

Gate 2 Carbon Calculator

Introduction

- This tool calculates the carbon emissions in the construction of an asset (embodied carbon emissions) and the emissions associated with annual operation.
- The input data required is based on information available at Gate 2 such as capacity, e.g. 10MI/d Activated Sludge plant.
- Carbon emissions are calculated from carbon-curves, derived from a best fit line through an existing data set of emissions and capacity.
- The Net Present Costs (NPCs) are derived from emissions embodied in the construction of the asset and operational emissions over a 40 year period, with a 3.5% discount rate.
- The NPCs are calculated according to the latest Defra guidelines with the Shadow Price of Carbon based on 2009 prices (£27.60 rising by 2% each year).

User Guide

- The user should enter quantities in the light blue cells in columns D~J.
- Compulsory input requirements are specific to individual Design Manual Categories (DMCs) and may include:
 - Capacity (m³ or p.e.);
 - Number of items;
 - Dosed flow (l/hr);
 - Pumping station power (kW) or flow (MI/d);
 - Pipe diameter (mm), length (m), depth to invert (m) and location (field or highway); and
 - Tonnes of treated dry solids (TTDS).
- Annual Electricity Consumption is an optional input for some DMCs. When the major input has been entered, if a value for electricity appears in the Annual Electricity Consumption input cell, a default electricity usage has been calculated by the tool. This electricity usage is used in the calculation of operational emissions. If the user knows the electricity usage for the item, the default electricity can be overwritten and the tool will use this new electricity usage for operational emissions. Those items with no default electricity input require compulsory input of electricity usage for calculation of operational emissions.
- The 'Ancillary Works' category is a generic additional item to allow the user to make an allowance for construction of items that are not included in the principal DMC.
- Holding the mouse over column C will reveal a comment containing a description of the items included within each DMC. More detailed descriptions of the items included or excluded in a DMC are provided in the individual tabs for each DMC.
- Carbon has been used throughout this tool to represent carbon dioxide equivalent.
- The carbon curves are presented for information only and do not allow user input. They will be updated by the administrator when additional data is available.
- If more than one instance of a DMC is required (e.g. for multiple diameters of water mains) the model should be run with the different capacities and the results recorded in the Record Sheet by clicking the "copy" button in the Design Manual Input Sheet.
- A new copy of the Carbon Tool should be used for each project.

Process Emissions

- The operational emissions calculated by this tool are typically in addition to the operational emissions reported annually in the June returns.
- The operational emissions for a number of additional treatment processes are taken from the UKWIR 08/WW/20/3 report and include direct emissions from operation of the process, indirect emissions from electricity use and chemical dosing and emissions associated with sludge disposal. These additional processes are:
 - activated carbon;
 - biofilters;
 - phosphorous removal;
 - activated sludge;
 - sludge digestion; and
 - tertiary treatment
- In all other treatment processes, direct emissions, emissions embodied in the production of chemicals and emissions as a result of additional sludge are excluded.
- The reduction in NO₂ emissions downstream of an effluent discharge point that may result from improved levels of treatment are not included.

Related Documents:

Severn Trent Water Design Manual

UKWIR report 08/WW/20/3 'Water Framework Directive: Sustainable Treatment Solutions for Achieving Good Ecological Status'

Carbon Accounting PR09 Phase 1 report

Version Control

[illegible]

Gate 2 Carbon Calculator Record Sheet

[illegible]

USER INSTRUCTIONS

Enter quantities for required Design Manual Categories in the pale blue cells in columns D to J. Some contain drop-down lists. Annual Electricity Consumption must be entered if a default (ITALICS) is not available. The default electricity consumption can be overwritten if there is more information. The Carbon Emissions and Net Present Cost are displayed in columns L to N. The Design Manual Category must be copied to the Record Sheet by clicking the button in column O to record the calculations.

Design Manual Category				User Input			Proposed Year of Construction	Embodied CO ₂ _{eq} (kgCO ₂ _{eq})	Operational CO ₂ _{eq} (kgCO ₂ _{eq} /yr)	Net Present Cost of Carbon	Copy to Record Sheet
Water Resources and Treatment	Boreholes		No. of boreholes	Annual Electricity Consumption (kWh)			2012	0	0	£0	
	Service Reservoirs & Water Retaining Structures		Capacity (m ³)				2009	0	0	£0	
	Arsenic Removal		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Fluoridation		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	pH Correction		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Clarification		Capacity (Mld)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Filtration		Flow (Mld)		Annual Electricity Consumption (kWh)		2009	0	0	£0	
	Activated Carbon - Removal of Endocrine Disruptors (Full flow)		Flow (Mld)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Activated Carbon - Removal of Pesticides (Full flow)		Flow (Mld)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Activated Carbon - Removal of Zinc (Full flow)		Flow (Mld)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Iron & Manganese Treatment		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Nitrate Treatment		Flow to Treatment (m ³ /hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
Disinfection		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0		
Stabilisation & Conditioning		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0		
Water Transfer and Distribution	Distribution Mains & Service Pipes ...contd		Length (m)		Diameter (mm)		2012	0	-	£0	
			Pipe Location		Depth to invert (m)						
	Pumping Stations		Flow (Mld)		Annual Electricity Consumption (kWh)		2014	0	0	£0	
	Trunk Mains ...contd		Length (m)		Diameter (mm)		2009	0	-	£0	
			Pipe Location		Depth to invert (m)						
Sewerage	Sewage Pumping Stations ...contd		Pump Power (kW)		Pipe Length (m)	3.5	Depth to invert (m)	2012	1,133,971	920,220	£729,860
			Pipe Diameter (mm)		Pipe Location	1713568	Annual Electricity Consumption (kWh)				
	Sewer Rehabilitation ...contd		Sewer Length (m)		Diameter (mm)		2012	0	-	£0	
			Pipe Location		Depth to invert (m)						
Sewage Treatment	Manholes		No.				2012	0	-	£0	
	Inlet Works		m ³ /d		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Primary Sedimentation		Capacity (m ³)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Bio Filters (Trickling Filters)		Capacity (p.e.)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Chemical Phosphorous Removal		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	122,182	376,344	£291,878	
	Activated Sludge Process		Capacity (p.e.)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Enhanced Biological Phosphorous Removal		Capacity (p.e.)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Sludge Digestion (new plant)		TTDS per annum		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Sludge Thickening - Centrifuge Dewatering		TTDS per annum		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Sludge Thickening - Sludge Press		No. of works		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Sludge Drying		TTDS per annum		Annual Natural Gas Consumption (kWh)		2012	0	0	£0	
	Sludge Mixing		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Tertiary Treatment		Capacity (Mld)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Small Sewage Treatment Works		Capacity (p.e.)		Annual Electricity Consumption (kWh)		2012	0	0	£0	
Access to Assets	Flooring		Floor area (m ²)				2012	183,775	-	£4,855	
	Guarding of Equipment		No. of works				2012	0	-	£0	
	Lifting Equipment		No. of plants		Annual Electricity Consumption (kWh)		2012	0	0	£0	
Civil Engineering	Access Road		Road Length (m)				2012	30,558	-	£1,977	
	Outfall Structures		No. of structures				2012	1,223	-	£32	
	Tunnelling & Low Dig Techniques		Tunnel length (m)				2012	106,660	-	£2,818	
Other	Environmental and Landscape		No. of sites				2012	0	-	£0	
	Remote Asset Monitoring (Telemetry) Systems		No. of works		Annual Electricity Consumption (kWh)		2012	1,751	235,215	£178,980	
	Security and Fencing		No. of installations		Annual Electricity Consumption (kWh)		2012	0	0	£0	
	Site Investigation		No. of sites				2012	0	-	£0	
	Ancillary Works		No. of works				2012	0	-	£0	
Renewable Energy	CHP		TTDS per annum		Power generated per annum (kWh)		2012	0	0	£0	

