REPORT

NORMAN DISNEY & YOUNG

Energy & Greenhouse Gas Assessment

Revision: B - Final
Issued: 06 March 2009

Greystanes Industrial Estate

Dexus Property Group

CONFIDENTIAL

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1 EXECUTIVE SUMMARY

1.1 PURPOSE

The purpose of this report is to provide an estimation of the energy consumption and carbon dioxide emissions for the proposed development of Greystanes Industrial Estate. The estimated figures have been based on assumptions for energy consumption or loads for each building type. An estimation of carbon dioxide emissions associated with motor vehicles has also been carried out. This has also has been based on assumptions for trip frequency and length and on vehicle emission rates.

The report covers the proposed master plan, as well as three alternative options.

The energy and emissions have been estimated for both a typical development where there are no energy saving measures in place, as well as a development where the initiatives described in the Urban Design Plan have been adopted.

The information provided in this report is for information purposes only. It does not provide any guarantee in terms of actual energy consumption and emissions associated with the development.

1.2 SUMMARY

For a typical development (no energy saving measures), the total carbon dioxide emissions for the various development options range from 28,493 to 30,181 tonnes CO_2 per annum, with the proposed development emissions estimated at 29,873 tonnes CO_2 per annum.

For a development adopting the energy saving initiatives from the Urban Design Plan, the total carbon dioxide emissions for the various development options range from 16,989 to 18,405 tonnes CO_2 per annum, with the proposed development emissions estimated at 18,314 tonnes CO_2 per annum.

The CO_2 saving associated with the proposed development by adopting the energy saving initiates are estimated at 11,559 tonnes CO_2 per annum. This equates to approximately a 39% reduction.

1.3 INFORMATION SOURCES

1. Development Options Totals by Mackenzie Pronk Architects.
2. Urban Design Plan (Issue J) by Turner Hughes Architects.
3. The Australian Institute of Refrigeration, Air-Conditioning and Heating (AIRAH) Handbook (3rd Edition).
4. Australian Standard AS/NZS 3000:2007 Electrical Installations.
5. NABERS Office Rating Tool (Whole Building).
6. Green Star Industrial PILOT Energy Calculator Guide (2009).

1.4 REVISION HISTORY

Rev	Date Issued	Comment
P0	02 March 2009	Draft
A	04 March 2009	Final Review
B	06 March 2009	Final

2 ANALYSIS

The estimation of the energy consumption and carbon dioxide emissions has been broken down into four main areas.

- Offices
- Warehouses
- Car parking
- Transport

Each area is discussed below with descriptions of assumptions made and results.

2.1 OFFICES

The AIRAH handbook provides the following ranges for electricity consumption in office buildings. The figures are based on 2500 operating hours per year.

- Electricity 125 - 261 kWh / m^2 per year

The above figures assume all heating and hot water is provided via electricity.

Using the office areas provided on the 'Development Options Totals' the following ranges have been calculated.

Table 1 – Annual office energy consumption and CO_2 emissions ranges based on AIRAH data

	Office Area (m^2)	Electricity Consumption (kWh)		CO_2 Emissions (tonnes CO_2)	
		Lower	Upper	Lower	Upper
Proposed	20,900	2,612,500	5,454,900	2,456	5,128
Option 1	19,663	2,457,875	5,132,043	2,310	4,824
Option 2	16,497	2,062,125	4,305,717	1,938	4,047
Option 3	11,336	1,417,000	2,958,696	1,332	2,781

In line with the target referred to in the Urban Design Plan (UDP), an estimation has also been carried out assuming the office areas achieve a 4 Star NABERS Office rating based on whole building.

For 4 Stars the office should have an emission rate of 193 kg CO_2/m^2. This has then been converted to electricity consumption assuming that electricity accounts for 100% of the total energy consumed.

Table 2 – Annual office energy consumption and CO_2 emissions based on NABERS 4 Star Office

	Office Area (m^2)	CO_2 Emissions (tonnes CO_2)	Electricity Consumption (kWh)
Proposed	20,900	4,034	4,291,170
Option 1	19,663	3,795	4,037,190
Option 2	16,497	3,184	3,387,150
Option 3	11,336	2,188	2,327,498

2.2 WAREHOUSES

Energy consumption associated with warehouses has been estimated by calculating maximum demand and then applying an assumed profile for a year.

