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. 10Ml/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 (m^3 or p.e.);
  - Number of items;
  - Dosed flow (l/hr);
  - Pumping station power (kW) or flow (Ml/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 NO_2 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

Revision	Purpose and Description	Originated	Checked	Reviewed	Date
0	Final for issue to client	[redacted]			29/05/2009
1	Inclusion of Record Sheet				23/06/2009

Gate 2 Carbon Calculator Record Sheet

Project Ref.	Date	Author	Design Manual Category	User Input				Proposed Year of Construction	Design Life (yrs)	Embodied Carbon (CO_2eq)	Operational Carbon (CO_2eq/yr)	Net Present Cost of Carbon
Example	*20/07/2009*	*AA*	*Pumping Stations*	[redacted]	*Flow (Ml/d)*	[redacted]	*Annual Electricity Consumption (kWh)*	*2009*	*40*	*139,492*	*238,349*	*£204,586*
			Chemical Phosphorous Removal		Dosed Flow (l/hr)		Annual Electricity Consumption (kWh)	2012	20	122,182	376,344	£291,878
			Flooring		Floor area (m2)			2012	40	183,775	-	£4,855
			Lifting Equipment		No. of plants		Annual Electricity Consumption (kWh)	2012	20	7,812	0	£361
			Access Road		Road Length (m)			2012	15	30,558	-	£1,977
			Outfall Structures		No. of structures			2012	40	1,223	-	£32
			Remote Asset Monitoring (Telemetry) Systems		No. of works		Annual Electricity Consumption (kWh)	2012	20	1,751	235,215	£178,980
			Sewage Pumping Stations		Pump Power (kW)		Pipe Length (m) [redacted] Depth to invert (m)	2012	40	5,544,891	1,648,728	£1,400,481
			...contd		Pipe Diameter (mm)		Pipe Location [redacted] Annual Electricity Consumption (kWh)					
			Tunnelling & Low Dig Techniques		Tunnel length (m)			2012	40	586,630	-	£15,498
									Sum Total	6,478,822	2,260,287	£1,894,063
									tCO2e	**6,479**	**2,260**	

Severn Trent Water

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} ($kgCO_{2eq}$/yr)	Net Present Cost of Carbon
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		Length (m)		Diameter (mm)				2012	0	-	£0
	...contd		Pipe Location		Depth to invert (m)							
	Pumping Stations		Flow (Ml/d)		Annual Electricity Consumption (kWh)				2014	0	0	£0
	Trunk Mains		Length (m)		Diameter (mm)				2009	0	-	£0
	...contd		Pipe Location		Depth to invert (m)							
Sewerage	Sewage Pumping Stations	[redacted]	Pump Power (kW)	[redacted]	Pipe Length (m)	3.5	Depth to invert (m)		2012	5,544,891	1,648,728	£1,400,481
	...contd	[redacted]	Pipe Diameter (mm)	[redacted]	Pipe Location	*3070143*	Annual Electricity Consumption (kWh)					
	Sewer Rehabilitation		Sewer Length (m)		Diameter (mm)				2012	0	-	£0
	...contd		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	[redacted]	Dosed Flow (l/hr)	[redacted]	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 (Ml/d)		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	[redacted]	Floor area (m^2)						2012	183,775	-	£4,855
	Guarding of Equipment		No. of works						2012	0	-	£0
	Lifting Equipment	[redacted]	No. of plants		Annual Electricity Consumption (kWh)				2012	7,812	0	£361
Civil Engineering	Access Road	[redacted]	Road Length (m)						2012	30,558	-	£1,977
	Outfall Structures	[redacted]	No. of structures						2012	1,223	-	£32
	Tunnelling & Low Dig Techniques	[redacted]	Tunnel length (m)						2012	586,630	-	£15,498
Other	Environmental and Landscape		No. of sites						2012	0	-	£0
	Remote Asset Monitoring (Telemetry) Systems	[redacted]	No. of works	[redacted]	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

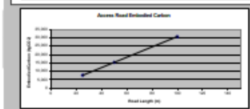
Access Road

Embodied Carbon Emissions

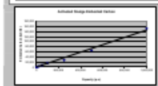
Design Manual Work Package	Road Length (m)	Design Life (yrs)	Carbon cost (kg CO2)
Access Road	100	15	30,000

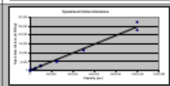
Operational Carbon Emissions

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



	Included	Excluded
Embodied Carbon	[illegible] access road - [illegible] subbase and [illegible] sealing	Kerbs and drainage
	-	-
	-	-


Activated Sludge Embodied Carbon
Capacity (p.e.)


