Appendix Q

# Greenhouse Gas Inventory

CiviLake

22 June 2010

# Teralba Sustainable Resource Centre

## Greenhouse Gas Inventory

# Teralba Sustainable Resource Centre

Greenhouse Gas Inventory

Prepared for

CiviLake

Prepared by

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# 1.0 Introduction

## 1.1 Background

The proposed Teralba Sustainable Resource Centre (the facility) will be located at Lots 42, 43, 54 and 53 Racecourse Rd, Teralba, New South Wales.

The proposed recycling centre will store hard waste/construction and demolition materials including concrete, bricks, gravel and crushed rock road base, asphalt, and tiles as well as green waste from parks and horticulture operations and will separate, crush, screen, blend and modify this material to produce products suitable for reuse in council operations and for the wider community.

The operational period is assumed to be 30 years. During operation recyclable/reuseable materials will be transported to the site by contractors, and other external parties. The processed recycled/reuseable materials will be transported from the site using the facilities vehicles.

The construction period will be approximately 3 years. No site office/facilities that use electricity will be installed during the construction stage.

## 1.2 Purpose and Objectives

An inventory of the estimated Greenhouse Gas (GHG) emissions associated with the construction and operation of the proposed Teralba Sustainable Resource Centre has been undertaken.

This GHG inventory has been prepared to inform the Environmental Assessment of the facility. The purpose of this inventory is to:

- Identify the sources of GHG emissions for the construction and operational stages
- Quantify the GHG emissions associated with each GHG source
- Present the Scope 1 and Scope 2 GHG emissions associated with the construction and operational stages of the proposed facility
- Identify opportunities which may be implemented to reduce the GHG emissions associated with the construction and operation of the facility.

# 2.0 Scope

This GHG Inventory has been undertaken for the Scope 1 and Scope 2 emissions associated with the construction and operation stages of the project. The assumed operational period of the facility is 30 years.

The sources of construction GHG emissions which have been included in this inventory include:

- Fuel used to operate construction equipment onsite
- Fuel used to transport construction/waste materials to/from the site.

The sources of operational GHG emissions which have been included in this inventory include:

- Fuel used by operational equipment onsite
- Fuel used to transport waste/reuseable materials to/from the site
- Purchased electricity used on-site by operational equipment
- Purchased electricity used on-site in the administration office.

Construction and operation GHG emission sources which have been included in this inventory are listed under each scope in the following table.

**Table 1: Construction and Operation Emission Sources**

| Scope 1 – Direct Emissions | Scope 2 – Indirect Emissions |
|---|---|
| **Construction Stage:**<br>The use of fuel by construction plant/equipment onsite.<br>The use of fuel for the transportation of construction/waste materials to/from the site. | |
| **Operational Stage:**<br>The use of fuel by operational plant/equipment onsite.<br>The use of fuel for the transportation of waste/reuseable materials to/from the site. | **Operational Stage:**<br>The use of electricity purchased from the grid onsite during operational stage. |

# 3.0 Methodology

This GHG inventory was undertaken in accordance with a methodology based on the general principles outlined in:

- National Greenhouse Accounts (NGA) Factors, Australian Government Department of Climate Change (DCC), June 2009
- Australian Standard (AS ISO 14064.2 – 2006) Greenhouse Gases Part 2: Specification with guidance at the project level for quantification and reporting of greenhouse gas emission reduction and removal enhancements (ISO 14062-2:2006, MOD)
- The Greenhouse Gas Protocol, World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), 2004.

To calculate the GHG emissions associated with the project, the following steps were undertaken:

a) The assumptions and data to be used in the assessment were determined

b) The total quantity of the electricity and fuel consumed was estimated

c) The quantity of GHG emissions resulting from fuel and electricity use were calculated using the NGA Factors methods and emission factors.

The assumptions and input data (estimated quantities of fuel and electricity used during the construction and operational stages of the proposed project) used in the inventory are contained in Appendix A.

