

# MoorLIFE 2020 Project:

D5 Carbon Audit Update Report 2021

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**(LIFE14 NAT/UK/000070)**



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## Executive Summary

Moors for the Future Partnership monitored the carbon footprint of the MoorLIFE2020 project, with the aim of identifying where carbon savings can be made.

This carbon audit builds upon the original MoorLIFE project carbon audit, by including additional activities (e.g. office energy use) that are both directly controlled by Moors for the Future Partnership (scope 1 activities), and indirectly associated (scopes 2 and 3).

The activities associated with scope 1, 2 and 3 were assigned using the D5 Carbon audit guide produced by Benson et al. (2016).

In total the project's greenhouse gas emissions were **921,504**kg CO<sub>2</sub>e (Carbon dioxide equivalents). This is the equivalent of the energy used by 110,970 homes in one year. The majority (60%) of the emissions were recorded in years 4 and 5, as the project activities varied between years.

The primary activities that contributed the most to total greenhouse gas emissions were:

- Helicopter Deliveries – 295,122 kg CO<sub>2</sub>e.
- Employee Commute – 280,949 kg CO<sub>2</sub>e.
- Contractor Travel by Road – 93,331 kg CO<sub>2</sub>e.

Analysis showed that the top three emitters of CO<sub>2</sub>e were concrete conservation actions (C2, C1 and C5). This ranking changed however, when looking at the intensity ratios (total Moors for the Future Partnership spend per CO<sub>2</sub>e emitted), with D2 becoming the action with the second most emitted kg CO<sub>2</sub>e, due to the number of journeys associated with this action.

Looking at kg CO<sub>2</sub>e by site it is possible to determine that Alport, Arnfield and Derwent and Howden were the sites that incurred the most carbon emissions during delivery of the associated site activities. However outside of the top 3 results the ranking does change with Castleshaw increase 14 places from 21<sup>st</sup> to 7<sup>th</sup>.

Key recommendations:

As part of the MoorLIFE 2020 project, Moors for the Future Partnership and our associated beneficiaries are committed to reducing our carbon footprint. This could be done by looking to implementing measures to reduce emissions from those activities that emit the most carbon, this could include:

- Siting lift points as close to the working area as possible, where possible
- Specifying local helicopter take-off sites and the right helicopters for the job
- Accurately specifying areas using desk-based GIS and helicopter-mounted GPS
- Car sharing / use of public transport when and where logistically possible
- Purchase or lease of vehicles with the lowest CO<sub>2</sub>/ km emissions (e.g. hybrid vehicles)

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# 1. Introduction

As part of the MoorLIFE 2020 (ML2020) project action D5, a carbon audit was undertaken for all greenhouse gas (GHG) emissions (carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) & nitrous oxide (N<sub>2</sub>O)) to assess the carbon footprint of the project. The different GHG emissions were converted into carbon dioxide equivalents (CO<sub>2</sub>e), allowing comparison between the different types of GHG emissions and a total emissions figure was calculated (OECD Statistics, 2013; Defra, 2017).

The aim of this document is to report the full kg CO<sub>2</sub>e figures associated with delivering:

- Year 1: 1<sup>st</sup> October 2015 – 31<sup>st</sup> March 2016
- Year 2: 1<sup>st</sup> April 2016 – 31<sup>st</sup> March 2017
- Year 3: 1<sup>st</sup> April 2017 – 31<sup>st</sup> March 2018
- Year 4: 1<sup>st</sup> April 2018 – 31<sup>st</sup> March 2019
- Year 5: 1<sup>st</sup> April 2019 – 31<sup>st</sup> March 2020
- Year 6: 1<sup>st</sup> April 2020 – 31<sup>st</sup> August 2021

ML2020 was delivered in partnership with a number of organisations: National Trust (NT), Royal Society for the Protection of Birds (RSPB) and Pennine Prospects (PP). Emissions incurred by activities undertaken by the project’s associated beneficiaries are reported on alongside those activities undertaken by (Moors for the Future Partnership) MFFP and any contractor travel associated with delivering the conservation works.

The different activities included within the carbon audit are identified in Table 1, along with the group or ‘scopes’ of emissions the activities relate to. Scope 1 and 2 activities relate to those actions which are controlled directly by MFFP (e.g. driving works vehicles), whereas scope 3 activities are activities which are indirectly controlled by MFFP (contractors and partners’ travel) (Carbon Trust, 2017).

**Table 1 - Activity and scope reported on in the MoorLIFE 2020 carbon audit**

| <b>Activity</b>                          | <b>Scope</b> |
|--|--------------|
| Works vehicle use                        | 1 and 3      |
| Project staff commute                    | 1 + WTT      |
| Contractor travel                        | 3 + WTT      |
| Volunteer travel                         | 1 + WTT      |
| Flying                                   | 3            |
| Deliveries                               | 3            |
| Office energy use (Moorland Centre only) | 2            |

Adapted from Benson *et al.* 2016

Since the original MoorLIFE carbon audit, the number of activities covered within the carbon audit was expanded to produce a more comprehensive audit. The original audit can be used as a guide for expected outcomes associated with the ML2020 carbon audit. Maskill *et al* (2015) identified that those activities involving helicopters and the delivery of materials produced the most carbon emissions.

An overview of the carbon released by partner is presented for our associated beneficiaries (see section 3.9 Associated beneficiaries CO<sub>2</sub>e contributions). This is not intended for direct comparison due to the different work areas and requirements of the sites that our associated beneficiaries work on. It has been included to allow our associated beneficiaries to put measures in place to reduce their carbon footprint, where applicable.

## 2. Methodology

*The following methodology was taken from 'A guide to the project carbon audit processes and protocols' ML2020 report that was written for the ML2020 project by Benson et al. (2016).*

### 2.1 Scope and boundaries of the MoorLIFE 2020 project carbon audit

The scope of the ML2020 carbon audit is defined as those activities carried out for, and invoiced to, the full suite of ML2020 project actions. In addition, where possible, supply chain emissions were included.

MFFP followed guidelines issued by the Department of Environment and Rural Affairs (Defra) for UK organisations and businesses complying with GHG reporting regulations where possible in order to produce a first order estimate of GHG emissions to a recognised national standard (Maskill *et al.* 2015).

The Defra guidelines (2009) state the importance of identifying the activities in an organisation (or in this case, the project) that are responsible for GHG emissions, and from which areas of an organisation (or project) information needs to be gathered.

There are three recognised groups of emissions-releasing activities, which are stated as follows:

**“Scope 1** – Direct emissions: Activities owned or controlled by your organisation that release emissions straight into the atmosphere. They are direct emissions.”

**“Scope 2** – Energy indirect: Emissions being released into the atmosphere associated with consumption of purchased electricity, heat, steam and cooling. These are consequences of an organisation’s activities, but occur at sources not owned or controlled by the organisation.”

**“Scope 3** – Other indirect: Emissions that are a consequence of your actions, which occur at sources which are not owned or controlled, and which are not classed as scope 2 emissions.”

Scope 1 and scope 2 emissions are the recommended emissions types to audit, and scope 3 are discretionary. Scope 3 emissions can be especially important because there is a risk, should the organisation or business responsible for those emissions undertake a carbon audit, of double counting. However, it is acknowledged that it can be difficult to identify whether emissions fall into scope 1 or scope 3.

The ML2020 project contracted out most of the concrete conservation actions (C) hence the following activities often fell within scope 3: delivery by road, flying, contractor travel, material production (e.g. brash cutting).

The previous EU-LIFE project MoorLIFE (MLFE) was the first MFFP project to have a carbon audit produced. The focus of the audit was restricted to the conservation works (C) actions that were controlled and supervised by MFFP.

In the previous MLFE carbon audit, helicopter travel to and from works site from helicopter company base were not reported on. These scope 3 emissions data are included in the present audit in recognition of helicopter “commute” distances. GHG emissions relating to Preparatory (A), Monitoring (D), Communications (E) and Project Management (F) actions were also not reported on in the MLFE carbon audit, whereas the present audit reports on the full range of project actions. Improvements were made to data recording systems in preparation for the ML2020 project delivery at MFFP, documenting recharges to individual ML2020 action codes, enabling reporting by action code, as well as by activity (Table 1).

Staff commute to the office (petrol/diesel) was also reported on the present project audit, which was omitted from the scope of the previous MLFE audit. Office energy use was another new addition to the scope of the audit since the original MLFE project audit (scope 2 emissions). Scope 2 emissions for staff working from home were difficult to incorporate into the audit and a decision was made to exclude these.

## **2.2 UK greenhouse gas conversion factors**

GHG emissions figures were extracted annually from the Defra conversion factors spreadsheets, which are available to download online from [Government conversion factors for company reporting of greenhouse gas emissions - GOV.UK \(www.gov.uk\)](http://www.gov.uk/government/conversion-factors-for-company-reporting-of-greenhouse-gas-emissions)

## 2.3 Delivery by road

GHG emissions associated with the delivery by road of materials were audited for the full range of conservation works treatments, including:

- brash
- geotextile
- gully blocking
- lime, seed and fertiliser application
- plug planting
- *Sphagnum* application
- cutting

Identifying the type of vehicle involved in delivery of road by materials was key to assessing GHG emissions from this scope 3 activity as the different vehicle types use different conversion factors.