Operational Carbon Emissions
Capacity (p.e.)

Ancillary Works

Embodied Carbon Emissions

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

	Included	Excluded
Embodied Carbon	Connecting pipework 50m 150mm DI	
	Fencing 50m chain link 2.4m high [illegible] and gate	
	Valves and Splitter Chamber: 2no. Gate valves and 6no. Bends (50kg cast iron) and a 4m by 4m by 2m concrete chamber with 300mm thick walls	

Operational Carbon Emissions

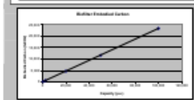
Design Manual Work Package	Carbon Cost (te CO2/yr)
No operational carbon associated with this item	

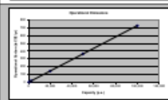
Embodied Carbon Emissions

[illegible]	Capacity	Design life	Carbon
[illegible]	0	[illegible]	0

Operational Carbon Emissions

[illegible]	Capacity	Default Annual Electricity	Carbon
[illegible]	0	0	0





Boreholes

Embodied Carbon Emissions

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

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

Operational Carbon Emissions

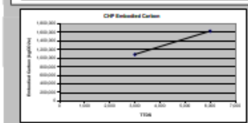
Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Boreholes	0	0

	Included	Excluded
Operational Carbon	All electrical 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)
n/a	0	40	0



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

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Generation (kWh)	Carbon Cost (kg CO2)
n/a	0	0

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

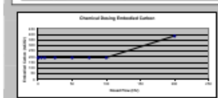
CHEMICAL DOSING

Embodied Carbon Emissions

Design Manual Work Package	Dmax Flow (l/s)	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	105,000
Sludge Mixing	0	20	0

Operational Carbon Emissions

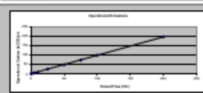
Design Manual Work Package	Dmax Flow (l/s)	Default Annual Electricity	Carbon Cost (kg CO2/yr)
Arsenic Removal	0	0	0
Fluoridation	0	0	0
pH Correction	0	0	0
Iron & Manganese Treatment	0	0	0
Disinfection	0	0	0
Stabilisation & Conditioning	0	0	0
Sludge Mixing	0	0	0



	Included	Excluded
Embodied Carbon	Bunded dosing area concrete construction	shower / eyewash, control panel
	Bulk storage tank plastic construction	Kiosks
	Pumped pipework	Control hardware
	Delivery of tank and pipework to site	[illegible]

Carbon	
kgCO2e	Dmax Flow (l/s)
200	0.1
200	1.0
200	4.0
200	10
200	25
200	50
200	75
200	100
[illegible]	200

Scaling factor relationship validity limits (l/s)	0.1	200
Scaling Factor (slope)	[illegible]	
Scaling Factor (intercept)	[illegible]	



	Included	Excluded
Operational Carbon	Chemical delivery to site	Specific chemical manufacture
	Dose pump power	Carbon loss if applicable
		any sludge produced

Carbon	
kgCO2e/yr	Dmax Flow (l/s)
[illegible]	0.1
[illegible]	1.0
[illegible]	4.0
10	10
25	25
50	50
75	75
100	100
[illegible]	200

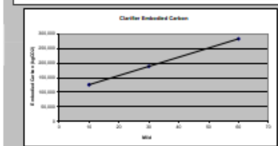
Scaling factor relationship validity limits (l/s)	0.1	200
Scaling Factor (slope)	0.97	
Scaling Factor (intercept)	[illegible]	

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

DAF CLARIFIER

Embodied Carbon Emissions

Design Manual Work Package	Ml/d	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 transit for maintenance

[illegible]

Environmental and Landscape

Embodied Carbon Emissions

Design Manual Work Package	No. of sites	Design Life (yrs)	Carbon total (te CO2)
Environmental and Landscape	0	60	0