Access Road

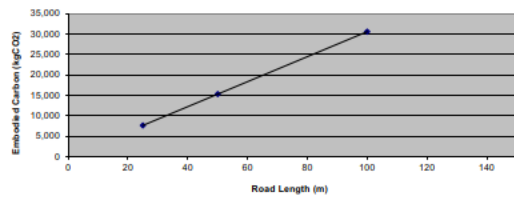
Embodied Carbon Emissions

Design Manual Work Package	Road Length (m)	Design Life (yrs)	Carbon Cost (kg CO2)
Access Road	100	15	30,558

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

Access Road Embodied Carbon

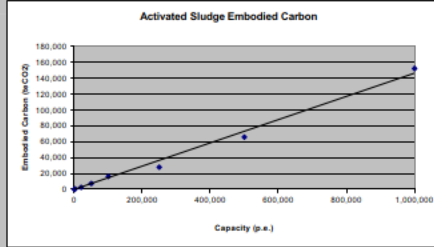


	Included	Excluded
Embodied Carbon	4m wide access road - 750mm sub-base and 75mm wearing	Kerbs and drainage
	-	-
	-	-

ACTIVATED SLUDGE (NITRIFICATION)

Embodied Carbon Emissions

Design Manual Work Package	Capacity (p.e.)	Design Life (yrs)	Design Life for calc (yrs)	Carbon Cost (kg CO2)
Enhanced Biological Phosphorus Removal	0	60	40	0
Activated Sludge Process	0	60	40	0



	Included	Excluded
Embodied Carbon	Rectangular concrete selector zone with mechanical mixers	Pumping to selector
	Rectangular concrete aerobic aeration lanes with fine bubble diffusers	Short cycle CO2 released during sewage treatment
	Concrete radial hopper bottom final settlement tanks, scraper bridges, SAS pumps and RAS	-

CARBON RELATIONSHIP

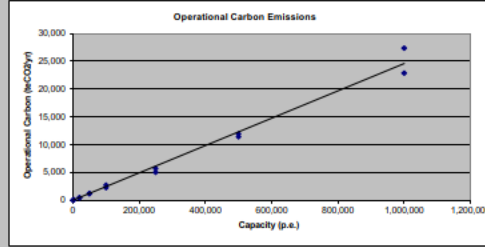
p.e.	tCO2
500	128
2,500	422
20,000	2,548
50,000	7,269
100,000	16,367
250,000	27,868
500,000	66,040
1,000,000	152,384

User input following Update to Carbon Calculations

Scaling factor relationship validity limits (Mtd)	500	1,000,000
Scaling Factor (slope)	0.15	
Scaling Factor (intercept)	0	

Operational Carbon Emissions

Design Manual Work Package	Capacity (p.e.)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2)
Enhanced Biological Phosphorus Removal	0	0	0
Activated Sludge Process	0	0	0



	Included	Excluded
Operational Carbon	Mechanical mixer power	Process control and building services
	Blower power for air delivery to the aeration lanes	Trace heating of rails
	RAS pumping	Short cycle CO2 released during biological treatment
	SAS pumping	Any emissions from sludge produced
	Scraper bridge	

CARBON RELATIONSHIP

p.e.	tCO2/yr	tCO2/yr (excl elec)
500	21	
2,500	58	
20,000	407	
50,000	1,209	
100,000	2,738	
250,000	5,017	
500,000	11,813	
1,000,000	27,392	

User input following Update to Carbon Calculations

500	11	6
2,500	57	30
20,000	457	242
50,000	1,143	606
100,000	2,286	1,211
250,000	5,716	3,029
500,000	11,432	6,059
1,000,000	22,863	12,117

Scaling factor relationship validity limits (p.e.)	500	27392	0.01
Scaling Factor (slope)	0.02		
Scaling Factor (intercept)	0.00		-0.22

ELECTRICITY RELATIONSHIP

p.e.	kWh/yr
500	10,275
2,500	51,375
20,000	410,998
50,000	1,037,494
100,000	2,054,988
250,000	5,137,469
500,000	10,274,938
1,000,000	20,549,876

User input following Update to Carbon Calculations

Scaling factor relationship validity limits (p.e.)	500	1000000
Scaling Factor (slope)	20.55	
Scaling Factor (intercept)	0.05	

Activated sludge to meet 1 mg/l NH ₄ -N	11
Activated sludge to meet 3 mg/l NH ₄ -N	1105
	10543
	21086

Ancillary Works**Embodied Carbon Emissions**

Design Manual Work Package	No. of works	Design Life (yrs)	Total Embodied Carbon (kg CO2)
Ancillary Works	0	40	0

Operational Carbon Emissions

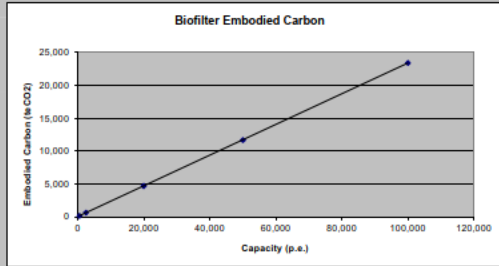
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

Embodied Carbon	Included	Excluded
	Connecting pipework; 50m 150mm DI	-
	Fencing; 50m chain link 2.4m high, post and gate	-
	Valves and Splitter Chamber; 2no. Gate valves and 5no. Bends (700kg cast iron) and a 2m by 2m by 2m concrete chamber with 300mm thick walls	-

