

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

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]

[illegible]



GATE 2 CARBON CALCULATOR

USER INSTRUCTIONS:

Enter quantities for required Design Manual Categories in the pale blue cells in this sheet 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 _{2eq} (kgCO _{2eq})	Operational CO _{2eq} (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
	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 (Ml/d)	Annual Electricity Consumption (kWh)	2012	0	0	£0
	Filtration		Flow (Ml/d)	Annual Electricity Consumption (kWh)	2009	0	0	£0
	Activated Carbon Removal of Endocrine Disruptors (Full flow)		Flow (Ml/d)	Annual Electricity Consumption (kWh)	2012	0	0	£0
	Activated Carbon Removal of Pesticides (Full flow)		Flow (Ml/d)	Annual Electricity Consumption (kWh)	2012	0	0	£0
	Activated Carbon Removal of Zinc (Full flow)		Flow (Ml/d)	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 (Ml/d)	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)	2012	0	0	£0
			Pipe Diameter (mm)	Pipe Location				
	Sewer Rehabilitation contd		Sewer Length (m)	Diameter (mm)	2012	0		£0
			Pipe Location	Depth to invert (m)				
	Manholes		No.		2012	0		£0
Sewage Treatment	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	235,215	£184,538
	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 (Ml/d)	Annual Electricity Consumption (kWh)	2012	122,182	235,215	£182,128
	Small Sewage Treatment Works		Capacity (p.e.)	Annual Electricity Consumption (kWh)	2012	0	0	£0
Access to Assets	Flooring		Floor area (m ²)		2012	9,359	-	£247
	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	0	-	£0
	Outfall Structures		No. of structures		2012	1,223	-	£32
	Tunnelling & Low Dig Techniques		Tunnel length (m)		2012	0	-	£0
Other	Environmental and Landscape		No. of sites		2012	1,663		£108
	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

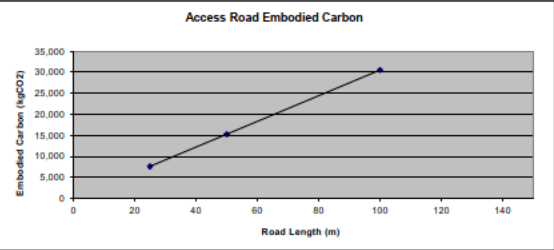
Access Road

Embodied Carbon Emissions

Design Manual Work Package	Road Length (m)	Design Life (yrs)	Carbon Cost (kg CO2)
Access Road	0	15	0

Operational Carbon Emissions

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

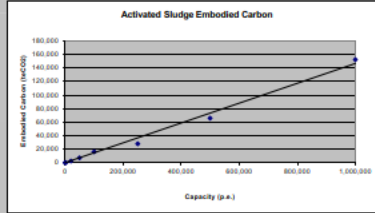


	Included	Excluded
Embodied Carbon	4m wide access road - 750mm sub-base and 75mm wearing	Kerbs and drainage
	-	-
	-	-

ACTIVATED SLUDGE (NITRIFICATION)

Embodied Carbon Emissions

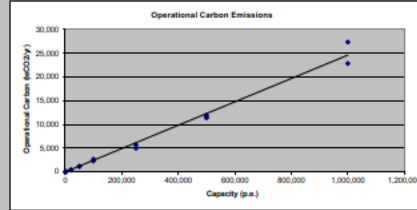
Design Manual Work Package	Capacity (p.a.)	Design Life (yrs)	Design Life for carbon (yrs)	Carbon Cost (kg CO2)
Enhanced Biological Phosphorus Removal Activated Sludge Process	0	60	40	0
	0	60	40	0



	Included	Excluded
Embodied Carbon	Rectangular concrete selector tank with mechanical mixer Rectangular concrete aeration lanes with fine bubble diffusers Concrete radial hopper bottom final settlement tanks, scraper loaders, SAS pumps and SAS	Pumping to selector tank Short cycle CO2 released during aeration treatment

Operational Carbon Emissions

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



	Included	Excluded
Operational Carbon	Mechanical mixer power Blower power for air delivery to the aeration lanes RAS pumping SAS pumping Scraper loader	Process control and effluent treatment Short cycle CO2 released during aeration treatment Any emissions from sludge produced

CARBON RELATIONSHIP

p.a.	tCO2/yr
500	126
2,500	622
25,000	2,540
50,000	7,269
100,000	18,367
250,000	27,888
500,000	46,045
1,000,000	100,360

Scaling factor relationship velocity limits (M/s)	500	1,000,000
Scaling Factor (slope)	0.19	
Scaling Factor (intercept)	0	

CARBON RELATIONSHIP

p.a.	tCO2/yr	tCO2/yr (incl. effl.)
500	21	
2,500	26	
25,000	407	
50,000	1,209	
100,000	2,738	
250,000	5,017	
500,000	11,815	
1,000,000	22,360	

Scaling factor relationship velocity limits (p.a.)	500	27,902
Scaling Factor (slope)	0.02	0.01
Scaling Factor (intercept)	0.00	-0.22

ELECTRICITY RELATIONSHIP

p.a.	MWh/yr
500	10,275
2,500	51,315
25,000	410,065
50,000	1,027,694
100,000	2,094,980
250,000	5,137,469
500,000	10,274,938
1,000,000	20,549,876

Scaling factor relationship velocity limits (p.a.)	500	1000000
Scaling Factor (slope)	20.55	
Scaling Factor (intercept)	0.00	

