Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NATIONAL ROADS AND GREENWAYS CONFERENCE 2023

Thursday 28th and Friday 29th September 2023

Session 6: Decarbonisation

Benchmarking: Carbon Assessment of the Macroom Bypass

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N22 Carbon Benchmarking

September 2023

N22 Site Team

N22 Baile Bhuirne to Macroom Road Development

The N22 Scheme - Roadworks

- 22km of Type 2 Dual Carriageway (2+2 road).
- 8km of Regional and Local Roads.
- Four junctions (three grade separated and one at grade).
- 190ha of land (Final Kerry Slug Habitat is 19ha of overall).

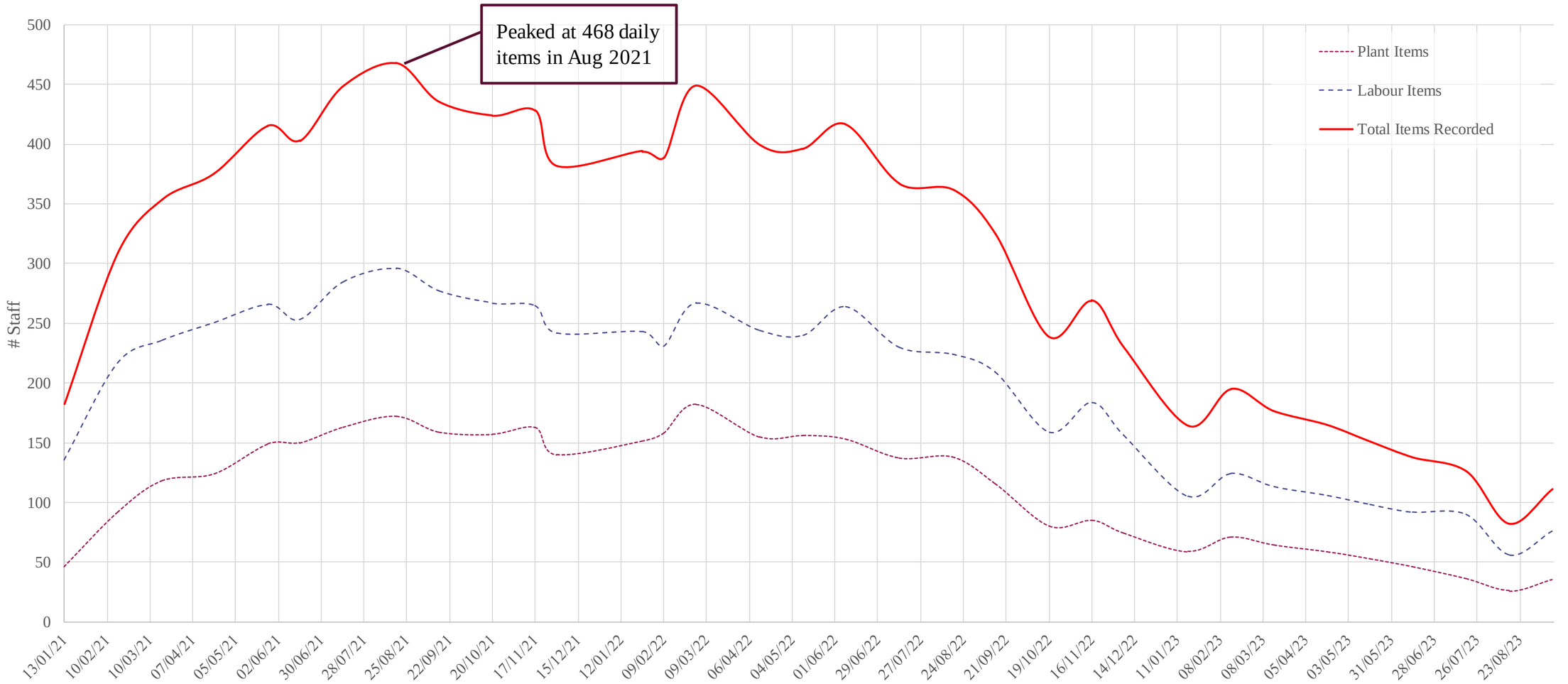
- Key Earthworks Statistics:
  - Cut - 2.9 million m^3 & Fill - 2.42 million m^3.
    - 1.2 million m^3 of rock with 600,000m^3 Blasted.
    - Cut 01 – 32m Deep with 500,000m3 of Rock.