BIOFILTERS

Embodied Carbon Emissions

Design Manual Work Package	Capacity (p.e.)	Design Life (yrs)	Carbon Cost (kg CO2)
Bio Filters	0	40	



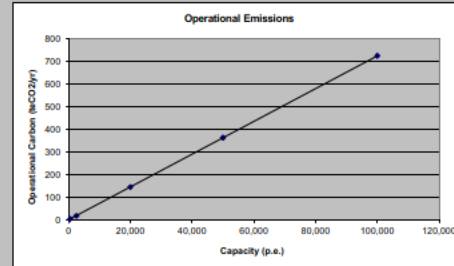
	Included	Excluded
Embodied Carbon	Circular trickling filters: concrete construction, distribution arms, rock media, recirculation pump.	Flow distribution
	Conical base humus tanks: concrete construction, desludge	Process control
	Connecting pipework	-

[illegible]

Scaling factor relationship validity limits (p.e.)	500	100000
Scaling Factor (slope)	0.23	
Scaling Factor (intercept)	55	

Operational Carbon Emissions

	Capacity (p.e.)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2)
Design Manual Work Package			
Bio Filters	0	0	



	Included	Excluded
Operational Carbon	Distribution arms	Any emissions from sludge produced
	Recirculation pump	-
	Desludge pump	-

CARBON RELATIONSHIP			
p.e.	tCO ₂ /yr	tCO ₂ /yr (excl elec)	
500	9	n/a	STW Carbon
2,500	9	n/a	
20,000	22	n/a	
50,000	48	n/a	
100,000	92	n/a	
500	4	3	UKWV Carbon calculations
2,500	18	13	
20,000	145	109	
50,000	363	272	
100,000	726	544	
			User input following Update to

Note - due to the discrepancy here, only Sustain tool values have been used

Scaling factor relationship validity limits (p.e.)	500	100000
Scaling Factor (slope)	0.0073	0.0054
Scaling Factor (intercept)	0.03	-0.02

p.e.	kWh/yr
500	1,741
2,500	8,706
20,000	69,648
50,000	174,119
100,000	348,238

Scaling factor relationship
validity limits (o.e.)
Scaling Factor (slope)
Scaling Factor (intercept)

UKWIR
assumptions
from Sustain
Tool

Boreholes**Embodied Carbon Emissions**

Design Manual Work Package	No. of Boreholes	Design Life (yrs)	Total Embodied Carbon (kg CO2)
Boreholes	0	20	0

Embodied Carbon	Included	Excluded
	Borehole with grouted in place casing for top section of borehole	Trial boreholes
	Pumps valves, motors and MCC	Test pumping
	Concrete headworks	-

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Boreholes	0	0

Operational Carbon	Included	Excluded
	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

CHP

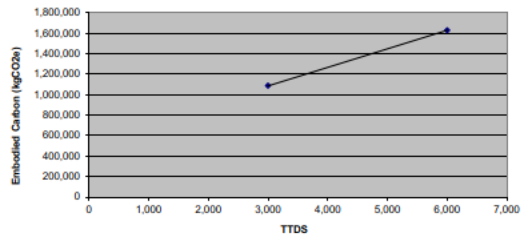
Embodied Carbon Emissions

Design Manual Work Package	TTDS/yr	Design Life (yrs)	Carbon Cost (kg CO2)
CHP	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Generation (kWh)	Carbon Cost (kg CO2)
CHP	0	0

CHP Embodied Carbon



	Included	Excluded
Embodied Carbon	Stainless steel sludge import and storage tanks and	
	Sludge press, pumps, valves, and MCC's	
	Package digester plant (glass coated steel) and double skinned ballon type gas storage vessel	

	Included	Excluded
Operational Carbon	User input of net electricity generated	Emission associated with the sale of ROCs
		Short cycle CO2 released during sewage treatment-
		Sludge disposal, on-site methane losses

CHEMICAL DOSING

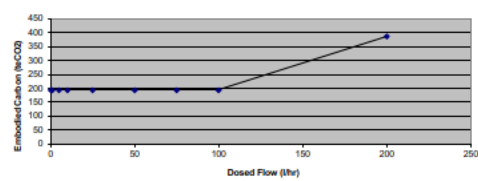
Embodied Carbon Emissions

Design Manual Work Package	Dosed Flow (l/hr)	Design Life (yrs)	Carbon Cost (kg CO2)
Arsenic Removal	0	20	0
Fluoridation	0	20	0
pH Correction	0	20	0
Iron & Manganese Treatment	0	20	0
Disinfection	0	20	0
Stabilisation & Conditioning	0	20	0
Chemical Phosphorous Removal	1	20	193,000
Sludge Mixing	0	20	0

Operational Carbon Emissions

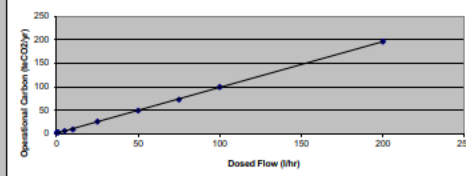
Design Manual Work Package	Dosed Flow (l/hr)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2/yr)
Arsenic Removal	0	0	0
Fluoridation	0	0	0
pH Correction	0	0	0
Iron & Manganese Treatment	0	0	0
Disinfection	0	0	0
Stabilisation & Conditioning	0	0	0
Sludge Mixing	0	0	0

Chemical Dosing Embodied Carbon



	Included	Excluded
Embodied Carbon	Bunded dosing area: concrete construction	Emergency shower / eyewash, control panel
	Bulk storage tank: plastic construction	Access
	Pumped pipework	Control hardware
	Delivery of tank and pipework to site	-

Operational Emissions



	Included	Excluded
Operational Carbon	Chemical delivery to site	Specific chemical manufacture
	Dose pump power	Carrier flow if applicable
	-	Emissions from any sludge generated

CARBON RELATIONSHIP

teCO2	Dosed Flow (l/hr)
193	0.2
193	1.0
193	5.0
193	10
193	25
193	50
193	75
193	100
387	200

STW Carbon Calculations for PR09

User Input to Existing Update to Carbon Calculations

Scaling factor relationship validity limits (l/hr)	0.2	200
Scaling Factor (slope)	1.93441	
Scaling Factor (intercept)	0	

CARBON RELATIONSHIP

teCO2/yr	Dosed Flow (l/hr)
3.3	0.2
3.3	1.0
6.6	5.0
19	10
27	25
50	50
73	75
100	100
196	200

STW Carbon Calculations for PR09

User Input to Existing Update to Carbon Calculations

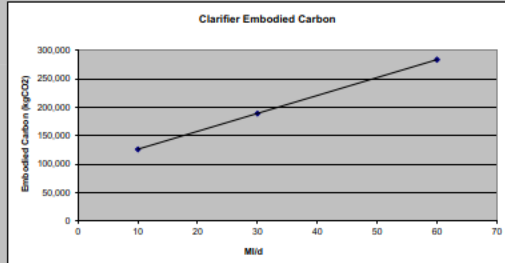
Scaling factor relationship validity limits (l/hr)	0.2	200
Scaling Factor (slope)	0.97	
Scaling Factor (intercept)	1.81	

Note UKWIR sustain tool not used for comparison as cannot be compared directly given inclusion of chemicals.