Fuel type was also important in assessing GHG emissions associated with road delivery. For example, an assumed fuel consumption of gas oil of 0.24 litres per km was used for GHG emissions calculations of tractor and tractor pulling trailer in the previous MLFE project audit when only distance data was available for the audit (Maskill *et al.* 2015).

Freighting goods conversion factors were used specifically for the shipment of goods over land, by sea or by air through a third party company. Factors are available for a whole vehicles' worth of goods or per tonne of good shipped via a specific transport mode (Defra, 2015).

## 2.4 Flying

GHG emissions associated with flying were audited for the full range of project conservation works treatments, listed under 2.3 Delivery by road.

Different treatment stages of the conservation works involving flying, a scope 3 activity, include:

- Application of material
- Delivery of material
- Stockpiling
- Distributing stockpile
- Removing empty bags
- Contractor travel

Defra conversion factors were extracted from the 'Fuels' tab. Additionally, 'Well to Tank (WTT) fuels' conversion factors were used to account for the upstream scope 3 emissions associated with extraction, refining and transportation of the raw fuel sources to site, prior to combustion (Defra, 2015).

Different helicopter models assume different fuel consumption (litres per km); therefore identifying helicopter model was key to assessing GHG emissions associated with flying. Table 1 in "MoorLIFE: A carbon audit of the project: final report" by Maskill *et al.* 2015, listed the assumed fuel consumption for the different helicopter models flown in the previous MLFE project. These figures are also presented in Table 2 of this report for quick reference, alongside the latest assumptions that were used in the ML2020 project audit.

**Table 2** The assumed fuel consumption of helicopters used in GHG emissions calculations when only distance data was available for the MLFE project audit alongside new assumed fuel consumption figures for use in the ML2020 audit.

| Helicopter model | Assumed fuel consumption (litres per km) |  |
|------------------|--|--|
|                  | MoorLIFE<br>(2011 – Sept 2015)           | MoorLIFE 2020<br>(Oct 2015 – Aug 2021) |
| Bell 205         | 4.80                                     | 5.00                                   |
| Single Squirrel  | 3.15                                     | 3.30                                   |
| Bell 206         | 1.50                                     | 1.60                                   |
| Long Ranger      | 1.25                                     | 1.50                                   |
| Hughes 500       | 0.80                                     | 1.58                                   |

Fuel consumptions for the MLFE project audit were obtained through interviews with the helicopter companies and were derived from records of a specific job, rather than presenting an average consumption figure. The latest updates from the helicopter companies were provided to the data owner in August 2016 (Table 2). The figures represented average fuel consumption whilst lifting a load at capacity for a typical Peak District job of a 3 km carry.

It was assumed that on average the helicopters fly approximately 60 km per hour when load lifting and this is generally how the helicopter companies estimate jobs for MFFP. Several helicopter flight logs were used to calculate this average speed for the previous MLFE project audit. This assumption was also valid for the ML2020 project audit, since helicopter models did not change.

For each activity involving flying charged to the project, fuel consumption of the helicopter model (Table 2) was multiplied by km flown to give total litres of fuel used for the job. Total litres of fuel used was then multiplied by the aviation turbine fuel conversion factor (kg CO<sub>2</sub>e per vehicle unit), for each GHG in turn: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and Total Indirect GHG (upstream WTT emissions). The sum of these figures gave total kg CO<sub>2</sub>e for the flight activity.

In preparation for ML2020 carbon audit data acquisition, a clause was incorporated into tenders with the expectation that contractors would be able to provide the number of litres of fuel used per job. Therefore the assumptions in Table 2 were only used in cases where this information was not able to be provided by the company.

## 2.5 Travel

GHG emissions associated with travel by project staff and contractors, by road and public transport, were audited for the full range of project actions.

### Contractor travel

Records of information about contractor travel to works sites were used to audit GHG emissions arising from this scope 3 activity (Table 1).

Travel by contractor staff from base (or otherwise from a home address or local accommodation) to site occurred typically at the manual application stage of the conservation works treatments: geotextile (fixing), gully blocking, plug planting and *Sphagnum* works. Contractor travel for brash works was necessary at both the production and manual application (spreading) stages of treatment.

Identifying the type of vehicle used to transport contractor staff was key in assessing GHG emissions associated with contractor travel. Type of vehicle was identified in the annual Defra conversion factors spreadsheets, on the 'Passenger vehicles' tab.

We also reported on the upstream scope 3 emissions associated with extraction, refining and transportation of the raw fuels before they were used to power the transport mode. These indirect emissions factors were found on the '*WTT conversion factors for passenger vehicles and business travel on land*' tab (Defra, 2015).

### Staff travel

#### MFFP: pool vehicles

The '*passenger vehicles*' conversion factors (scope 1) were used to report on GHG emissions associated with pool vehicles. Additionally, the '*WTT conversion factors for passenger vehicles and business travel on land*' were used to report the upstream scope 3 emissions associated with extraction, refining and transportation of the raw fuels before they were used to power the transport mode (Defra, 2015).

#### Beneficiary organisations: pool vehicles

The '*passenger vehicles*' conversion factors and '*WTT conversion factors for passenger vehicles and business travel on land*' were used to report on pool vehicles in the same way as for the MFFP pool vehicles.

#### MFFP: employee-owned vehicles

The '*business travel- land*' conversion factors were used to report on vehicles that were used by MFFP but weren't owned by the organisation. This included mileage for business purposes in cars owned by employees, public transport and hire cars (Defra, 2015).

#### **Beneficiary organisations: employee-owned vehicles**

GHG emissions arising from partner employee-owned vehicles were reported in the same way as detailed under MFFP employee-owned vehicles.

#### **Project staff travel by public transport: road and rail**

GHG emissions arising from travel by rail or bus by volunteers were reported by “passenger.km”.

#### **Project staff commute**

GHG emissions arising from project staff commute were reported in the same way as detailed under MFFP employee-owned vehicles.

#### **Volunteer travel**

GHG emissions arising from travel by road by volunteers were reported in the same way as detailed under MFFP employee-owned vehicles.

GHG emissions arising from travel by rail by volunteers are reported by “passenger.km”.

## 2.6 Office energy use

GHG emissions associated with water and electricity consumption were reported on for the primary MFFP staff base: Moorland Centre, Edale. Whilst the facility is shared by four accountable services: MFFP, Peak District National Park Authority (PDNPA) Visitor Centre, PDNPA Ranger Service and Fieldhead campsite, the campsite tenant billed the PDNPA for our contribution to the water supply (MFFP/Visitor Centre/Rangers). The campsite is therefore not accounted for in the PDNPA's Moorland Centre usage figures (see Table 3). However, this still leaves a situation where three accountable services are sharing one facility/utility bill. The split across the three services was therefore estimated in order to determine MFFP's contribution. Further still, an estimation was made to isolate the contribution of the ML2020 project out of the full programme of MFFP projects Table 4. Similarly, the utility bill figures for electricity consumption were for the Moorland Centre as a collective: MFFP/Visitor Centre/Rangers, and did not include the campsite's contribution, so the same splits were used to estimate the contribution that the ML2020 project made to electricity consumption.

The amount of time which each accountable service used the building each year was also considered (Table 5). Whilst calculating the energy used in heating, the amount of floor space used by each accountable service was taken into account along with how this changed over the lifetime of the project (Table 3 and Table 4).

### Moorland Centre electricity usage

Prior to February 2017, the electricity supply to the Moorland Centre and Fieldhead Campsite was supplied by two separate systems; meaning that the Fieldhead Campsite electricity usage was already excluded from the total energy usage figures. From February 2017, the Fieldhead Campsites electricity usage was included within the Moorland Centres usage figures, due to a combined system being installed; this meant that for these subsequent years, the electricity used on the campsite was subtracted from the total energy figures. As both accountable services used electricity meters, it was simply a case of subtracting the campsites usage figure from total electricity usage to calculate electricity used solely by the Moorland Centre. The data was provided per quarter for operations during the day and night. For the purposes of the carbon audit the nightly figures were excluded from the calculations as the Moorland Centre was not used at night.

With the Moorland Centre electricity usage separated from total electricity usage, the MFFP split was calculated using the inventory of energy using appliances spreadsheet. This spreadsheet identified the wattage of each appliance and which appliance each accountable service used at the Moorland Centre. The total wattage of each of these appliances was totalled up for each accountable service and a percentage split was calculated as in the example in Table 3 below.

Table 3. Estimations for the percentage split of energy using appliances at the Moorland Centre by the three accountable services sharing the facility in year 1 and 2 of ML2020

| Service        | Percentage of total wattage (Year 1) | Percentage of total wattage (Year 2) |
|----------------|--------------------------------------|--------------------------------------|
| MFFP           | 35 %                                 | 37%                                  |
| Visitor Centre | 31 %                                 | 29%                                  |
| Ranger Service | 33 %                                 | 34%                                  |

### Moorland Centre heating usage

Heating at the Moorland Centre was controlled by 2 separate heat pumps which utilised electricity to generate heat. The amount of heating used by each accountable service was dictated by the floor space used by each accountable service.

