GC2030

Golf Course 2030

The Climate Impact of Golf Courses

A Case Study from Minchinhampton Golf Club, UK

Contents.

This report is part of the series of Golf Course 2030 publications on the Climate Impact of Golf Courses. The other reports in this series are:

- Climate Impact of Golf Courses: Carbon Balances in Golf Course Landscapes
- Climate Impact of Golf Courses: A sampling protocol to determine golf course soil carbon fluxes

Case Study venue:

Minchinhampton Golf Club, England, UK

www.minchinhamptongolfclub.co.uk

When estimating carbon sequestration, carbon emissions, and the resulting carbon balance on golf courses it is critical to clearly define which parts of the golf facility are included. Golf courses have the potential to sequester carbon in non-turf areas, however research on carbon sequestration in these areas on golf courses has not been conducted to date. Therefore, this report focuses exclusively on carbon sequestration and emission of golf course turfgrass areas.

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Introduction.

This is the first time that golf courses in the UK have been tested to determine their soil carbon sequestration rate.

Determining the soil carbon sequestration rate of a UK golf course

The goal of this case study was to demonstrate the use of the ***Golf Course 2030 Soil Carbon Sampling Protocol***. To the authors knowledge, this is the first time that golf courses in the UK have been tested to determine their soil carbon sequestration rate.

The potential for golf courses to sequester atmospheric carbon has excited many in the industry, however, studies on the carbon sequestration potential of golf courses are severely limited. As such, further research is required to better resolve the sequestration potential that golf courses provide. Golf Course 2030 aims to help fill this research gap through supporting more studies of golf course soil carbon sequestration, such as this case study of two golf courses in the UK.

This case study does not merely quantify carbon sequestration, but also quantifies carbon emissions of the two golf courses which participated in the study. Through quantification of both carbon sequestration and emissions, this study is able to estimate the carbon balance of both golf courses from the time they were constructed to today.

The results of this study can help in guiding future management of golf courses, specially by providing insight of how golf courses can be operated in a carbon neutral or carbon negative manner. In addition, case studies such as these help the golf industry set realistic targets for climate action, mitigation, and offsetting.

Methods.

Site selection

Minchinhampton Golf Club (MGC) was selected as the site for this case study because the historical land use of the golf course was well known (i.e., agricultural crop production) and the surrounding landscape is still used for agricultural production. These traits of a known historical land use and a surrounding landscape that is still under the historical land use are important when applying the ***Golf Course 2030 Soil Carbon Sampling Protocol***. In addition, Minchinhampton was chosen because the facility has golf courses of three different ages, which provided us the opportunity to study the effect of time since construction on the golf courses carbon stock.

Site description

MGC is located in southwest England near the village of Stroud (Figure 1). The club has three courses, the Old Course built in 1889, the Avening course built in 1975, and the Cherington course built in 1993. The Avening and Cherington courses are the focus of this study. Because of limited time during the sampling campaign, the Old Course was not sampled, but this may yet occur.

Figure 1. Minchinhampton Golf Club is located in Stroud, 50km northeast of Bristol.

Figure 2. The site of the Avening and Cherington courses in December 1945 (left) and July 2021 (right). Imagery from Google Earth Pro (2022).

Land use history

Prior to the construction of the Avening course in 1975 and the Cherington course in 1995 both sites were used for agriculture (Figure 2). The area surrounding the golf courses are still used for agriculture today. Today these fields are cropped with a rotation of rapeseed, oats, spring and winter barley, linseed, and wheat. The farm uses "minimal tillage".

Soils & construction

The native soil at Minchinhampton Golf Club contains course fragments of rock. Coarse fragments in soil includes particles larger than 2mm and smaller than 25cm. The original plan was to sample to a 20cm depth, however the course fragments in the soil made pounding the soil sampling probes to this depth impossible. Thus, soil samples were taken to 10cm depth. For the carbon stock estimates in this study, we assume a course fragment fraction of 10% on the golf course and the agricultural fields.

The coarse fragment content at the soil surface on the Avening course was originally a problem for both turfgrass establishment and for golfers playing the course. As such, the fairways were heavily topdressed with both sand and organic material to bury the native soil profile. In addition, crates were placed in the fairways where golfers playing the course could place loose rocks.

During the construction of the Cherington course, the topsoil was ploughed, and a potato picker was used to separate out the largest coarse fragments. A stone burying machine was also used to push coarse fragments deeper into the soil profile. At the end of this process there were no coarse fragments on the soil surface that were more than 7.5cm.

Soil sampling

An earlier draft of the ***Golf Course 2030 Soil Carbon Sampling Protocol*** was used to guide the sampling the strategy in this study and thus the exact sampling strategy used for this report differs slightly from the published sampling protocol.