DAF CLARIFIER

Embodied Carbon Emissions

Design Manual Work Package		Mild	Design Life (yrs)	Carbon Cost (kg CO2)
Clarification		0	40	0



	Included	Excluded
Embodied Carbon	DAF units	
	Sludge separators, blowers, pumps, diffusers and pipes	
	MCC	

Operational Carbon Emissions

Design Manual Work Package		Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2)
Clarification		0	0

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

Environmental and Landscape

Embodied Carbon Emissions

Design Manual Work Package	No. of sites	Design Life (yrs)	Carbon Cost (kg CO2)
Environmental and Landscape	0	15	0

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	Allowance for 20 m3 of excavation	-

Equipment Guarding**Embodied Carbon Emissions**

Design Manual Work Package	No. of sites	Design Life (yrs)	Carbon Cost (kg CO2)
Guarding of Equipment	0	20	0

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	Installation of new gate and fencing	-

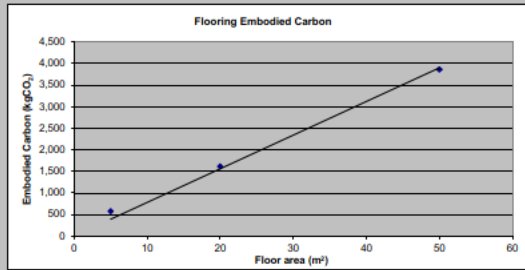
Flooring

Embodied Carbon Emissions

Design Manual Work Package	Floor Area (m ²)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Flooring	2500	40	183,775

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO ₂ /yr)
No operational carbon associated with this item	



	Included	Excluded
Embodied Carbon	Concrete flooring	-

INLET WORKS

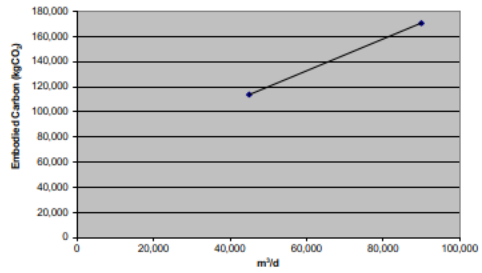
Embodied Carbon Emissions

Design Manual Work Package	m ³ /d	Design Life (yrs)	Carbon Cost (kg CO2)
Inlet Works	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Inlet Works	0	0

Inlet Works Embodied Carbon



	Included	Excluded
Embodied Carbon	Inlet channel, splay channel, bypass channel	
	CSO	
	MESH flooring and handrails	
	Inlet Screens	
M&E		

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

LIFTING EQUIPMENT**Embodied Carbon Emissions**

Design Manual Work Package	No. of plants	Design Life (yrs)	Carbon Cost (kg CO2)
Lifting Equipment	0	20	0

	Included	Excluded
Embodied Carbon	Steel frame and winch	

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Lifting Equipment	0	0

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

MANHOLES**Embodied Carbon Emissions**

Design Manual Work Package	No. of Manholes	Design Life (yrs)	Carbon Cost (kg CO2)
Manholes	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	One manhole	Trench/pipework associated with the manhole

MEGA FILTERS

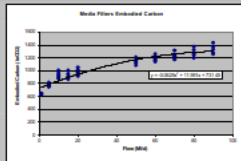
Embedded Carbon Emissions

Design Manual Work Package	Flow (MGD)	Life Cycle Emissions (kg CO2e)	Carbon Cost (\$/kg CO2e)
Filteration	0	40	40
Advanced Carbon Removal of Endocrine Disruptors	0	40	40
Advanced Carbon Removal of Pharmaceuticals	0	40	40
Advanced Carbon Removal of Blue	0	40	40

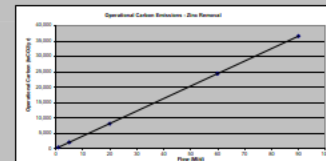
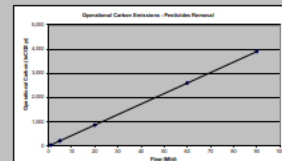
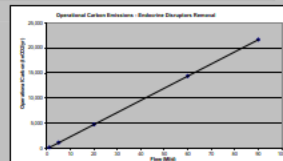
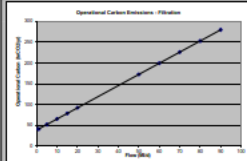
Operational Carbon Emissions

Design Manual Work Package	Flow (MGD)	Default Annual Electricity (kWh)	Carbon Cost (\$/kg CO2e)
Filteration	0	0	0
Advanced Carbon Removal of Endocrine Disruptors	0	0	0
Advanced Carbon Removal of Pharmaceuticals	0	0	0
Advanced Carbon Removal of Blue	0	0	0

	Included	Excluded
Operational Carbon	Process water pump Mechanical pump power Air blower power	



Carbon	Process	Water
Advanced Carbon	Filteration, Water consumption	Water
Advanced Carbon	Advanced Carbon Removal of Endocrine Disruptors, Water consumption	Water
Advanced Carbon	Advanced Carbon Removal of Pharmaceuticals, Water consumption	Water
Advanced Carbon	Advanced Carbon Removal of Blue, Water consumption	Water



Flow (MGD)	Carbon (kg CO2e)
0	40
1	40
2	40
3	40
4	40
5	40
6	40
7	40
8	40
9	40
10	40
11	40
12	40
13	40
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99	40
100	40

To update the carbon equation after user input, select cell D37 and click button

Flow (MGD)	Carbon (kg CO2e)
0	40
1	40
2	40
3	40
4	40
5	40
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7	40
8	40
9	40
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100	40

Flow (MGD)	Carbon (kg CO2e)
0	40
1	40
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Flow (MGD)	Carbon (kg CO2e)
0	40
1	40
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Flow (MGD)	Carbon (kg CO2e)
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100	40

Monitoring and Telemetry**Embodied Carbon Emissions**

Design Manual Work Package	No. of works	Design Life (yrs)	Carbon Cost (kg CO2)
Remote Asset Monitoring (Telemetry) Systems	1	20	1,751