A record of the floor space associated with each room in the Moorland Centre was provided by PDNPA property services, and included those rooms previously used by the campsite. We identified which areas were used by MFFP; an example is provided in Table 4.

Table 4. Estimation of floor space used by MFFP at the Moorland Centre to estimate heating usage for year 1 and 2 of ML2020

| Area  | Floor Space (M <sup>2</sup> ) Year 1 | Floor Space (M <sup>2</sup> ) Year 2 |
|---|--------------------------------------|--------------------------------------|
| Offices ground floor (including toilets and lobby)                        | 41.8                                 | 41.8                                 |
| Offices first floor   | 87.4                                 | 87.4                                 |
| Lab and office above (was ranger briefing centre, workshop and stairwell) |                                      |                                      |
| Stores including plant room   | 38.3                                 | 38.3                                 |
| Campsite facilities   |                                      |                                      |
| Visitor centre  |                                      |                                      |
| Sedum room and meeting room   |                                      | 95.06                                |
| <b>Total office space (M<sup>2</sup>)</b>                                 | <b>167.5</b>                         | <b>262.56</b>                        |

|  |            |            |
|--|------------|------------|
| <b>Percentage floor space used by MFFP</b> | <b>30%</b> | <b>47%</b> |
|--|------------|------------|

Calculating the GHG emissions used to heat the Moorland Centre involved subtracting the electricity used by both heat pumps from total electricity used by the Moorland Centre to obtain a total heating figure. The percentage floor space used by MFFP was calculated and then applied to the total heating figure, giving the total heat used by MFFP to heat the Moorland Centre. The electricity used by both heat pumps was provided by PDNPA property services.

### Expansion of the office space for the Moorland Centre

To successfully deliver the ML2020 project the MFFP team expanded rapidly at the start of the project, to accommodate this rise in staff numbers MFFP spread into additional areas of the Moorland Centre. This meant that both electrical appliances used by MFFP and floor space increased (Table 4). Table 5 identifies when each new room was first used by MFFP.

**Table 5. Date each area of the Moorland Centre building were first used by MFFP staff**

| <b>Area</b>                   | <b>Date first used</b> |
|-------------------------------|------------------------|
| Sedum office and meeting room | July 2016              |
| Middle office                 | April 2017             |
| Lichen office                 | February 2017          |
| Sphagnum office               | April 2016             |

### Days per year that MFFP are operational vs the other PDNPA accountable services

In a typical year, the different accountable services that utilise the Moorland Centre work different hours (e.g. the MFFP team occupied the building all year round, the PDNPA visitor centre closed in winter). This split was not taken account of within the carbon audit calculations, as the heating was not controlled on a room by room basis, and as MFFP occupied the majority of the building, changing any of the heating settings would impact on a room used by MFFP.

Splitting electrical use by the hours each accountable service was operational was not applicable either, as any electricity used to operate appliances (e.g. computers) were taken account of by the electricity meters and the office energy use spreadsheet record.

### Calculating staff working hours for ML2020

Multiple projects were delivered by MFFP staff members, meaning that not all energy used at the Moorland Centre was attributed to ML2020. To take account of this the proportion of time each staff member spent on ML2020 was calculated per annum from their timesheets and an average staff time figure calculated. This proportion was then applied to the overall energy usage. Staff time spent on the

ML2020 project was calculated annually for the first 2 years of the project as additional staffing resource was added, thus increasing total staff hours on ML2020 each year.

### **Calculating water usage for the Moorland Centre**

The Moorland Centre and the Fieldhead Campsite were supplied by the same water pipe, with a sub-meter for the water used by the Fieldhead Campsite. In order to calculate the water usage by the Moorland Centre, the campsite metered figure was subtracted from the total water-metered figure. It was not possible to identify which water was used by which PDNPA accountable service. Therefore a total water usage figure for the whole building was used. Total water usage figures and sub-metered water figures were supplied quarterly.

## **2.7 Calculating intensity ratios by action code**

In order to aid with the overarching monitoring of the project, all ML2020 works were attributed to an action code, meaning a split per action could be calculated. Where multiple actions were associated with a single journey it was possible to work out the split due to the way mileage was recorded. This meant that the carbon emitted could be attributed to a specific action. Intensity ratios for this were also calculated using total MFFP spend to give an intensity ratio for each action code expressed as kg CO<sub>2</sub>e per £ spent. This was chosen because it was the only definitive business metric common for all action codes.

The per action mileage figure used in this calculation does not include the figures for office energy usage or employee commute. This is due to the diversity of actions that MFFP staff members work on, and the associated difficulty of attributing a proportion of the employee commute and office energy usage figure to that employee in order to split it down by action code. This does mean that some action codes which are purely desk based actions (e.g. action D5) are not accurately reflected by the intensity ratios, as these do not have any associated mileage. Where this is the case these have been excluded from the analysis.

## **2.8 Calculating intensity ratios by site**

Carbon emitted by site was calculated because the mileage of all journeys recorded the destination(s). It was then a case of splitting down each journey by destination and working out the carbon emitted in the same way as identified in the travel section. A number of assumptions were made as not all starting points were recorded. Therefore, where a journey had multiple destinations but only one start location the total mileage was split evenly between the different destinations.

In order to calculate the intensity ratios per site, the total mileage attributed to that site was divided by the area of the site in hectares to give an intensity ratio for each site expressed as kg CO<sub>2</sub>e emitted during commuting to the site per area of the site in hectares (ha).

## 2.8 Assumptions

A number of assumptions were made when calculating the GHG emissions figures. A full list of the assumptions made is presented in Appendix 1 Assumptions made of this report.

### 3. Results

#### 3.1. Total carbon emission in year six

In total, 81,827 kg CO<sub>2</sub>e were emitted during year 6 of the project (Table 6). This was considerably less than the other years because the project is winding down.

#### 3.2 Total carbon emissions

Total GHG emissions for entire project were 921,504 kg CO<sub>2</sub>e to date, which is the equivalent of the energy used by 110,970 homes in one year. The majority (60%) of those emissions were associated with years 4 and 5. This coincides with when MFFP had the two biggest delivery seasons in the partnership’s history.

Figure 1 shows the kg CO<sub>2</sub>e across project years. As the scope of activities each year vary there is no comparison available to make between project years. To note year 1 was a preparatory year, which meant that not all members of staff were working on the project and not all activities (e.g. travel, deliveries road) were undertaken in this year. In addition to this, the number of employees increased since the project began. Additionally year 6 represents the final year of the project and the winding down of activities.

Table 6. Total kg CO<sub>2</sub>e for all partners by activity per project year

| Activity                       | Scope    | Year 1               | Year 2               | Year 3               | Year 4               | Year 5               | Year 6               | Total                |
|--------------------------------|----------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                |          | kg CO <sub>2</sub> e |
| Contractor Travel - Helicopter | 3        | 0.0                  | 3,378.7              | 30,604.7             | 30,014.3             | 228.9                | 1,914.0              | 66,140.7             |
| Contractor Travel - Road       | 3        | 0.0                  | 14,14.5              | 5,679.3              | 24,599.0             | 41,957.3             | 19,681.9             | 93,331.9             |
| Delivery - Flying              | 3        | 0.0                  | 18,483.3             | 21,944.3             | 92,362.5             | 138,414.5            | 23,917.9             | 295,122.6            |
| Delivery - Road                | 3        | 0.0                  | 4,452.0              | 5,067.0              | 8,816.1              | 5,654.1              | 7,688.4              | 31,677.6             |
| Employee Commute               | 1 + WTT* | 7,979.6              | 5,6843.3             | 72,342.5             | 75,899.3             | 67,280.0             | 604.5                | 280,949.2            |
| Pool Car Travel                | 1 + WTT* | 222.4                | 2,590.7              | 8,707.6              | 8,830.5              | 7,892.5              | 1,726.8              | 29,970.5             |
| Project Staff Travel           | 1 + WTT* | 998.5                | 4,499.8              | 4,408.2              | 8,882.0              | 10,248.6             | 11,305.1             | 40,342.1             |
| Volunteer Travel               | 1 + WTT* | 0.0                  | 715.0                | 1,612.7              | 4,224.6              | 2,848.8              | 2,510.9              | 11,912.1             |
| Cutting                        | 3        | 0.0                  | 732.5                | 6162.8               | 4,509.1              | 5,186.2              | 7,557.1              | 24,147.7             |

|                              |   |         |          |          |          |          |         |          |
|------------------------------|---|---------|----------|----------|----------|----------|---------|----------|
| Office Energy Use            | 2 | 3,106.2 | 7,808.7  | 7,450.6  | 8,436.0  | 7,069.2  | 0.0**   | 33,870.7 |
| Bogtastic Van Generator      | 2 | 0.0     | 0.0      | 53.3     | 113.1    | 165.0    | 68.9    | 400.3    |
| <b>Total CO<sub>2</sub>e</b> |   | 12435.4 | 101898.1 | 165970.6 | 270161.4 | 289211.9 | 81827.4 | 921504.8 |

\*Well-to-tank (WTT) conversion factors were used to report the upstream Scope 3 emissions associated with extraction, refining and transportation of the raw fuels before they are used to power the transport mode' (UK Government GHG Conversion Factors for Company Reporting, Defra); \*\* Not included within the Total CO<sub>2</sub>e figure as the office was closed for significant portions of the year due to Covid 19; \*\*\*year 1 was a 6 month period; \*\*\*\*year 6 figure is 18 month period.

