Intended for
Vantage Data Centers DUB11 Limited

Date
March **2022**

Project Number
1620012232

VANTAGE DUBLIN DATA CENTER

VOLUME 3: TECHNICAL APPENDICIES

RAMBOLL

Volume 3: Technical Appendices
Table of Contents

Technical Appendix 1.1: IEMA Quality Mark Checklist

Table 1.1: IEMA Quality Mark Check	
EIA Commitment and ES Review Criteria	
EIA Commitment 1: Regulatory Compliance[1]	
a) Does the ES, in the light of the project being assessed, identify, describe and assess effects on:	√
- Human Beings	√
- Fauna & Flora	√
- Soil	√
- Water	√
- Air	√
- Climate	√
- Landscape	√
- Cultural Heritage	√
- Material Assets	√
b) Does the ES attempt to set out the interaction between the factors set out under criteria 1.a)?	√
c) Does the ES contain a clear section, or sections, providing a description of the project comprising information on the site, design and size of the project?	√
d) Does the ES contain a section, or sections, that describe the likely significant effects of the proposed project on the environment?	√
e) Does the ES contain a clear section, or sections, that provide a description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects?	√
f) Does the ES contain a clear section, or sections, that provides the data required to identify and assess the main effects which the project is likely to have on the environment?	√
g) Does the ES contain a section, or sections, that outline the main alternatives studied by the developer and an indication of the main reasons for his choice, taking into account the environmental effects?	√
h) Has a Non-Technical Summary been produced containing an outline of the information mentioned in 1c) to 1h)?	√
EIA Commitment 4: EIA Context	
A) Scoping	
i) Has the ES clearly stated what effects will be addressed and how this decision was reached?	√
ii) Are the main environmental concerns and their locations, where relevant, clearly identified with an explanation of the risks posed from the project? Including relevant environmental issues beyond the boundary of the proposal?	√
iii) Does the ES identify the environmental issues that will not be assessed and explain why they are not being considered further?	√

[1] A number of the criteria under this Commitment cover similar issues to criteria set out in the other three Commitments, below. Where this occurs IEMA recognise that there will inevitably be some overlap between the criteria. However, the assessment of the criteria under this Commitment is focussed on the presence or absence of the issue, whereas the assessment of similar criteria, within the other three Commitments, will focus on the quality of the consideration of the issue in question.

Table 1.1: IEMA Quality Mark Check	
EIA Commitment and ES Review Criteria	
iv) Is the sub-topic scope undertaken in relation to each of the topics included in the EIA appropriate and focussed	√
B) Alternatives, including iterative design	
i) Does the ES set out the main alternatives that were considered at different points during the development of the proposal?	√
ii) Are the main reasons for the selection of the proposal over distinct alternatives and design iterations easily identifiable?	√
iii) Does the ES clearly indicate how the EIA process, environmental issues and consultee responses influenced the iterative design process that led to the proposed project?	√
EIA Commitment 5: EIA Content	
A) Baseline	
i) Does the ES describe the current condition of those aspects of the environment that are likely to be significantly affected by the development?	√
ii) Is the sensitivity / importance of the baseline environment clearly evaluated?	√
iii) Are limitations in the baseline information identified and clearly set out?	√
B) Assessment	
i) Are the methods for establishing the magnitude of impacts on the receiving environment clearly defined?	√
ii) Does the ES set out a generic methodology for the assessment and evaluation of significance OR clearly explain and justify a specific method for each environmental issue?	√
iii) Does the assessment of significance consider the impact's deviation from the established baseline condition? (e.g. the sensitivity of the environment, the extent to which the impact is reversible, etc.).	√
iv) Does the ES identify the significance of impacts that would be anticipated to remain following the successful implementation of any mitigation set out in the ES?	√
vii) Does the ES give appropriate prominence to both positive and negative effects relative to their significance?	√
C) Environmental Management	
i) Does the ES describe the measures proposed to be implemented to avoid, reduce, and if possible, remedy significant adverse impacts of the proposed development?	√
ii) Is an indication of the effectiveness of the stated mitigation measures provided?	√
iii) Are details provided related to any management plans that the ES indicates should be implemented to deliver the mitigation measures and/or monitor the environmental impact of the project?	√
iv) Does the ES identify the general groups who will be responsible for the follow-up programme?	√