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	

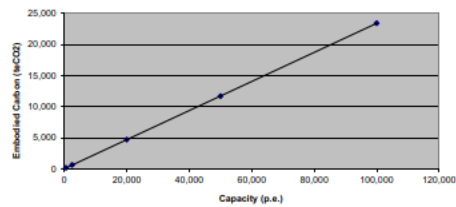
Embodied Carbon	Included	Excluded
	Connecting pipework; 50m 150mm DI	-
	Fencing; 50m chain link 2.4m high, post and gate	-
	Valves and Splitter Chamber; 2no. Gate valves and 5no. Bends (700kg cast iron) and a 2m by 2m by 2m concrete chamber with 300mm thick walls	-

BIOFILTERS

Embodied Carbon Emissions

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

Biofilter Embodied Carbon



	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	-

CARBON RELATIONSHIP

p.e.	kgCO2
500	189
2,500	656
20,000	4,723
50,000	11,681
100,000	23,396

Carbon Calculations for p.e. 500 to 100,000

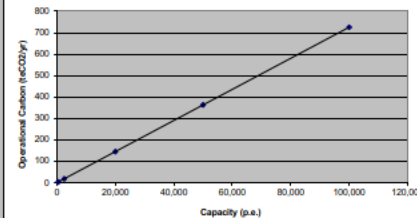
User input/allowed Update to Carbon Calculations

Scaling factor relationship validity limits (p.e.)	500	100000
Scaling Factor (slope)	0.23	
Scaling Factor (intercept)	95	

Operational Carbon Emissions

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

Operational Emissions



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

CARBON RELATIONSHIP

p.e.	kgCO2/yr	kgCO2/yr (excl elec)
500	9	n/a
2,500	9	n/a
20,000	22	n/a
50,000	48	n/a
100,000	92	n/a

3 Year Carbon Calculations

User input/allowed Update to Carbon Calculations

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

ELECTRICITY RELATIONSHIP

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

3 Year Carbon Calculations

User input/allowed Update to Carbon Calculations

Scaling factor relationship validity limits (p.e.)	500	100000
Scaling Factor (slope)	3.48	
Scaling Factor (intercept)	0.00	

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

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

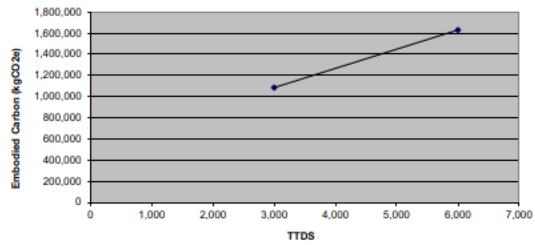
Embodied Carbon Emissions

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

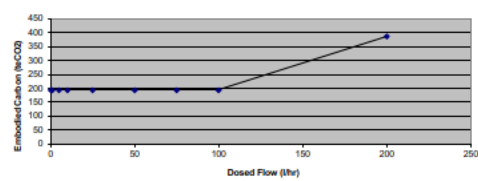
Embodied Carbon Emissions

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	0	20	0
Sludge Mixing	0	20	0

Operational Carbon Emissions

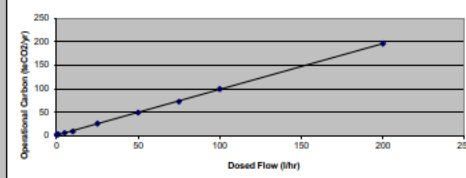
Design Manual Work Package	Dosed Flow (l/hr)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2/yr)
Arsenic Removal	0	0	0
Fluoridation	0	0	0
pH Correction	0	0	0
Iron & Manganese Treatment	0	0	0
Disinfection	0	0	0
Stabilisation & Conditioning	0	0	0
Sludge Mixing	0	0	0

Chemical Dosing Embodied Carbon



	Included	Excluded
Embodied Carbon	Bundled 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

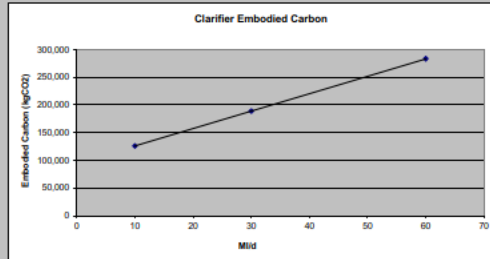
Scaling factor relationship validity limits (l/hr)	0.2	200
Scaling Factor (slope)	0.97	
Scaling Factor (intercept)	1.81	

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	1	15	1,663

	Included	Excluded
Embodied Carbon	Allowance for 20 m3 of excavation	-

Operational Carbon Emissions

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

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	-

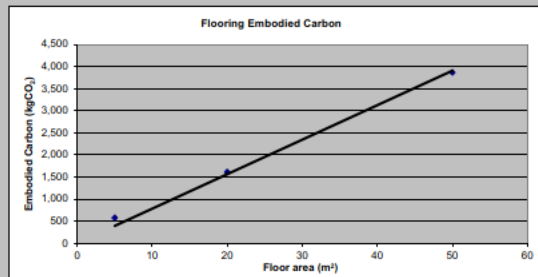
Flooring

Embodied Carbon Emissions

Design Manual Work Package	Floor Area (m2)	Design Life (yrs)	Carbon Cost (kg CO2)
Flooring	125	40	9,359