The soil corer used in this study was 5cm in diameter. Three soil samples were taken from the fairways and roughs on five holes of each golf courses. Three subsamples were collected for each sample. Aboveground biomass was removed, and all three soil core subsamples were placed in a bucket, well mixed and 500g of soil was placed in a sample bag for analysis (Note: The laboratory that did the analyses for this study required 500g of soil for each sample, however most soil testing labs to do not require this much soil. Make sure to check with the lab analysing your samples before sampling to determine the weight of soil needed for each sample). Organic matter and soil organic carbon (SOC) content were determined using a C:N analyser at European Turfgrass Laboratories. Carbon stocks were calculated as is specified in the ***Golf Course 2030 Soil Carbon Sampling Protocol***.

Establishing a confidence level for offsite samples

The main source of uncertainty in the ***Golf Course 2030 Soil Carbon Sampling Protocol*** comes from the selection of the offsite sampling location. The methodology of the protocol uses the offsite sampling location as a proxy for the soil carbon stock of the golf course at the time of construction. The following ten conditions allow for a confidence level to be established to determine a confidence level for the offsite sampling location (9 or more conditions met – high confidence, 6 to 8 conditions met – medium confidence, five or fewer conditions met – low confidence).

Nine conditions of the ten conditions were satisfied in this study, meaning that we have high confidence that the offsite sampling location represents the soil carbon stock of the golf course at the time of construction.

Question	**Answer** (this study)
Was the historical land use of the golf course identified?	Yes
Were the offsite sampling location(s) immediately adjacent to the course and still under the historical land use of the golf course?	Yes
Does the offsite sampling location(s) cover the same land area as the golf course?	Yes
Did the samples taken in the offsite sampling location span a similar geographic extent to the samples on the golf course?	Yes
Does the offsite sampling location(s) have similar soil texture (sand, silt, and clay percentage) as the golf course?	Yes
Does the offsite sampling location(s) have the same depth to water table as the golf course?	Yes
No samples were taken within less than 20m from each other.	Yes
No samples were taken on steep hills, at the bottom of steep valleys, or immediately adjacent to streams or rivers.	Yes
Were 30 soil samples taken from the offsite location(s) (20 soil organic carbon and 10 bulk density samples)?	Yes
The composition of the native soil underlying the fairways and roughs of the golf course was not significantly changed during construction or by the management of the course.	No

A map of soil carbon and bulk density sampling locations at the Avening and Cherington courses