Table 1.1: IEMA Quality Mark Check	
EIA Commitment and ES Review Criteria	
EIA Commitment 6: EIA Communication	
A) Consultation	
i) Does the description of any consultation include details of those who were contacted, including statutory and non-statutory consultees, and the public?	√
ii) Does the main text of the ES provide a summary of the main issues raised by consultees?	√
iii) Does the ES set out if any of the issues raised by consultees will not be dealt with in the ES?	√
If so is clear justification set out as to why the issue has been scoped out?	√
B) ES Quality	
i) Does the ES provide appropriate illustrations through the use of maps and/or diagrams? In particular this should cover:	
- the location of the site, site layout and boundary,	√
- operational appearance,	√
- main environmental receptors and	√
- impacts displayed in a visual format where appropriate.	√
ii) Is the area of proposed land clearly described and indicated on an appropriate map or diagram?	√
iii) Are the anticipated timescales of construction, operation and (where appropriate) decommissioning of the proposal clearly set out in the main text?	√
iv) Is the information in the ES presented in a manner in which a non-specialist would be able to logically identify information they were seeking?	√
v) Are technical terms kept to a minimum, with a glossary provided?	√
C) Non-Technical Summary (NTS)	
i) Does the NTS provide sufficient information for the non-specialist reader to understand the main environmental impacts of the proposal without reference to the main ES?	√
ii) Are maps and diagrams included in the NTS that, at a minimum, illustrate the location of the application site, the footprint of the proposed development, and the location of relevant key features?	√
iii) Is it clear that the NTS was made available as a separate, stand-alone document to facilitate a wider readership?	√

EIA Quality Mark

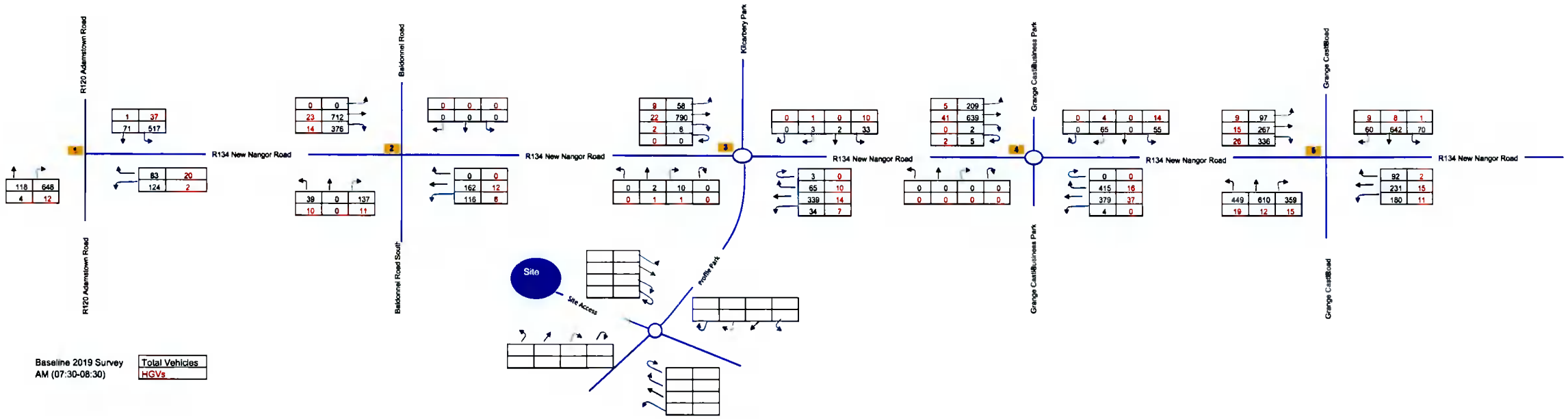
This Environmental Statement, and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development, was undertaken in line with the EIA Quality Mark Commitments.