	Included	Excluded
Embodied Carbon	allowance [illegible] vegetation	

Operational Carbon Emissions

Design Manual Work Package	Carbon total (te 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 total (kg CO2)
Guarding of Equipment	0	40	0

	Included	Excluded
Embodied Carbon	Installation of new [illegible]	

Operational Carbon Emissions

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

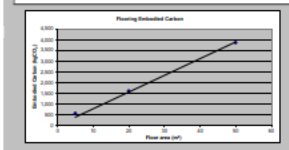
Flooring

Embodied Carbon Emissions

Design Manual Work Package	Floor Area (m2)	Design Life (yrs)	Carbon Cost (kg CO2)
Flooring	2800	60	163,775

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	
Carbon		

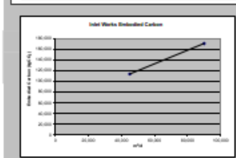
INLET WORKS

Embodied Carbon Emissions

Design Manual Work Package	m³/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 [illegible])
Inlet Works	0	0



	Included	Excluded
Embodied Carbon	Inlet chamber, [illegible] channel, bypass channel	
	GRG	
	Mesh flooring and handrails	
	Inlet Screens	
	MCC	

	Included	Excluded
Operational Carbon	Electrical 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	1	20	7,912

	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	Electricity power to run the process: building services, pumps.	Fuel in travel for maintenance

MANHOLES

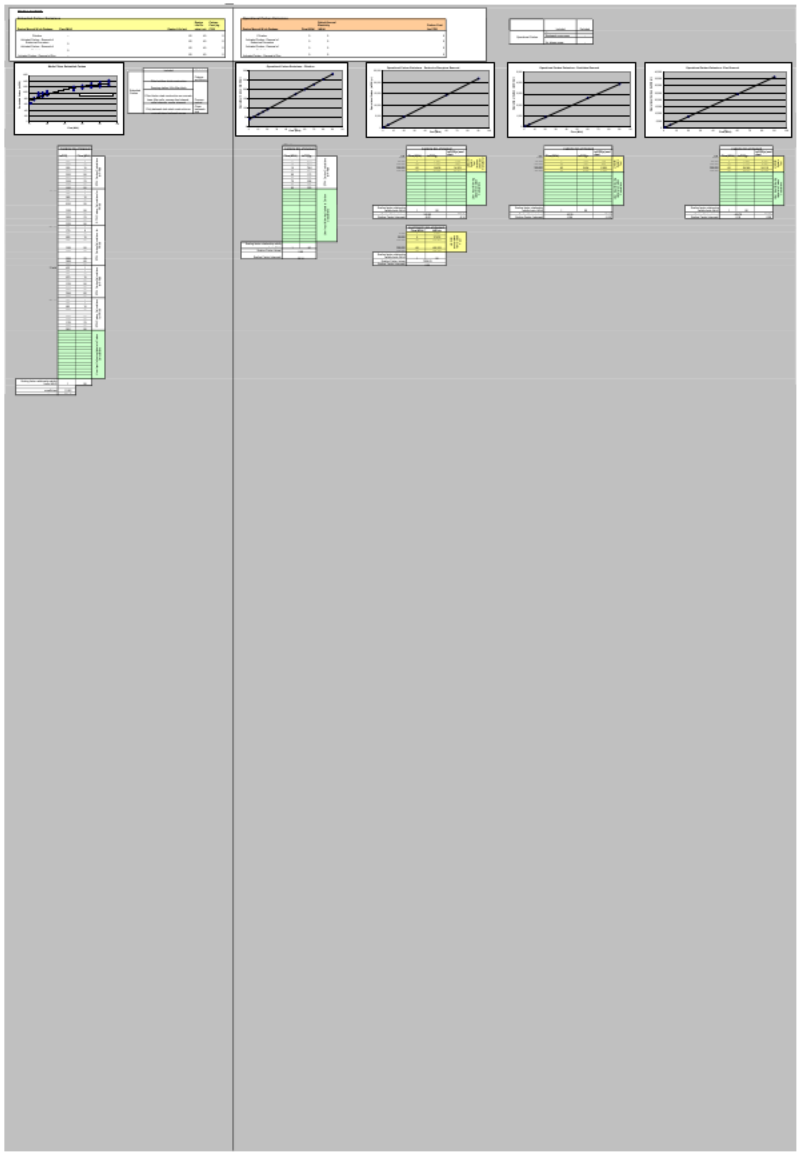
Embodied Carbon Emissions

Design Manual Work Package	No. of Manholes	Design Life (yrs)	Carbon cost (kg CO2)
Manholes	[illegible]	40	[illegible]

