish Water land only. A further 121 ha were restored on third-party land for water quality purposes.

Line C4.12 Woodland created in year

The reported value in **Line C4.12** of 573 ha consists of 507 ha of natural regeneration at Loch Katrine, with the remaining 66 ha planting completed within the reporting year at five sites: Rosebery (the remainder of the previous year's project, planted in April 2023), Fruid, West Feal, Rakerfield and Mill Glen.

As outlined in Line C4.2, new woodland will be added to the inventory figures after five years. Therefore, woodland created in AR23 is expected to be added to **Line C4.2** - Total area of woodland in 2028, and woodland planted in AR24 is expected to be added to Line C4.2 in 2029. This depends upon the success of the planting and only established woodland will be added to the inventory. Each year, as is standard for forestry and woodland creation, new sites are inspected annually, and failed trees replaced with new ones (this is known as 'beating up').

As planned, for most sites we completed surveys, scheme development, land entry agreement and submissions to Scottish Forestry by mid-year to maximise the time available to obtain Scottish Forestry approval (needed to obtain grant funding) and complete planting in-year. However, planting at four sites was postponed until 2024/25: one site due to delays in legal

agreements with the tenant, another due to a capital project taking place on site that needs to complete prior to woodland being created, and the two larger sites (approx. 50 ha each) due to taking longer than anticipated to pass through the regulatory approval process with Scottish Forestry.

This remains a relatively new area for Scottish Water. We continue to learn from each year's projects and revise our processes to improve delivery in future years of the programme. The delay of the larger sites demonstrates the need for further increasing the lead time for larger or more sensitive sites.

Line C4.13 Grassland restored and created in year

No grassland projects took place within the reporting year.

Line C4.14 Other land cover changes in year

No other land cover change projects took place within the reporting year.

Line C4.15 Total land area changed in year

During AR24, 766 ha of land cover change took place (sum of **Lines C4.11- C4.14**).

Line C4.16 Peatland restored in year (forecast benefit in future years)

The reported figure of -3,723 tCO2e is an annual figure, which is calculated based on the difference in emissions factor between actively eroding peat (the assumed original condition at the site) and drained peat, multiplied by the number of hectares restored. Monitoring in future years will provide more data on actual condition.

We use the Peatland Code v1.2 for this calculation because that was used to estimate peatland emissions in the baseline inventory. When the inventory is recalculated for AR25, the latest version of the Peatland Code (currently v2) will be used for all emissions calculations. This will lead to a reduction in numbers both for gases emitted from our peatland and for gases avoided through restoration. Further explanation will be given in AR25.

C4.17 Woodland created in year (forecast benefit in future years)

The reported figure of -3,249 tCO2e is an annual figure, which is calculated by multiplying the number of hectares planted by the sequestration rate for the type of woodland created (based on species, yield class and planting density). This is captured in the appraisal document for each new area of woodland. Sequestration from new woodland is not counted for the first five years. As described in **Lines C4.2 and C4.12**, this aligns with the Woodland Carbon Code and allows sufficient time to enable the planting to become established and for us to confidently report the sequestration associated with the new land cover type.

C4.18 Grassland restored and created in year (forecast benefit in future years)

There has been no activity focussed on grassland during AR24.

C4.19 Other land cover (forecast benefit in future years)

There has been no activity focussed on other land use during AR24.

5.2.2 Lines C4.20-C4.24 Expenditure

Line C4.20 Expenditure on peatland restoration in year

The expenditure figure of £744k consists of contractor costs for physical restoration, all overheads, surveys etc.

As with past years' figures, this should not be used to calculate £/ha or £/tCO2e avoided. Costs in year are not all directly related to restoration work in-year. In particular, the figure includes condition surveys at sites that might need full, partial or no restoration, which is likely to take place in future years, and purchase of materials for restoration in one year that are not used until the following year.

C4.21 Expenditure on forestry creation in year

Expenditure of £715k consists of all costs associated with screening, surveys, site preparation (e.g. road construction, fencing, ground preparation), planting and all overheads.

As with past years' figures, this should not be used to calculate £/ha or £/tCO2e abated. Costs in-year are not all directly related to work in-year. For example, they include invoices for screening work for all potential woodland sites in the process, whether or not they prove suitable for planting (the majority of them do not); surveys and third-party time for sites that were planned for delivery in AR24 (whether or not they were planted in year); and some early surveys for future sites that are planned for delivery in AR25.

Line C4.22 Expenditure on grassland restoration and creation in year

No grassland projects took place within the reporting year.

Line C4.23 Other land cover

No other land cover change projects took place within the reporting year.

Line C4.24 Expenditure on land managed for sequestration in year

The reported figure of £1,459k is the sum of **Lines C4.20-4.23**.

5.2.3 Lines C4.25-C4.27 Memo Lines

Line C4.25 Total area of landholdings in previous year

The total area of landholdings of 23,219 ha is the same as that given in AR23. As explained earlier in the commentary, this number will change as data improves and as more of our operational sites can be included in the assessment. Changes will be reported on a three-yearly basis when the baseline work is repeated.

Line C4.26 Total CO2e emissions from landholdings in previous year

The total emissions from landholdings of 2,517 tCO2e is a reduction in AR23 of 6,683 tCO2e on AR22 emissions. This is due to the peatland condition surveys that were described in the AR23 commentary.

Line C4.27 Expenditure on land managed for sequestration in previous year

£1,017k was invested in projects during AR24, 40% of which was associated with the Land Management Plan for Loch Katrine.