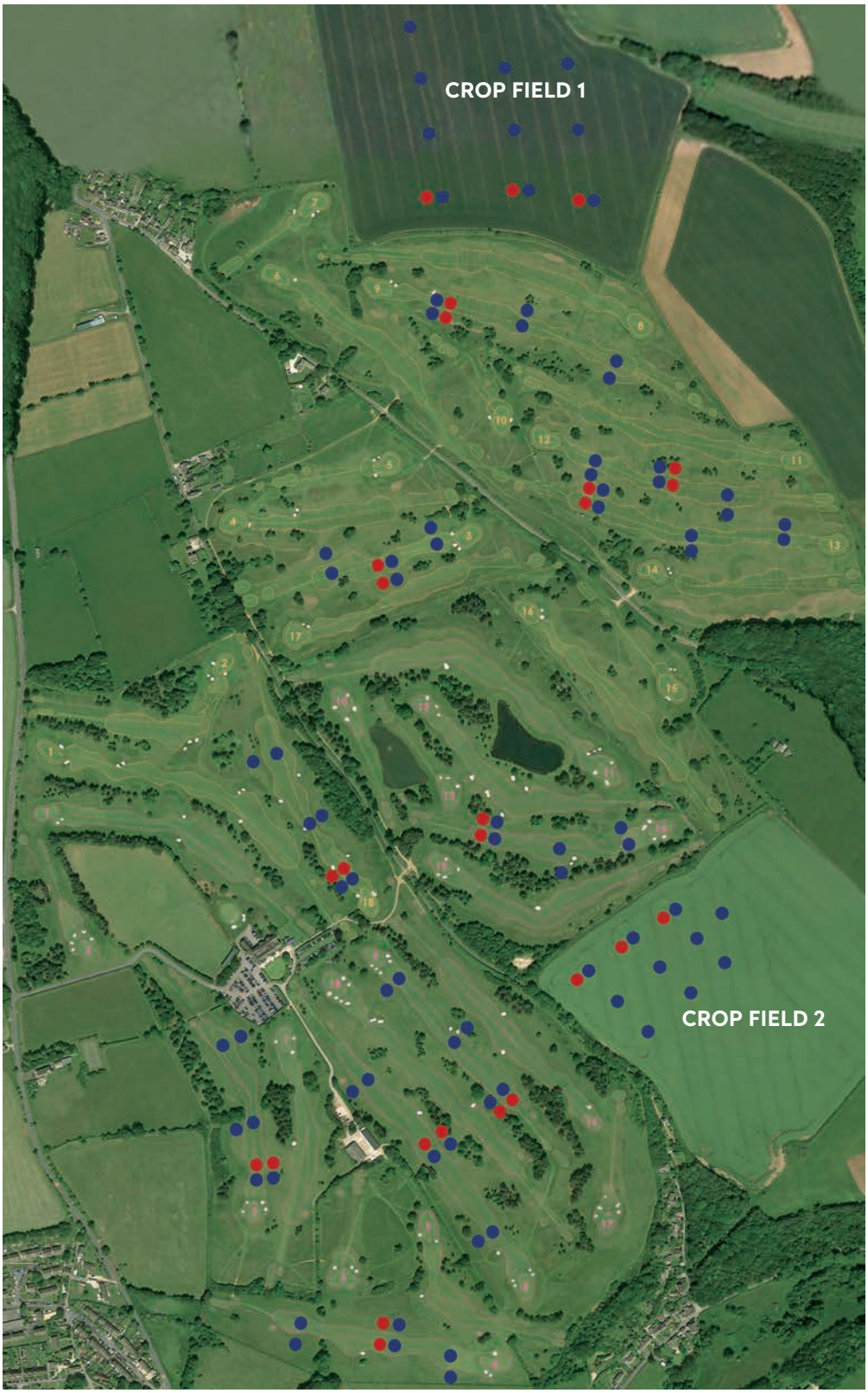


Figure 3. Blue dots indicate where soil organic carbon (SOC) samples were taken and red dots indicate where bulk density samples were taken.

Results.

Soil texture

The soil texture of the golf course and the crop fields (the offsite sampling location) was similar. However, the golf courses had higher sand content and a lower silt and clay content. This is very likely due to the golf course receiving sand topdressing applications.

Site	Sand (%)	Silt (%)	Clay (%)	Textural Classification
Crop Fields (n=4)	11.7	63.8	24.5	Silty Clay Loam
Avening (n=4)	21.7	57.1	21.3	Clay Loam
Cherington (n=4)	21.1	56.8	22.1	Clay Loam

List of Unit Abbreviations

Mg	Megagram (1Mg = 1,000,000g or 1,000kg)
ha	Hectare (1ha = 10,000m^2)
m^3	Cubic meter
m	Meter
yr	Year
n	Sample number

The term 'carbon sequestration' refers to a carbon flux that transfers carbon from the atmosphere to the soil.

The term 'carbon emission' refers to a carbon flux that transfers carbon from the soil or from a fossil fuel back to the atmosphere.

Soil carbon sequestration calculations

Below are the soil carbon flux calculations to determine the soil carbon fluxes at the Avening and Cherington courses. The steps refer to the methodology presented in the ***Golf Course 2030 Soil Carbon Sampling Protocol***.

Steps 1, 2, 3: Determining the areas of the Avening and Cherington courses.

Area	Avening	Cherington
A_F (ha)	13.0	15.3
A_R (ha)	11.1	16.5
A_T (ha)	24.1	31.6
P_F (%)	54%	48%
P_R (%)	46%	52%

A_F area of fairway
A_R area of rough
A_T total area (sum of fairway and rough)
P_F percentage of fairway
P_R percentage of rough

Steps 4 and 5: Calculating the soil organic carbon content and bulk density of the Avening and Cherington fairways and roughs.

	Avening	Cherington
SOC_{GCF} (%)	6.13	6.77
SOC_{GCR} (%)	6.81	6.55
BD_{GCF} (Mg m^{-3})	0.91	0.94
BD_{GCR} (Mg m^{-3})	0.85	0.88

SOC_{GCF} average soil organic carbon content of golf course fairways
SOC_{GCR} average soil organic carbon content of golf course roughs
BD_{GCF} average bulk density of golf course fairways
BD_{GCR} average bulk density of golf course roughs

Steps 6 and 7: Calculating the golf course wide soil organic carbon content and bulk densities of the Avening and Cherington courses.

	Avening	Cherington
SOC_{GC} (%)	6.44	6.66
BD_{GC} (Mg ha^{-1})	0.88	0.91

SOC_{GC} average golf course wide soil organic carbon content
BD_{GC} average golf course wide bulk density

Step 8: Calculating the average soil organic carbon content and bulk density of the offsite sampling location.

	Crop Field 1	Crop Field 2
SOC_{OS} (%)	4.44	3.24
BD_{OS} (Mg m^{-3})	0.93	1.00

SOC_{OS} average offsite sampling location soil organic carbon
BD_{OS} average offsite sampling location bulk density

Step 9: Calculating the carbon stock of the Avening and Cherington courses and the offsite sampling location.