	Included	Excluded
Embodied Carbon	One manhole	Transit/ppeswork associated with the manhole

Operational Carbon Emissions

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



Monitoring and Telemetry

Embodied Carbon Emissions

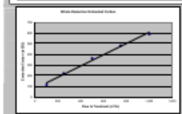
Design Manual Work Package	No. of works	Design Life (yrs)	Carbon Cost (kg CO2)
Remote Asset Monitoring (Telemetry) Systems	1	20	1,330

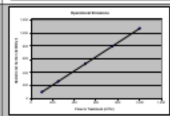
	Included	Excluded
Embodied Carbon	MCC, Cabinet and cabling	

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	Carbon Cost (kg CO2/yr)
Remote Asset Monitoring (Telemetry) Systems	[illegible]	[illegible]

	Included	Excluded
Operational Carbon	still includes power to run the process, building services, pumps,	Fuel in travel for maintenance





OUTFALL STRUCTURES

Embodied Carbon Emissions

Design Manual Work Package	No. of structures	Design Life (yrs)	Carbon load (kg CO2)
Outfall Structures	1	40	1,[illegible]

	Included	Excluded
Embodied Carbon	Head wall	Scour protection
	Flap valve	

Operational Carbon Emissions

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

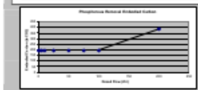
PHOSPHOROUS REMOVAL

Embedded Carbon Emissions

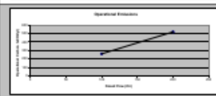
Design Manual Work Package	Grand Flow (l/hr)	Design Life (yrs)	Carbon Cost (kg CO2)
Chemical Phosphorous Removal	1	20	[illegible]

Operational Carbon Emissions

Design Manual Work Package	Grand Flow (l/hr)	Electricity (kWh)	Carbon Cost (kg CO2/yr)
Chemical Phosphorous Removal	1	[illegible]	[illegible]



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



	Included	Excluded
Operational Carbon	Electricity / Power use	-
	Chemical delivery	-
	Sludge disposal	-
	Fabric emissions	-

CARBON

kgCO2	Grand Flow (l/hr)
[illegible]	[illegible]

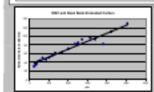
CARBON RELATIONSHIP

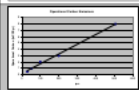
kgCO2/yr	Grand Flow (l/hr)	kgCO2/yr (post plan)
[illegible]	[illegible]	[illegible]

ELECTRICITY

Grand Flow (l/hr)	kWh/yr
[illegible]	[illegible]

Scaling factor relationship	[illegible]	[illegible]
Scaling Factor (slope)	[illegible]	
Scaling Factor (intercept)	[illegible]	





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, palisades, 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	[illegible] power to run the process building services, pumps.	Fuel in travel for maintenance

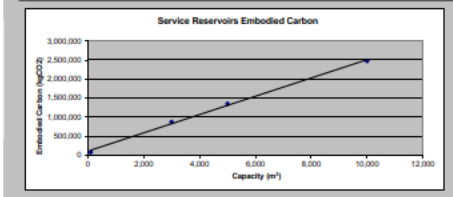
Service Reservoirs

Embodied Carbon Emissions

Design Manual Work Package	Capacity (m^3)	Design Life (yrs)	Carbon Cost (kg CO2)
Service Reservoirs & Water Retaining Structures	0	40	0