The N22 Scheme - Structures

- 110 x Structures including:
  - 4 x Riverbridges / 12 x Underbridges / 5 x Overbridges
    53 x Culverts / 21 x Accommodation Underpasses /
    13 x Retaining Walls

- Key Structures Information:
  - S26 Laney Riverbridge - Constructed with 49.9m long
    155tn beams, which were longest ever used in Ireland & UK.
    Concrete Bridge Beams on the N22 Baile Bhuirne to Macroom Road Development - YouTube
  - S03 Bohill Riverbridge – 120m Steel Bridge, with 2 Spans
    and push launched into final position from assembly site.

Plant and Labour Summary



Note: *Labour **i**ncludes operatives and foremen but not engineers & admin staff.*
Plant does not include hand operated equipment

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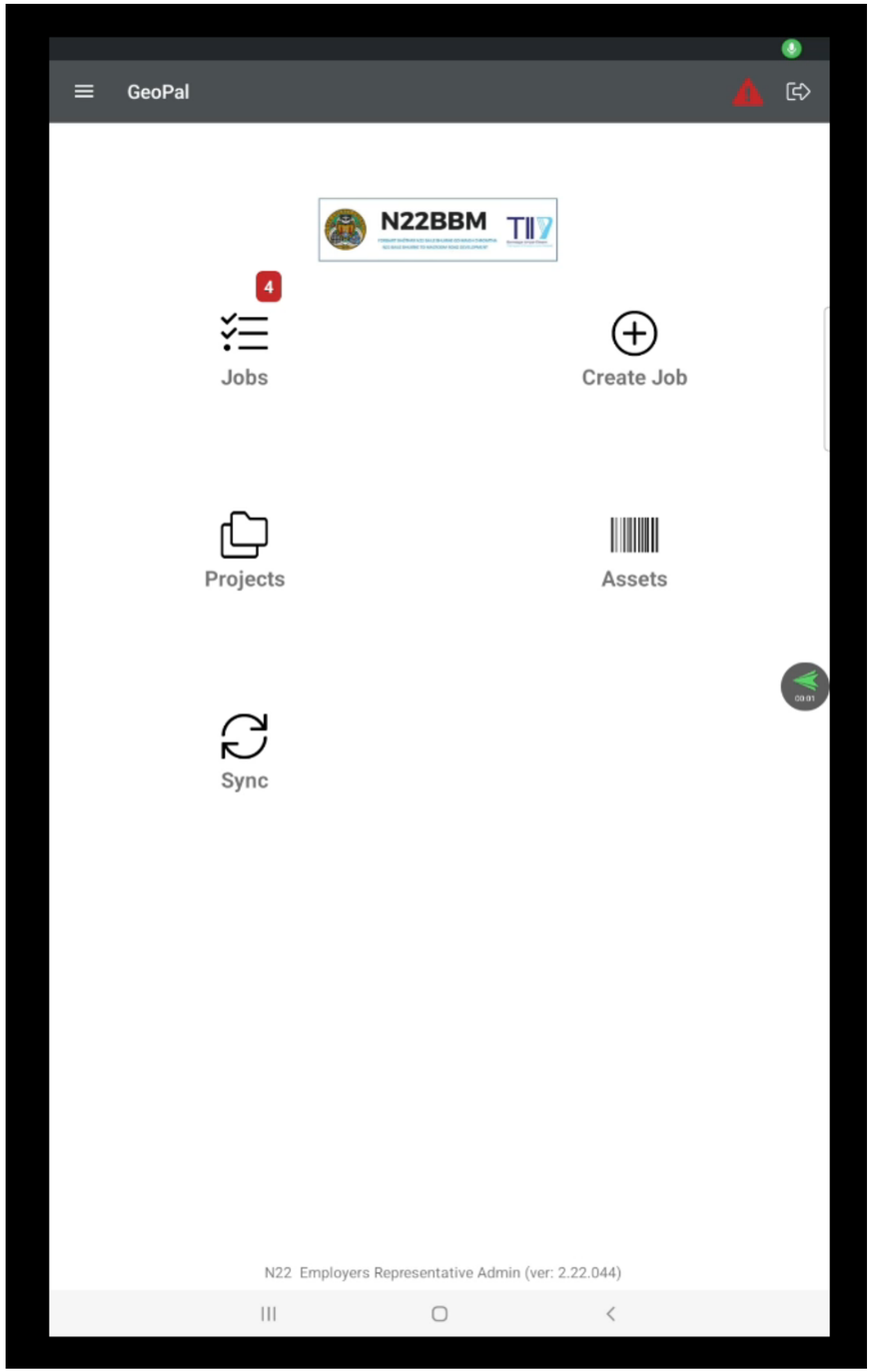
Innovative Solution to Record Keeping

“Geopal- Tablet App”