It has been assumed that the warehouse areas are not conditioned (i.e. no heating or cooling), but have mechanical ventilation. Therefore, all energy consumption associated with the warehouses is electricity.

Australian/NZ Standard AS/NZS 3000:2007 (Electrical Installations) provides the following guidance on estimating maximum demand for warehouses.

- Light & Power Range: 5 - 15 VA/m^2 Average: 10 VA/m^2
- Ventilation Range: 5 VA/m^2 Average: 5 VA/m^2

To convert VA to kW a power factor of 0.85 has been used.

The profiles in Appendix A were then assumed and used to model a year's energy consumption. The profiles have been based on those detailed in the Green Star Industrial PILOT Energy Calculator Guide (2009). Profiles have been assumed for working weekdays and weekends/public holidays. It has been assumed that there are 252 working weekdays per year, with the balance being weekends/public holidays.

Using the warehouse areas provided on the 'Development Options Totals' the following ranges have been calculated.

Table 3 – Annual warehouse energy consumption and CO_2 emissions ranges

	Warehouse Area (m^2)	Lighting & Power Electricity Consumption (kWh)		Ventilation Electricity Consumption (kWh)	Total Electricity Consumption (kWh)		CO_2 Emissions (tonnes CO_2)	
		Lower	Upper		Lower	Upper	Lower	Upper
Proposed	22,0555	4,246,235	12,738,705	4,033,642	8,279,877	21,018,583	7,783	19,757
Option 1	22,3263	4,298,371	12,895,113	4,083,168	8,381,539	21,276,651	7,878	20,000
Option 2	22,0879	4,252,473	12,757,419	4,039,568	8,292,041	21,049,459	7,794	19,786
Option 3	22,6969	4,369,721	13,109,162	4,150,945	8,520,666	21,629,828	8,009	20,332

In line with the target referred to in the Urban Design Plan (UDP), an estimation has also been carried out assuming ventilation is provided via natural means and lighting/power is reduced through maximised daylight penetration. Table 4 below shows our estimation on the basis of light and power density of 12 VA/m^2.

Table 4 – Annual warehouse energy consumption and CO_2 based on UDP.

	Warehouse Area (m^2)	Lighting & Power Electricity Consumption (kWh)	CO_2 Emissions (tonnes CO_2)
Proposed	220,555	10,190,964	9,580
Option 1	223,263	10,316,090	9,697
Option 2	220,879	10,205,935	9,594
Option 3	226,969	10,487,330	9,858

2.3 CAR PARKING

It is assumed that all car parking areas are provided with lighting.

Australian/NZ Standard AS/NZS 3000:2007 (Electrical Installations) provides the following guidance on estimating maximum demand for carparks.

- Open Air Range: 0 - 10 VA/m^2 Average: 5 VA/m^2

It has been assumed that car parking areas are provided with lighting for 8 hours per day, 252 days per year.

Using the car parking areas provided on the 'Development Options Totals' the following ranges have been calculated.

Table 5 – Annual car parking energy consumption and CO_2 emissions ranges

	Carpark Area (m^2)	Energy Consumption (kWh)		CO_2 Emissions (tonnes CO_2)	
		Lower	Upper	Lower	Upper
Proposed	26,365	0	531,518	0	500
Option 1	40,736	0	821,238	0	772
Option 2	32,287	0	650,906	0	612
Option 3	40,064	0	807,690	0	759

The estimation for this development is based on an average maximum demand of 5 VA/m^2. The table below shows the energy consumption and emissions on this basis.

Table 6 – Estimated annual car parking energy consumption and CO_2 emissions

	Carpark Area (m^2)	Energy Consumption (kWh)	CO_2 Emissions (tonnes CO_2)
Proposed	26,365	225,895	212
Option 1	40,736	349,026	328
Option 2	32,287	276,635	260
Option 3	40,064	343,268	323

2.4 TRANSPORT

The transport element has been split into two sections:

- Staff vehicles
- Delivery vehicles

Emissions from these vehicles has been based on assumed frequency and trip distance, plus vehicle emission rates.

2.4.1 Staff Vehicles

The 'Development Options Totals' provide details of the total number of parking spaces.

The following assumptions have been made:

- 90% of the parking spaces are used by staff (10% spare for visitors).
- Each occupied space represents a car doing a round trip of 20km.
- The average vehicle emission rate is 180 g CO_2/km.