Operational Carbon Emissions

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



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

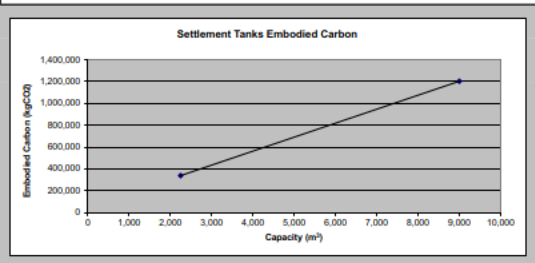
PRIMARY SETTLEMENT TANKS

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



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

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

SEWERAGE PIPELINES

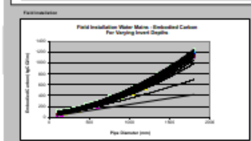
Embodied Carbon Emissions

Design Manual Work Package	Length (m)	Diameter (mm)	Depth (m)	Field/Highway	Design Life (yrs)	Design Life for calcs (yrs)	Carbon Cost (kg CO2)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	60	0
[illegible]	[illegible]	[illegible]	[illegible]	Field	100	60	[illegible]

Operational Carbon Emissions

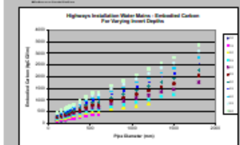
Design Manual Work Package	Carbon Cost (kg CO2)
No operational carbon associated with this item	
No operational carbon associated with this item	

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



Installation locations	Invert Depth
Field	1
Highways	1.5
	2
	2.5
	3
	3.5
	4
	4.5
	5
	5.5
	6

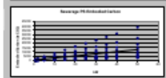
Sewage Pumping Station

Embodied Carbon Emissions

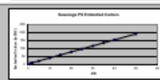
Sewer Manual/Work Pattern	Flow (l/s)	Design life (yrs)	Design life for (yrs) (?)	Carbon cost (kg CO2) (?)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Operational Carbon Emissions

Design Manual/Work Pattern (?)	Flow (l/s) (?)	Default Annual Electricity (?)	Carbon cost (kg CO2) (?)
[illegible]	[illegible]	[illegible]	[illegible]



	Included	Excluded
Embodied Carbon	[illegible]	[illegible]
	[illegible]	
	[illegible]	[illegible]



	Included	Excluded
Operational Carbon	[illegible]	[illegible]

Site Investigation

Embodied Carbon Emissions

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

Operational Carbon Emissions

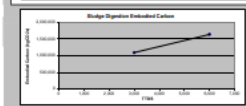
Design Manual Work Package	Carbon Load (kg CO2/yr)
No operational carbon associated with this item	

	Included	Excluded
Embodied Carbon	Site investigation boreholes	Sampling equipment
	Plant/fuel	

SLUDGE DIGESTION

Embodied Carbon Emissions

Design Manual Work Package	TTDS/yr	Design Life (yrs)	Carbon Cost (kg CO2)
[illegible]	0	20	0

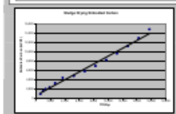


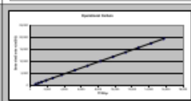
	Included	Excluded
Embodied Carbon	Stainless steel sludge	
	Sludge press, pumps, valves and MCCs	
	Package digestion plant (glass coated steel) unit	

Operational Carbon Emissions

Design Manual Work Package	Annual Electricity Consumption (kWh)	TTDS/yr	Carbon Cost (kg CO2)
[illegible]	0	0	0

	Included	Excluded
Operational Carbon	Electricity/power to run the process	Fuel (travel) for maintenance
	Emissions from disposal of sludge	

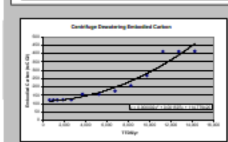

Sludge Drying Embodied Carbon


Operational Carbon

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 [illegible]	0	60	40	0



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

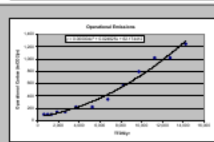
CARBON RELATIONSHIP		
TTDS/yr	kgCO2	
[illegible]	[illegible]	STW Carbon Calculations for P Bay
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
		User Input Information/data to Extend Calculations

Scaling factor relationship validity limits (TTDS/yr)	[illegible]	[illegible]
Quadratic coefficient	0.000002	
x coefficient	[illegible]	
c intercept	[illegible]	

To update the carbon equation after user input, select cell B60 and click button.