Operational Carbon Emissions

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



	Included	Excluded
Embodied Carbon	Concrete flooring	-

INLET WORKS

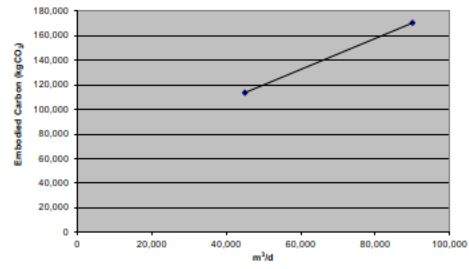
Embodied Carbon Emissions

Design Manual Work Package	m ³ /d	Design Life (yrs)	Carbon Cost (kg CO ₂)
Inlet Works	0	40	0

Operational Carbon Emissions

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

Inlet Works Embodied Carbon



	Included	Excluded
Embodied Carbon	Inlet channel, splay channel, bypass channel	
	CSO	
	Mech. Hoisting 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

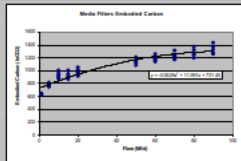
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

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

MECA FILTERS

Embedded Carbon Emissions

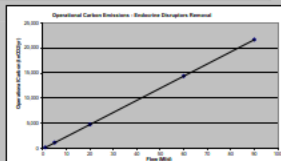
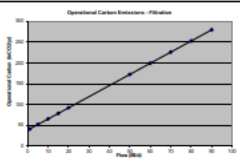
Design Manual Work Package	Flow (MGD)	Life Time Emissions (kg CO2e)	Carbon Cost (\$/kg CO2e)
Filtration	0	402	402
Advanced Carbon Removal of Endocrine Disruptors	0	402	402
Advanced Carbon Removal of Pesticides	0	402	402
Advanced Carbon Removal of DBP	0	402	402



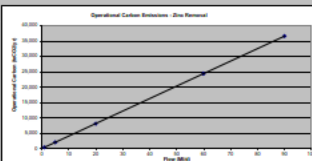
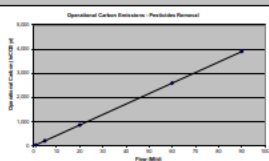
Excluded Carbon	Included Carbon
Filter building, filter construction	Filter building, filter construction
Carbon emission DB in flow sheet	Carbon emission DB in flow sheet
Filter design, water consumption on concrete bases, filter cake, upstream head chamber, water chemistry, media, electricity	Filter design, water consumption on concrete bases, filter cake, upstream head chamber, water chemistry, media, electricity
Only background work, steel construction, air, electricity, water, background, water	Only background work, steel construction, air, electricity, water, background, water

Operational Carbon Emissions

Design Manual Work Package	Flow (MGD)	Default Annual Emissions (kg CO2e)	Carbon Cost (\$/kg CO2e)
Filtration	0	0	0
Advanced Carbon Removal of Endocrine Disruptors	0	0	0
Advanced Carbon Removal of Pesticides	0	0	0
Advanced Carbon Removal of DBP	0	0	0



	Included	Excluded
Operational Carbon	Advanced carbon removal Endocrine Disruptors Pesticides DBP	Advanced carbon removal Endocrine Disruptors Pesticides DBP



Flow (MGD)	Carbon Emissions (kgCO2e)
0.000	0
0.001	16.02
0.002	32.04
0.003	48.06
0.004	64.08
0.005	80.10
0.006	96.12
0.007	112.14
0.008	128.16
0.009	144.18
0.010	160.20
0.011	176.22
0.012	192.24
0.013	208.26
0.014	224.28
0.015	240.30
0.016	256.32
0.017	272.34
0.018	288.36
0.019	304.38
0.020	320.40
0.021	336.42
0.022	352.44
0.023	368.46
0.024	384.48
0.025	400.50
0.026	416.52
0.027	432.54
0.028	448.56
0.029	464.58
0.030	480.60
0.031	496.62
0.032	512.64
0.033	528.66
0.034	544.68
0.035	560.70
0.036	576.72
0.037	592.74
0.038	608.76
0.039	624.78
0.040	640.80
0.041	656.82
0.042	672.84
0.043	688.86
0.044	704.88
0.045	720.90
0.046	736.92
0.047	752.94
0.048	768.96
0.049	784.98
0.050	801.00
0.051	817.02
0.052	833.04
0.053	849.06
0.054	865.08
0.055	881.10
0.056	897.12
0.057	913.14
0.058	929.16
0.059	945.18
0.060	961.20
0.061	977.22
0.062	993.24
0.063	1009.26
0.064	1025.28
0.065	1041.30
0.066	1057.32
0.067	1073.34
0.068	1089.36
0.069	1105.38
0.070	1121.40
0.071	1137.42
0.072	1153.44
0.073	1169.46
0.074	1185.48
0.075	1201.50
0.076	1217.52
0.077	1233.54
0.078	1249.56
0.079	1265.58
0.080	1281.60
0.081	1297.62
0.082	1313.64
0.083	1329.66
0.084	1345.68
0.085	1361.70
0.086	1377.72
0.087	1393.74
0.088	1409.76
0.089	1425.78
0.090	1441.80
0.091	1457.82
0.092	1473.84
0.093	1489.86
0.094	1505.88
0.095	1521.90
0.096	1537.92
0.097	1553.94
0.098	1569.96
0.099	1585.98
0.100	1602.00