	Avening	Cherington
CS_{GC} (Mg C ha^{-1})	56.8	60.5
CS_{OS} (Mg C ha^{-1})	37	

CS_{GC} average golf course carbon stock
CS_{OS} average offsite sampling location carbon stock

Carbon sequestration on golf courses primarily occurs via the turfgrass-soil system, while carbon emissions primarily occur through the combustion of fossil fuels on golf courses.

Carbon sequestration at the Avening course

Step 10: The estimated carbon stock of the Avening course was 56.8 Mg C ha^{-1} and the estimated carbon stock of the crop fields was 37.0 Mg C ha^{-1}. Thus, we estimate that the Avening course has sequestered 19.8 Mg C ha^{-1} from the time course was constructed to when the soil sampling for this project occurred in the summer of 2023.

$\Delta CS_A = 56.8 \text{ Mg C ha}^{-1} - 37.0 \text{ Mg C ha}^{-1}$

$\Delta CS_A = 19.8 \text{ Mg C ha}^{-1}$

Step 11: The CSOE (Carbon Sequestered or Emitted) is equal to the area of the golf course (24.1 ha) multiplied by the total change in carbon stock. The Avening course has sequestered a total of 477 Mg C since it's construction.

$CSOE_A = 19.8 \text{ Mg C ha}^{-1} * 24.1 \text{ ha}$

$CSOE_A = 477 \text{ Mg C}$

Step 12: If we divide the weight of carbon sequestered per hectare (ΔCS_A) by the age of the golf course (GCA), we can derive the average yearly carbon sequestration rate for the Avening course (R_A) from 1974 (the year the golf course opened) to 2023 (the year the soil sampling occurred).

GCA = 48 yr

$R_A = 0.41 \text{ Mg C ha}^{-1} \text{yr}^{-1}$

Carbon sequestration at the Cherington course

Step 10: The average carbon stock of the Cherington course was 60.5 Mg C ha^{-1} and the average carbon stock of the crop fields was 37.0 Mg C ha^{-1}. Thus, we estimate that the Cherington course has sequestered 23.5 Mg C ha^{-1} from the time course was constructed to when the soil sampling for this project occurred in the summer of 2023.

$\Delta CS_C = 60.5 \text{ Mg C ha}^{-1} - 37.0 \text{ Mg C ha}^{-1}$

$\Delta CS_C = 23.5 \text{ Mg C ha}^{-1}$

Step 11: CSOE (Carbon Sequestered or Emitted) is equal to the area of the golf course (31.8 ha) multiplied by the total change in carbon stock. The Cherington course has sequestered a total of 734 Mg C since it's construction.

$CSOE_C = 23.1 \text{ Mg C ha}^{-1} * 31.6 \text{ ha}$

$CSOE_C = 743 \text{ Mg C}$

Step 12: If we divide the weight of carbon sequestered per hectare (ΔCS_C) by the age of the golf course (GCA), we can derive the average yearly carbon sequestration rate for the Cherington course (R_C) from 1993 (the year the golf course opened) to 2023 (the year the soil sampling occurred) the time golf course opened to when the soil sampling occurred.

