

Embodied Carbon

Date: 21st July 2022

Report of: Chief Officer Highways and Transportation

Report to: Consultative Meeting of Climate Emergency Advisory Committee

Will the decision be open for call in? Yes No

Does the report contain confidential or exempt information? Yes No

Brief summary

This report seeks to outline the current practices undertaken within Highways and Transportation to address the climate emergency with specific reference to **embodied carbon**

The report will briefly examine;

- carbon calculation tools
- procurement
- low carbon materials
- offsetting

Introduction

The Highways and Transportation Service is fully committed to reducing its carbon footprint and impact. Each team within the Service is identifying means of working towards the Council's target. It is a simple fact however that the building of infrastructure generates carbon emissions.

The appendix outlines some innovative work that has been undertaken in respect of the Flood Alleviation Scheme, whilst bringing vitally important significant flood defences to the city where there was none previously. The key areas where carbon emissions are generated are;

- Asphalt
- Concrete
- Steel
- Other raw materials
- Materials sent to landfill, and
- Construction Vehicles

Other key area of concern which is often very emotive is the removal of green space and trees.

Although not directly linked to embodied carbon but should be considered is the consequence of building infrastructure, especially roads. This can lead to more traffic and higher speeds generating

further carbon emissions. There is a counter argument that reducing congestion can also reduce carbon emissions?

New highway infrastructure is generally provided to achieve other strategic objectives to accommodate for example new development including businesses, retail outlets and housing developments, all of which can generate further carbon emissions.

In addition to the above, both new and existing highway infrastructure needs to be maintained which again can generate carbon.

H&T Response to Address Embodied Carbon

H&T has set up a climate emergency task group looking at not only embodied carbon but how it reacts to the climate emergency and the whole life carbon footprint of the service and what it delivers.

Over the last two years, the Highways and Transportation service has delivered an annual capital programme of circa. £200m. Included in this are some major infrastructure projects such as the East Leeds Orbital Route (ELOR), the Leeds Flood Alleviation Scheme Phase 2 (LFAS2).

These major infrastructure schemes have been delivered through existing frameworks which themselves already have carbon calculation tools and carbon targets incorporated into their operation.

Carbon Calculation Tools

In order to assess the carbon footprint of delivering infrastructure, this has to be calculated and be auditable. As mentioned above, some of the existing frameworks used by H&T already have facilities and methodologies for calculating the carbon generated on the project. A number of the consultants employed by H&T are also developing carbon calculation tools not only to assess embodied carbon, but also to assess the whole life carbon footprint of a project.

This is an area where standardisation is required, and it is likely that a national standard will be adopted for local government driven by central government funders such as DfT and WYCA.

The LFAS2 has done a great deal of work on carbon emissions working with the Environment Agency outlined in a short note in Appendix 1.

Procurement

H&T is reducing its reliance on other frameworks and is procuring a suite of three bespoke frameworks to deliver infrastructure works of varying sizes;

- Minor Works Contractor Framework < £2m,
- Intermediate Works Contractor Framework £2m to £7m, and the
- Major Works Contractor Framework > £7m.

Each of these frameworks has a social value element, in line with the Council's procurement guidance, with a commitment made by suppliers based on the Leeds Themes, Outcomes and Measures (TOM's). A significant part of the TOM's is based around the climate emergency with a commitment to reduce carbon emissions including embodied carbon.

Works are awarded to suppliers through mini competition and there is the ability to promote lower carbon materials through the social value element but also being able to specify lower carbon materials within the scope of the works.

Lower Carbon Materials

The construction industry as a whole is reacting to the global climate issues with many new lower carbon products emerging on the market. Many of these, however, are at a premium and I suspect that only over time as they become more widely used will they start to become comparable replacements. The current rate of inflation and the conflict in Ukraine is only adding to the pressures in adopting these lower carbon materials.

H&T is fully committed to reducing its carbon footprint and accepts the challenge often working within finite budgets from both public and private promoters. In order to achieve this, less infrastructure may be delivered whilst some may not be delivered at all due to their carbon content.