	Included	Excluded
Embodied Carbon	MCC, Cabinet and cabling	

Operational Carbon Emissions

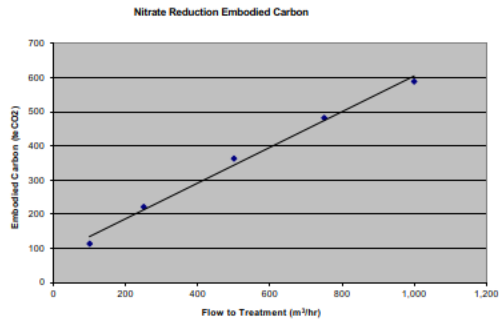
Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Remote Asset Monitoring (Telemetry) Systems	438000	235,215

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

NITRATE REDUCTION (ION EXCHANGE)

Embodied Carbon Emissions

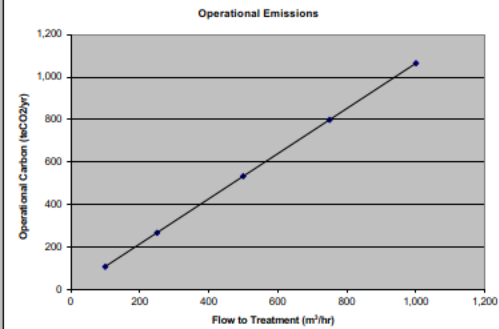
Design Manual Work Package	Flow to Treatment (m ³ /hr)	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Nitrate Treatment	0	15	15	0



Included	Excluded
Treatment building: concrete base slab, steel wall and roof construction, steel pipework, pumps, strainers.	Internal walls, fixtures and fittings.
IX Vessels: concrete slab, steel pressure vessels.	Pipework other than main process.
Salt / Waste bund: high-sided concrete bund containing duty / assist salt bulk storage and duty waste tanks.	Media manufacture.
New length of water main to form bypass	-

Operational Carbon Emissions

Design Manual Work Package	Flow to Treatment (m ³ /hr)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2)
Nitrate Treatment	0	0	0



Included	Excluded
All inclusive power to run the process: building services, booster pumps, regeneration, waste transfer.	Any emissions from salt residue
Salt transport to bulk storage.	Salt manufacture

OUTFALL STRUCTURES**Embodied Carbon Emissions**

Design Manual Work Package	No. of structures	Design Life (yrs)	Carbon Cost (kg CO2)
Outfall Structures	1	40	1,223

Operational Carbon Emissions

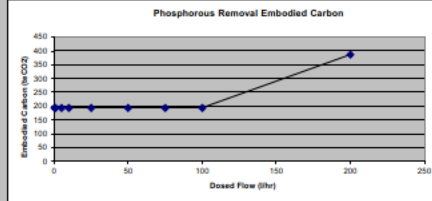
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	Head wall	Scour protection
	Flap valve	

PHOSPHOROUS REMOVAL

Embodied Carbon Emissions

Design Manual Work Package	Dosed Flow (l/hr)	Design Life (yrs)	Carbon Cost (kg CO2)
Chemical Phosphorous Removal	1	20	193,000



	Included	Excluded
Embodied Carbon	Bunded dosing area: concrete construction	Emergency shower eyewash, control panel.
	Bulk storage tank: plastic construction	Access
	Pumped pipework	Control hardware.
	Delivery of tank and pipework to site	-

CARBON RELATIONSHIP	
toCO ₂	Dosed Flow (l/hr)
193	0.2
193	1.0
193	5.0
193	10
193	25
193	50
193	75
193	100
387	200

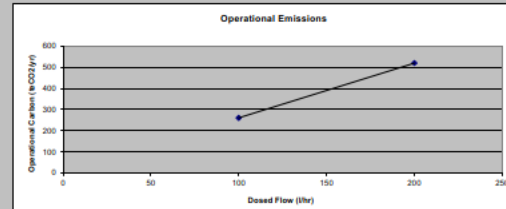
STW Carbon Calculations
for PR09

User Input following Update to Carbon Calculations

Scaling factor relationship validity limits (l/hr)	0.2	200
Scaling Factor (slope)	1.93441	
Scaling Factor (Intercept)	0	

Operational Carbon Emissions

Design Manual Work Package	Dosed Flow (l/hr)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2/yr)
Chemical Phosphorous Removal	1	1346	3,600



	Included	Excluded
Operational Carbon	Electricity/ Power use	-
	Chemical Delivery	-
	Sludge Disposal	-
	FeCl ₃ emissions	-

[illegible][illegible]

Scaling factor relationship validity limits (l/hr)	100.0	200
Scaling Factor (slope)	2.60	1.89
Scaling Factor (intercept)	1.00	2.00

ELECTRICITY RELATIONSHIP		
Dosed flow (l/hr)	kWh/yr	
100	134.56	
200	269.13	
100	200	
	1345.69	
	0.00	

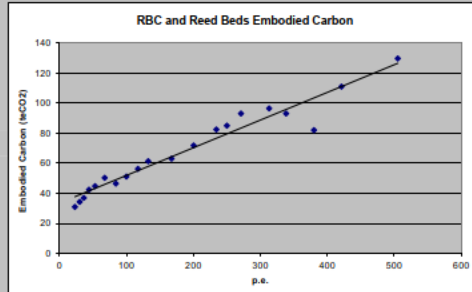
UKWIR
assessments

Scaling factor relationship validity limits (1/hr)	100	200
Scaling Factor (slope)	1345.69	
Scaling Factor (intercept)	0.00	

RBC & Reed Beds

Embodied Carbon Emissions

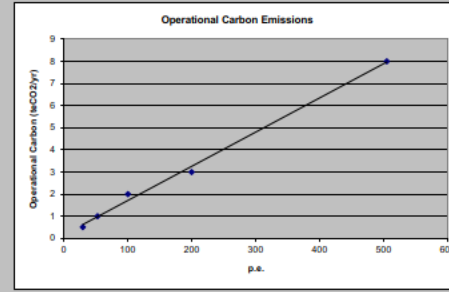
Design Manual Work Package	Capacity (p.e.)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Small Sewage Treatment Works	0	20	0



	Included	Excluded
Embodied Carbon	RBC: concrete base, size-dependent GRP or concrete tank, GRP cover, steel shaft and media holders, polypropylene	Pumping to treatment. Gravity flow is assumed.
	Reed bed: sand base, bed lining, lining protection, gravel fill, outlet chamber and ductile iron decant arm, transport of materials	-
	Pipes: inlet, outlet and distribution	-

Operational Carbon Emissions

Design Manual Work Package	Capacity (p.e.)	Default Annual Electricity (kWh)	Carbon Cost (kg CO ₂)
Small Sewage Treatment Works	0	0	0