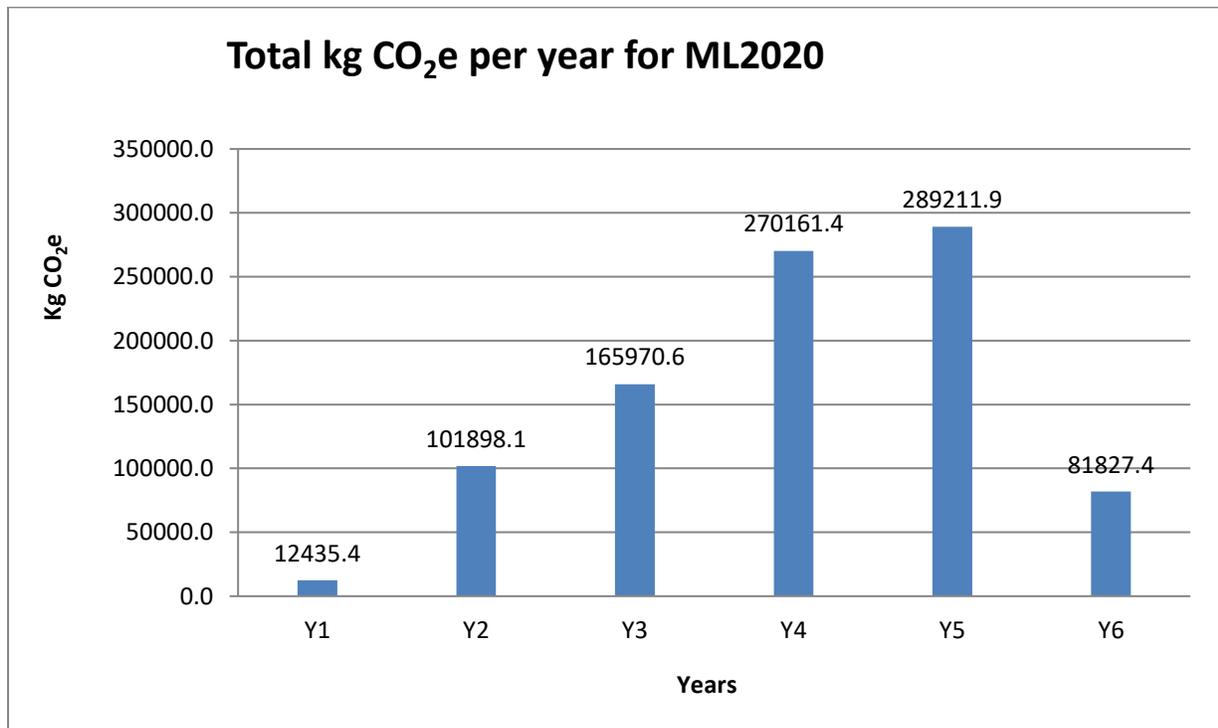


Figure 1 - Total kg CO<sub>2</sub>e expenditure per project year\* by the MoorLIFE2020 project to date (Project years 1–6)

\*year 1 was a 6 month period; \*\*year 6 figure is 18 month period

### 3.3. Travel

Travel figures are presented below by project year, split by travel activity (Table 7). Whilst the amount of work requiring travel undertaken for the project was variable over the life of the project, years 5 and 6 saw some additional effects of the COVID-19 pandemic: notably significantly less office commute emissions were reported in year 6. Additionally, March 2020 saw the project team move to a home working arrangement for the first lockdown and homeworking largely continued throughout year 6. The largest total contribution to staff travel emissions was the employee commute, despite there being overwhelmingly reduced office commute taking place in year 6 of the project Figure 2.

Table 7. Travel emissions by activity and project year associated with the ML2020 project to date

|                             | Y1<br>kg CO <sub>2</sub> e<br>(1 <sup>st</sup> October<br>2015 – 31 <sup>st</sup><br>March 2016) | Y2<br>kg CO <sub>2</sub> e<br>(1 <sup>st</sup> April 2016<br>– 31 <sup>st</sup> March<br>2017) | Y3<br>kg CO <sub>2</sub> e<br>(1 <sup>st</sup> April 2017<br>– 31 <sup>st</sup> March<br>2018) | Y4<br>kg CO <sub>2</sub> e<br>(1 <sup>st</sup> April 2018<br>– 31 <sup>st</sup> March<br>2019) | Y5<br>kg CO <sub>2</sub> e<br>(1 <sup>st</sup> April 2019<br>– 31 <sup>st</sup> March<br>2020) | Y6<br>kg CO <sub>2</sub> e<br>(1 <sup>st</sup> April 2020-<br>31 <sup>st</sup> Aug 2021) | Total<br>kg CO <sub>2</sub> e |
|-----------------------------|--|--|--|--|--|--|-------------------------------|
| <b>Employee Commute</b>     | 7,980  | 56,843   | 72,343   | 75,899   | 67,280   | 605  | 280,950                       |
| <b>Pool Car Travel</b>      | 222  | 2,591  | 8,708  | 8,830  | 7,892  | 1,727  | 29,970                        |
| <b>Volunteer Travel</b>     | 0  | 715  | 1,613  | 4,225  | 2,849  | 2,511  | 11,912                        |
| <b>Project Staff Travel</b> | 1,127  | 5,479  | 6,346  | 12,357   | 12,515   | 16,157   | 53,981                        |
| <b>Total</b>                | 9,329  | 65,628   | 89,010   | 101,311  | 90,536   | 21,000   | 376,814                       |

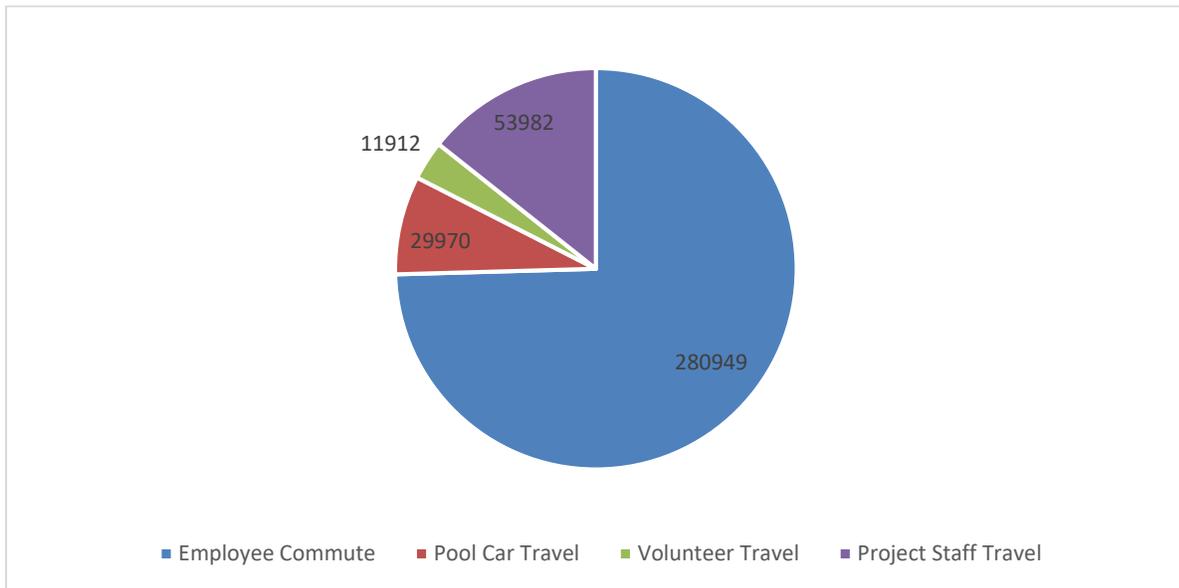
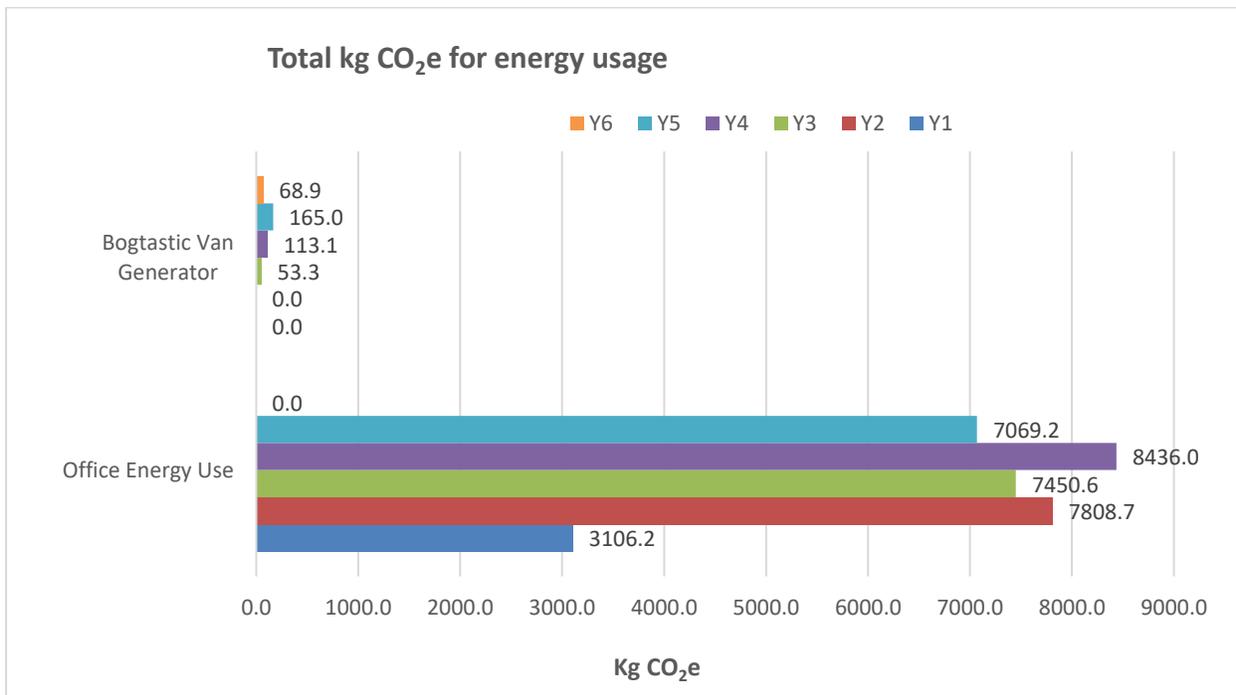