The EIA Quality Mark is a voluntary scheme, operated by the Institute of Environmental Management and Assessment (IEMA), through which EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in the following areas:

- *EIA Management*
- *EIA Team Capabilities*
- *EIA Regulatory Compliance*
- *EIA Context & Influence*
- *EIA Content*
- *EIA Presentation*
- *Improving EIA practice*

To find out more about the EIA Quality Mark please visit:
www.iema.net/qmark

Technical Appendix 7.1: Traffic Flow and Distribution Diagrams



Baseline 2019 Survey
AM (07:30-08:30)

Total Vehicles
HGVs

KEY

Client
Vantage Data Centers Dub11 Limited

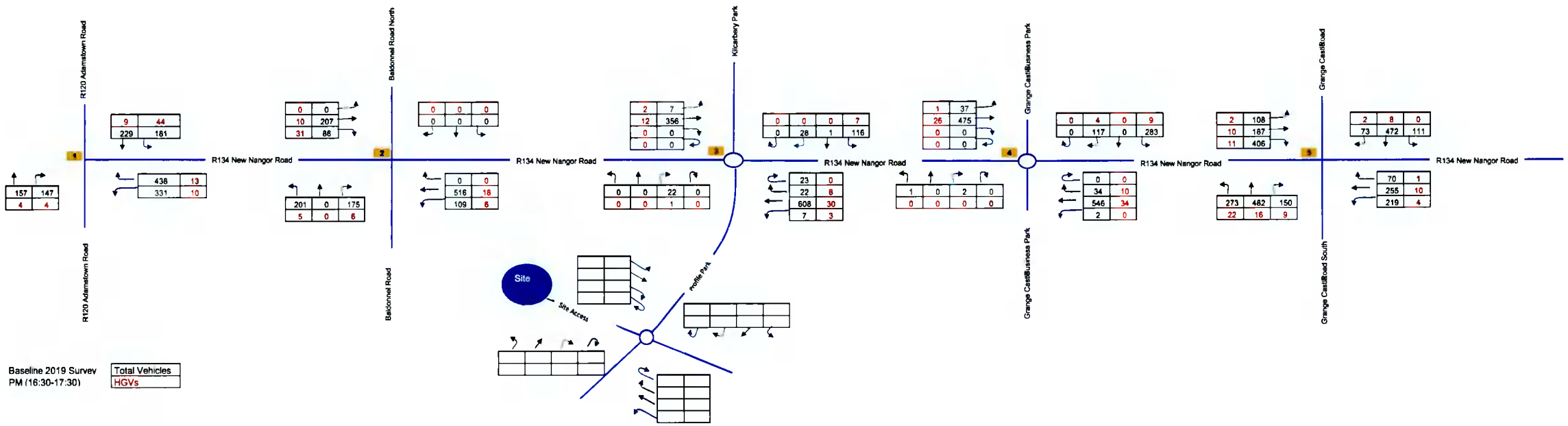
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Baseline 2019 Traffic Flows AM Peak