	Included	Excluded
Operational Carbon	RBC shaft motor	Process control and panel services
	-	Any emissions from reed bed process and sludge produced by RBC

Security and Fencing

Embodied Carbon Emissions

Design Manual Work Package	No. of works	Design Life (yrs)	Carbon Cost (kg CO2)
Security and Fencing	0	20	0

	Included	Excluded
Embodied Carbon	Security doors, padlocks, intruder detection system, and access control system	-
	Gate and Fencing	

Operational Carbon Emissions

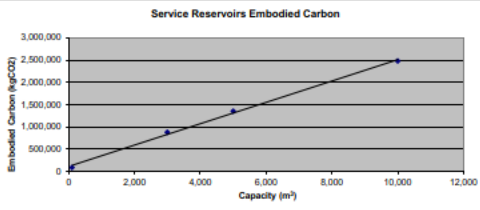
Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Security and Fencing	0	0

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

Service Reservoirs

Embodied Carbon Emissions			
Design Manual Work Package	Capacity (m ³)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Service Reservoirs & Water Retaining Structures	0	40	0

Operational Carbon Emissions	
Design Manual Work Package	Carbon Cost (kg CO ₂ /yr)
No operational emissions associated with this item	



	Included	Excluded
Embodied Carbon	Reinforced Concrete Tank	Pumps, MCC etc
	Granular Fill and valves	
	Transport of materials to site	

PRIMARY SETTLEMENT TANKS

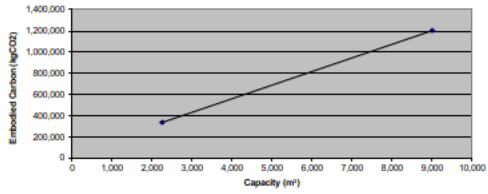
Embodied Carbon Emissions

Design Manual Work Package	Capacity (m ³)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Primary Sedimentation	0	40	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO ₂ /yr)
Primary Sedimentation	0	0

Settlement Tanks Embodied Carbon



Embodied Carbon	Included	Excluded
	IBC Distribution Chamber	Connecting pipework etc
	PST	
	Desludging Chambers	
	Hopper	

Operational Carbon	Included	Excluded
	All-inclusive power to run the process: building services, output	Fuel in travel for maintenance

SEWERAGE PIPELINES

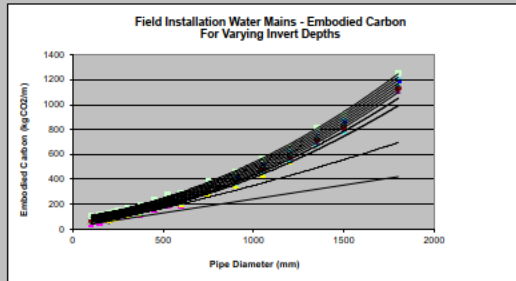
Embodied Carbon Emissions

Design Manual Work Package	Length (m)	Diameter (mm)	Depth (m)	Field/Hig hway	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sewer Rehabilitation	0	0	0		0	0	0	0	0	0	0	0	0	0	0	100	40	0
Sewage Pumping Stations	3690	700	3.5	Field	0	0	0	0	0	1E+06	0	0	0	0	0	100	40	1,073,407

Operational Carbon Emissions

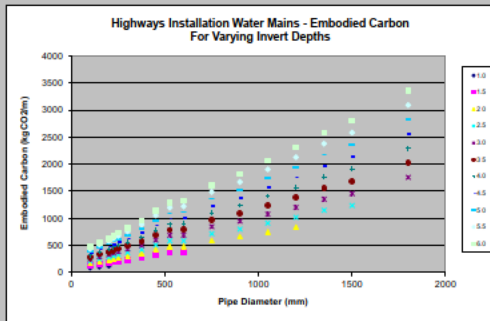
Design Manual Work Package	Carbon Cost (kg CO2)
No operational carbon associated with this item	
No operational carbon associated with this item	

Field Installation



	Included	Excluded
Embodied Carbon	Pipes: materials, transport to site, bed, surround and trench reinstatement	Materials other than VC or Ductile Iron
	Trench reinstatement	CSOs
	Manholes, covers and frames	Pumping stations

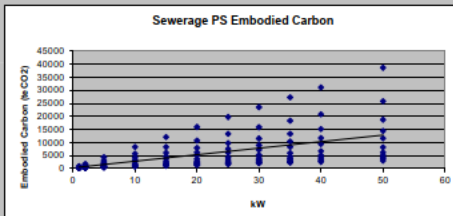
Highways Installation



Sewage Pumping Station

Embodied Carbon Emissions

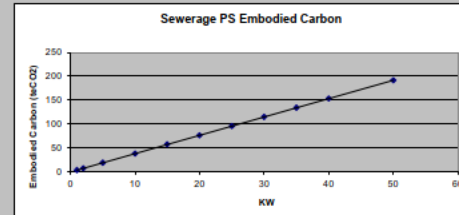
Design Manual Work Package	Power kW	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sewage Pumping Station	240	60	40	60,564



Embodied Carbon	Included	Excluded
	Concrete blinding, base and	Step irons
	Pre-cast concrete rings and roof slab	
	Pipework incoming and	Pump

Operational Carbon Emissions

Design Manual Work Package	Power kW	Default Annual Electricity usage (kWh)	Carbon Cost (kg CO2)
Sewage Pumping Station	240	1,713,568	920,220



Operational Carbon	Included	Excluded
	Pump power electricity	Maintenance and inspection

Site Investigation**Embodied Carbon Emissions**

Design Manual Work Package	No. of sites	Design Life (yre)	Carbon Cost (kg CO2)
Site Investigation	0	20	0

Operational Carbon Emissions

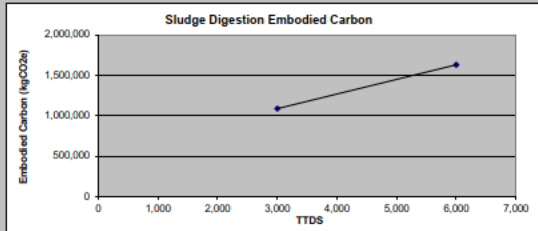
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

Embodied Carbon	Included	Excluded
	Site Investigation boreholes	Sampling equipment
	Trial Pits	-

SLUDGE DIGESTION

Embodied Carbon Emissions

Design Manual Work Package	TTDS/yr	Design Life (yrs)	Carbon Cost (kg CO2)
Sludge Digestion (new plant)	0	20	0



	Included	Excluded
Embodied Carbon	Stainless steel sludge	
	Sludge press, pumps, valves and MCC's	
	Package digester plant (glass coated steel) and	

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	TTDS/yr	Carbon Cost (kg CO2)
Sludge Digestion (new plant)	0	0	0