5.3 Investment

Related to Management Approach MA077, Scottish Water continues to improve its understanding of annual carbon capture and carbon stocks in landholdings, identifying opportunities for improvement, establishing credible and transparent mechanisms for carbon accounting and working towards delivering increases in annual carbon capture of our landholdings. We are developing partnerships with key stakeholders, such as Forestry and Land Scotland, and developing an engagement approach to work with tenant farmers, neighbours and others to facilitate the delivery of carbon capture.

In AR24 we invested £744k in peatland restoration covering physical restoration, surveys and overheads predominantly at Afton, Lintrathen & Backwater and Loch Katrine. In the coming 2 years we expect to invest a further £1.1m in these projects. Also, in AR24, £715k was invested in forestry creation projects covering screening work for all potential woodland sites, surveys and third-party time for sites planned for delivery in AR24 and some early surveys for future sites that are planned for delivery in AR25.

5.4 Data

5.4.1 Data sources and confidence grades

Data for **Lines C4.1-C4.5** are taken from the Scottish Water land greenhouse gas baseline inventory described above. This consists of the extent of landholdings covered by Scottish Water's GIS system used to assess carbon status. This excludes those small areas of land associated with, for example, operational sites and assets, which were not part of this initial carbon assessment. The division of landholdings between the land types is based on national data sets and will be updated over time with Scottish Water site data.

Land Cover - The work was commissioned through the James Hutton Institute (JHI) who compiled nationally available data sets (soils, land cover, habitats, national peatland assessments) on a 50x50 m grid to create an inventory for each of Scottish Water's land holdings. It is based on eight land cover classes: Peatland, Forestry-Broadleaved, Forestry-Coniferous, Arable land, Improved grassland, Rough grassland, Moorland, and Montane habitats.

The base land cover map was the freely available Land Cover of Scotland 1988 (LCS88), which represents upland landcover well. Forestry planting is the biggest land cover change since this data was derived. LCS88 was corrected for forestry planting using both Scottish Water forestry data and the Forest Research 2019 National Forest Inventory.

As noted in commentary **Lines C4.6 and C4.7**, these national data sets will be superseded by ground-truthed field surveys where they are available. In the case of peatland, we can update this annually as the survey results become available, and for woodland as part of the three-year inventory refresh. Surveys of other land cover types are likely to take place on a site-by-site basis, for example at Loch Katrine as part of the ten-year Land Management Plan developed with Forestry and Land Scotland.

Carbon inventory - It is important to note that carbon performance of landholdings is a relatively new and developing area, particularly for top-down national assessments. The carbon inventory is assessed using national and international principles and methods for carbon assessment, coupled with expertise from the JHI that adopts the latest academic methodologies for assessing carbon stocks and flows in land cover, soil and vegetation types, as well as national peatland inventory data for indicative condition.

As this is a developing area, a key element of the three-yearly inventory update is a commitment to review methodologies against the latest guidance, academic literature and carbon factors to ensure that they are robust. Where field surveys are completed, the inventory will be updated with the relevant ground-truthed data. Any changes in input data or method in light of new developments and field work will be explained.

Confidence grades for area **Lines C4.1-C4.5** and **Lines C4.11-C4.15** have been assigned based on the use of GIS polygons provided by our land agents, and national data sets of land cover provided and analysed by JHI.

Confidence grades for emissions/sequestration **Lines C4.6-C4.10** and **Lines C4.16-C4.19**) have been assigned based on the above land use, plus peatland condition, assumptions on tree age and use of proxy tree species for sequestration rates. All data were provided and analysed by JHI except the ground-truthed peatland conditions assessments, which were conducted by peatland experts and the subsequent emissions calculation applied after discussions with JHI.

5.4.2 Data improvement programmes

Land use and condition is expected to change over time and the strategic and field data sets used to inform it will continually be reviewed and update. Data improvement work is currently prioritising:

Land cover - field surveys at peatland sites continue to show that the extent of peatland may be much less than assumed from national data sets. Further information is required to assign alternative land cover/habitat types, but the work has led to a re-scoping of the survey approach with a goal to assess all key peatlands to inform AR25.

Peatland condition - as well as differences in peatland extent, survey work is showing that there are differences between the assumed condition (which forms a broad range of carbon performance) and the confirmed field condition. Our objective is to survey the majority of peatland to inform a full inventory update in AR25. This will enable us to set a much narrower range of emissions from peatland.

Woodland age and species - improvements will be made by corroborating the age and species composition of woodlands on our landholdings. A programme of desk-based record searches and field surveys has been undertaken to ground-truth our woodlands and this will be used to improve our land inventory update to be reported in AR25. As with peatland, we anticipate this will lead to a narrowing of the range currently assigned to the amount of carbon captured.

Assumptions used for forecast data - the annual figure for projected emissions savings from restored peatland is currently calculated based on the difference in Peatland Code v1.2 emissions factors between actively eroding peat (the assumed original condition at the site) and drained peat, multiplied by the number of hectares restored. We do not use the lower emissions factor for the category of near natural peat, as it is thought that drained peatland is unlikely to return to near natural condition. However, findings at south Loch Katrine, where sheep were removed from the catchment, suggest this might be possible. Monitoring in future years will provide more data. The updated inventory in AR25 will use the latest version of the Peatland Code (currently v2), so these numbers will change significantly. An explanation will be provided in AR25.

The annual figure for projected carbon sequestration from newly created woodland is calculated by multiplying the number of hectares planted by the sequestration rate for the type of woodland created (based on species, yield class and planting density). Sequestration from new woodland is not counted for the first five years. As described in **Line C4.2**, above, this aligns with the Woodland Carbon Code and allows sufficient time to enable the planting to become established and for us to confidently report the sequestration associated with the new land cover type.