- Easy to use Tablet Interface
- Live Record Keeping
- All Programme Codes are Preloaded
- Labour & Plant from Dropdown List
- All records are Geolocated
- Uploaded to CCC Dashboard



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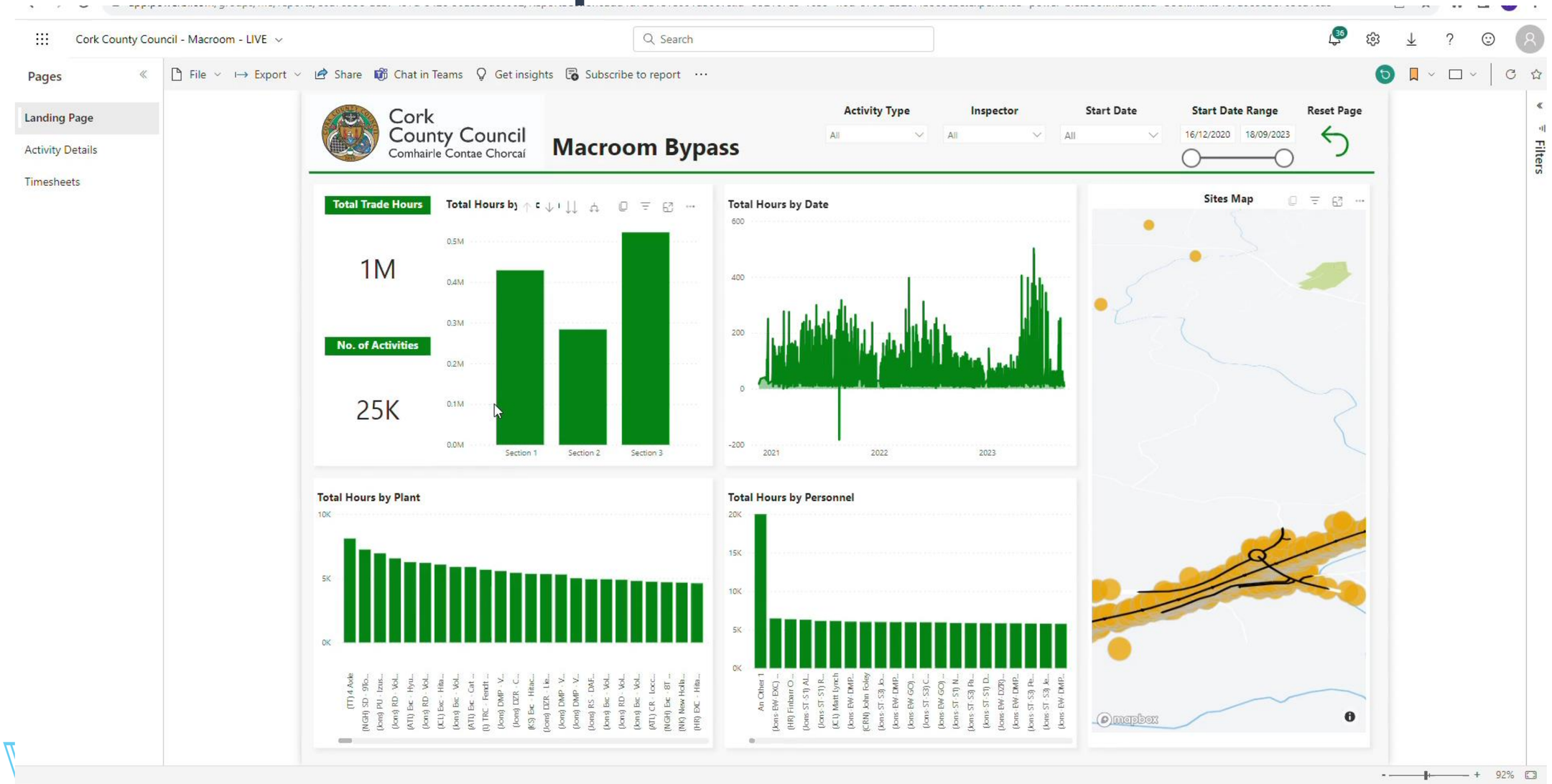
Innovative Solution to Record Keeping

“Geopal- PowerBI Dashboard”



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N22 Carbon Benchmarking

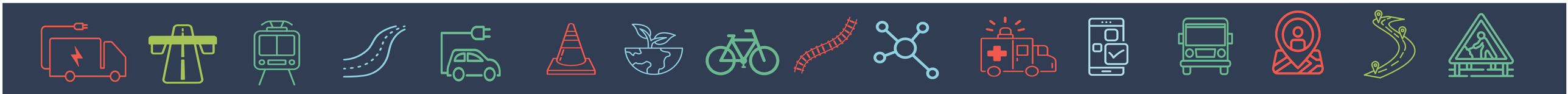
September 2023

AECOM

Agenda

1. Background and purpose of study
2. Methodology
3. Key findings
4. Application to road infrastructure

Aim: To present the findings of the N22 carbon benchmarking analysis and discuss the application of this in carbon management for future road infrastructure projects.