Emissions of GHGs are reported in this assessment as tonnes of carbon dioxide equivalent (t CO2-e) as it is the universally accepted measure for calculating the Global Warming Potential (GWP)[1] of different greenhouse gases to derive a single greenhouse gas emissions unit. $CO_2$ is used as the reference gas with a GWP of 1.

Table 1 presents the GWP of the six GHGs (which are commonly known as the Kyoto GHG's).

**Table 2: Global Warming Potential of Greenhouse Gases**

| Greenhouse Gas | Global Warming Potential (GWP) |
|---|---|
| Carbon Dioxide (CO2) | 1 |
| Methane (CH4) | 21 |
| Nitrous Oxide (N2O) | 310 |
| Sulphur Hexafluoride (SF6) | 23,900 |
| Hydrofluorocarbons (HFCs) | HFC5 – 1,300-11,700 (depending on the HFC) |
| Perfluorocarbons* (PFCs) | CF4 – 6,500. C2F6 – 9,200 |

*Note: *Varies depending on compound*

GHG emissions are categorised into three different scopes (either scope 1, 2 or 3) in accordance with the Intergovernmental Panel on Climate Change (IPCC) and Australian Government GHG accounting/classification systems.

**Scope 1** emissions, also called "direct emissions" are emissions which are generated directly by the project, e.g. emissions generated by the use of diesel fuel by construction plant/equipment.

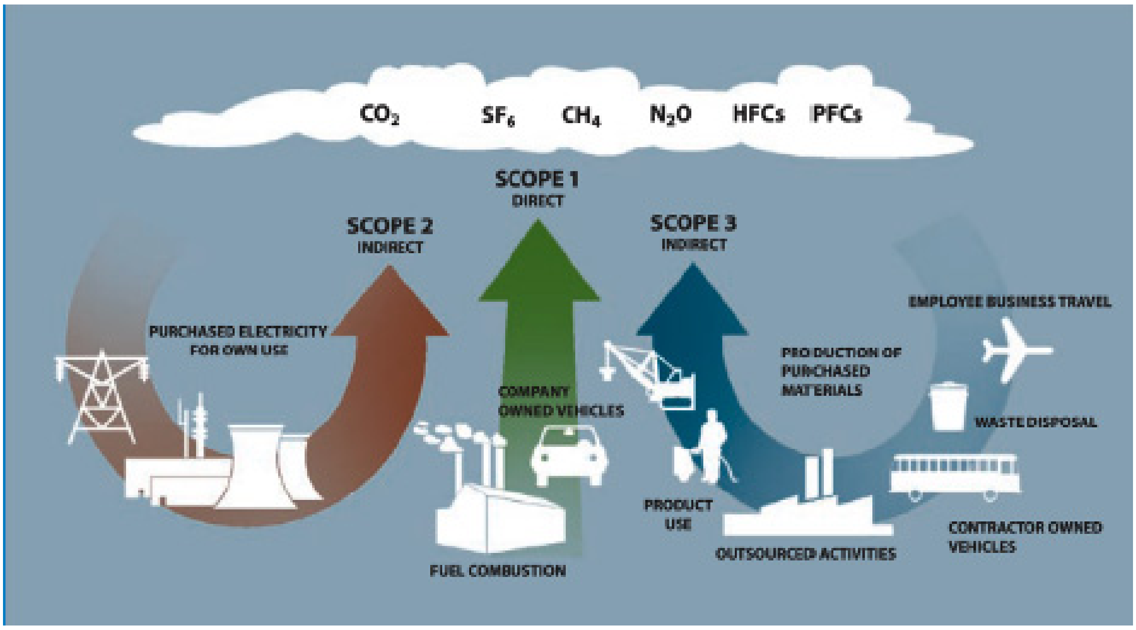
**Scope 2** emissions, also referred to as "indirect emissions" are emissions which are generated outside of the project's boundaries to provide energy to the project, e.g. the use of purchased electricity from the grid.