Based on these assumptions the following emissions have been calculated.

Table 7 – Annual CO_2 emissions associated with staff vehicles

	No. Parking Spaces	CO_2 Emissions (tonnes CO_2)
Proposed	1,413	1,154
Option 1	1,481	1,209
Option 2	1,174	959
Option 3	1,456	1,189

2.4.2 Delivery Vehicles

The following assumptions have been made:

- 1 delivery/pickup per day per 500m^2 of warehouse area.
- Average distance travelled by each delivery vehicle is 100km.
- The average vehicle emission rate is 300 g CO_2/km.

Based on these assumptions the following emissions have been calculated.

Table 8 – Annual CO_2 emissions associated with delivery vehicles

	Warehouse Area (m^2)	No. deliveries/ pick-ups per day	CO_2 Emissions (tonnes CO_2)
Proposed	220,555	441	3,335
Option 1	223,263	447	3,376
Option 2	220,879	442	3,340
Option 3	226,969	454	3,432

3 TOTAL ENERGY CONSUMPTION & EMISSIONS

Based on the analysis in the previous section the following total energy consumption and carbon dioxide emissions have been calculated.

3.1 TYPICAL DEVELOPMENT – NO ENERGY SAVING MEASURES

Table 8 shows the energy consumption and emissions associated with the offices, warehouses and car parking only (transport is excluded).

Table 9 shows the figures associated with transport only.

Table 10 shows the total emissions associated with the development (including transport).

Table 9 – Annual energy consumption and CO_2 emissions for offices, warehouses and car parking

	Energy Consumption (kWh)	CO_2 Emissions (tonnes CO_2)
Proposed	27,005,001	25,385
Option 1	27,229,932	25,596
Option 2	26,006,082	24,446
Option 3	25,396,214	23,872

Table 10 – Annual CO_2 emissions associated with transport only

	CO_2 Emissions (tonnes CO_2)
Proposed	4,488
Option 1	4,585
Option 2	4,298
Option 3	4,621

Table 11 – Total annual CO_2 emissions associated with the development

	CO_2 Emissions (tonnes CO_2)
Proposed	29,873
Option 1	30,181
Option 2	28,744
Option 3	28,493

3.2 DEVELOPMENT WITH ENERGY SAVING INITIATIVES AS PER UDP

Table 12 shows the energy consumption and emissions associated with the offices, warehouses and car parking only (transport is excluded).

Table 13 shows the figures associated with transport only.

Table 14 shows the total emissions associated with the development (including transport).

Table 12 – Annual energy consumption and CO_2 emissions for offices, warehouses and car parking

	Energy Consumption (kWh)	CO_2 Emissions (tonnes CO_2)
Proposed	14,708,030	13,826
Option 1	14,702,307	13,820
Option 2	13,869,720	13,038
Option 3	13,158,096	12,369

Table 13 – Annual CO_2 emissions associated with transport only

	CO_2 Emissions (tonnes CO_2)
Proposed	4,488
Option 1	4,585
Option 2	4,298
Option 3	4,621

Table 14 – Total annual CO_2 emissions associated with the development

	CO_2 Emissions (tonnes CO_2)
Proposed	18,314
Option 1	18,405
Option 2	17,336
Option 3	16,989