Operational Carbon Emissions

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

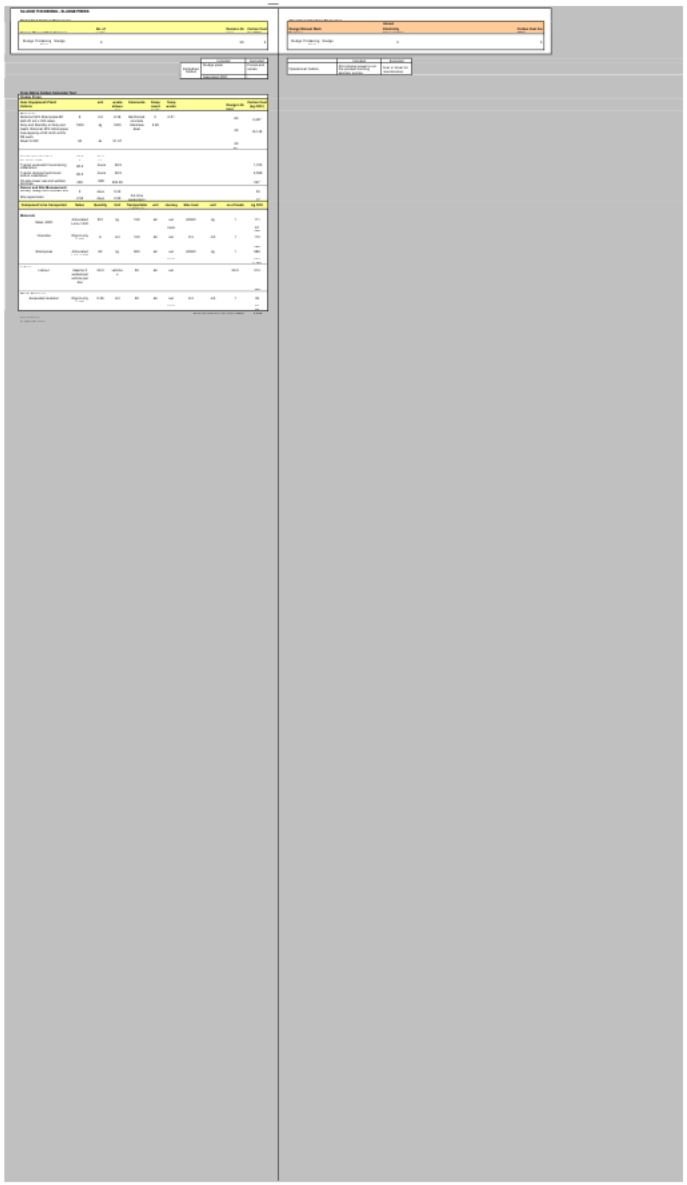


	Included	Excluded
Operational Carbon	Electrical power to run centrifuge	Building services, process control, labour
		Any emissions from decomposition of sludge products

CARBON RELATIONSHIP		
TTDS/yr	kgCO2/yr	
[illegible]	[illegible]	STW Carbon Calculations for P Bay
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
		User Input/Updating Operation Carbon Calculations

Scaling factor relationship validity limits (TTDS/yr)	[illegible]	[illegible]
Quadratic coefficient	0.000004	
x coefficient	0.024925	
c intercept	[illegible]	

To update the carbon equation after user input, select cell B60 and click button.



Kto.-Gruppe TITELBEZEICHNUNG – Kto.-Gruppe PHASEN

Bezeichnung Kontenrahmen Kto.-Gruppe	Nr. ref	Standard Kto.	Farbton Kto.
Budget Titelbezeichnung Beispiel	0	100	0

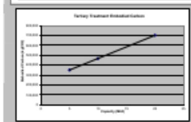
Kto.-Gruppe Titel	Titel Kto.-Gruppe Beispiel Titelbezeichnung	Nr. Kto.-Gruppe Titel Beispiel Titelbezeichnung
Kto.-Gruppe Titel Beispiel Titelbezeichnung	Titel Kto.-Gruppe Beispiel Titelbezeichnung	Nr. Kto.-Gruppe Titel Beispiel Titelbezeichnung