Background, Purpose & Scope of Study

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Background:

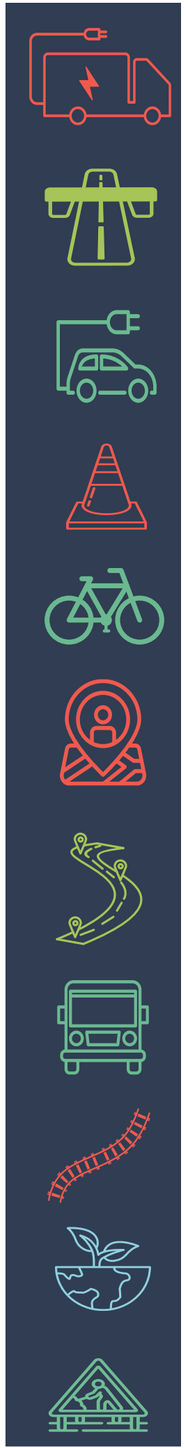
AECOM worked with the N22 Project Team and Transport Infrastructure Ireland (TII) in the development of a series of carbon benchmarks for TII road projects, with the use of the TII Carbon Tool.

Purpose & Scope

Using As-Built data from the N22 project, the purpose of the study was **to quantify the emissions for a range of road structures and develop a series of carbon benchmarks for these structures.**

The benchmarks will enable TII to:

- At a strategic level, plan against anticipated sectoral carbon budgets.
- At a project level, provide high level carbon estimates at early design stages (e.g., optioneering); and
- Provide a benchmark against which to compare/validate the carbon performance of other Ireland road schemes when practitioners are using the TII Carbon Tool.



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Methodology

Overview

The elements of the N22 scheme considered within the development of the carbon benchmarks include the following:

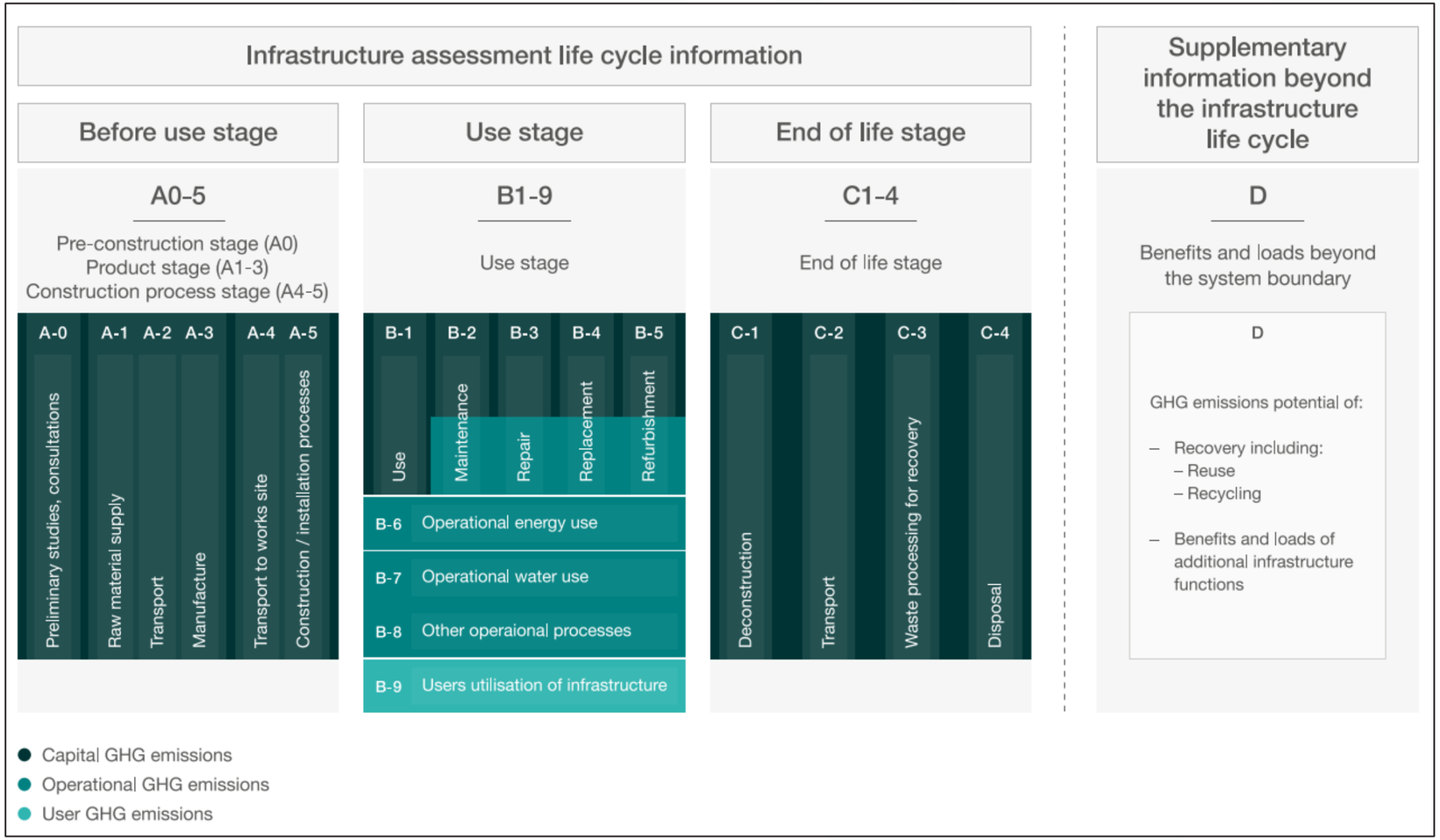
Embodied carbon	**Construction materials**	The embodied carbon associated with the construction material quantities.
	Transport of materials	The carbon associated with the transport of construction materials to the site by vehicle type, i.e. HGV, LGV etc.
Construction activities	**Clearance & demolition:**	The carbon emissions associated with the clearance and demolition activities before construction of the road scheme.
	Plant use:	The carbon associated with the litres of fuel used by plant and equipment during the construction phase.
	Land use change:	The carbon emissions associated with the land use change associated with the construction of the road scheme, i.e. the loss of forest, peatland etc.
	Employee commuting:	The carbon associated with the transport of site operatives to and from the construction site for different transport types.