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

Flow (MGD)	Carbon Emissions (kgCO2e)
0.000	0
0.001	16.02
0.002	32.04
0.003	48.06
0.004	64.08
0.005	80.10
0.006	96.12
0.007	112.14
0.008	128.16
0.009	144.18
0.010	160.20
0.011	176.22
0.012	192.24
0.013	208.26
0.014	224.28
0.015	240.30
0.016	256.32
0.017	272.34
0.018	288.36
0.019	304.38
0.020	320.40
0.021	336.42
0.022	352.44
0.023	368.46
0.024	384.48
0.025	400.50
0.026	416.52
0.027	432.54
0.028	448.56
0.029	464.58
0.030	480.60
0.031	496.62
0.032	512.64
0.033	528.66
0.034	544.68
0.035	560.70
0.036	576.72
0.037	592.74
0.038	608.76
0.039	624.78
0.040	640.80
0.041	656.82
0.042	672.84
0.043	688.86
0.044	704.88
0.045	720.90
0.046	736.92
0.047	752.94
0.048	768.96
0.049	784.98
0.050	801.00
0.051	817.02
0.052	833.04
0.053	849.06
0.054	865.08
0.055	881.10
0.056	897.12
0.057	913.14
0.058	929.16
0.059	945.18
0.060	961.20
0.061	977.22
0.062	993.24
0.063	1009.26
0.064	1025.28
0.065	1041.30
0.066	1057.32
0.067	1073.34
0.068	1089.36
0.069	1105.38
0.070	1121.40
0.071	1137.42
0.072	1153.44
0.073	1169.46
0.074	1185.48
0.075	1201.50
0.076	1217.52
0.077	1233.54
0.078	1249.56
0.079	1265.58
0.080	1281.60
0.081	1297.62
0.082	1313.64
0.083	1329.66
0.084	1345.68
0.085	1361.70
0.086	1377.72
0.087	1393.74
0.088	1409.76
0.089	1425.78
0.090	1441.80
0.091	1457.82
0.092	1473.84
0.093	1489.86
0.094	1505.88
0.095	1521.90
0.096	1537.92
0.097	1553.94
0.098	1569.96
0.099	1585.98
0.100	1602.00

Flow (MGD)	Carbon Emissions (kgCO2e)
0.000	0
0.001	16.02
0.002	32.04
0.003	48.06
0.004	64.08
0.005	80.10
0.006	96.12
0.007	112.14
0.008	128.16
0.009	144.18
0.010	160.20
0.011	176.22
0.012	192.24
0.013	208.26
0.014	224.28
0.015	240.30
0.016	256.32
0.017	272.34
0.018	288.36
0.019	304.38
0.020	320.40
0.021	336.42
0.022	352.44
0.023	368.46
0.024	384.48
0.025	400.50
0.026	416.52
0.027	432.54
0.028	448.56
0.029	464.58
0.030	480.60
0.031	496.62
0.032	512.64
0.033	528.66
0.034	544.68
0.035	560.70
0.036	576.72
0.037	592.74
0.038	608.76
0.039	624.78
0.040	640.80
0.041	656.82
0.042	672.84
0.043	688.86
0.044	704.88
0.045	720.90
0.046	736.92
0.047	752.94
0.048	768.96
0.049	784.98
0.050	801.00
0.051	817.02
0.052	833.04
0.053	849.06
0.054	865.08
0.055	881.10
0.056	897.12
0.057	913.14
0.058	929.16
0.059	945.18
0.060	961.20
0.061	977.22
0.062	993.24
0.063	1009.26
0.064	1025.28
0.065	1041.30
0.066	1057.32
0.067	1073.34
0.068	1089.36
0.069	1105.38
0.070	1121.40
0.071	1137.42
0.072	1153.44
0.073	1169.46
0.074	1185.48
0.075	1201.50
0.076	1217.52
0.077	1233.54
0.078	1249.56
0.079	1265.58
0.080	1281.60
0.081	1297.62
0.082	1313.64
0.083	1329.66
0.084	1345.68
0.085	1361.70
0.086	1377.72
0.087	1393.74
0.088	1409.76
0.089	1425.78
0.090	1441.80
0.091	1457.82
0.092	1473.84
0.093	1489.86
0.094	1505.88
0.095	1521.90
0.096	1537.92
0.097	1553.94
0.098	1569.96
0.099	1585.98
0.100	1602.00

Flow (MGD)	Carbon Emissions (kgCO2e)
0.000	0
0.001	16.02
0.002	32.04
0.003	48.06
0.004	64.08
0.005	80.10
0.006	96.12
0.007	112.14
0.008	128.16
0.009	144.18
0.010	160.20
0.011	176.22
0.012	192.24
0.013	208.26
0.014	224.28
0.015	240.30
0.016	256.32
0.017	272.34
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0.024	384.48
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0.040	640.80
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0.050	801.00
0.051	817.02
0.052	833.04
0.053	849.06
0.054	865.08
0.055	881.10
0.056	897.12
0.057	913.14
0.058	929.16
0.059	945.18
0.060	961.20
0.061	977.22
0.062	993.24
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0.064	1025.28
0.065	1041.30
0.066	1057.32
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0.069	1105.38
0.070	1121.40
0.071	1137.42
0.072	1153.44
0.073	1169.46
0.074	1185.48
0.075	1201.50
0.076	1217.52
0.077	1233.54
0.078	1249.56
0.079	1265.58
0.080	1281.60
0.081	1297.62
0.082	1313.64
0.083	1329.66
0.084	1345.68
0.085	1361.70
0.086	1377.72
0.087	1393.74
0.088	1409.76
0.089	1425.78
0.090	1441.80
0.091	1457.82
0.092	1473.84</