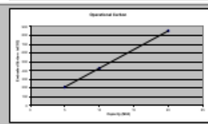
Kto.-Gruppe Kontenrahmen Text

Kto.-Gruppe Kontenrahmen Text	Kto.	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text	Kto.-Gruppe Kontenrahmen Text
Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text	4	4.0	0.00	Kto.-Gruppe Kontenrahmen Text Beispiel	0	0.00				100	0.000
Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text Beispiel	7000	kg	7000	Kto.-Gruppe Kontenrahmen Text Beispiel	0.00					100	70.0.00
Kto.-Gruppe Kontenrahmen Text Beispiel	00	00	00.00							00	0
Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text Beispiel											
Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text Beispiel	00.0	Kto.-Gruppe	00.0								7.725
Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text Beispiel	00.0	Kto.-Gruppe	00.0								4.500
Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text Beispiel	1900		1900	00.0.00							190
Kto.-Gruppe Kontenrahmen Text Beispiel Kto.-Gruppe Kontenrahmen Text Beispiel	0	Kto.-Gruppe	0.00								00
Kto.-Gruppe Kontenrahmen Text Beispiel	0.00	Kto.-Gruppe	0.00	0.0 0.0							0

Kategorien Kto.-Gruppe Kontenrahmen Text Beispiel	Nr. Kto.-Gruppe Kontenrahmen Text Beispiel	Bezeichnung Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel
Kto.-Gruppe Kontenrahmen Text Beispiel											
Kto.-Gruppe Kontenrahmen Text Beispiel		Kto.-Gruppe Kontenrahmen Text Beispiel	00.0	kg	7.00	00	Kto.-Gruppe Kontenrahmen Text Beispiel	000000	kg	7	0.0
Kto.-Gruppe Kontenrahmen Text Beispiel		Kto.-Gruppe Kontenrahmen Text Beispiel	0	0.0	7.00	00	Kto.-Gruppe Kontenrahmen Text Beispiel	0.0	0.0	7	7.0
Kto.-Gruppe Kontenrahmen Text Beispiel		Kto.-Gruppe Kontenrahmen Text Beispiel	00	kg	00.0	00	Kto.-Gruppe Kontenrahmen Text Beispiel	000000	kg	7	000
Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	00.0	Kto.-Gruppe Kontenrahmen Text Beispiel	0.0	00	Kto.-Gruppe Kontenrahmen Text Beispiel			00.0	00.0
Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	Kto.-Gruppe Kontenrahmen Text Beispiel	0.00	0.0	0.0	0.0	Kto.-Gruppe Kontenrahmen Text Beispiel	0.0	0.0	7	00

TERTIARY TREATMENT





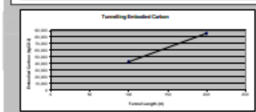
TUNNELLING & LOW DIG TECHNIQUES

Embodied Carbon Emissions

Design Manual Work Package	Tunnel length (m)	Design Life (yrs)	Carbon total (kg CO2)
Tunnelling and low dig techniques	[illegible]	[illegible]	[illegible]

Operational Carbon Emissions

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



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

WATER MAINS

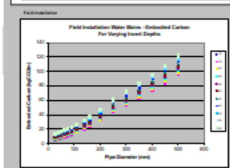
Embodied Carbon Emissions

Design Manual Work Package	Length (m)	Diameter (mm)	Depth (m)	Flow (l/s)	Design Life (yrs)	Design Life for sums (yrs)	Carbon Cost (kg CO2)
[illegible]	0	0	0	0	[illegible]	40	0
[illegible]	0	0	0	0	[illegible]	40	0

Operational Carbon Emissions

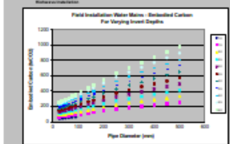
Design Manual Work Package	Carbon Cost (kg CO2)
[illegible]	

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

[illegible] Installation



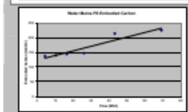
Water Mains Pumping Station

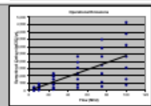
Embodied Carbon Emissions

[illegible]	Flow (Ml/d)	[illegible]	Design Life for [illegible]	Carbon Cost [illegible]
[illegible]	0	[illegible]	[illegible]	0

Operational Carbon Emissions

Design Manual Work Package	Flow (Ml/d)	Annual Electricity [illegible]	Carbon Cost [illegible]
[illegible]	0	[illegible]	0





[illegible]

Waste Allowances - Proportion

Waste Stream	Percentage (%) of waste by volume in comparison to the total volume	Proportion of waste by volume in comparison to the total volume
Plastic	11.1%	0.111
Inert	40.5%	0.405
Bricks	7.5%	0.075
Ferrous metal	6.4%	0.064
Concrete	6.0%	0.060
Insulation	4.5%	0.045
Non-ferrous	4.0%	0.040