GCA = 30 yr

$R_C = 0.78 \text{ Mg C ha}^{-1} \text{yr}^{-1}$

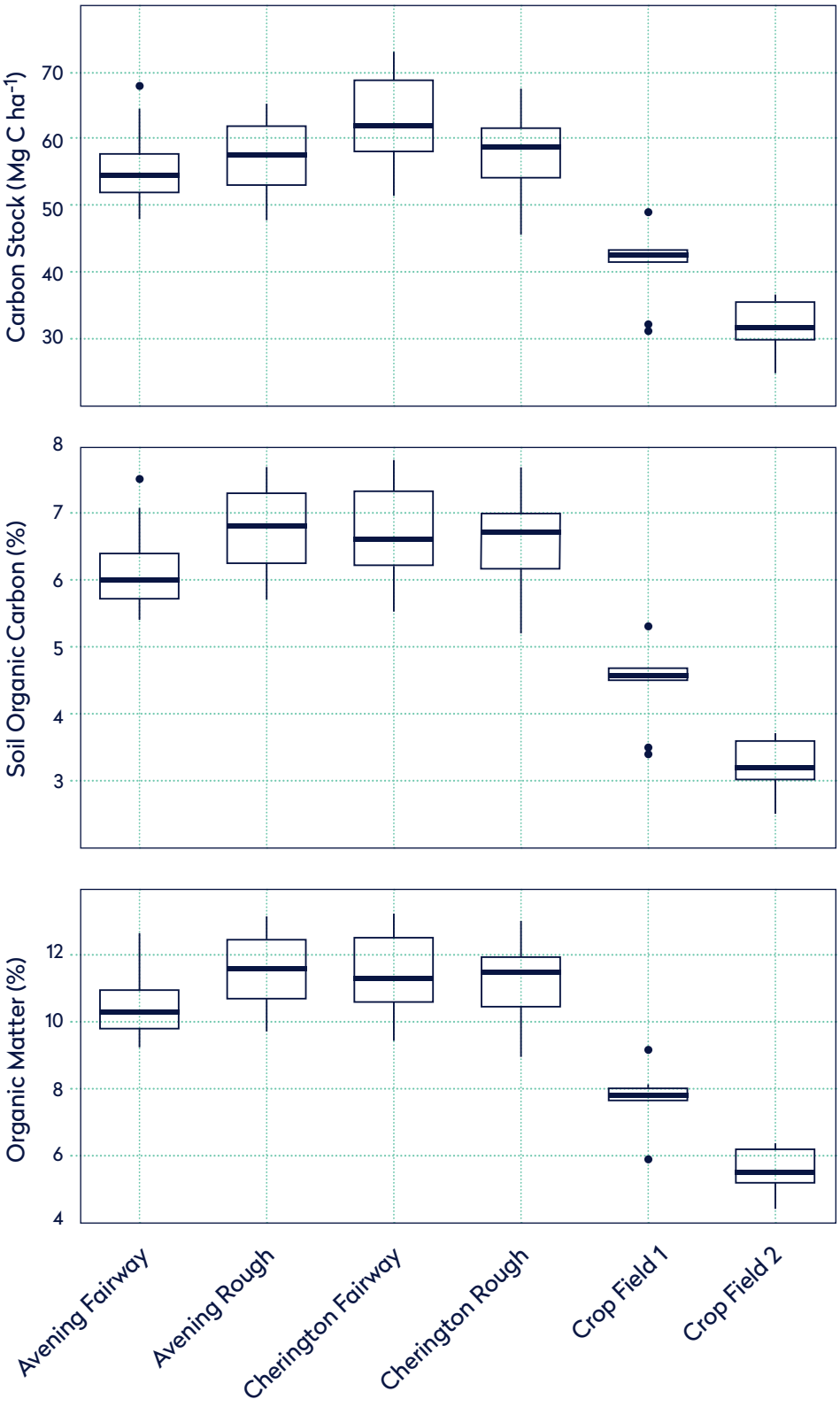


Figure 4. Organic matter, soil organic carbon (SOC), and carbon stock on the Avening fairways, Avening rough, Cherington fairway, Cherington rough, Crop field 1, and Crop field 2. All three graphs are related but are all showing different indices. Organic matter varies in its SOC content but is typically between 50 and 60 percent carbon. The carbon stock is highly dependent on SOC content but is also influenced by depth over which the stock is estimated, the bulk density, and the coarse fragment content.

Carbon emissions.

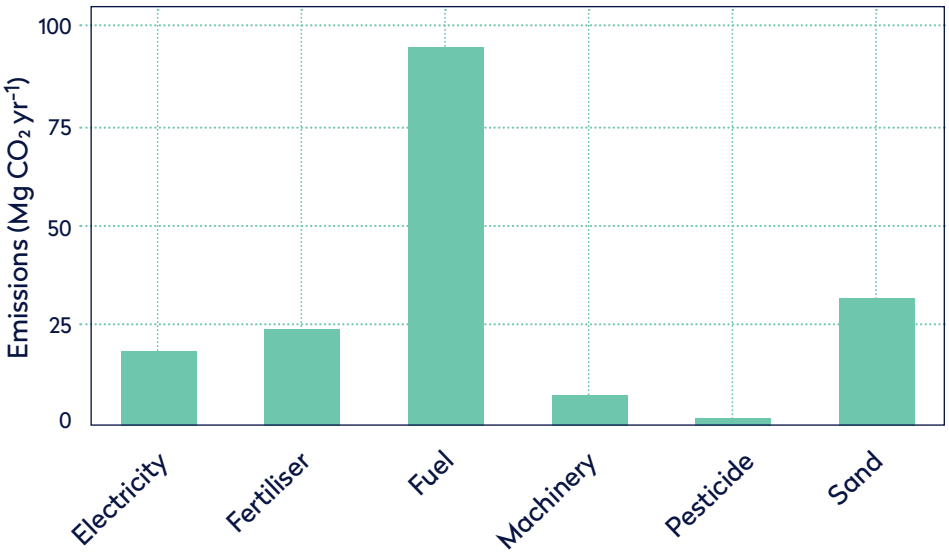
Estimating carbon emissions

To calculate the carbon balance of the Minchinhampton Golf Club (MGC) we calculated the carbon emissions of the golf course maintenance activities using the model presented in Bekken and Soldat (2021) and which was developed collaboratively with GEO Foundation. This model calculates carbon emissions from golf course maintenance activities and does not estimate emissions from the clubhouse or other facilities at the golf course. The model includes emissions from the maintenance equipment, maintenance facility, and the irrigation pump. The model estimates Scope 1, 2, and 3 emissions. We present the emissions data in six categories: Electricity, Fertiliser, Fuel, Machinery, Pesticide, and Sand.