**Scope 3** emissions are upstream emissions due to third party supply chains that are in direct relation to the project (e.g. extraction, production and transport of purchased materials and waste disposal offsite).

The GHG emission scopes are illustrated in the following figure.

[1] The GWP of a GHG is the radiative forcing impact contributing to global warming relative to one unit of $CO_2$.

**Figure 1: GHG Emission Scopes** (Source: http://www.yale.edu/sustainability/images/emissions.jpg)




## 3.1 GHG Emission Calculation Methods Used

### 3.1.1 Diesel Fuel

To calculate the scope 1 GHG emissions from the consumption of diesel the following formula[2] was used:

**GHG emissions (t $CO_2$-e) = ((Q x ECF) / 1000) x ($EF_{CO2}$ + $EF_{CH4}$ + $EF_{N2O}$)**

Where: Q is the quantity of fuel (in kL).

ECF is the relevant energy content factor (in GJ/kL).

$EF_{CO2}$ is the relevant $CO_2$ emission factor (in kg $CO_{2\text{-}e}$/GJ).
$EF_{CH4}$ is the relevant $CH_4$ emission factor (in kg $CO_{2\text{-}e}$/GJ).
$EF_{N2O}$ is the relevant $N_2O$ emission factor (in kg $CO_{2\text{-}e}$/GJ).

### 3.1.2 Electricity

To calculate the scope 2 indirect GHG emissions from the consumption of purchased electricity from the grid the following formula[2] was used:

**GHG emissions (t $CO_2$-e) = Q x ($EF_{\text{for scope 2}}$ /1000)**

Where: Q is the quantity of purchased electricity (in kWh).

$EF_{\text{for scope 2}}$ is the scope 2 emissions factor for NSW (in kg $CO_{2\text{-}e}$/kWh).

The emissions factors used to calculate the GHG emissions associated with diesel and electricity use were sourced from the NGA Factors (June 2009) workbook.

Refer to Appendix B for details of the GHG emission calculations undertaken for this GHG Inventory.

[2] Sourced from the DCC NGA Factors (June 2009).

# 4.0 Results

The Table below presents the estimated GHG emissions associated with the construction and operation of the proposed Lake Macquarie Recycling Facility.

**Table 3: Construction and Operational Greenhouse Gas Emission Results**

| | GHG Emission Source | Quantity | GHG Emissions (t CO2-e) | | |
|---|---|---|---|---|---|
| | | | *Scope 1* | *Scope 2* | Total |
| Construction Stage | Diesel fuel use – Construction equipment | 362 kL | *976* | - | 976 |
| | Diesel fuel use – Transport of materials | 883 kL | *2,382* | - | 2,382 |
| | **Total Construction Emissions** | | ***3,358*** | **-** | **3,358** |
| Operational Stage | Diesel fuel use – Mobile equipment | 140 kL/yr | *379* | - | 379 |
| | Diesel fuel use – Stationary equipment | 24 kL/yr | *63* | - | 63 |
| | Diesel fuel use – Transport of materials | 1,365 kL/yr | *3,683* | - | 3,683 |
| | Electricity use – Equipment | 42,000 kWh/yr | - | *37* | 37 |
| | Electricity use – Administration Office | 10,000 kWh/yr | - | *9* | 9 |
| | **Total Operational Emissions – per annum** | | ***4,125*** | ***46*** | **4,171** |
| | **Total Operational Emissions – for 30 yr period** | | ***123,742*** | ***1,388*** | **125,130** |

As shown in the table above:

- The construction of the facility will generate approximately 3,400 t$CO_2$-e
- The operation of the facility will generate approximately 4,200 t$CO_2$-e per annum
- The operation of the facility for a 30 year period will generate approximately 125,000 t$CO_2$-e.

The results show that the majority of GHG emissions are Scope 1 emissions associated with the use of diesel fuel to transport the recyclable/reuseable materials from the site.