Trials of lower carbon materials are being conducted on a number of schemes e.g. on the A63 in Garforth where a small access into a new residential development used a warm-mix asphalt pavement construction saving 4300kg of CO₂. These new lower carbon materials will be monitored for performance but warm lay asphalt is already becoming more readily available as a standard viable option.

Other areas where embodied carbon can be reduced is in low carbon concrete, using recycled steel and on ELOR, the use of energy efficient site cabins saved over 500 tonnes of CO₂ being produced.

Lower carbon materials are not the whole solution and may account for a 20% reduction. Other areas such as low emission site vehicles, the use of bio diesel, and reducing the amount of material going to landfill by recycling is just as important.

Another important factor to be considered is the offsetting that can be done by landscaping and planting, mainly by planting trees. On ELOR, around 3000 new trees will be planted with a further 30,000 whips with the total landscaping area equivalent to Roundhay Park.

Summary

The climate emergency is real and positive action is being taken. As a Client and Employer, H&T can significantly influence the carbon footprint of what we build but many lower carbon alternatives are currently new technology and/or experimental. Over time, these lower carbon materials will become the norm helping to achieve net zero.

Reducing the amount of embodied carbon in the material that are used is only part of the answer. Other measures such as;

- Incorporating emissions standards into contracts with suppliers.
- Using ultra-low emission or electric vehicles where they meet the needs of maintenance and support work.
- Reducing the use of carbon-intensive equipment during road renewal work.
- Using energy-efficient lighting for roadsides, tunnels and signage.
- Recycling and reducing the amount of material going to landfill
- Planting trees for capturing to offset the carbon produced

The current pressures on finance and material availability cannot be ignored and only adds to the challenge. However, through new procurement routes linked in with strong social value requirements significant carbon savings will continue to be made.

Recommendations – To receive and note the contents of the report, and comment upon it as appropriate

Appendix 1

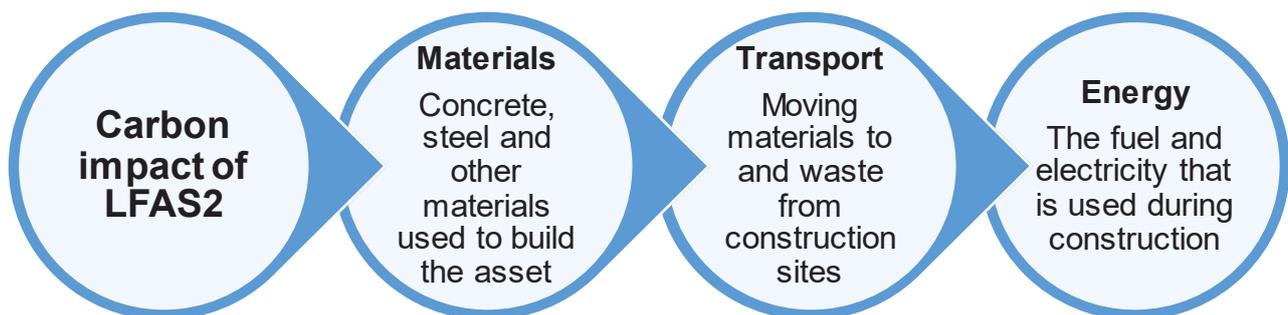
Leeds Flood Alleviation Scheme (Phase 2): Carbon savings and low carbon innovation

This document provides an overview of the carbon impact of the Leeds Flood Alleviation Scheme Phase 2 (LFAS2). It demonstrates the carbon savings of reducing flood risk and captures some of the innovative low carbon activities taking place through the construction of the scheme.

LFAS2 aims to reduce flood risk to communities and businesses along the River Aire corridor between Leeds Rail Station and Apperley Bridge. The scheme will provide a one-in-200-year level of protection against flooding in the LFAS2 area. Once delivered, the scheme will reduce flood risk and provide better protection for 1,048 homes and 474 businesses.

Carbon and infrastructure

The construction, operation and decommissioning of assets is a major source of greenhouse gases (GHGs), henceforth referred to as “carbon equivalents”¹. Leeds City Council (LCC) has recognised the scale of the challenge of reaching Net Zero emissions in the UK by 2050 by declaring a climate emergency in 2019 and prioritising the reduction of carbon in infrastructure projects.