Overview

The development of the carbon benchmarks has been conducted in accordance with the **PAS 2080: 2023 Carbon Management in Buildings & Infrastructure** standard, meaning the analysis of carbon was done so using specified life cycle stages.

The scope of the benchmarking study has been limited to the '**Before Use**' stage **A0-A5.**

Road user emissions are not included in the scope of this assessment.



Approach to benchmarking

For what road components did we develop carbon benchmarks?

Through consultation with TII and the N22 Project Team, carbon benchmarks were developed for the following road structures:

1. Accommodation Overbridge
2. Combined Accommodation Underbridges
3. Junction Underbridges
4. River Bridges
5. Accommodation Underbridges
6. Overbridges
7. Combined Underbridge
8. Underbridges
9. Pedestrian Underpass
10. Culverts
11. Junctions
12. Side Roads
13. Mainline

Carbon benchmark represented an **average volume of carbon** in a specific type of structure.

Where possible, the benchmark was averaged from four examples of the same type of structure.

Methodology

The following approach was used to develop a series of carbon benchmarks for the N22 Baile Bhuirne to Macroom Road Development:

Stage 1:

Data Collation

Data for each of the structures was provided by the N22 Project Team. The data provided was separated into structures, e.g. per individual bridge.

Stage 2:

Data Cleansing

Raw data was converted to enable correct emissions factors to be applied.

Stage 3:

Data Entry

The reviewed data was entered into the **TII Carbon Tool.**

Quality assurance was carried out throughout the process.

Stage 4:

Data Analysis

The data was aggregated and analysed to attain:

- a carbon benchmark or average volume of carbon per type of structure.
- a carbon benchmark per unit of that structure i.e., carbon per square meter of bridge etc.

Collaboration with TII and N22 Project Team occurred throughout

Assumptions and Limitations

- Underpinning the analysis were a series of assumptions made by AECOM and the N22 Project Team.
- This included assumptions regarding unit conversion, transport mode, material quantities, or design specifications and industry standards.
- In all cases of assumption use, details have been recorded to ensure transparency in the carbon benchmarks developed.

Employee Commuting:

Site teams recorded the transport modes and distances travelled by site operatives on a given day, and averaged this over the course of 1 week, to produce an average km/ operative/ day.

E.g., 8.33% carpool, 50% travel by car (25% by small car, and 25% by large car) and 45% travel by van. The remaining 5% travel by bike.