Figure 2. Total emissions in kg CO<sub>2</sub>e associated with staff travel activities for the ML2020 project to date (Project years 1-6)

### 3.4 Energy usage

The two main sources of scope 2 activities were office energy usage and the generator in the BogTastic van (Figure 3). These were classed as source 2 emissions because it involved the production of energy using electricity, water, gas etc. In year 5 and 6 the office energy usage decreases due to COVID-19 pandemic preventing employees working from the office. As it is impossible to determine which part of year 6 staff could work in the office and those staff that did work in the office, it meant that year 6 figures had to be removed from the total CO<sub>2</sub>e figure. Overall, the kg CO<sub>2</sub>e generated remained consistent at approximately 7000 kg CO<sub>2</sub>e generated each year, except year 1, which reported half a year.



\*year 1 was a 6 month period

\*\*year 6 figure is 18 month period

Figure 3 - Kg CO<sub>2</sub>e produced by different energy sources for all project year to date (Year 1-6)

In accordance with government guidelines for reporting GHG emissions produced from fuels (Defra, 2017), the petrol used in the BogTastic van generator was not included within the final carbon audit figures presented in Table 8, as they are classed as outside the scope of the carbon audit. This is because it uses petrol purchased from the forecourt which is blended with biofuels (Defra, 2017), and if a fuel source

includes biofuels then it is counted as net 0 since the fuel source absorbs some carbon during its production (Defra, 2014). The reason the emissions in year 3 are significantly lower than subsequent years is because we received the BogTastic van partway through year 3 and engagement visits vary throughout the project by nature of the events calendar. Whereas year 6 saw the Bogtastic van usage decline because of the Covid-19 Pandemic.

**Table 8 - Outside scope electricity generated from the BogTastic Van generator**

| Year | Emissions (kg CO <sub>2</sub> e) |
|------|----------------------------------|
| 1    | No van                           |
| 2    | No van                           |
| 3    | 1.65                             |
| 4    | 5.23                             |
| 5    | 4.04                             |
| 6    | 1.67                             |

### 3.5 Contractor travel

Figure 4 below identifies that for contractor travel by road the total kg CO<sub>2</sub>e increased from 0 in year 1 to 41,957 kg CO<sub>2</sub>e in year 5, which is when it peaked. Contractor travel by helicopter also increased from 0 in year 1 to 30,604 kg CO<sub>2</sub>e in year three, which is when usage peaks. The reason there is 0 kg CO<sub>2</sub>e in year 1 for both attributes, is that this was a preparatory year and no conservation activities were undertaken.

Generally contractor travel by helicopter is always higher than contractor travel – by road because of the amount of carbon used in aviation fuel when compared to motor vehicle fuel. However, in year 5 and 6, there was limited contractor travel journey undertaken by helicopter, due to the type of conservation works undertaken in those years. This explained why the trend was reversed in those years.

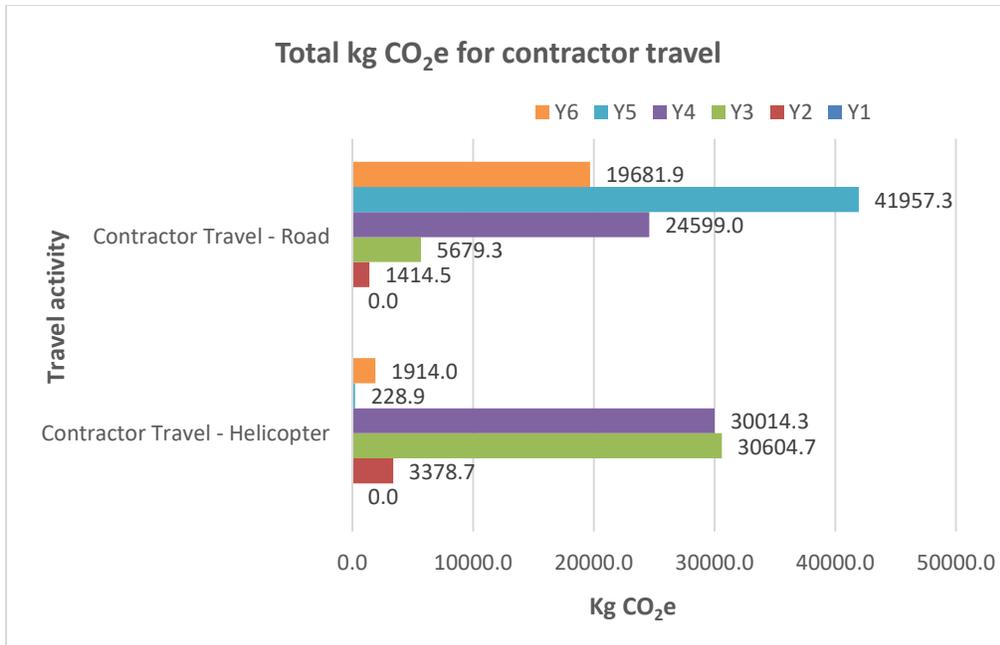


Figure 4 - Total kg CO<sub>2</sub>e for all contractor travel

\*year 1 was a 6 month period; \*\*year 6 figure is 18 month period

### 3.6 Delivery of materials

The amount of material delivered by road peaked in year 4 with 8,816 kg CO<sub>2</sub>e with the other years staying constant around the 5000 kg CO<sub>2</sub>e (Figure 5). This peak was due to a peak in the type of activity and the materials used to deliver it in year four, (e.g. three times as much brash was delivered compared to year 5). The materials delivered by helicopter increased year on year up until the final year when works are slowing down. This is a direct result of the amount / type of works delivered as part of the project (e.g. three times as many stone dams were installed in year 5 compared to year 4).

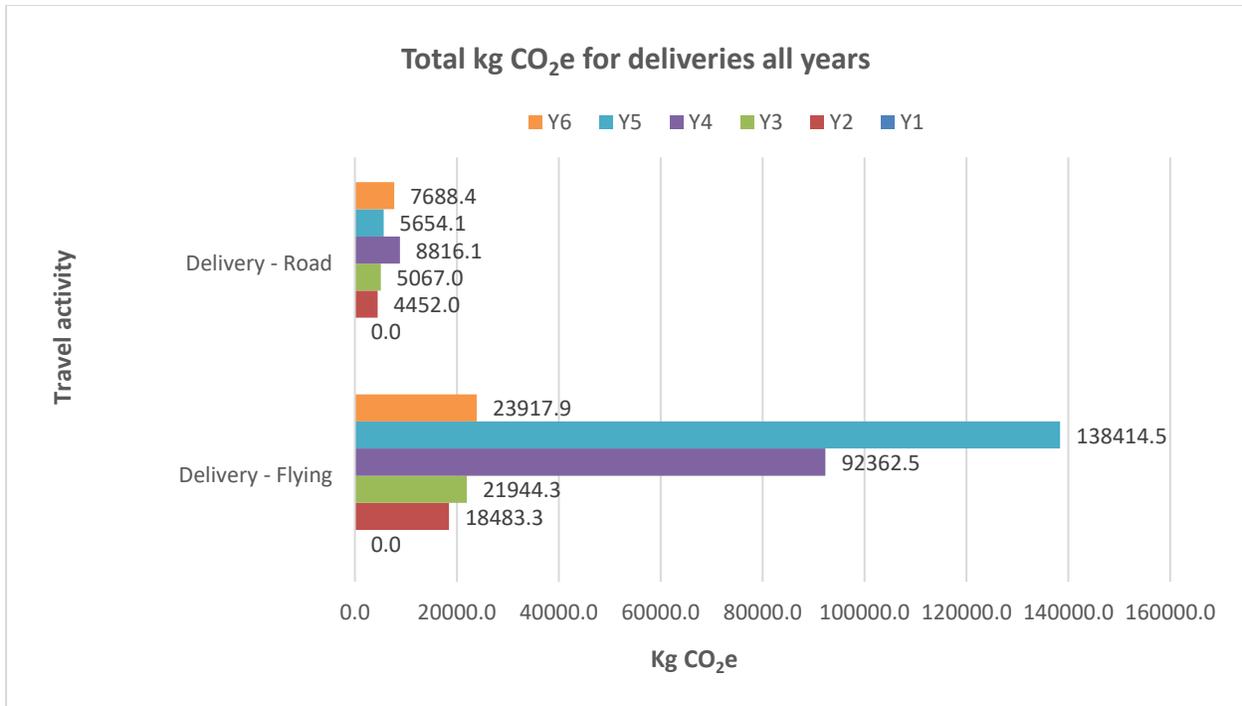


Figure 5 - Total kg CO<sub>2</sub>e for all deliveries for all years of the project

\*year 1 was a 6 month period; \*\*year 6 figure is 18 month period

### 3.7. Cutting

Cutting (e.g. *Molinia Caerulea*, *Calluna Vulgaris* and *Rhododendron Spp*) was variable over project years, as per the project plan. Emissions associated with cutting are presented in Table 9.