Source: http://www.wastecalculatorconstruction.org/activity.asp

Materials and Components - Emission Factors

Component	Energy Intensity	Carbon Intensity		
	MJ/kg	kg CO_2/kg		
Pipe, Ductile Iron	7.15	2.51		
Pipe, HDPE	7.85	2.0		
Material	**Energy Intensity**	**Carbon Intensity**		**Density**
	MJ/kg	kg CO_2/kg	kg CO_2/m^3	kg/m^3
General Concrete	0.95	0.130	320	2403
Reinforced Concrete	1.91	0.203	500	2403
Cement	4.6	0.82	1255	1506
General Bricks	3	0.2	384	1922
General Aggregate	0.15	0.008	12-18	1522
Sand for fillers	0.1	0.0051	6	1201
Stainless Steel	51.5	6.15		7480-8000
Mild Steel		1.558		7900
Cast Iron		2.906		6800-7800
Anthracite (General stone used as a proxy)		0.021	50-46	2600
Resin		5.5		
Epoxide resin (used as Sealants and Adhesives) (cradle to gate)		5.91		
Fibreglass		1.35		
Glass Reinforced Plastic (GRP) (sum of fibreglass and resin values as actual proportions unknown)		7.26		1650.4
Asphalt road surface		0.14	320	2500
Polythene		2.1		930
Grass		0.11		
Linear		0.1		
Roofing felt		3.8	3500	1000
Paint		5.1		
		[illegible]		
Employee Carbon emissions for off-site design, travel and [illegible]		0.03		

Passenger Road Transport Emission Factors

Vehicle	kg CO_2 per miles	kg CO_2 per km
Petrol Car 1.4 - 2.0 litre	0.3442	0.2139
Diesel Car >2.0 litre	0.4153	0.2580

Road Freight Transport Emission Factors

Vehicle	% Weight laden	Fuel per km (l)	Fuel Conversion factor	CO_2 Emission/km	Estimated Carrying Capacity	
					kg	m^3
Rigid Lorry (>17t)	0%			0.758		8.3
Rigid Lorry (>17t)	100%			1.195		8.3
Articulated Lorry (>33t)	0%			0.657	20000	
Articulated Lorry (>33t)	100%			1.111	20000	

Site Vehicles and Plant (Weights refer to vehicle weight)

	CO_2 Emissions (kg/hour)
Articulated Dump Truck (25-30t)	32
Excavator Medium 16-25 tonnes	[illegible]
Loader (mid-wheeled, 1.5m^3)	31
Drilling Rig	33

Operational Emission Factors

Electricity emissions factors		
Grid_EF_CO2	0.43052	kg CO2 / kWh
Grid_EF_CO2_Sustain_Tool	0.523	kg CO2 / kWh
Natural_Gas_EF_Sustain_Tool	0.206	kg CO2 / kWh

Transport Distances for Materials/Components

Material/ Component	Notes	Distance from Source to Site	
Mains Pipe - Ductile Iron		600	km
Mains Pipe - HDPE		600	km
Resin	For lining of pipes	100	km
General concrete		100	km
Steel	Assumed to be Mild steel	100	km
Stainless Steel		100	km
Gravel/Granular fill		100	km
Asphalt/Bitumen		100	km
Sand for fillers		[illegible]	km
Pumps - cast iron/stainless steel		600	km
GRP		100	km
Labour	Average commuting distance of site work force	50	km
Standard Default Distance	Used for miscellaneous components	100	km
Nearest licensed tip	For excavated and waste materials	50	km

Net Present Cost over 40 years for 1 kw Life

Design Life (yrs)	Year					
	2009	2010	2011	2012	2013	2014
15	0.3675	0.3666	0.3656	0.3647	0.3636	0.3626
20	0.3492	0.3475	0.3469	0.3461	0.3455	0.3448
25	0.3468	0.3461	0.3452	0.3445	0.3441	0.3435
33	0.3447	0.3443	0.3434	0.3427	0.3421	0.3415
40	0.3375	0.3272	0.3269	0.3264	0.3262	0.3257
Operational	0.8420	0.8146	0.7574	0.7606	0.7342	0.7084

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