LFAS2 carbon reduction

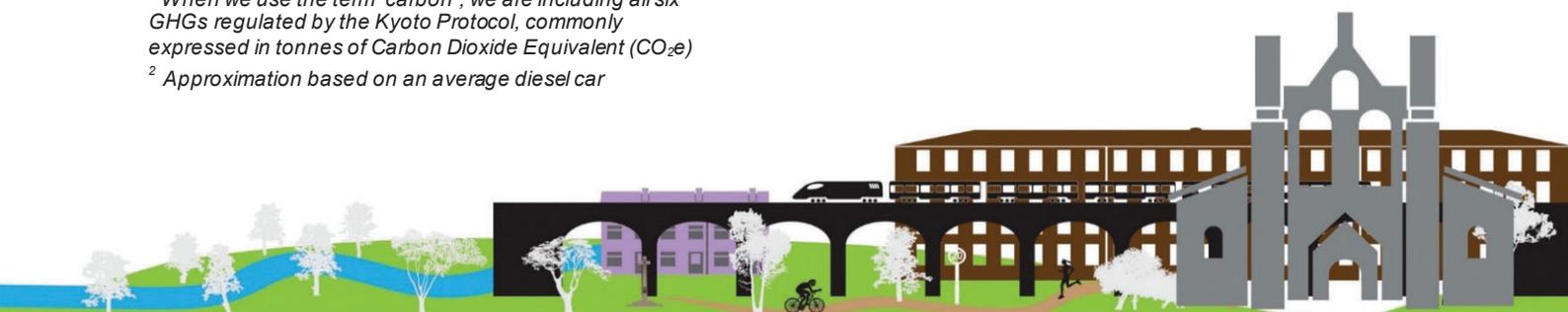
To address the carbon impact of the scheme, we established a **carbon baseline** – the quantity of carbon that would be emitted because of the scheme without additional mitigation. The baseline emissions associated with the construction of LFAS2 are estimated to be approximately 23,600 tonnes of CO₂ equivalent (tCO₂e). That is the equivalent of driving around the world 3,500 times².

We are working closely with engineers and contractors on the project to reach the targets set out below. Carbon specialists are sharing insights from the carbon baseline and suggesting alternative, lower-carbon approaches.

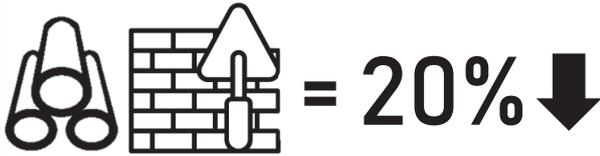
We will continue to monitor progress against our targets as the design progresses.

¹ When we use the term “carbon”, we are including all six GHGs regulated by the Kyoto Protocol, commonly expressed in tonnes of Carbon Dioxide Equivalent (CO₂e)

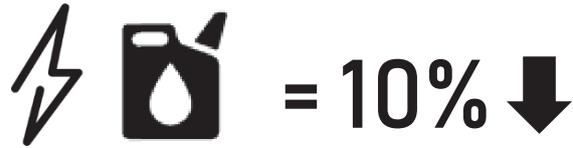
² Approximation based on an average diesel car



LFAS2 carbon reduction targets



Most of the baseline emissions are expected to arise from the use of materials. LCC has set a **20%** carbon reduction target from the use of materials. If this target is reached, this would reduce scheme emissions by approximately 3,200 tonnes – shaving off around 480 trips around the world.



Just under 25% of carbon is associated with fuel and electricity use during construction. LCC has set a reduction target of **10%** for the carbon from construction energy use. If this target is reached, this would reduce scheme emissions by over 500 tonnes, shaving off another 80 trips around the world.

The carbon impact of flooding

Whilst measuring and minimising carbon emissions from constructing the flood walls remains the overall target, it is also important to consider the potential carbon avoided aspects. We worked with the Edinburgh Centre for Carbon Innovation at the University of Edinburgh to quantify the carbon impacts associated with flood damages within the City of Leeds. The aim of the study was to estimate the potential carbon savings associated with preventing flood damages granted by the installation of the Leeds Flood Alleviation Scheme (LFAS) Phase 1 and Phase 2.