Table 9 - Total kg CO<sub>2</sub>e for cutting of all habitats for all project years

|                | Year 1* | Year 2 | Year 3 | Year 4 | Year 5 | Year 6** |
|----------------|---------|--------|--------|--------|--------|----------|
| <b>Cutting</b> | 0       | 732    | 6,162  | 4,509  | 5,186  | 7,557    |

\*year 1 was a 6 month period; \*\*year 6 figure is 18 month period

### 3.8. Intensities ratios

#### Intensity ratio by action code

The results in Table 10 indicate the key ML2020 actions that emitted the largest total amount of kg CO<sub>2</sub>e and the intensity ratio. Action C2 emitting the largest total amount (205,283 tonnes of kg CO<sub>2</sub>e) across

the whole project and had the largest carbon emitted per total spent on it. The top 3 actions (C2, C1, C5) all involve concrete conservation actions when ranked by total carbon emitted for the whole project.

However, when changing the ranking to intensity ratio, we see a slight change in the order with action D2 becoming the second largest emitter of CO<sub>2</sub>e for the whole project. This is primarily because of the large number of journeys that were undertaken to deliver it.

The least amount of CO<sub>2</sub>e attributed to an action is D3 with 4,977 kg CO<sub>2</sub>e across the whole project. Comparing this to the intensity ratios for the different action codes, we see that this is slightly different with actions D1 and E7 having the least amount of carbon emitted by total amount spent on it.

The intensity ratios in Table 10, show the intensity ratio for the key ML2020 actions, a full list is available in Appendix 2 Total CO<sub>2</sub>e and associated intensity ratio for all action codes. The key actions are those actions where travel included a large part of the works. This is because it is impossible to determine the proportion of office energy and employee commute was used to deliver desk based actions. These have been excluded from the analysis above because of this.

**Table 10 Total CO<sub>2</sub>e emitted by action code for MFFP as part of the ML2020 project and associated intensity ratios for selected actions**

| Action | Title  | Total GHG emissions (kg CO <sub>2</sub> e) | TOTAL spend by action* | Intensity ratio (kg CO <sub>2</sub> e per pound (£) spent) |
|--------|--|--|------------------------|--|
| C1     | Protecting active blanket bog by stabilising bare peat   | 173,914                                    | £1,514,604.84          | 0.11   |
| C2     | Restoring hydrology  | 205,283                                    | £1,141,213.40          | 0.17   |
| C3     | Increasing heterogeneity   | 30,433                                     | £586,083.05            | 0.05   |
| C4     | Controlling invasive species   | 4,012                                      | £34,527.30             | 0.11   |
| C5     | Increasing sphagnum  | 35,798                                     | £1,795,071.27          | 0.01   |
| D1     | Monitoring of concrete conservation actions using earth observation  | 7,966                                      | £169,134.43            | 0.04   |
| D2     | Monitoring the biodiversity and ecosystem service impacts at demonstration sites and against blanket bog restoration trajectories at other project sites | 25,550                                     | £161,608.97            | 0.15   |
| D3     | Monitor peat pipe blocking effectiveness and efficiency and produce best practice guidance   | 4,977                                      | £60,925.02             | 0.08   |
| E7     | Bogtastic & fire aware   | 7,426                                      | £141,307.32            | 0.04   |

\* The total spend figures are from 13<sup>th</sup> December 2021

### *Intensity ratio by site*

When comparing the kg CO<sub>2</sub>e emitted by site it is possible to determine that Alport had the largest carbon expenditure and intensity ratio across the whole project with 138,558.52 kg CO<sub>2</sub>e emitted to deliver the works, providing an intensity ratio of 119.21 kg CO<sub>2</sub>e per ha, see Table 11.

The three sites that had highest CO<sub>2</sub>e emissions and intensity ratios were those sites which involved both calm team works and monitoring by the Science team. This is because there are regular journeys to undertake the required monitoring, and on top of this the delivery of work leads to a lot of emissions from helicopter works and contractor travel.

The least amount of kg CO<sub>2</sub>e emitted was for Mossy Lea, with just 4.72 kg CO<sub>2</sub>e emitted to deliver the ML2020 works, excluding the 22 sites that had no works associated with them. When looking at the intensity ratio, we see that the lowest intensity ratio is also for Mossy Lea, with an intensity ratio of 0.005 CO<sub>2</sub>e. This is because no conservation work was undertaken on site, and only one journey to the site was recorded. Comparing the total amount of kg CO<sub>2</sub>e to the intensity ratios a number of changes in the ranking occur, with one of the biggest change being Castleshaw, jumping from 21<sup>st</sup> to 7<sup>th</sup> in the list.

Appendix 3 Total CO<sub>2</sub>e and associated intensity ratio for all sites provides a full list of the total kg CO<sub>2</sub>e and intensity ratios for all sites identified as part of the ML2020.

**Table 11 Total CO<sub>2</sub>e emitted by site as part of the ML2020 project and associated intensity ratio**

| Site             | Size of site (Ha) | Total carbon (kg CO <sub>2</sub> e) | Intensity ratio (kg CO <sub>2</sub> e per ha) |
|------------------|-------------------|-------------------------------------|---|
| Alport           | 1,162             | 138,558.52                          | 119.21  |
| Ashop            | 1,641             | 25,547.54                           | 15.56   |
| Ashway           | 970               | 25,750.99                           | 26.56   |
| Birchinlee       | 1,473             | 29,933.62                           | 20.32   |
| Bobus            | 151               | 4.56                                | 0.03  |
| Castleshaw       | 223               | 5,640.71                            | 25.24   |
| Close Moss       | 992               | 5,064.54                            | 5.10  |
| Crowden          | 2,286             | 10,337.19                           | 4.52  |
| Derwent & Howden | 2,300             | 78,295.43                           | 34.04   |
| Ilkley Moor      | 769               | 205.92                              | 0.26  |
| Mossy Lea        | 892               | 4.72                                | 0.005   |
| Pikenaze         | 957               | 8,463.34                            | 8.84  |
| Readycon Dean    | 183               | 2,827.25                            | 15.45   |

### 3.9 Associated beneficiaries CO<sub>2</sub>e contributions

Table 12 identifies the split by partners to allow our associated beneficiaries to identify where they can reduce the amount of carbon emitting activities.

**Table 12 - Total CO<sub>2</sub>e contributions (kg) by associated beneficiaries for all years associated with the ML2020 project and the highest contributing activities**

| <b>Partner</b> | <b>All project total kg CO<sub>2</sub>e</b> | <b>Highest contributing activities towards the total</b> |
|----------------|---|--|
| MFFP           | 724,668                                     | Deliveries – flying and contractor travel - road         |
| NT             | 159,670                                     | Deliveries – flying and employee commute                 |
| PP             | 2,660                                       | Employee commute and project staff travel                |
| RSPB           | 34,505                                      | Deliveries – flying and pool car travel                  |

## 4. Impacts

Research undertaken by Worrall *et al.* (2011) identified that restoration of state 2 (bare peat) active blanket bog sites (MFFP, 2012) can produce a significant overall positive carbon benefit. A carbon modelling exercise undertaken by Professor Fred Worrall, Durham University (2021) investigated the GHG benefits of the restoration techniques that were used to diversify the 68 ML2020 blanket bog sites, including heather cutting, gully blocking and *Sphagnum* planting. Worrall reported an achieved carbon and GHG benefit in 48 % of the restoration areas. The modelling work showed that gully blocking coupled with *Sphagnum* planting had the greatest GHG impact. GHG benefit was shown to accelerate over time and the accumulated net present value of the GHG at non-traded carbon prices was forecast to be £6 million by 2080. Further work was recommended in order to reduce uncertainty in the results, which were different between phase 1 (2020) and phase 2 (2021) modelling, due to the changes in vegetation attribution between years. The phase 2 modelling showed an overall immediate disbenefit of 364 tonnes CO<sub>2e</sub>/yr, whereas the phase 1 modelling had shown an overall saving of 1490 tonnes CO<sub>2e</sub>/yr in the first year after restoration (Worrall, 2021).