RAMBOLL

Date	Prepared By
05/12/2021	BVK
Figure No. 1620012232-005/EIAR/7.11	Revision 1



KEY

Client
Vantage Data Centers Dub11 Limi

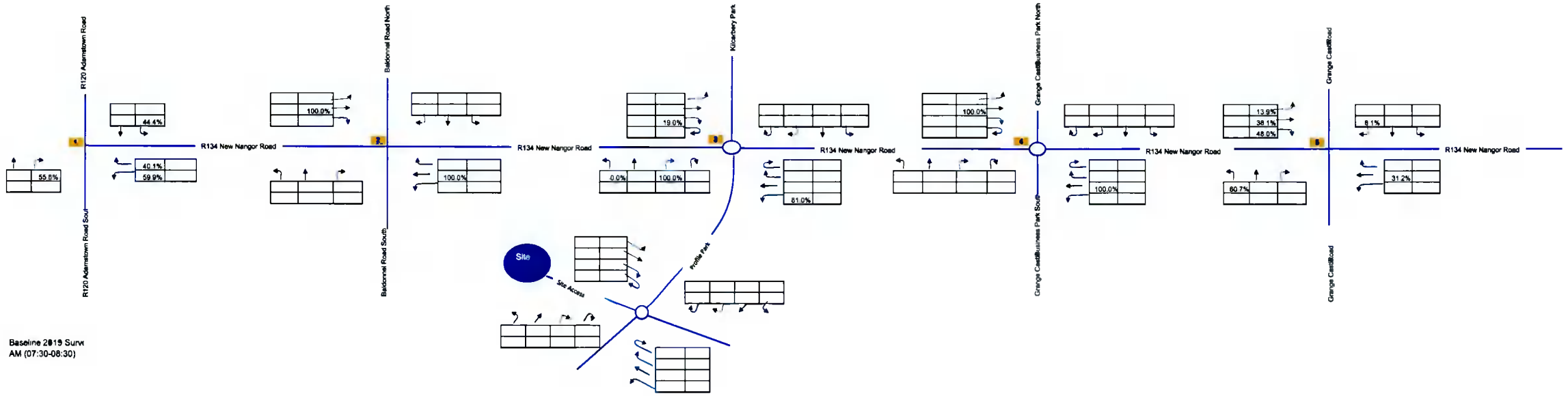
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Baseline 2019 Traffic Flows PM Peak

RAMBOLL

Date	Prepared
05/12/2021	BVK
Figure No. 1620012232-005/EIAR/7.12	Revision 1



KEY

Client
Vantage Data Centers Dub11 Limited

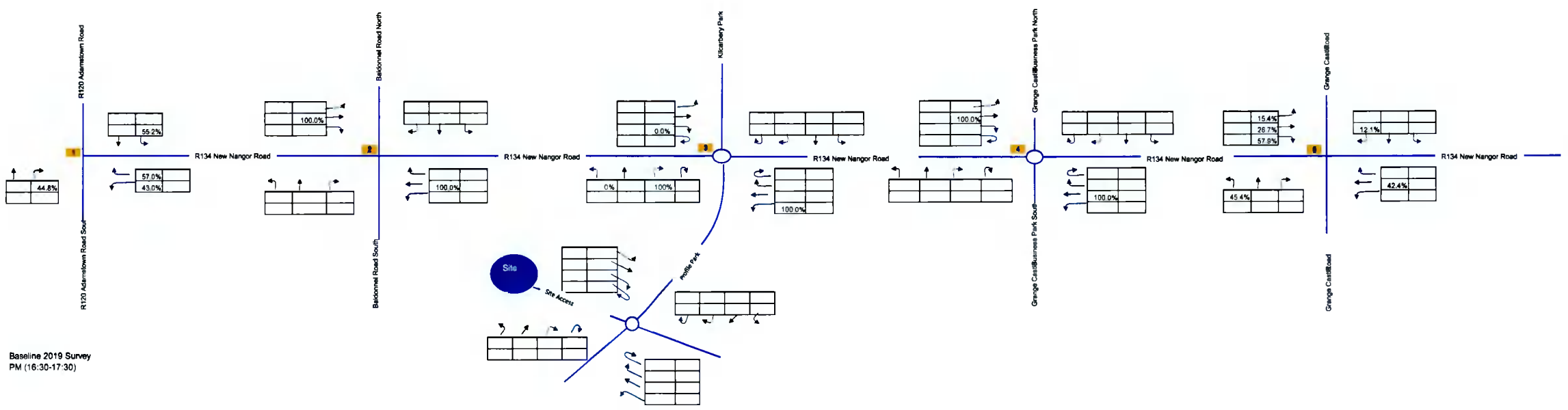
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Baseline 2019 Trip Distribution AM Peak

RAMBOLL

Date	Prepared By
05/12/2021	BVK
Figure No. 1620012232-005/EIAR/7.13	Revision 1



Baseline 2019 Survey
PM (16:30-17:30)

KEY

Client
Vantage Data Centers Dub11 Limi

Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Baseline 2019 Trip Distribution PM Peak