APPENDIX A – WAREHOUSE PROFILES

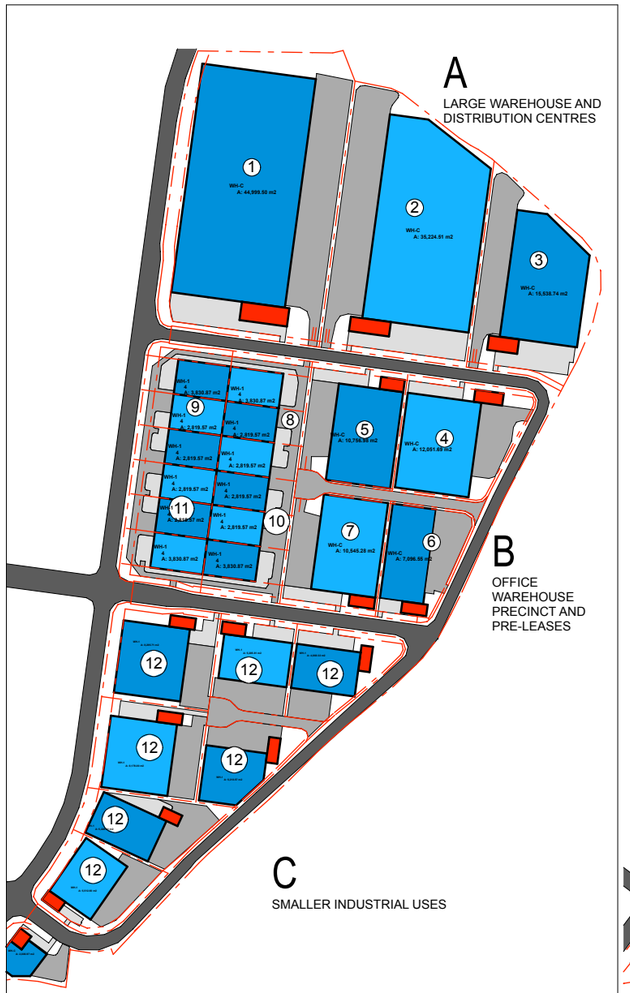
Table A-1 – Warehouse light & power profiles for weekdays & weekends/public holidays

Time	Light and Power load as a percentage of maximum demand	
	Working Weekdays	**Weekends and Public Holidays**
0000 – 0400	10%	10%
0400 – 0500	40%	10%
0500 – 1900	100%	10%
1900 – 2000	80%	10%
2000 – 2100	60%	10%
2100 – 2200	40%	10%
2200 – 2300	20%	10%
2300 – 2400	10%	10%

Table A-2 – Warehouse ventilation profiles for weekdays & weekends/public holidays

Time	Ventilation load as a percentage of maximum demand	
	Working Weekdays	**Weekends and Public Holidays**
0000 – 0500	0%	0%
0500 – 2100	100%	0%
2100 – 2400	0%	0%

APPENDIX B – DEVELOPMENT OPTIONS TOTALS

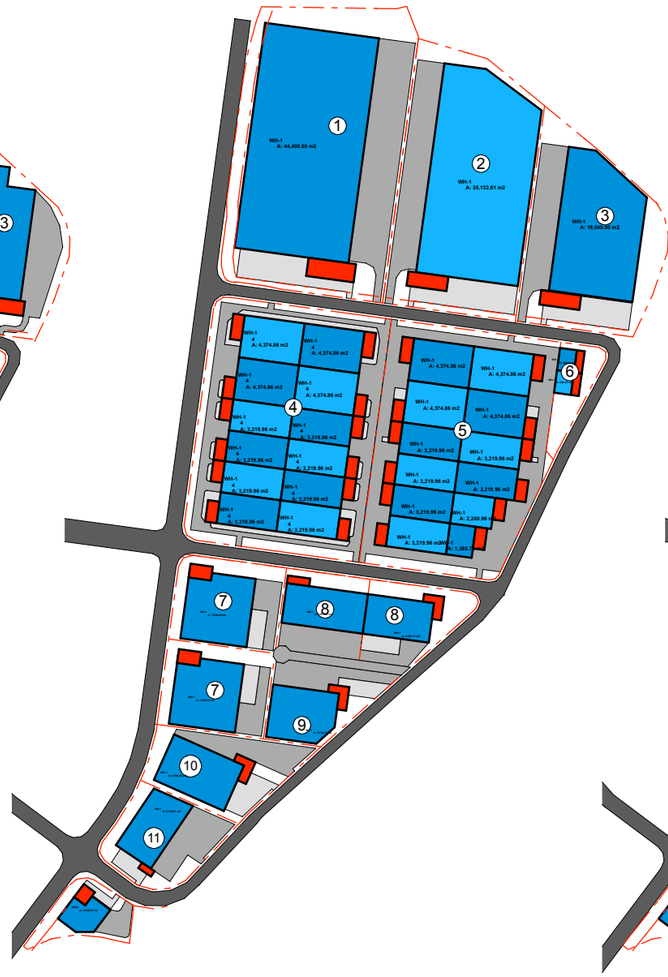


PROPOSED MASTER PLAN

SITE TOTAL AREA	~~430,857 m²~~	472,312 m2
WAREHOUSE TOTAL AREA	~~218,582 m²~~	220,555 m2
OFFICES TOTAL AREA	~~9,039 m²~~	20,900 m2
AWNING AREA TOTAL AREA	~~11,281 m²~~	12,875 m2
CAR PARKING TOTAL AREA CAR SPACES = 1,166	~~32,980 m²~~	26,365 m2 - 1413 car spaces
HARD-STAND AREA TOTAL AREA	~~97,467 m²~~	97,730 m2
LANDSCAPE AREA TOTAL AREA	~~72,676 m²~~	67,140 m2