Emissions Category	Scope 1	Scope 2	Scope 3
Electricity 		Carbon emissions from the generation of grid electricity in the UK that is used at MGC.	Carbon emissions of electricity that is lost during the transmission and distribution of electricity in the UK.
Fertiliser 	Emissions from denitrification of nitrogen fertilisers after application.		Carbon emissions from the manufacturing of nitrogen, phosphorus, and potassium fertilisers.
Fuel 	Carbon emissions from the combustion of all fuels at MGC. This includes fuels to power all machinery and heat the maintenance facility.		Carbon emissions from the manufacturing of fuels used at MGC.
Machinery 			Carbon emissions from the manufacturing, transport and repair of machinery at MGC.
Pesticide 			Carbon emissions from the manufacturing of herbicides, insecticides, and fungicides used at MGC.
Sand 			Carbon emissions from the mining and transport of sand to the facility.

Carbon emissions

Carbon emissions to maintain the golf courses totalled 178 Mg CO_2 yr^{-1}. Fuel use accounted for 96 Mg CO_2e yr^{-1} or 54% of all carbon emissions from the golf course maintenance activities at Minchinhampton Golf Club. Sand was the second highest emitting category of emissions (32 Mg CO_2 yr^{-1}), followed fertiliser (24 Mg CO_2 yr^{-1}), electricity (18 Mg CO_2 yr^{-1}), machinery (7.1 Mg CO_2 yr^{-1}), and pesticide (0.2 Mg CO_2 yr^{-1}).



There is a total of 55.7 ha of maintained turf between the Avening and Cherington courses at Minchinhampton Golf Club, meaning that carbon emissions per hectare of maintained turf was 3.2 Mg CO_2e ha^{-1} yr^{-1}. If we assume that the amount of carbon emitted to maintain the Avening and Cherington golf courses has stayed constant in every year since they were constructed, we can estimate the total amount of carbon emitted in the maintenance of the two golf courses since they opened for play.

$$EA = 3.2 \text{ Mg } CO_2 \text{ ha}^{-1}\text{yr}^{-1} * 24.1 \text{ ha} * 48 \text{ yr} = 3702 \text{ Mg } CO_2$$

$$EC = 3.2 \text{ Mg } CO_2 \text{ ha}^{-1}\text{yr}^{-1} * 31.6 \text{ ha} * 30 \text{ yr} = 3034 \text{ Mg } CO_2$$

Thus, the maintenance emissions at the Avening course have totalled 3702 Mg CO_2e and at the Cherington course have totalled 3034 Mg CO_2e.

Carbon balance.

Quantifying carbon fluxes as carbon (C) or carbon dioxide (CO_2)

Quantifying carbon fluxes can be achieved by using the weight of elemental carbon (C) or the weight of carbon dioxide (CO_2). Soil carbon stocks are typically quantified as the weight of C, because the C in soil is chemically bonded to many different elements and thus it is simplest to track the weight of C in the soil. However, when that soil carbon is respired by soil microbes, the carbon is released to the atmosphere primarily as CO_2. Similarly, when fossil fuels are combusted, the carbon is also released to the atmosphere primarily as CO_2. This is why carbon emissions are typically quantified in terms of the weight of CO_2. However, we can convert between units of C and CO_2 by accounting for the differences in molar mass between the two molecules. The molar mass of CO_2 is 44 g mol^{-1}, while the molar mass of C is 12 g mol^{-1}. In this report, we convert the weight of C sequestered by the golf courses to the weight of CO_2 so that this quantity is comparable to the weight of CO_2 emitted by maintenance of the golf courses. With both sequestration and emissions in units of CO_2, a carbon balance for the Avening and Cherington courses can be determined.

To establish a carbon balance, we need to convert the rate of soil carbon sequestration at the Avening and Cherington courses from the weight of carbon (C) to the weight of carbon dioxide (CO_2).

$$CSOE_A = 477 \text{ Mg C} * \frac{44 \frac{\text{g } CO_2}{\text{mol}}}{12 \frac{\text{g C}}{\text{mol}}} = 1749 \text{ Mg } CO_2$$

$$CSOE_c = 743 \text{ Mg C} * \frac{44 \frac{\text{g } CO_2}{\text{mol}}}{12 \frac{\text{g C}}{\text{mol}}} = 2724 \text{ Mg } CO_2$$

We define the carbon balance for the Avening and Cherington courses as the carbon emissions of maintenance minus the soil carbon sequestration that has occurred from the time the golf courses opened for play until the time soil carbon sampling occurred in 2023. During its 48 years of operation, from 1975 to 2023, the Avening course emitted 3702 Mg CO_2 and has sequestered 1753 Mg CO_2. Thus, the Avening course has emitted 1949 Mg CO_2 more to the atmosphere than it is has sequestered from the atmosphere. Soil carbon sequestration offset 47% of the carbon emissions. For the golf course to be carbon neutral over the study period (1975-2023) emissions would have needed to have been reduced by over 2 times.