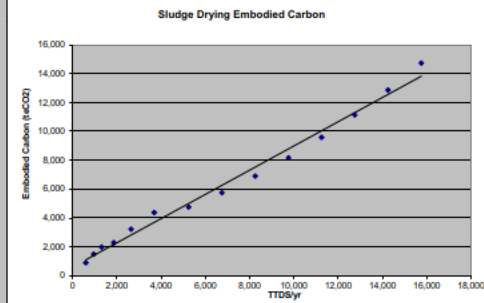


	Included	Excluded
Operational Carbon	All-inclusive power to run the process	Fuel in travel for maintenance
	Emissions from disposal of sludge	-

SLUDGE DRYING

Embodied Carbon Emissions

Design Manual Work Package	TTDS/yr	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sludge Drying	0	60	40	0



	Included	Excluded
Embodied Carbon	Sludge treatment building; concrete base, steel structure; Sludge dewaterer dryer; mild steel machinery and plastic paneling.	Fixtures and fittings; Process control

TTDS/yr	teCO2
600	894
960	1,495
1,320	1,974
1,860	2,285
2,640	3,234
3,690	4,372
5,250	4,749
6,750	5,738
8,250	6,895
9,750	8,166
11,250	9,579
12,750	11,139
14,250	12,858
15,750	14,734

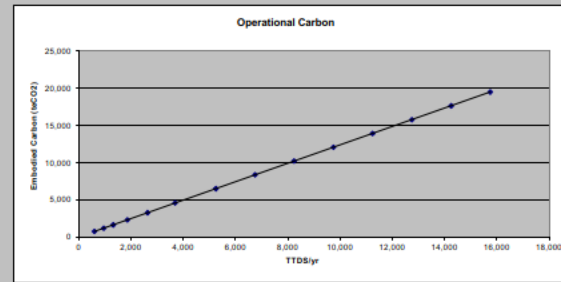
STW Carbon Calculations for P809

User Input following Update to Carbon Calculations

Scaling factor relationship validity limits (TTDS/yr)	0	0
Scaling Factor (slope)	0.94	
Scaling Factor (intercept)	595.48	

Operational Carbon Emissions

Design Manual Work Package	TTDS/yr	Annual Natural Gas Consumption (kWh)	Carbon Cost (kg CO2/yr)
Sludge Drying	0	0	0



	Included	Excluded
Operational Carbon	Power from gas; Power from electricity; Transport of sludge to agriculture; Delivery of polymer	Short-cycle CO2 emissions and other direct emissions of GHGs from drying; Building services; Any emissions from decomposition of sludge products; Polymer manufacture

TTDS/yr	teCO2/yr
600	744
960	1,191
1,320	1,637
1,860	2,308
2,640	3,274
3,690	4,577
5,250	6,511
6,750	8,371
8,250	10,921
9,750	12,092
11,250	13,952
12,750	15,812
14,250	17,672
15,750	19,532

STW Carbon Calculations for P809

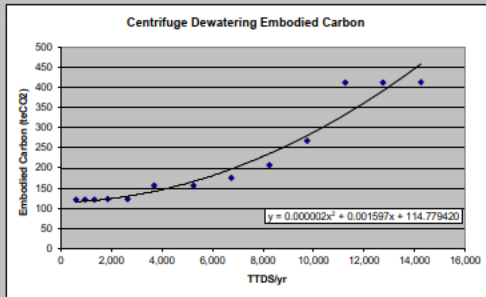
User Input following Update to Carbon Calculations

Scaling factor relationship validity limits (M/d)	600	15750
Scaling Factor (slope)	1.24	
Scaling Factor (intercept)	0.53	

SLUDGE THICKENING - CENTRIFUGE DEWATERING

Embodied Carbon Emissions

Design Manual Work Package	TTDS/yr	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sludge Thickening - Centrifuge dewatering	0	60	40	0



	Included	Excluded
Embodied Carbon	Sludge treatment building: steel construction on concrete slab	Fixtures and fittings
	Centrifuge machines: steel construction	Odour control. Process control. Conveyors.

CARBON RELATIONSHIP	
TTDS/yr	tCO2/yr
600	121
960	121
1,320	121
1,680	123
2,040	123
2,400	156
2,760	156
3,120	176
3,480	207
3,840	268
4,200	412
4,560	414

STW Carbon Calculations for P909

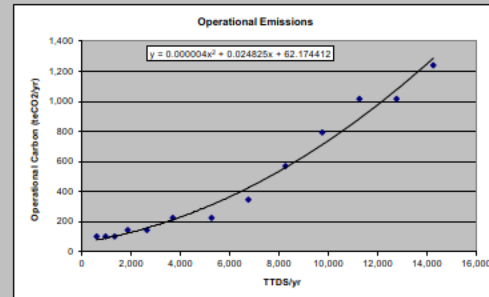
User input following Update to Carbon Calculations

Scaling factor relationship validity limits (TTDS/yr)	600	14250
Quadratic coefficient	0.000002	
x coefficient	0.001597	
y intercept	114.77942	

To update the carbon equation after user input, select cell D63 and click button

Operational Carbon Emissions

Design Manual Work Package	TTDS/yr	Default Annual Electricity (kWh)	Carbon Cost (kg CO2)
Sludge Thickening - Centrifuge dewatering	0	0	0



	Included	Excluded
Operational Carbon	Electrical power to run centrifuge	Building services, process control, labour
	-	Any emissions from decomposition of sludge products

CARBON RELATIONSHIP	
TTDS/yr	tCO2/yr
600	102
960	102
1,320	102
1,680	142
2,040	142
2,400	224
2,760	224
3,120	346
3,480	370
3,840	794
4,200	1,017
4,560	1,017
4,920	1,241

STW Carbon Calculations for P909

User input following Update to Carbon Calculations

Scaling factor relationship validity limits (TTDS/yr)	600	14250
Quadratic coefficient	0.000004	
x coefficient	0.024825	
y intercept	62.174412	

To update the carbon equation after user input, select cell Q60 and click button

SLUDGE THICKENING - SLUDGE PRESS

Embodied Carbon Emissions

Design Manual Work Package	No. of works	Design Life (yrs)	Carbon Cost (kg CO2)
Sludge Thickening - Sludge Press	0	20	0

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2)
Sludge Thickening - Sludge Press	0	0

	Included	Excluded
Embodied Carbon	Sludge press	Pumps and valves
	Associated MCC	-

	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

From Atkins Carbon Calculator Tool:

Item: Equipment/ Plant/ Vehicle		unit	waste allowance	Comments	Component grade	Temp works			Design Life (yrs)	Carbon Cost (kg CO2)
Materials:										
Rotomat SP4 Strainpress RC slab 20 m2 x 300 deep.	6	m3	6.36	Reinforced concrete	0	0.01			60	3,427
Duty and Standby or Duty and Assist: Rotomat SP4 Strainpress has capacity of 60 m3/h at 6% DS each.	1000	kg	1000	Stainless steel	0.65				20	10,148
Steel for RC MCC	48	kg	51,072	Steel					20	969
	500	kg	500						29	
Construction:										
Construction Duration	10.0	days								
No of site staff	4	no.								
Typical excavator hours during installation	80.0	hours	80.0							1,705
Typical dumper truck hours during installation	80.0	hours	80.0							2,588
On-site power use and welfare facilities	200	kWh	200.00							537
Design and Site Management:										
Survey, design and contract docs	5	days	5.00							35
Site supervision	2.50	days	2.50	full-time supervision						17
Component to be transported	Notes	Quantity	Unit	Transportation distance	unit	Journey	Max load	unit	no of loads	kg CO2
Materials										
Steel, MCC	Articulated Lorry (>33t)	551	kg	100	km	out	20000	kg	1	111
						back				67
										178
Concrete	Rigid Lorry (>17t)	6	m3	100	km	out	8.3	m3	1	112
						back				78
										190
Strainpress	Articulated Lorry (>33t)	80	kg	800	km	out	20000	kg	1	889
						back				534
										1,422
Labour										
Labour	Assume 2 workers per vehicle per day	20.0	vehicles	50	km	out			20.0	214
						back				214
										428
Waste Removal										
Excavated material	Rigid Lorry (>17t)	0.36	m3	50	km	out	8.3	m3	1	39
						back				
										95
										7,195

Assumptions:
1x 60m3/h press

TUNNELLING & LOW DIG TECHNIQUES

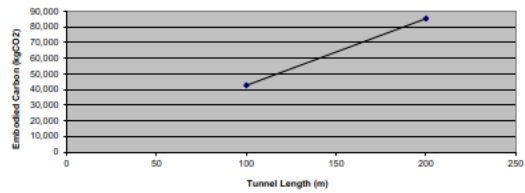
Embodied Carbon Emissions

Design Manual Work Package	Tunnel length (m)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Tunnelling and low dig techniques	250	40	106,660

Operational Carbon Emissions

Design Manual Work Package	Carbon Cost (kg CO ₂ /yr)
No operational carbon associated with this item	

Tunnelling Embodied Carbon



Embodied Carbon	Included	Excluded
	Tunnel excavation and associated manholes	-
	Concrete lining of tunnels	-

WATER MAINS

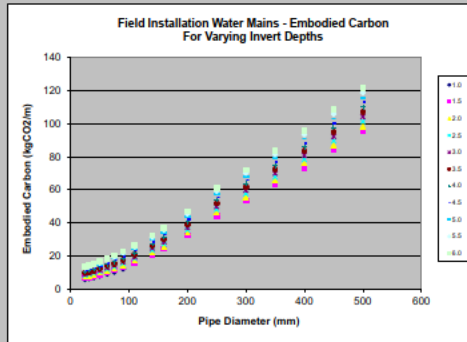
Embodied Carbon Emissions

Design Manual Work Package	Length (m)	Diameter (mm)	Depth (m)	Field/HI gwhwy												Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO ₂)
Distribution Mains & Service Pipes	0	0	0	0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	100	40	0
Trunk Mains	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	100	40	0

Operational Carbon Emissions

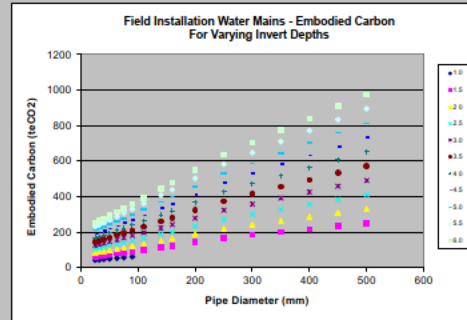
Design Manual Work Package	Carbon Cost (kg CO ₂)
No operational carbon associated with this item	

Field Installation

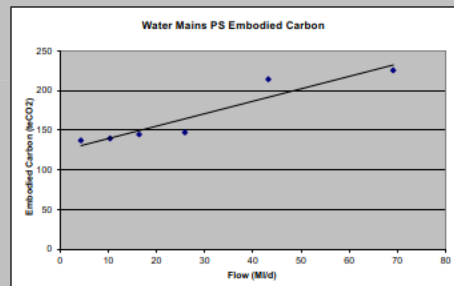


	Included	Excluded
Embodied Carbon	Pipes, materials, transport to site, bed, surround and trench reinstatement	Materials other than PE80 or ductile iron
	Trench reinstatement	-
	-	Pumping stations

Highways Installation



Design Manual Work Package	Flow (Mld)	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Pumping Stations	0	60	40	0



	Included	Excluded
Embodied Carbon	Building: brick construction on concrete base, sheet steel roof	Fixtures and fittings.
	Pump: material for 2 duty and 1 standby units	Cabling and process control
	Pipework: inlet and outlet manifolds, individual pump sections.	

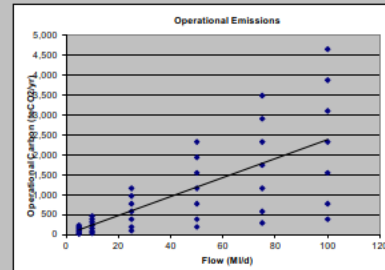
[illegible]

Scaling factor relationship validity limits (Mid)	4	69
Scaling Factor (slope)	1.57	
Scaling Factor (intercept)	123.78	

STW Carbon
Calculations for
PR09

User Input following Update to Carbon

Design Manual Work Package	Flow (Ml/d)	Annual Electricity usage (kWh)	Carbon Cost (kg CO2)
Pumping Stations	0	248,256	0



	Included	Excluded
Operational Carbon	Pump power electricity	Building services, process control, maintenance and inspection.

CARBON RELATIONSHIP		
Flow (Mld)	in	to CO ₂ y
5		19
10		39
25		97
50		194
75		291
100		388
5		39
10		78
25		194
50		388
75		582
100		776
5		78
10		155
25		388
50		776
75		1,164
100		1,552
5		116
10		233
25		582
50		1,164
75		1,746
100		2,328
5		155
10		310
25		776
50		1,552
75		2,328
100		3,104
5		194
10		388
25		970
50		1,946
75		2,910
100		3,880
5		233
10		466
25		1,164
50		2,328
75		3,492
100		4,656

Scaling factor relationship validity limits (M/d)	5	100
Scaling Factor (slope)	23.83	
Scaling Factor (intercept)	0.00	