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

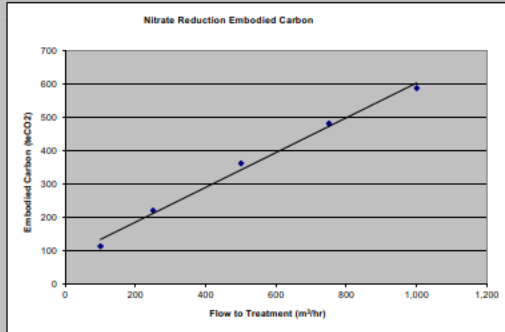
Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Remote Asset Monitoring (Telemetry) Systems	438000	235,215

	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

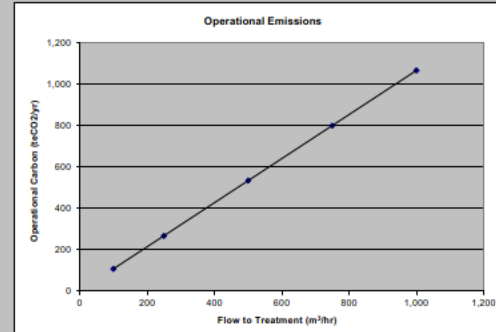
Design Manual Work Package	Flow to Treatment (m ³ /hr)	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO ₂)
Nitrate Treatment	0	15	15	0



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 CO ₂)
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

	Included	Excluded
Embodied Carbon	Head wall	Scour protection
	Flap valve	

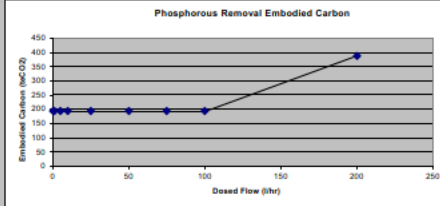
Operational Carbon Emissions

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

PHOSPHOROUS REMOVAL

Embodied Carbon Emissions

Design Manual Work Package	Dosed Flow (l/hr)	Design Life (yrs)	Carbon Cost (kg CO2)
Chemical Phosphorous Removal	0	20	0



	Included	Excluded
Embodied Carbon	Bundled 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

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

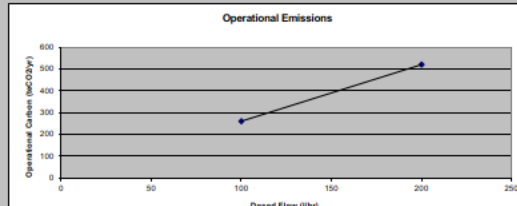
STW Carbon Calculations for PQ9

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	0	0	0



	Included	Excluded
Operational Carbon	Electricity/Power use	-
	Chemical Delivery	-
	Sludge Disposal	-
	F&C3 emissions	-

CARBON RELATIONSHIP

p.e.	teCO2/yr	Dosed Flow (l/hr)	teCO2/yr (excl elec)
50,000	261	100	191
100,000	521	200	380

UKWIR Sustain Tool

User input following Update to Carbon Calculations

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
50,000	100	134,569
100,000	200	269,138

UKWIR Sustain Tool

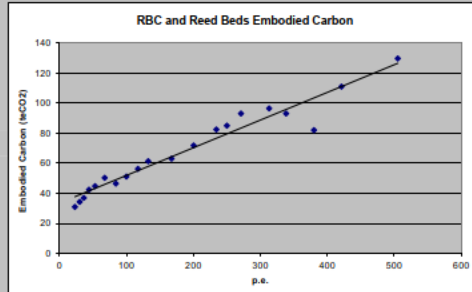
User input following Update to Carbon Calculations

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

RBC & Reed Beds

Embodied Carbon Emissions

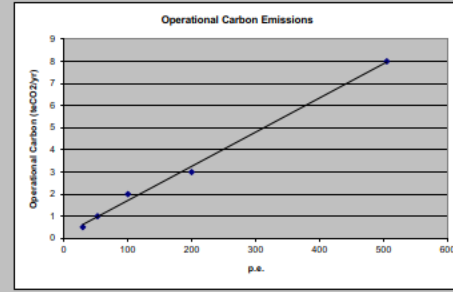
Design Manual Work Package	Capacity (p.e.)	Design Life (yrs)	Carbon Cost (kg CO ₂)
Small Sewage Treatment Works	0	20	0



	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

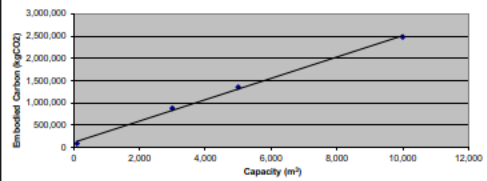
	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

Service Reservoirs

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

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

Service Reservoirs Embodied Carbon



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

PRIMARY SETTLEMENT TANKS

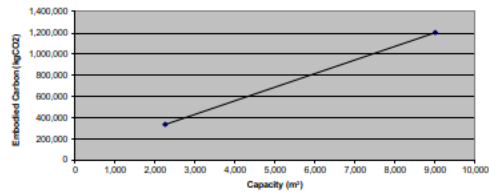
Embodied Carbon Emissions

Design Manual Work Package	Capacity (m ³)	Design Life (yrs)	Carbon Cost (kg CO2)
Primary Sedimentation	0	40	0

