

Duffin Outfall EA Phase 2 – Greenhouse Gas Estimates for Alternative Solutions

Assumptions:

- Simple approach has been used to estimate GHG emissions. GHG Emission = Quantity * Emission Factor per quantity unit .
- For some items, emission factors haven't been found in the existing literature. For these parameters, emission factors were either derived using the literature based information or assumed. Table 1 presents emission factors used in the calculation along with their references.

Construction				
S. No.	Item	Units	Emission Factor	Reference
1	Soil Excavation and on-site disposal	kg CO ₂ e/m ³	23.62	UKWIR (2008)
2	Rock Excavation and on-site disposal	kg CO ₂ e/m ³	74.32	UKWIR (2008)
3	Below ground pipe installation	kg CO ₂ e/m ³	4700	UKWIR (2008)
4	Fill and compaction	kg CO ₂ e/m ³	5.5	UKWIR (2008)
5	Concrete placing (32MPa)	kg CO ₂ e/m ³	297	UKWIR (2008)
6	Structural steel work	kg CO ₂ e/m ³	1390	UKWIR (2008)
7	Truck transport	kg Co ₂ e/km/tonne	0.05	UKWIR (2008), CN (2007)
8	Construction Equipment (energy)	kg CO ₂ e/MWh	304	CAPP (2003), Ontario Power generation
9	Boat transport	kg Co ₂ e/km/tonne	0.005	UKWIR (2008), CN (2007)
Operation				
1	Power use	kg Co ₂ e/MWh	304	CAPP (2003), Ontario Power generation
2	Chemical use	kg Co ₂ e/Tonne	77	Johnston, A. (2012)
3	Chemical transport	kg Co ₂ e/km/tonne	0.05	UKWIR (2008), CN (2007)
4	Truck transport	kg Co ₂ e/km/tonne	0.05	UKWIR (2008), CN (2007)

Results:

Construction Phase						
#	Items	GHG Emission (kgCO ₂ -e)				
		Alternative 1 - Optimized Plant	Alternative 2 - Modify Existing Outfall	Alternative 3 - Tertiary Treatment	Alternative 4 - Outfall Extension	Alternative 5 - New Outfall
1	Soil Excavation and on-site disposal	0	0	379,115	226,760	5,563
2	Rock Excavation and on-site disposal	0	0	1,192,803	713,452	408,377
3	Below ground pipe installation	0	0	0	0	7,520,000
4	Fill and compaction	0	0	24,750	90,057	0
5	Concrete placing (32MPa)	0	0	3,317,490	176,258	1,663,769
6	Structural steel work	0	0	0	0	0
7	Truck transport	0	47	123,521,211	327,447	31,067,659
8	Construction Equipment (energy)	0	0	40,736	81,472	1,427,280
9	Boat transport	0	0	0	1,474,560	16,092,985
Operation Phase						
1	Power use	0	0	59,876,752	0	0
2	Chemical use	924,000	924,000	1,672,440	924,000	924,000
3	Chemical transport	2,160,000	2,160,000	7,076,376	2,160,000	2,160,000
Total		3,084,000	3,084,047	197,101,673	6,174,007	61,269,633

References:

UKWIR (2008). Carbon Accounting in the UK Water Industry: Guidelines for Dealing with Embodied Carbon and Whole Life Carbon Accounting, Water UK, Report Ref. No. 08/CL/01/6.

CN (2007). Greenhouse Gas Calculator Emission Factors, <http://www.cn.ca/en/greenhouse-gas-calculator-emission-factors.htm>, website accessed on Feb4, 2013.

CAPP (2003). Guide - Calculating Greenhouse Gas Emissions, The Canadian Association of Petroleum Producers (CAPP), Docs # 55904.

Johnston, A. H. (2012). Developing a Greenhouse Gas Emissions Calculation Tool for Water Utilities, MS Thesis, Environmental Engineering and Science, Clemson University.