Additionally, the non-ecological GHG emissions that are associated with the project delivery that are presented in this report are all 'one-off' emissions. Over time the project is forecast to have made a positive carbon benefit due to the accumulated GHG benefit (Worrall, 2021). Despite this, MFFP and our associated beneficiaries are committed to reducing the carbon footprint associated with the project through a number of key areas.

The outcomes of the project carbon audit indicate that the greatest saving could be achieved in areas relating to staff travel / employee commute, which contributed the most to total GHG emissions in 3 out of the 5 project years, excluding year 6 which was affected by COVID-19 pandemic. Some recommendations are:

- Car sharing / use of public transport when and where logistically possible.
- Purchase or lease of vehicles with the lowest CO<sub>2</sub>/ km emissions (e.g. hybrid vehicles).
- Optimise/ reduce number of meetings - use of remote meeting facilities / telephone and video conferences.
- Work from home days.

Additionally, the greatest individual carbon emissions are in relation to helicopter journeys, therefore undertaking the following actions will also help to reduce our carbon footprint:

- Specifying local helicopter take-off sites and the right helicopters for the job, where appropriate.
- Accurately specifying areas using desk-based GIS and helicopter-mounted GPS.
- Siting lift points as close to the working area as possible.

## 5. Lessons learnt

In future, to make data processing more efficient it is suggested that when employees record their destination on a travel claim the ML2020 site is also recorded. Road names (e.g. A57) or local / colloquial names (e.g. Snake Summit) caused a number of issues including:

1. There can be more than one ML2020 site along a road making it difficult to ascertain which site was visited without significant investigation.
2. It can be difficult to ascertain which location the employee visited as there can be more than one place with the same name, or the place is not shown on a map. This again meant that each one had to be investigated before a site could be assigned to the journey.

Not only is this inefficient but it also adds a degree of error into the calculations, as journeys could be assigned to the wrong site especially where employees have left the organisation and can't be contacted to verify the location of the journey.

## 6. Conclusion

In total the project has emitted **921,504** kg CO<sub>2</sub>e to date, which is the equivalent of running 110,970 homes for 1 year. The majority (60%) of the emissions were recorded in year 4 (270,161 kg CO<sub>2</sub>e) and year 5 (289,211 kg CO<sub>2</sub>e) due to the type and amount of restoration activities that was undertaken in those years.

Analysis of the data indicates that the three activities that contributed the largest amount to total kg CO<sub>2</sub>e throughout the project were:

- Helicopter Deliveries – **295,122 kg CO<sub>2</sub>e.**
- Employee Commute – **280,949 kg CO<sub>2</sub>e.**
- Contractor Travel by Road – **93,331 kg CO<sub>2</sub>e.**

Whilst operations involving flying were expected to contribute a significant amount of kg CO<sub>2</sub>e, based upon the findings of the original MoorLIFE carbon audit, employee commute was not expected to be such a significant contribution. This could be due to a number of factors, including a significant increase in the number of staff delivering the project compared to the original MoorLIFE project.

In depth analysis of the data identified that the top three sites (Alport, Arnfield and Derwent and Howden) that emitted the largest amount of kg CO<sub>2</sub>e and had the largest intensity ratios, were those sites where both conservation works and regular monitoring visits were undertaken. Outside the top three sites the ranking changed depending on if they were ranked by total emissions or by the intensity ratio, with Castleshaw being one of the largest changes in ranking.

Total carbon emitted by action code figures revealed that the top three total emissions were associated with the concrete conservation actions (C2, C1, C5 respectively). However, the top three changed when looking at it by intensity ratio, with action D2 being the second most intensive action that we carried out. This was due to the large number of journeys that were undertaken as part of the works. The site that recorded the least amount of CO<sub>2</sub>e emitted was Mossy Lea with just 4.72 kg CO<sub>2</sub>e.

With employee commute contributing a significant share to the total kg CO<sub>2</sub>e emitted for each year of the project, recommendations for implementing / encouraging staff to undertake the following measures would have the greatest impact in reducing the carbon footprint of future peatland restoration projects:

- Car sharing / use of public transport when and where logistically possible.
- Optimise/ reduce number of meetings - use of remote meeting facilities/telephone and video conferences.
- Purchase or lease of vehicles with the lowest CO<sub>2</sub>/ km emissions (e.g. hybrid vehicles).

Whilst the largest individual GHG emissions are produced from helicopter use, other ways to reduce the emissions would be to:

- Specify local helicopter take-off sites and the right helicopters for the job.
- Accurately specify areas using desk-based GIS and helicopter-mounted GPS.
- Siting lift points as close to the working area as possible.

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## Appendix 1 Assumptions made

### Conservation works

1. For helicopter flights from base to site it is assumed that a straight line is flown. Fuel consumption multiplied by km flown.
2. Stone wagons are 100 % laden if delivering 20 tonnes.
3. Tractor and trailer uses 0.24 litres of diesel per km.
4. Heather Cutting – Cutting tractor travels 12.5 m per bag / bale and collecting vehicles travel 50 m per bag on average. Assume one cutting tractor and one collecting tractor per job.

### Helicopter works

1. Helicopter base to site flights – Assumed that a straight line is flown from base to site. Fuel consumption multiplied by km flown.
2. Helicopter Fuel is calculated as Aviation Turbine Fuel – Scope 1 as there is no option on Scope 3
3. MoorLIFE carbon audit did not include flights from base to site eg. AH flying from Devon to Glossop. ML2020 audit includes these journeys and also the ground crew journeys.

### Travel

1. All notes for individual entries are noted on the relevant spreadsheet using the comments function.

### Commute

1. A commute is defined either as a person's journey from home to base or home to a meeting point (where there may be an onward journey to site).
2. The estimation does not take account of holidays.
3. If an employee walks / cycles / car shares to work then the total number of days worked on ML2020 is reduced to take account of this change.
4. If an employee only undertakes, on average 0.25 days or less than this on ML2020 then the figure is rounded down to 0 and they are excluded from the calculation.
5. The number of weeks worked on ML2020 is dependent on when the employee started, and only includes full weeks, if an employee started mid-week, this week is discounted, to take account of any inductions they would be required to take.

6. Only full weeks are taken account of, therefore if a person started part-way through a week, this is not included within the calculation.
7. If an employee commutes to two bases regularly, the commute to the second base (e.g. Aldern house) is included as a separate entry.

### **Pool Cars**

1. We are only interested in number of miles, not the number of people within the car.

### **Working from home**

1. It is better to use an accurate figure is included within the calculations, but if this isn't possible then an estimate is fine, because days spent working from home can be ad-hoc.

### **Volunteer Travel**

1. Only those volunteers that submit a travel claims are captured within the data, if they do not submit a travel claim we cannot prove the journey for audit purposes.

### **Office Energy Use**

1. We are not expecting co-beneficiaries to report on office energy use.
2. As it is difficult to calculate the weekly energy usage for ML2020, the campsite electricity figure for February 2017 has not been separated out from total energy usage.

### **Split by Site**

1. Where a journey had multiple destinations but only 1 starting location. The mileage was split equally between those destinations.

## Appendix 2 Total CO<sub>2</sub>e and associated intensity ratio for all action codes

| Group | Action | Total GHG emission (kg CO <sub>2</sub> e) | Rank by Total GHG emissions | Intensity ratio | Rank by intensity ratio |
|-------|--------|---|-----------------------------|-----------------|-------------------------|
| A     | 1      | 113.7706                                  | 21                          | 0.016907        | 24                      |
| A     | 2      | 82.56389                                  | 22                          | 0.087311        | 14                      |
| A     | 3      | 406.5631                                  | 19                          | 0.662975        | 2                       |
| A     | 4      | 3026.181                                  | 10                          | 0.563119        | 3                       |
| A     | 5      | 494.1946                                  | 18                          | 0.017871        | 23                      |
| A     | 6      | 74.20307                                  | 23                          | 0.00847         | 26                      |
| A     | 7      | 2070.979                                  | 11                          | 0.061387        | 17                      |
| C     | 1      | 173914.9                                  | 2                           | 0.114825        | 13                      |
| C     | 2      | 205283.6                                  | 1                           | 0.179882        | 9                       |
| C     | 3      | 30433.96                                  | 4                           | 0.051928        | 19                      |
| C     | 4      | 4012.073                                  | 9                           | 0.1162          | 12                      |
| C     | 5      | 35798.35                                  | 3                           | 0.019943        | 22                      |
| C     | 6      | 1798.116                                  | 12                          | 0.280884        | 6                       |
| D     | 1      | 7966.731                                  | 6                           | 0.047103        | 21                      |
| D     | 2      | 25550.18                                  | 5                           | 0.158099        | 10                      |
| D     | 3      | 4977.284                                  | 8                           | 0.081695        | 15                      |
| D     | 4      | 587.469                                   | 17                          | 0.392499        | 5                       |
| D     | 5      | 234.5761                                  | 20                          | 0.207133        | 8                       |
| D     | 6      | 49.14418                                  | 25                          | 0.003722        | 27                      |
| E     | 1      | 1360.011                                  | 13                          | 0.056002        | 18                      |
| E     | 2      | 24.44354                                  | 26                          | 0.065905        | 16                      |
| E     | 3      | 6.168036                                  | 27                          | 0.471562        | 4                       |
| E     | 4      | 615.0907                                  | 16                          | 0.013243        | 25                      |
| E     | 5      | 52.68622                                  | 24                          | 2.19709         | 1                       |
| E     | 6      | 978.7179                                  | 14                          | 0.14492         | 11                      |
| E     | 7      | 6722.822                                  | 7                           | 0.047576        | 20                      |
| F     | 1      | 830.3575                                  | 15                          | 0.254492        | 7                       |