Emissions Factors:

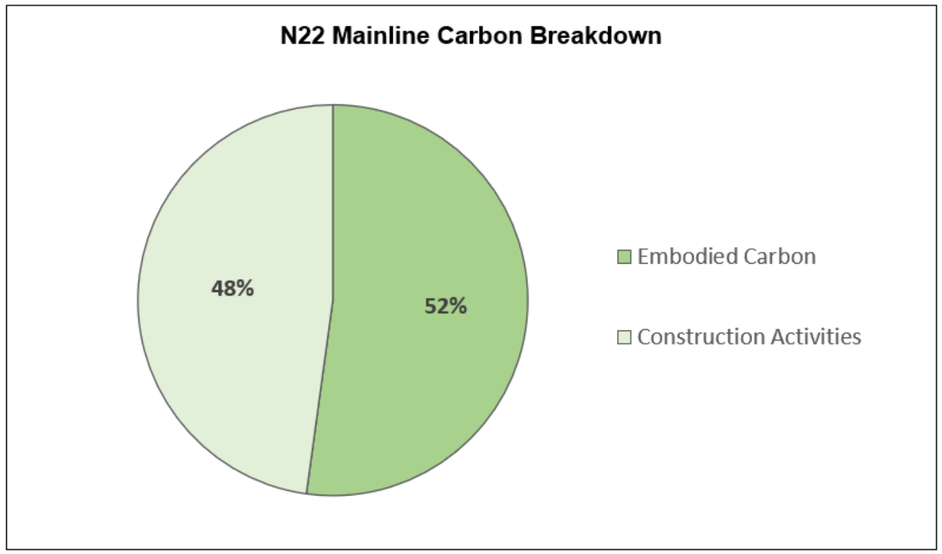
Where construction materials have been used that do not have an exact emissions factor, expertise and project experience has been used to determine a suitable alternative emissions factor to apply to the material within the TII Carbon Tool.

Key Findings

Summary of Findings

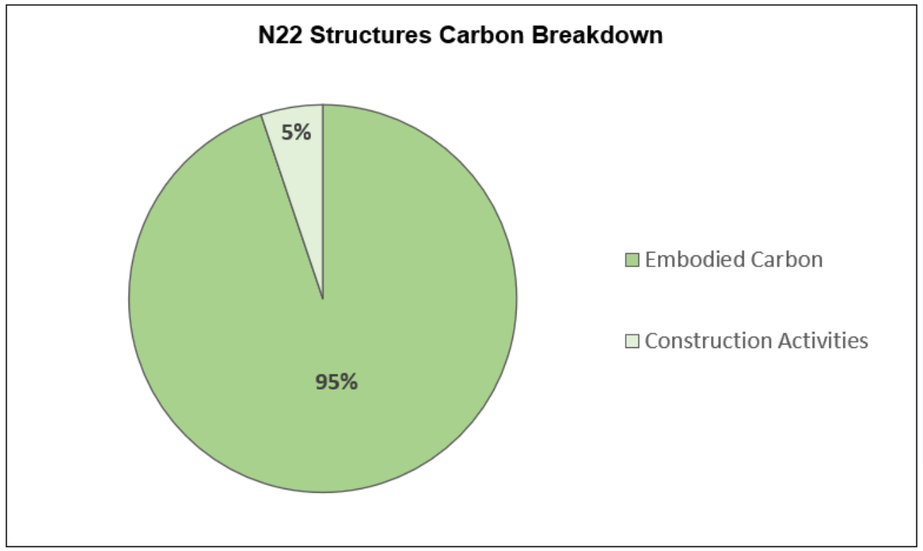
Mainline summary
Type 2 Dual Carriageway (22.2 km)

Mainline (incl. side roads & junctions)	Total Carbon (tCO_2e)	% Footprint
Embodied Carbon	34,781	52%
Construction Activities	31,868	48%
Mainline total carbon	**66,649**	
Carbon Benchmark per km	**3,002**	
Carbon Benchmark per km per lane	**751**	



Structures summary:
Type 2 Dual Carriageway (22.2 km)