Operational Carbon Emissions

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

Settlement Tanks Embodied Carbon



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

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

SEWERAGE PIPELINES

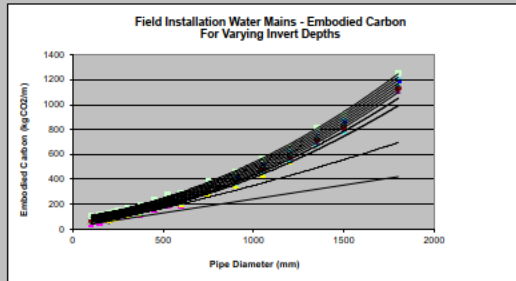
Embodied Carbon Emissions

Design Manual Work Package	Length (m)	Diameter (mm)	Depth (m)	Field/Hig hway											Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sewer Rehabilitation	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
Sewage Pumping Stations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	40

Operational Carbon Emissions

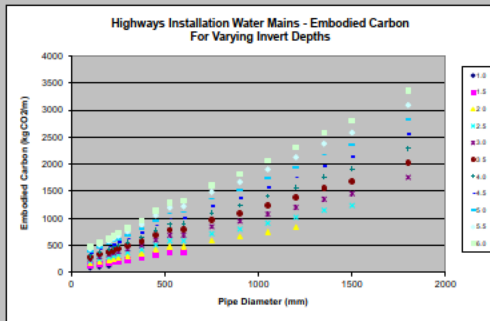
Design Manual Work Package	Carbon Cost (kg CO2)
No operational carbon associated with this item	
No operational carbon associated with this item	

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

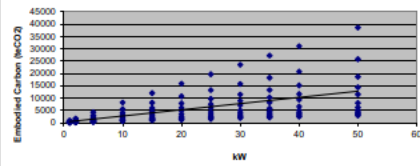


Sewage Pumping Station

Embodied Carbon Emissions

Design Manual Work Package	Power kW	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
Sewage Pumping Station	0	60	40	0

Sewerage PS Embodied Carbon

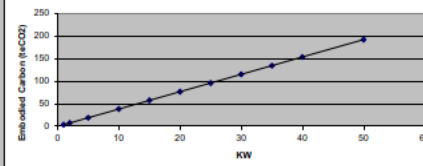


Embodied Carbon	Included	Excluded
	Concrete blinding, base and	Slap irons
	Pre-cast concrete rings and roof slab	
	Pipework incoming and	Pump

Operational Carbon Emissions

Design Manual Work Package	Power kW	Default Annual Electricity usage (kWh)	Carbon Cost (kg CO2)
Sewage Pumping Station	0	0	0

Sewerage PS Embodied Carbon



Operational Carbon	Included	Excluded
	Pump power electricity	Maintenance and inspection

Site Investigation**Embodied Carbon Emissions**

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

Operational Carbon Emissions

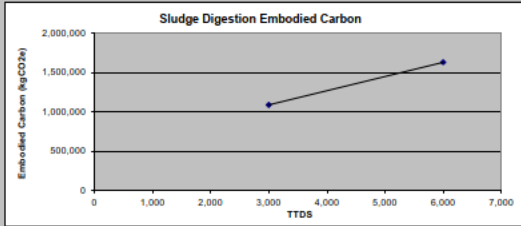
Design Manual Work Package	Carbon Cost (kg CO2/yr)
No operational carbon associated with this item	

Embodied Carbon	Included	Excluded
	Site Investigation boreholes	Sampling equipment
	Trial Pits	

SLUDGE DIGESTION

Embodied Carbon Emissions

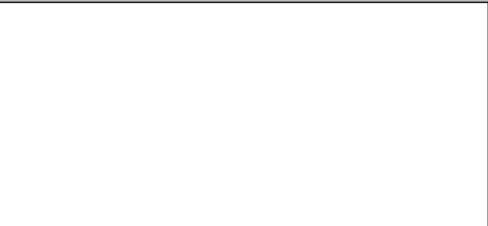
Design Manual Work Package	TTDS/yr	Design Life (yrs)	Carbon Cost (kg CO2)
Sludge Digestion (new plant)	0	20	0



	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



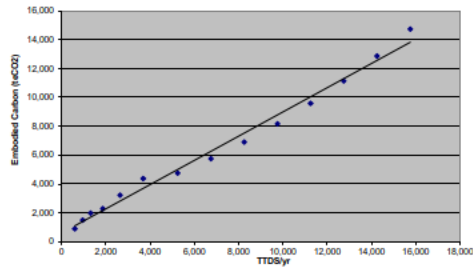
	Included	Excluded
Operational Carbon	All-inclusive power to run the process	Fuel in travel for maintenance
	Emissions from disposal of sludge	-

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

Sludge Drying Embodied Carbon



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

TTDS/yr	teCO2
600	894
960	1,495
1,320	1,974
1,860	2,285
2,640	3,224
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 P609