RAMBOLL

Date	Prepared
05/12/2021	BVK
Figure No.	Revision
1620012232-005/EIAR/7.14	1

Technical Appendix 7.2: Accident Data

N

Rock Road Mansions

Nangor Road

R134

Kilcarberry Park

77 m

R136

R134

R134

77 m

78 m

Profile Park

75 m

Grange Castle South

Profile Park

Grange Castle Golf Course

91 m

0.15 0.07 0 0.15 0.3 0.45 0.6 Kilometers

Esri, Intermap, NASA, NGA, USGS, Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS

KEY

- Site
- 'Slight' Accident
- 'Serious' Accident
- 'Fatal' Accident
- ACCIDENT DATA 2012
- ACCIDENT DATA 2013
- ACCIDENT DATA 2014
- ACCIDENT DATA 2015
- ACCIDENT DATA 2016

Client
Vantage Data Centers Dub11 Limi

Project Title
VDC DUB 1

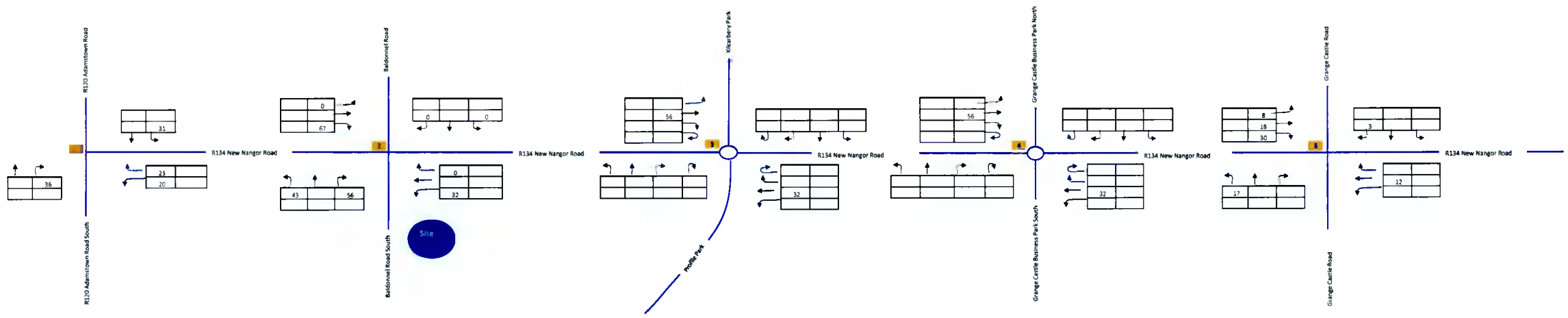
Project Number
1620012232-005

Figure Title
Accident Data

RAMBOLL

Date	Prepared
05/012/2021	BVK
Figure No.	Revision
1620012232-005/EIAR/7.21	1

Technical Appendix 7.3: Cumulative Schemes Daily Traffic Flow Diagrams



Cumulative Development: SD18A/0134
Operation Stage

Daily

Trip Generation

	Daily	
	Arriv	Dep
Total Vehicles	142	142

Trip Distribution:
As per the supporting EIAR, traffic accessing/egressing the site has been taken to have a 70/30 split with 70% of traffic heading north towards the Baldonnel Road/R134 junction and 30% heading south towards the Baldonnel Road / Aylmer Road junction. Trip distribution on the other junctions will be the same with the 2019 traffic surveys