The detailed GHG emission calculation results for the electricity and fuel use sources are presented in the detailed results tables in Appendix B.

## 4.1 Comparison with NSW emissions

NSW's annual GHG emissions[3] are approximately 162.7 million t $CO_2$-e. In NSW 5.3 million t $CO_2$-e of emissions are associated with the waste sector. The construction of the project equates to approximately 0.002% of NSW's current annual GHG emissions. The operation of the project per annum equates to approximately 0.003% of NSW's current annual GHG emissions.

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[3] DCC, May 2009, Australia's National Greenhouse Accounts: State and Territory Greenhouse Gas Inventories 2007. http://www.climatechange.gov.au/inventory/2007/pubs/state_territory_inventoryv.pdf

# 5.0 Opportunities to Reduce GHG Emissions

Opportunities to reduce GHG emissions associated with the construction stage of the facility are as follows.

- Assess the fuel efficiency of the construction plant/equipment prior to selection and where practical use equipment with the highest fuel efficiency or equipment which uses lower GHG intensive fuel such as biofuels (e.g. biodiesel, ethanol).
- Ensure construction equipment used is maintained to reduce energy efficiency losses associated with damaged/unmaintained equipment.
- Consider the distance of construction material suppliers prior to procurement to minimise transport related emissions.
- Plan construction works to avoid double handling of materials.

Opportunities to reduce GHG emissions associated with the operational stage of the facility include:

- Assess the energy efficiency of operational equipment prior to selection and where practical procure the most energy efficient equipment.
- Assess the fuel efficiency of operational equipment and transport vehicles prior to selection and where practical procure the most fuel efficient equipment/vehicles or equipment/vehicles which use lower GHG intensive fuel such as biofuels (e.g. biodiesel, ethanol).
- Ensure operational equipment used is maintained to reduce energy efficiency losses associated with damaged/unmaintained equipment.
- Undertake an Energy Audit of the facility to assess energy use and identify additional potential energy efficiency improvements which could be implemented.
- Increase the use of electricity from sustainable sources. For example, a number of solar panels will be installed at the facility. Increasing the size of the panels would further reduce the GHG emissions associated with the use of electricity purchased from the grid. Alternatively the facility could commit to purchasing a percentage or all of the electricity required to operate the facility from renewable power sources.

# References

Australian Standard (AS ISO 14064.2 – 2006) *Greenhouse Gases Part 2: Specification with guidance at the project level for quantification and reporting of greenhouse gas emission reduction and removal enhancements (ISO 14062-2:2006, MOD)*.

DCC, May 2009, Australia's *National Greenhouse Accounts: State and Territory Greenhouse Gas Inventories 2007*. http://www.climatechange.gov.au/inventory/2007/pubs/state_territory_inventoryv.pdf

DCC, June 2009, *National Greenhouse Accounts (NGA) Factors.*

http://www.climatechange.gov.au/workbook/index.html

World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), 2004, *The Greenhouse Gas Protocol A Corporate Accounting and Reporting Standard.*

# Appendix A

# GHG Inventory Input Data

# Appendix A: GHG Inventory Input Data

Key: Input data in Green cells

Lake Maquarie City Council (LMCC)

**Scope 1** emissions, also called "direct emissions" are emissions which are generated directly by the project, e.g. emissions generated by the use of diesel fuel by construction plant/equipment.
**Scope 2** emissions, also referred to as "indirect emissions" are emissions which are generated outside of the project's boundaries to provide energy to the project, e.g. the use of purchased electricity from the grid.