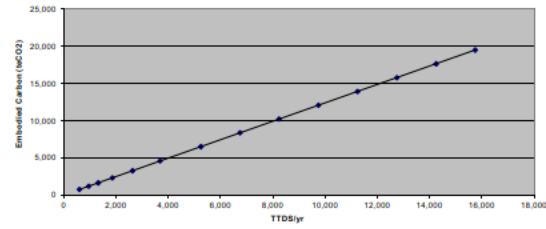
User Input following Update to Carbon Calculations

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

Operational Carbon



	Included	Excluded
Operational Carbon	Power from gas	Short-cycle CO ₂ emissions and other direct emissions of GHGs from drying
	Power from electricity	Building services
	Transport of sludge to agriculture	Any emissions from decomposition of sludge products
	Delivery of polymer	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 P609

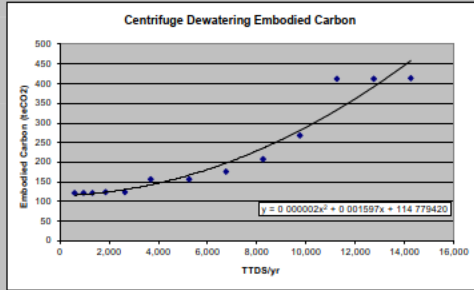
User Input following Update to Carbon Calculations

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 Carbon Cost 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
600	121
960	121
1,320	121
1,680	123
2,640	123
3,690	156
5,250	156
6,750	176
8,250	207
9,750	268
11,250	412
12,750	412
14,250	414

STW Carbon Calculations for PR09

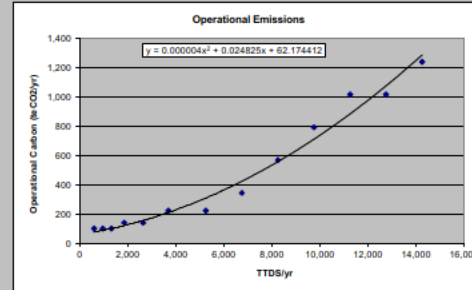
User Input following Update to Carbon Calculations

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
2,640	142
3,690	224
5,250	224
6,750	246
8,250	270
9,750	294
11,250	1,017
12,750	1,017
14,250	1,341

STW Carbon Calculations for PR09

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	-

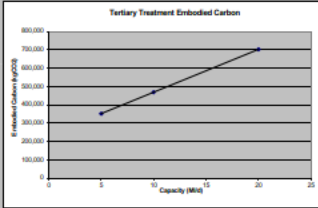
	Included	Excluded
Operational Carbon	All-inclusive power to run the process: building services, pumps.	Fuel in travel for maintenance

From Atkins Carbon Calculator Tool:

Sludge Press										
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						20	969
	500	kg	500	Steel					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				56
										95
										7,195

Assumptions:
1x 60m3/h press

Embodied Carbon Emissions			
Design Manual Work Package	Capacity (MWh)	Design Life (yrs)	Carbon Cost (kg CO2e)
Tertiary Treatment	0	40	0



Embodied Carbon	EXCLUDED	INCLUDED
Design Manual Work Package	-	-
Tertiary Treatment	-	-

CARBON RELATIONSHIP		
Capacity (MWh)	kgCO2e	Notes
0	260,307	Alkene Carbon Calculator
10	267,476	
20	270,653	

Scaling factor relationship	1	25
Scaling factor relationship	1	25
Scaling factor relationship	1	25

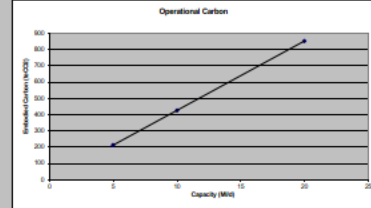
From Alkene Carbon Calculator Tool:

Item	Equipment/Plant/vehicle	unit	volume/area/weight	Comments	Component	Temp works	Design Life (yrs)	Carbon Cost (kg CO2e)
Materials								
Feed pump station	25.2	m3	26.71	Underground concrete structure, assume 2m x 2m x 1m deep	0	0.01	60	14,360
Submersible pump and valves	3000	kg	3000.00	Standard steel	0.5	0.01	20	27,462
8 nos. Deep bed sand filters (6m x 4.6m x 1.5m deep)	426.588	m3	455.34	RC Trench type deep bed sand filter for suspended solids and steel framework	0	0.01	60	245,339
Media material	426.588	m3	473.81	Gravel	0	0	10	3,016
Backwash pump station	25.2	m3	26.71	reinforced concrete	0	0.01	60	14,360
Submersible pump and valves	3000	kg	3000.00	One duty-one standby @ 20 bars	0.5	0	20	27,475
Backwash tank	68.48	m3	63.79	Allowance for 1 hour backwash volume @ RC tanks, 10m x 10m x 4.5m	0	0.01	60	50,533
MCC	550	kg	550.00	Steel	0.5	0	20	1,454
Material store	550	kg	550.00	Reinforced steel	0.5	0	20	4,613
Material storage bins	7,675	m3	8.47	Assume building footprint of 20.0m	0	0	60	3,254
Reinforcing steel	45470.84	kg	48368.29	1% steel				53
Contributions								
Construction Duration	67.5	days						97
No. of site staff	8	no						11,512
Typical excavator hours during construction	540.0	hours	540.0					34,936
Typical dumper truck hours during construction	1080.0	hours	1080.0					7,250
On-site power use and welfare	2700	kWh	2700.00					69
Design and Site Management	10	days	10.00	10% design supervision				117
Component to be transported								
Name	Quantity	unit	Transportation	unit	Journey	Max load	no. of loads	kg CO2e
Materials								
Concrete	Rigid Lorry (x170)	603	m3	100	km	out	8.3	73
Bricks	Rigid Lorry (x170)	8	m3	100	km	out	8.3	2
S Steel pumps	Articulated Lorry (x200)	6000	kg	100	km	in	20000	1
Steel	Articulated Lorry (x200)	48886	kg	100	km	in	20000	3
Sand for filters	Rigid Lorry (x170)	474	m3	100	km	out	8.3	58
Labour								
Labour	Assume 2 vehicles per vehicle car day	270.0	vehicles	50	km	out	270.0	2,888
Waste Removal								
Concrete/brick/land waste removal	Rigid Lorry (x170)	78.94	m3	50	km	out	8.3	10
Steel waste removal	Articulated Lorry (x200)	2013.45	kg	50	km	out	20000	1