During its 30 years of operation, from 1993 to 2023, the Cherington course has emitted 3034 Mg CO_2 and has sequestered 2724 Mg CO_2. Therefore, the Cherington course has emitted 309 Mg CO_2 more to the atmosphere than it is has sequestered from the atmosphere. Soil carbon sequestration offset 89% of the carbon emissions. For the golf course to be carbon neutral over the study period (1993-2023) carbon emissions would have needed to have been reduced only slightly.

Carbon balance = Emissions – Sequestration

Emission, sequestration, and carbon balance of the Avening course from 1975 to 2023

Total emissions: 3702 Mg CO_2

Total sequestration: 1753 Mg CO_2

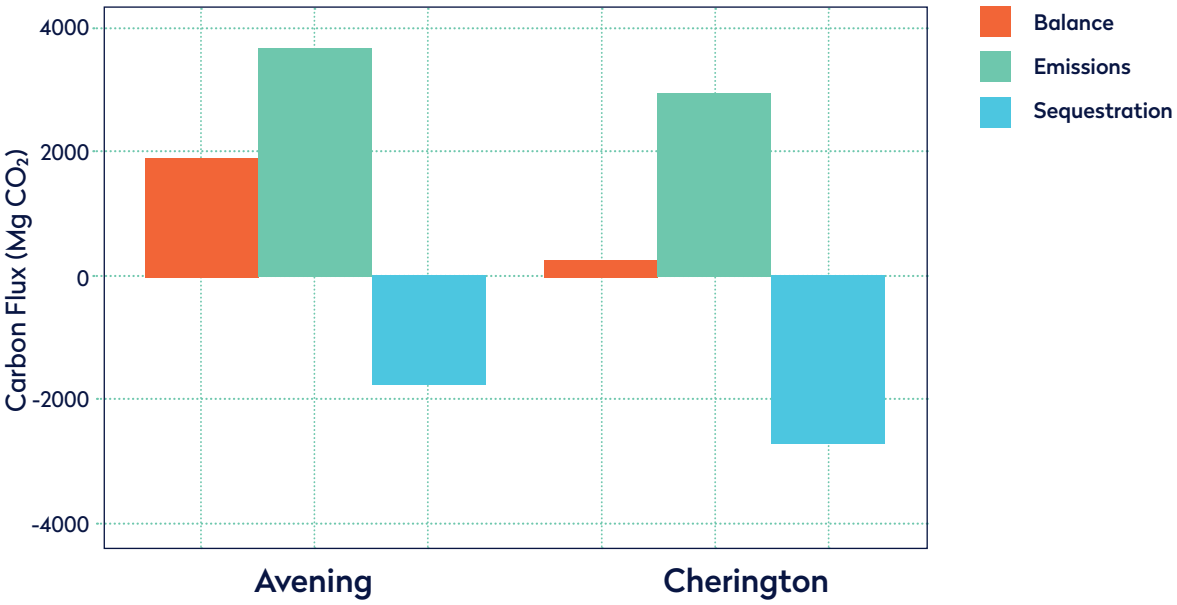
Carbon balance: 1949 Mg CO_2

Emission, sequestration, and carbon balance of the Cherington course from 1993 to 2023

Total emissions: 3034 Mg CO_2

Total sequestration: 2724 Mg CO_2

Carbon balance: 309 Mg CO_2



Discussion.

In this study, we followed the ***Golf Course 2030 Soil Carbon Sampling Protocol***, which estimates the soil carbon concentration at two moments in time: when the golf course was constructed and when the soil sampling was completed. By comparing the soil carbon stock at these points in time, taking the difference and dividing by the number of years, the average yearly carbon sequestration rate can be estimated.

However, this sequestration rate cannot be extrapolated into the future with a high degree of confidence until more testing is completed. This is because when a golf course is first constructed on a previously agricultural soil, as was the case in this study, previous studies indicate that the sequestration rate is high for the first 25-30 years, but then often decreases thereafter. In the table ***A Review of Golf Course Sequestration Studies*** (below) the time to equilibrium, is a measure of the number of years after turfgrass establishment that soil sequestration rates stay high before falling to rates that are much lower or near zero. The golf courses in this study are 48 and 30 years old, meaning that the sequestration rates that we measured in this study are likely higher than they will be in the future. Thus, extrapolating the sequestration rates found in this study indefinitely into the future very likely overestimates the carbon sequestration capacity of the soils on the Avening and Cherington courses.