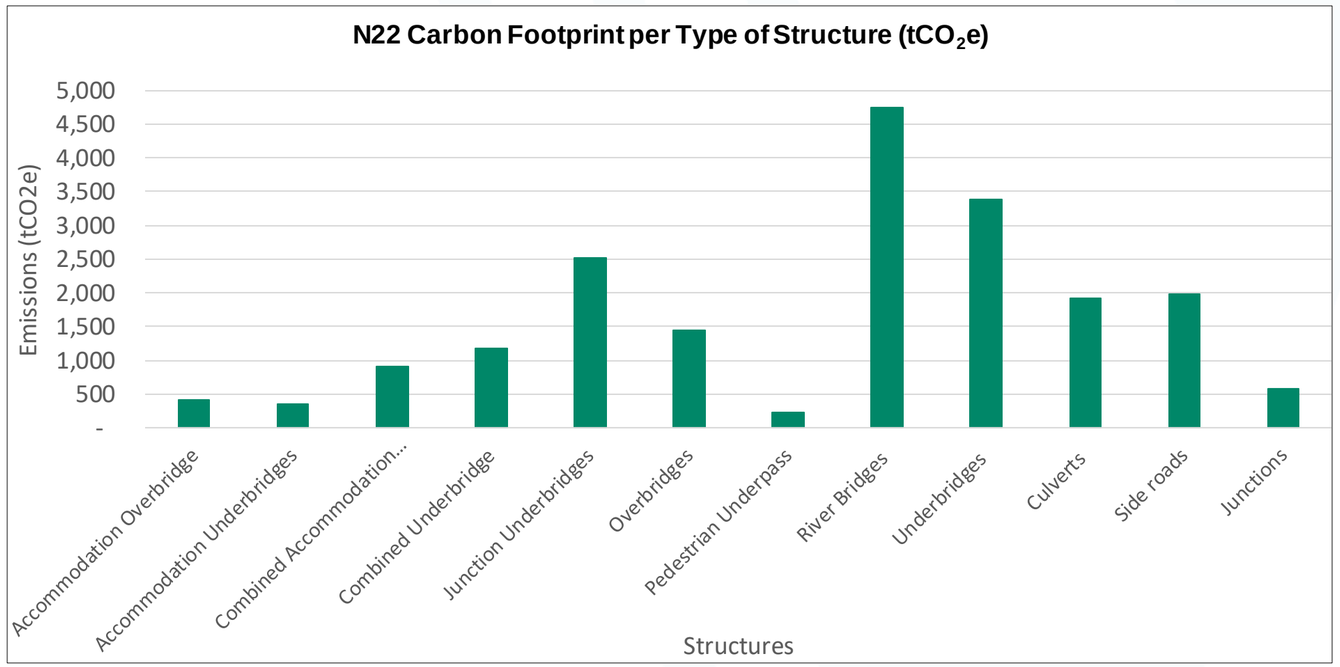
Structures (bridges & culverts)	Total Carbon (tCO_2e)	% Footprint
Embodied Carbon	46,592	95%
Construction Activities	2,537	5%
Structures benchmarked - Total carbon	**49,129**	



Carbon Benchmarks

Carbon benchmark per Type of Structure

Structure Type	No. of structures	Total Carbon (tCO_2e)	Average Carbon per Structure Type (tCO_2e)	Average Carbon per unit (tCO_2e)	Unit
Accommodation Overbridge	1	408	408	0.55	m²
Accommodation Underbridges	4	1,383	346	2.53	m²
Combined Accommodation Underbridges	3	2,740	913	4.52	m²
Combined Underbridge	2	2,341	1,170	3.86	m²
Junction Underbridges	2	5,016	2,508	6.78	m²
Overbridges	4	5,752	1,438	3.06	m²
Pedestrian Underpass	2	443	221	2.70	m
River Bridges	4	18,989	4,747	3.20	m²
Underbridges	3	10,135	3,378	4.20	m²
Culverts	1	1,923	1,923	2.10	m
Side roads	1	1,981	1,981	0.53	m
Junctions	5	2,882	576	0.61	m



The carbon results for the structures have been separated into useable benchmarks, as follows:

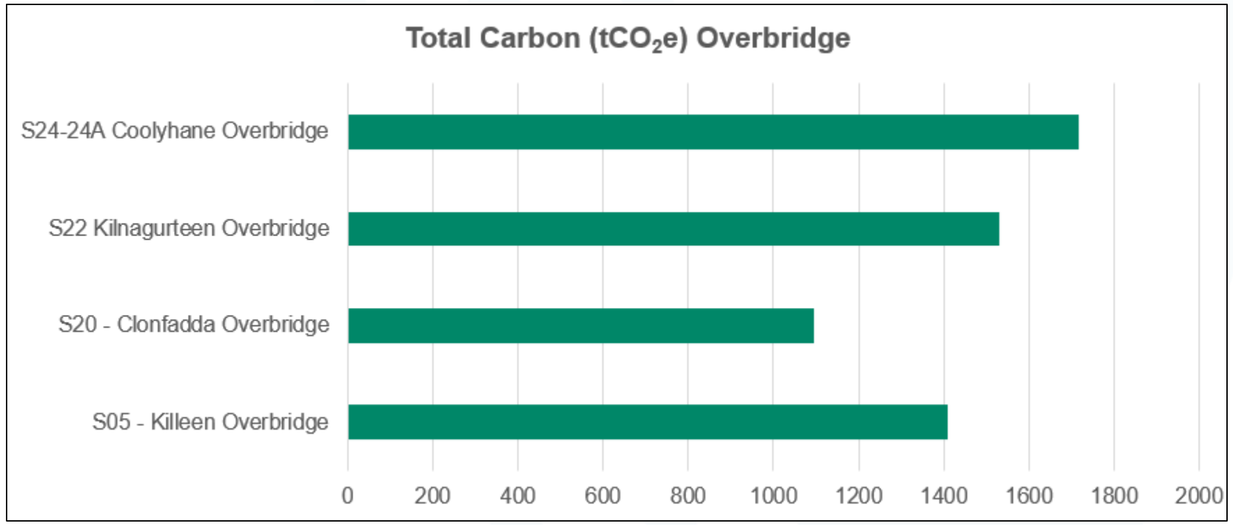
- Total Carbon (tCO_2e) **per each individual structure**, i.e. S28A Accommodation Underbridge,
- Total Carbon (tCO_2e) **per each Structure category**, i.e. Accommodation Underbridge, calculated by taking an average of the 4 Accommodation Underbridge structures.
- Total Carbon (tCO_2e) **per unit**, i.e. per square meter of Accommodation Underbridge, per km of Side Roads, etc.

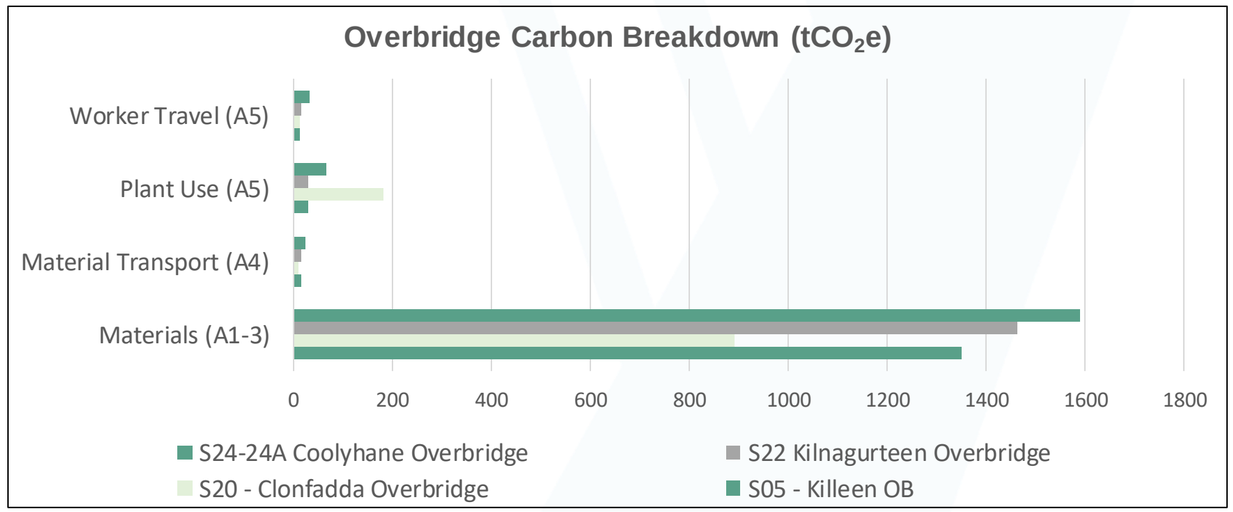
Carbon Benchmarks

Overbridge example:

As an example, the carbon benchmarking associated with **four Overbridges** are presented.

Structure name	Bridge deck area (m^2)	Carbon per Structure (tCO_2e)	Carbon per m^2 (tCO_2e)
S05 - Killeen Overbridge	423	1410	3.33
S20 - Clonfadda Overbridge	361	1097	3.04
S22 Kilnagurteen Overbridge	484	1530	3.16
S24-24A Coolyhane Overbridge	632	1716	2.71
Total Carbon (tCO_2e)		5752	
Carbon Benchmark per structure		**1438**	
Carbon Benchmark per m^2 of OB			**3.06**





Application to Road Infrastructure

Application to Road Infrastructure

The results of this carbon benchmarking analysis can be incorporated in TII's Carbon Tool to:

- Allow for a more accurate early estimate of carbon for road projects.
- Allow for the early identification of carbon hotspots and therefore the best places for mitigation.
- Allow for comparative analysis of detailed design against the carbon benchmarks.
- Allow for the management of carbon budgets in the transport sector.

Would not have been possible without the collaboration with the N22 Project Team and the **comprehensive As-Built dataset** they were able to share.