Assumptions:
Assumed Sand Filter with Material Coating

Embodied Carbon Cost (kg CO2e) 487,816

Operational Carbon Emissions			
Design Manual Work Package	Capacity (MWh)	Default Annual Electricity (kWh)	Carbon Cost (kg CO2e/yr)
Tertiary Treatment	0	0	0



Operational Carbon	EXCLUDED	INCLUDED
Design Manual Work Package	-	-
Tertiary Treatment	-	-

CARBON RELATIONSHIP		
Capacity (MWh)	kgCO2e/yr	Notes
0	210	Carbon Calculator
10	210	
20	210	

Scaling factor relationship	1	25
Scaling factor relationship	1	25
Scaling factor relationship	1	25

ELECTRICITY RELATIONSHIP		
Capacity (MWh)	kWh/yr	Notes
0	0	Carbon Calculator
10	0	
20	0	

Scaling factor relationship	1	25
Scaling factor relationship	1	25
Scaling factor relationship	1	25

TUNNELLING & LOW DIG TECHNIQUES

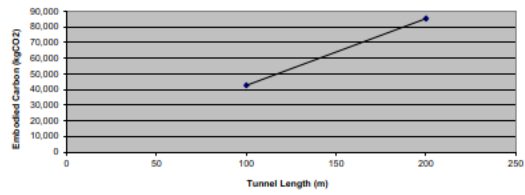
Embodied Carbon Emissions

Design Manual Work Package	Tunnel length (m)	Design Life (yrs)	Carbon Cost (kg CO2)
Tunnelling and low dig techniques	0	40	0

Operational Carbon Emissions

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

Tunnelling Embodied Carbon



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

WATER MAINS

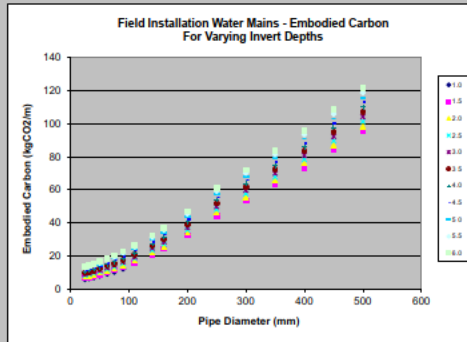
Embodied Carbon Emissions

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

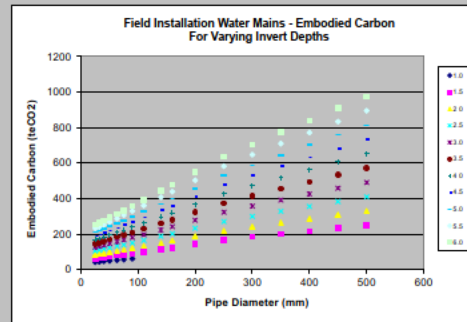
Design Manual Work Package	Carbon Cost (kg CO ₂)
No operational carbon associated with this item	

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

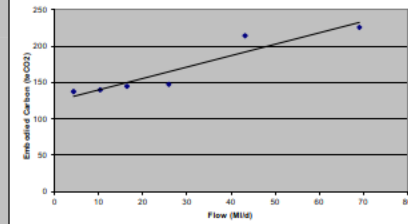


Water Mains Pumping Station

Embodied Carbon Emissions

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

Water Mains PS Embodied Carbon



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

CARBON RELATIONSHIP	
Flow (Mld)	kgCO2
4.9	137
10.4	140
18.4	145
23.9	147
43.2	214
69.1	226

STW Carbon Calculations for PR09

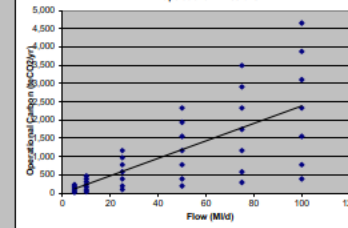
User Input (Drawing Update to Carbon Calculations)

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

Operational Carbon Emissions

Design Manual Work Package	Flow (Mld)	Annual Electricity usage (KWh)	Carbon Cost (kg CO2)
Pumping Stations	0	248,256	0

Operational Emissions



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

CARBON RELATIONSHIP	
Flow (Mld)	kgCO2/yr
5	39
10	78
25	194
50	388
75	582
100	776

STW Carbon Calculations for PR09

User Input (Drawing Update to Carbon Calculations)

Scaling factor relationship validity limits (Mld)	5	100
Scaling Factor (slope)	23.83	
Scaling Factor (intercept)	0.00	