### Appendix 3 Total CO<sub>2</sub>e and associated intensity ratio for all sites

| Site name        | Total GHG emissions (kg CO <sub>2</sub> e) | Rank by total GHG emissions | Intensity ratio | Rank by intensity ratio |
|------------------|--|-----------------------------|-----------------|-------------------------|
| Alport           | 138558.5                                   | 1                           | 119.2152565     | 1                       |
| Arnfield         | 72023.11                                   | 3                           | 73.82368505     | 2                       |
| Derwent & Howden | 78295.43                                   | 2                           | 34.04873887     | 3                       |
| East Crowden     | 4370.722                                   | 24                          | 29.68487772     | 4                       |
| Widdop           | 17522.56                                   | 7                           | 29.32488699     | 5                       |
| Ashway           | 25751                                      | 5                           | 26.56103966     | 6                       |
| Castleshaw       | 5640.71                                    | 21                          | 25.24893134     | 7                       |
| Birchinlee       | 29933.63                                   | 4                           | 20.32259411     | 8                       |
| Heptonstall      | 15909.67                                   | 8                           | 19.83074542     | 9                       |
| Soyland          | 15854.77                                   | 9                           | 19.7545454      | 10                      |
| Deanhead         | 6617.909                                   | 20                          | 18.94457717     | 11                      |
| Ashop            | 25547.54                                   | 6                           | 15.56367902     | 12                      |
| Readycon Dean    | 2827.255                                   | 26                          | 15.45058601     | 13                      |
| Ovenden          | 6752.042                                   | 19                          | 14.8846478      | 14                      |
| Turley Holes     | 11657.15                                   | 11                          | 14.69432712     | 15                      |
| Warley Moor      | 7845.258                                   | 15                          | 14.3473111      | 16                      |
| Oxenhope Moor    | 2820.924                                   | 27                          | 14.32334607     | 17                      |
| Butterly         | 1472.35                                    | 29                          | 13.91920655     | 18                      |
| Rishworth South  | 7229.182                                   | 17                          | 13.84953281     | 19                      |
| Stalybridge      | 14615.15                                   | 10                          | 13.44974076     | 20                      |
| Langfield        | 7678.052                                   | 16                          | 13.26771638     | 21                      |
| Pikenaze         | 8463.342                                   | 13                          | 8.842799741     | 22                      |
| Ronksley         | 8016.225                                   | 14                          | 6.999836292     | 23                      |
| Thornton Moor    | 1133.786                                   | 31                          | 6.994376817     | 24                      |
| Wessenden        | 4755.09                                    | 23                          | 6.144237111     | 25                      |
| Rishworth North  | 7074.78                                    | 18                          | 6.090115158     | 26                      |
| Keighley Moor    | 2391.575                                   | 28                          | 5.408288908     | 27                      |
| Close Moss       | 5064.542                                   | 22                          | 5.107478002     | 28                      |
| Crowden          | 10337.19                                   | 12                          | 4.52271402      | 29                      |
| Peaknaze         | 3768.37                                    | 25                          | 3.061838984     | 30                      |
| The Roaches      | 509.4736                                   | 36                          | 1.391630492     | 31                      |
| Noe Stool        | 62.50702                                   | 52                          | 0.987892121     | 32                      |
| Snailsden        | 772.2679                                   | 32                          | 0.941890526     | 33                      |
| Nether Moor      | 595.9463                                   | 35                          | 0.912876196     | 34                      |
| Saddleworth      | 1332.247                                   | 30                          | 0.842890861     | 35                      |

|                               |          |    |             |    |
|-------------------------------|----------|----|-------------|----|
| <b>Blackstone Edge</b>        | 369.2719 | 37 | 0.827037857 | 36 |
| <b>High Brown Hill</b>        | 740.4331 | 33 | 0.826602309 | 37 |
| <b>Ughill Moors</b>           | 196.6288 | 43 | 0.824614755 | 38 |
| <b>Trawden</b>                | 302.8702 | 39 | 0.754023139 | 39 |
| <b>Roych</b>                  | 293.0318 | 40 | 0.6205466   | 40 |
| <b>Morridge</b>               | 148.3671 | 45 | 0.475349694 | 41 |
| <b>Bradfield</b>              | 661.2249 | 34 | 0.463142417 | 42 |
| <b>Harden Moor</b>            | 38.8648  | 55 | 0.411856444 | 43 |
| <b>Crompton Moor</b>          | 8.46266  | 66 | 0.316696436 | 44 |
| <b>Brown Edge</b>             | 36.98506 | 56 | 0.277328656 | 45 |
| <b>Wessenden Head</b>         | 304.7428 | 38 | 0.269703411 | 46 |
| <b>Ilkley Moor</b>            | 205.9233 | 42 | 0.267888779 | 47 |
| <b>Cupwith Hill</b>           | 26.91982 | 60 | 0.236038864 | 48 |
| <b>Holcombe Moor NT</b>       | 106.4337 | 48 | 0.233258061 | 49 |
| <b>Deer Hill Moss</b>         | 72.30373 | 51 | 0.221292386 | 50 |
| <b>Twizle Head</b>            | 72.98434 | 50 | 0.188715112 | 51 |
| <b>Moscar North</b>           | 137.2297 | 46 | 0.179262383 | 52 |
| <b>Combs Moss</b>             | 90.07817 | 49 | 0.174311758 | 53 |
| <b>Woodhead</b>               | 213.1152 | 41 | 0.147508815 | 54 |
| <b>Walsden</b>                | 31.20563 | 59 | 0.131717335 | 55 |
| <b>Stanbury Moor</b>          | 41.89568 | 54 | 0.092357106 | 56 |
| <b>Langsett</b>               | 113.557  | 47 | 0.088014167 | 57 |
| <b>Pule</b>                   | 15.30679 | 62 | 0.085104765 | 58 |
| <b>Big Moor and Leash Fen</b> | 184.9338 | 44 | 0.077161747 | 59 |
| <b>North Lees</b>             | 19.31575 | 61 | 0.05313281  | 60 |
| <b>Midhope</b>                | 36.70843 | 57 | 0.036728094 | 61 |
| <b>Scout Moor</b>             | 46.64696 | 53 | 0.036317447 | 62 |
| <b>Bobus</b>                  | 4.569518 | 68 | 0.030332402 | 63 |
| <b>Thurlstone</b>             | 12.11707 | 63 | 0.022149025 | 64 |
| <b>Moscar South</b>           | 35.69587 | 58 | 0.021215661 | 65 |
| <b>Crag Estate</b>            | 11.7482  | 64 | 0.012779689 | 66 |
| <b>Butterworth</b>            | 8.845256 | 65 | 0.011108227 | 67 |
| <b>Mossy Lea</b>              | 4.728038 | 67 | 0.005298064 | 68 |
| <b>Bodkin Farm</b>            | 0        | 69 | 0           | 69 |
| <b>Broomhead</b>              | 0        | 70 | 0           | 70 |
| <b>Edgworth Enclosure</b>     | 0        | 71 | 0           | 71 |
| <b>Emmott Moor</b>            | 0        | 72 | 0           | 72 |
| <b>Grindsbrook</b>            | 0        | 73 | 0           | 73 |
| <b>Holcombe Moor MOD</b>      | 0        | 74 | 0           | 74 |
| <b>Moscar Flats</b>           | 0        | 75 | 0           | 75 |

|                          |   |    |   |    |
|--------------------------|---|----|---|----|
| <b>Musden Head Moor</b>  | 0 | 76 | 0 | 76 |
| <b>Oakworth Moor</b>     | 0 | 77 | 0 | 77 |
| <b>Stott Hill Moor</b>   | 0 | 78 | 0 | 78 |
| <b>Sutton Moor</b>       | 0 | 79 | 0 | 79 |
| <b>Thurris Rough</b>     | 0 | 80 | 0 | 80 |
| <b>Turncliffe Common</b> | 0 | 81 | 0 | 81 |
| <b>West Crowden</b>      | 0 | 82 | 0 | 82 |
| <b>Winterhill</b>        | 0 | 83 | 0 | 83 |
| <b>Yeoman Hill</b>       | 0 | 84 | 0 | 84 |
| <b>Burbage</b>           | 0 | 85 | 0 | 85 |
| <b>Walshaw</b>           | 0 | 86 | 0 | 86 |
| <b>Haworth Moor</b>      | 0 | 87 | 0 | 87 |
| <b>Higher Moor</b>       | 0 | 88 | 0 | 88 |
| <b>Nab Water</b>         | 0 | 89 | 0 | 89 |
| <b>Stanbury Moor</b>     | 0 | 90 | 0 | 90 |