## Construction Stage

Note: Construction period is approx. 3 years

### Scope 1 Emissions - Construction Fuel Use

Construction Plant

| Construction Plant | Fuel Consumption Rate(L/hr) or (L/km) [State units in Ref] | Reference / Assumptions | Fuel Type (e.g. diesel, LPG, gasoline) | Reference / Assumptions | Time Used (hrs) or Distance Travelled (km)[State units in Ref.] | Reference / Assumptions | Total Fuel Used (L) |
|---|---|---|---|---|---|---|---|
| Site vehicle - Twin Cab Hi Lux 4x4 ute | 0.125 | Toyota website: L/km | Diesel | LMCC - M. Hale: Strategic Operations Coordinator | 30 | LMCC: Klm per day/300 days per year | 3,375 |
| D6 Dozer | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/100 days per year | 36,000 |
| Water Cart | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/ 275 days per year | 99,000 |
| Grader | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/ 50 days per year | 18,000 |
| Roller | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/50 days per year | 18,000 |
| Generator - Honda E U 30 | 50 | AECOM: L/week | Diesel | LMCC | 4 | LMCC: hours per day/ 300 days per year | 180,000 |
| Excavator | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/20 days per year | 7,200 |
| *TOTAL FUEL USE (kL) - Construction equipment* | | | | | | | *362* |
| Haulage of material to site | 0.546 | AECOM: L/km | Diesel | LMCC | 34 | LMCC: movements per day/300 days per year | |
| | | | | | 45 | LMCC: km approx average haul distance | 751,842 |
| *TOTAL FUEL USE (kL) - Transport of materials* | | | | | | | *752* |
| TOTAL FUEL USE (kL) | | | | | | | 1,113 |

### Scope 2 Emissions - Construction Electricity Use

Construction Site Office/s

| | | Reference / Assumptions |
|---|---|---|
| No. of site offices | LMCC: nil | |
| Time operational (months) | | |
| % of electricity sourced from green power | | |

Other Construction Electricity Use

| | Total electricity use over construction period | Reference / Assumptions | % of electricity sourced from green power | Reference / Assumptions |
|---|---|---|---|---|
| Lighting | LMCC: nil | | | |
| Others... | | | | |

## Operation Stage

| | | | | |
|---|---|---|---|---|
| Operational period for GHG Inventory | 30 | Years | LMCC: Minimum 30 years. Based on requirements for future playing fields in the area | Reference / Assumptions |
| No. of operational days/yr | 300 | Days | LMCC: Based on 6 day week/50 weeks per year | Reference / Assumptions |

Scope 1 Emissions - Operation Fuel Use

Operational Plant - powered by diesel/other fuel

| Plant | Fuel Consumption Rate(L/hr) or (L/km)[State units in Ref.] | Reference / Assumptions | Fuel Type (e.g. diesel, LPG, gasoline) | Reference / Assumptions | Time Used (hrs) or Distance Travelled (km)[State units in Ref.] | Reference / Assumptions | Total Fuel Used (L/yr) | Total Fuel Used - Operational Life (L/30yrs) |
|---|---|---|---|---|---|---|---|---|
| Site Truck - Hi lux Twin Cab 4x4 | 0.125 | Toyota website: L/km | Diesel | LMCC | 30 | LMCC: Klm per day/300 days per year | 1125 | 33,750 |
| Loader x 2 | 15 | AECOM: L/hr | Diesel | LMCC | 12 | LMCC: hours per day/275 days per year | 99000 | 2,970,000 |
| Water Cart | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/275 days per year | 33000 | 990,000 |
| Excavator | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/60 days per year | 7200 | 216,000 |
| *TOTAL FUEL USE (kL) - Mobile equipment* | | | | | | | *140* | *4,210* |
| Crusher | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/60 days per year | 7200 | 216,000 |
| Screen | 15 | AECOM: L/hr | Diesel | LMCC | 8 | LMCC: hours per day/120 days per year | 14400 | 432,000 |
| Tub Grinder | 100 | AECOM:L/day | Diesel | LMCC | 20 | LMCC: 20 days per year | 2000 | 60,000 |
| *TOTAL FUEL USE (kL) - Stationary equipment* | | | | | | | *24* | *708* |
| Delivery Trucks | 0.546 | AECOM: L/km | Diesel | LMCC | 73 | LMCC: movements/day, 300 days/year. 45km | 538083 | 16,142,490 |
| Trucks Transporting Material offsite | 0.546 | AECOM: L/km | Diesel | LMCC | 33653 | AECOM: Movements/year. 45 km distance. Transport assessment data dated 26 Aug 2009 | 826854.21 | 24,805,626 |
| *TOTAL FUEL USE (kL) - Transport of materials* | | | | | | | *1,365* | *40,948* |
| TOTAL FUEL USE (kL) | | | | | | | 1,529 | 45,866 |