The Carbon Management students calculated the carbon impacts associated with transport, commercial buildings, and residential buildings, respectively, in 2020. The student's reports estimated the carbon impacts associated with a 1-in-200-year event within the City of Leeds, using the extent of the 2015 Storm Eva Boxing Day flood event and modelled flood extent data as primary information sources.

Combined, the carbon impacts associated with a single 1-in-200-year flood event, and therefore the carbon emissions potentially prevented by LFAS during a similar event, were calculated to be 51,670 tCO_{2e}. This number provides evidence that LFAS, which is estimated to have a capital carbon footprint of 45,130 tCO_{2e}, delivers a potential net carbon saving of 6,540 tCO_{2e} by protecting the city from a single equivalent flood event*.



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The **carbon savings** associated with preventing a major flood event are equivalent to **one** of the journeys that we have estimated below...



Driving around the world **950 times** in a diesel car

One person flying one-way from JFK airport, New York to Heathrow airport **6,200 times**



1 million trips as a car passenger on the Dover to Calais ferry

**Although the study by students at the University of Edinburgh provides a positive message, a range of assumptions and limitations have been adopted during the analysis which may lead to an over or under estimation of the calculated carbon damage values derived. Further work is being carried out in 2021 to refine a robust methodology to calculate the carbon damage of flood events and provide an accurate framework.*

Low carbon innovation in action

Hydrotreated Vegetable Oil (HVO) – Crown Oil

We are trialling the use of HVO within the plant used for the pilings works in Zone 12 around the Home Office and Kirkstall Valley Farm site.

The carbon savings associated with HVO amount to 85-90% reduction compared to regular diesel. HVO is a more refined type of vegetable oil and burns much cleaner than diesel, which results in a cleaner exhaust with up to a third less particulate matter and hydrocarbons. This gives a 25% reduction in carbon monoxide and 10% reduction in nitrogen dioxide.

There is a slight increase in cost for the use of HVO, however the significant reduction in carbon emissions make it a viable option on many projects. The carbon emission factors for HVO is 0.34 kg CO_{2e}, whereas gas oil produces considerably more at 2.8 kg CO_{2e}.

Benefits

- Significant reduction in carbon emission when compared with traditional hydrocarbon fuel
- Environmental benefits e.g. air quality
- Applicable to a wide variety of plant
- Cost reductions as it becomes more widely used

Eco Sheet Piles – Arcelor Mittal

Sheet piles are sections of sheet materials with interlocking edges that are driven into the ground to provide earth retention and excavation support. On the Leeds FAS project these are used for flood defences.

We are using EcoSheetPiles, supplied by Arcelor Mittal, at Zone 12 at the Home Office site, which will contribute to the low carbon initiatives on LFAS2. These energy efficient products are from the range of EcoSheetPiles which are produced in mills located in Luxembourg from circa 100% scrap via electric arc furnace technology, as well as being fully reusable and recyclable.



Benefits

- Saving of 414kg CO_{2e}/tonne
- Lower CO_{2e} emissions during production than regular Sheet Piles
- 100% scrap and Electric Arc Furnace
- Fully reusable and recyclable
- Recycled scrap which avoids disposal to landfill

Electric vehicles

Electric vehicles and charging points are available at the LFAS2 site compound.

The electric pool cars on LFAS2 are used for site visits, inspections and consultation meetings with various parties. The three charging stations at the site compound are connected to the mains supply and procured from a green tariff.

Having electric vehicles on site enables us to meet agreed carbon targets and reduce project carbon emissions. Using an electric fleet also means the air quality in the environment is significantly enhanced, in comparison to traditional diesel fuel, which releases harmful gases into the atmosphere.



Benefits

- Reduction in on site carbon emissions using electric vehicles
- Commitment to meeting project carbon emission targets
- Environmental benefits e.g. air and noise quality
- Simple, convenient, and fast charging of vehicles on site
- Green tariff supply