In a review of nine studies that quantified golf course soil carbon fluxes, the turf-soil system on all nine golf courses sequestered atmospheric carbon. Sequestration rates ranged from 0.22 Mg C ha^{-1} yr^{-1} to 3.55 Mg C ha^{-1} yr^{-1}. The average sequestration rate in these studies nine was 0.96 Mg C ha^{-1} yr^{-1}. Thus, the soil carbon sequestration rates found in this study, 0.42 Mg C ha^{-1} yr^{-1} at the Avening course and 0.77 Mg C ha^{-1} yr^{-1} at the Cherington course, were slightly lower than the average sequestration rate found in these nine studies. However, the sequestration rates found in this study were well within the range of sequestration rates found in these previous studies on golf courses.

The results of this study confirm previous research which indicates that emissions from golf course maintenance activities are higher than soil carbon sequestration on golf courses. For golf courses to be carbon neutral or carbon negative, emissions need to be reduced from current levels.

A review of golf course sequestration studies (adapted from Braun et al. 2023)

Golf course location	Carbon sequestration rate (Mg C ha^{-1} yr^{-1})	Time to equilibrium	Reference
England, UK	0.42		This study
England, UK	0.77		This study
Colorado, USA	0.9 – 1.0	45	Qian and Follett (2002)
Colorado, USA	0.9 – 1.2	30	Bandaranayake et al. (2003)
New Zealand	0.69		Huh et al. (2008)
Nebraska, USA	0.32 – 0.78		Qian et al. (2010)
Ohio, USA	2.64 – 3.55	12 - 91 (depth dependent)	Selhorst and Lal (2011)
North Carolina, USA	0.72		Wang et al. (2014)
Kansas, USA	0.98 – 1.05		Braun and Bremer (2019)
Texas, USA	0.22		Gautam et al. (2020)
Kansas, USA	0.42 – 1.0	40	Hong et al. (2023)

Conclusion.

There is potential that emissions could be quickly and significantly reduced through investment in low carbon technologies.

The future of Minchinhampton Golf Club's carbon balance

The work completed here estimates the carbon balance of the Avening and Cherington courses from their construction in 1975 and 1993, respectively, to 2023 when soil sampling for this project occurred.

As mentioned previously, studies indicate that golf course soil carbon sequestration rates are highest in the first 25-30 years after they are converted from agricultural land. Thereafter, soil carbon sequestration rates decrease as organic matter levels in the soil reach a new steady state. As such, future sequestration rates at Avening and Cherington golf courses will very likely be lower than the rates measured in this study.

Conversely, emissions will only be reduced by making the necessary investments in low carbon technology. This report finds that 54% of all carbon emissions from the maintenance of the Avening and Cherington courses are from fuel use. As such, phasing out the use of fuels at the club will be the most effective way of reducing emissions. Currently, fuels are used to power maintenance equipment and to heat the maintenance facility.

Fuel consumption could be reduced by adoption of electric maintenance equipment and electric heating for the maintenance facility. The electricity needed to power this equipment also has a carbon cost. Assuming the electricity is sourced from the UK electricity grid, the lifecycle carbon cost of electric maintenance equipment, including manufacturing and a lifetime of charging and use, are currently about one quarter what they are petrol maintenance equipment in the UK electricity grid, which is already quickly decarbonising, continues to become less carbon intense. The club could also choose to become grid independent by the installation of onsite solar panels, which would even more quickly reduce emissions.

The carbon balance of the Avening and Cherington courses is currently positive for both courses (total emissions are higher than total sequestration). This will only become more positive as the courses age. However, there is potential that emissions could be quickly and significantly reduced through investment in low carbon technologies. With such investment, it is possible that the carbon balance of the two courses stabilises, such that the courses emissions and sequestration are in balance with one another.

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The R&A group of companies was formed in 2004 to take on The Royal and Ancient Golf Club of St Andrews' responsibilities for governing the Rules of Golf, staging The Open, golf's original championship, and developing the sport. The World Golf Museum in St Andrews is part of The R&A group.

Together The R&A and the USGA govern the sport of golf worldwide, operating in separate jurisdictions with a commitment to a single code for the Rules of Golf, Rules of Amateur Status and Equipment Standards. The R&A, through R&A Rules Ltd, governs the sport worldwide, outside of the United States and Mexico, on behalf of over 41 million golfers in 144 countries and with the consent of 159 organisations from amateur and professional golf.

The R&A has responsibility for running a series of world class amateur events and international matches in women's and girls' as well as men's and boys' golf. The R&A stages the AIG Women's Open and works with the DP World Tour to stage the Senior Open presented by Rolex.

The R&A is committed to investing £200 million over ten years in developing golf and supports the growth of the sport internationally, including the development and management of sustainable golf facilities. For more information, visit www.randa.org.

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