Scope 2 Emissions - Operational Electricity Use

| | | | | |
|---|---|---|---|---|
| % of operational electricity sourced from green power | nil | % | LMCC | Reference / Assumptions |

Site Office/ Buildings

| | | Reference / Assumptions |
|---|---|---|
| Total electricity use (kWh per year) | 10,000 | AECOM: kWh/yr |
| % of electricity sourced from green power | 100% | LMCC: based on a 4mw hours per annum system it should be 100% |

Operational Plant - powered by electricity

| Plant | Electricity Consumption Rate(kWh) | Reference / Assumptions | Time Used (hrs/day) | Reference / Assumptions | Total Electricity Used (kWh) |
|---|---|---|---|---|---|
| Asphalt Recycler | 15 | Assumed | 4 | LMCC: hours er day/150 days per year | 9000 |
| Pugmill | 15 | Assumed | 8 | LMCC: hours per day/275 days per year | 33000 |
| TOTAL ELECTRICITY USE (kWh/yr) | | | | | 42,000 |

Operational Green waste Emissions

| | | Reference / Assumptions |
|---|---|---|
| Total volume of input green waste (tonnes/yr) | 5000m3 | LMCC: per year |
| Description of green waste (i.e. % easily decomposable materials such as grass/leaves compared to % branches, trunks, etc) | approx 3,000m3 will come in mulched, remainder will be branches and trunks which will be tub ground. Material will be onsold (within 3 months) before decomposition commences | LMCC |
| Description of Green waste processing | Tub Grinder | LMCC: 20 days per year |

Appendix B

# GHG Emission Calculations & Results

# Appendix B: GHG Emission Calculations and Results

## Results:

| Emission Source | Quantites | | Emissions (CO2-e tonnes) | | |
|---|---|---|---|---|---|
| | Scope 1 (kL) | Scope 2 (kWh) | Scope 1 | Scope 2 | TOTAL |
| Construction Stage | | | | | 3,004 |
| Construction fuel use | 1,113 | | 3,004 | | |
| Operational Stage (per year) | | | | | 4,171 |
| Operational fuel use (per year | 1,529 | | 4,125 | | |
| Operational electricity use (per year) | | 52,000 | | 46 | |
| *Operational Life (30 yrs)* | 45,866 | 1,560,000 | 123,742 | 1,388 | *125,130* |

Fuel Use - GHG Emission Calculations

Stationary Combustion

The cauculation of fuel use emissions was based on the methodology presented in the DCC NGA Factors (June 2009) section 2.1.3 Fuel combustion emissions - liquid fuels (for stationary combustion). Table 3 factors used.

Emissions (CO2-e tonnes)= Quantity (kL) x Energy Content Factor (GJ/kL) x Emissions Factor (kg CO2-e/GJ) / 1000

For diesel:

| | |
|---|---|
| ECF (GJ/kL) of diesel = | 38.6 |
| EF CO2 (kg CO2-e/GJ) = | 69.2 |
| EF CH4 (kg CO2-e/GJ) = | 0.1 |
| EF N2O (kg CO2-e/GJ) = | 0.2 |

Transport Combustion Emissions

The cauculation of fuel use emissions was based on the methodology presented in the DCC NGA Factors (June 2009) section 2.2 Transport Fuel emissions. Table 4 factors used.