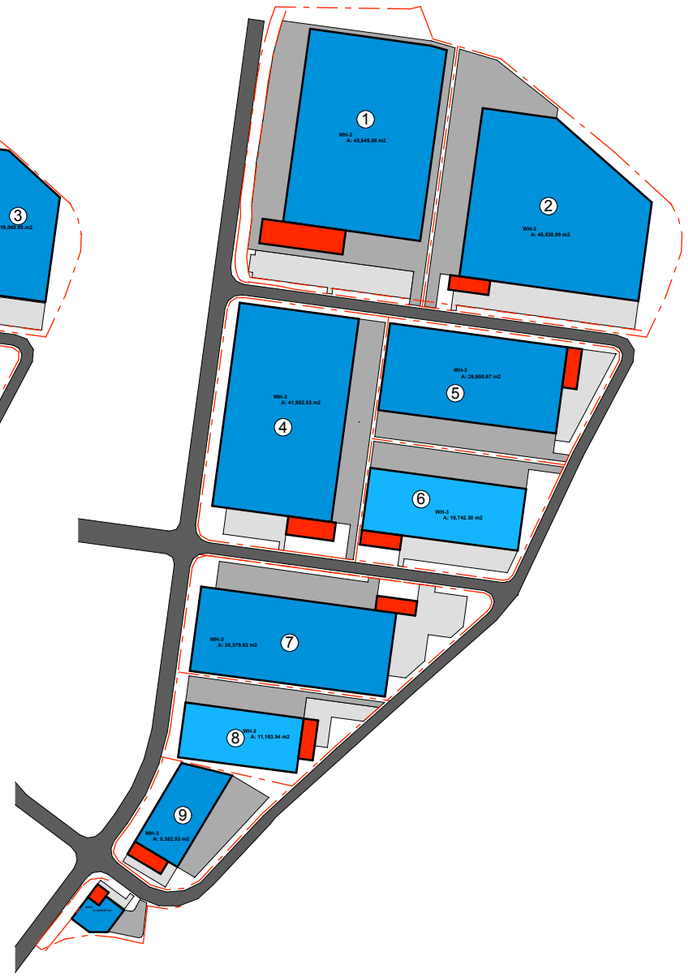
ALTERNATIVE OPTION 1

SITE TOTAL AREA	~~430,857 m²~~
WAREHOUSE TOTAL AREA	223,263 m²
OFFICES TOTAL AREA	19,633 m²
AWNING AREA TOTAL AREA	12,144 m²
CAR PARKING TOTAL AREA CAR SPACES = 1,481	40,736 m²
HARD-STAND AREA TOTAL AREA	98,717 m²
LANDSCAPE AREA TOTAL AREA	48,508 m²



ALTERNATIVE OPTION 2

SITE TOTAL AREA	~~430,857 m²~~
WAREHOUSE TOTAL AREA	220,879 m²
OFFICES TOTAL AREA	16,497 m²
AWNING AREA TOTAL AREA	11,868 m²
CAR PARKING TOTAL AREA CAR SPACES = 1,174	32,287 m²
HARD-STAND AREA TOTAL AREA	91,806 m²
LANDSCAPE AREA TOTAL AREA	102,157 m²



ALTERNATIVE OPTION 3

SITE TOTAL AREA	~~430,857 m²~~
WAREHOUSE TOTAL AREA	226,969 m²
OFFICES TOTAL AREA	11,336 m²
AWNING AREA TOTAL AREA	11,915 m²
CAR PARKING TOTAL AREA CAR SPACES = 1,456	40,064 m²
HARD-STAND AREA TOTAL AREA	84,809 m²
LANDSCAPE AREA TOTAL AREA	67,679 m²

DEVELOPMENT OPTIONS TOTALS

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