Emissions (CO2-e tonnes)= Quantity (kL) x Energy Content Factor (GJ/kL) x Emissions Factor (kg CO2-e/GJ) / 1000

For diesel:

| | |
|---|---|
| ECF (GJ/kL) = | 38.6 |
| EF CO2 (kg CO2-e/GJ) = | 69.2 |
| EF CH4 (kg CO2-e/GJ) = | 0.2 |
| EF N2O (kg CO2-e/GJ) = | 0.5 |

*Construction Fuel Use Emissions - Construction equipment:*

Quantity of fuel used (kL)= 362

*Results:*

| | | |
|---|---|---|
| Emissions CO2 = | 966 | $CO_{2\text{-}e}$ tonnes |
| Emissions CH4 = | 3 | $CO_{2\text{-}e}$ tonnes |
| Emissions N2O = | 7 | $CO_{2\text{-}e}$ tonnes |
| Total Emissions = | 976 | $CO_{2\text{-}e}$ tonnes |

*Construction Fuel Use Emissions - Transport of materials:*

Quantity of fuel used (kL)= 752

*Results:*

| | | |
|---|---|---|
| Emissions CO2 = | 2,008 | $CO_{2\text{-}e}$ tonnes |
| Emissions CH4 = | 6 | $CO_{2\text{-}e}$ tonnes |
| Emissions N2O = | 15 | $CO_{2\text{-}e}$ tonnes |
| Total Emissions = | 2,029 | $CO_{2\text{-}e}$ tonnes |

*Operational Fuel Use Emissions- Mobile Equiptment*

Quantity of fuel used (kL)= 140

*Results:*

| | | |
|---|---|---|
| Emissions CO2 = | 375 | $CO_{2\text{-}e}$ tonnes |
| Emissions CH4 = | 1 | $CO_{2\text{-}e}$ tonnes |
| Emissions N2O = | 3 | $CO_{2\text{-}e}$ tonnes |
| Total Emissions = | 379 | $CO_{2\text{-}e}$ tonnes |

*Operational Fuel Use Emissions - Stationary Equipment*

Quantity of fuel used (kL)= 24

*Results:*

| | | |
|---|---|---|
| Emissions CO2 = | 63 | $CO_{2\text{-}e}$ tonnes |
| Emissions CH4 = | 0 | $CO_{2\text{-}e}$ tonnes |
| Emissions N2O = | 0 | $CO_{2\text{-}e}$ tonnes |
| Total Emissions = | 63 | $CO_{2\text{-}e}$ tonnes |

*Operational Fuel Use Emissions - Transport of materials*

Quantity of fuel used (kL)= 1,365

*Results:*

| | | |
|---|---|---|
| Emissions CO2 = | 3,646 | $CO_{2\text{-}e}$ tonnes |
| Emissions CH4 = | 11 | $CO_{2\text{-}e}$ tonnes |
| Emissions N2O = | 26 | $CO_{2\text{-}e}$ tonnes |
| Total Emissions = | 3,683 | $CO_{2\text{-}e}$ tonnes |

| Electricity Use - GHG Emission Calculations | | |
|---|---|---|
| The cauculation of scope 2 electricity use emissions was based on the methodology presented in the | | |
| DCC NGA Factors (June 2009) section 2.3 Indirect emissions from consumption of purchased electricity. Table 5 factors used. | | |
| Emissions ($CO_2$-e tonnes)= Quantity (kWh)x scope 2 Emissions Factor (kg $CO_2$-e per kilowatt hour) /1000 | | |
| Scope 2 Emissions Factor for NSW = | 0.89 | kg $CO_2$-e per kilowatt hour |

*Operational Electricity Use Emissions - Equiptment*

Quantity of electricity used (kWh) = 42,000

*Results:*

| | | |
|---|---|---|
| Total Emissions = | 37 | $CO_{2\text{-}e}$ tonnes |

*Operational Electricity Use Emissions - Administration building*

Quantity of electricity used (kWh) = 10,000

*Results:*

| | | |
|---|---|---|
| Total Emissions = | 9 | $CO_{2\text{-}e}$ tonnes |