KEY

Client
Vantage Data Centers Dub11 Limi

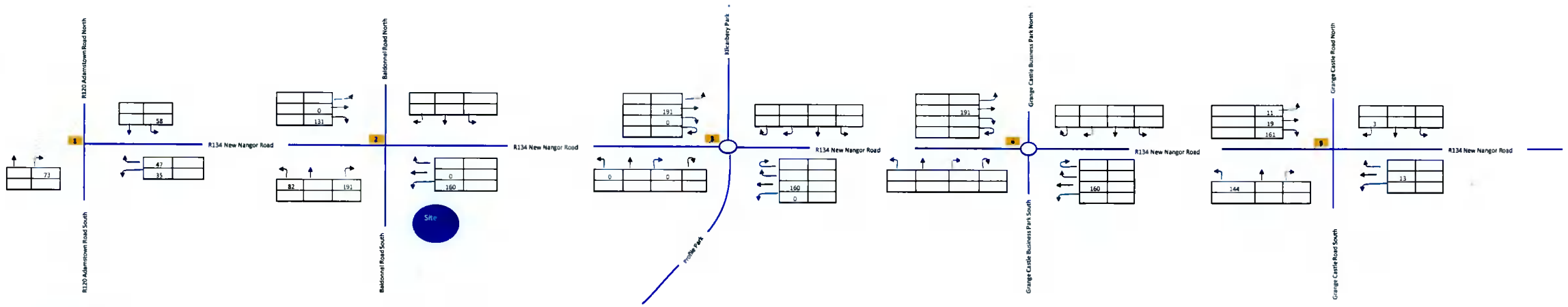
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "SD18A/0134" Operation Stage Daily Traffic Flows

RAMBOLL

Date	Prepared
06/12/2021	BVK
Figure No.	Revision
1620012232-005/EIAR/7.31	1



Cumulative Development: SD20A/0121
Demolition and Construction Stage

Daily

Trip Generation

	Daily	
	Arrv	Dep
Total Vehicles	420	420

SD20A/0121 (80,269sqm)
10 HGVs per hour
up to 300 vehicles per direction for commuting
Working hours: 07.00-19:00
12 hours

Trip Distribution:
Demolition and Construction traffic is distributed onto the network based upon the SD20A/0121 TIA
Light vehicle construction has been distributed across the surrounding road network in the same manner as the 2019 traffic surveys (57% of LGV arrivals to Grange Castle Busines Park are heading from Baldonnel Road South (North))
All heavy contruction traffic travels to the site from the N7 National Road and from the M50 arbital motorway via the R134 and R136 and departs along the same routes

KEY

Client
Vantage Data Centers Dub11 Limited

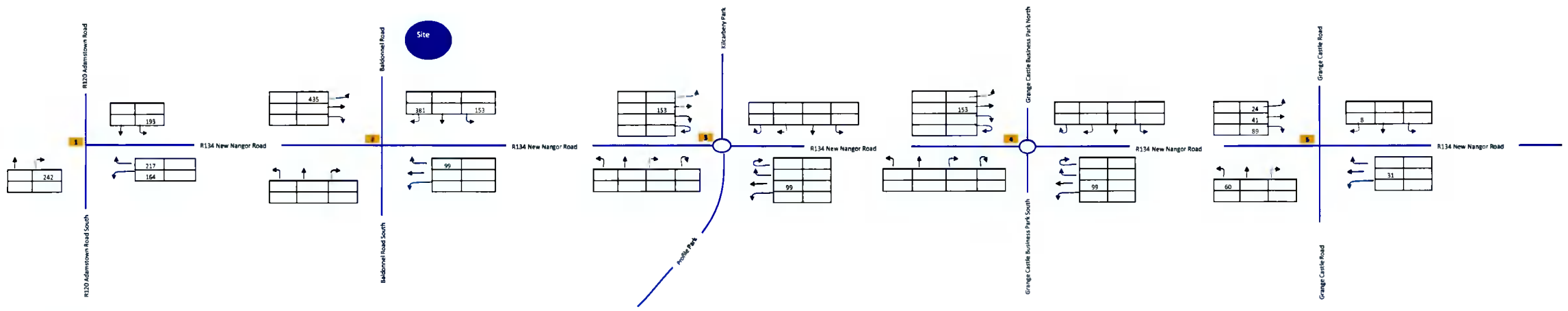
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "SD20A/0121" Construction Stage Daily Traffic Flows

RAMBOLL

Date	Prepared By
06/12/2021	BVK
Figure No.	**Revision**
1620012232-005/EIAR/7.32	1



Cumulative Development: SD20A/0283
Demolition and Construction Stage

Daily

Trip Generation

	Daily	
	Arriv	Dep
Total Vehicles	534	534

Based on the "SD20A_0283" EIAR
Max of 400 operatives and a ratio of 1.5 operatives per vehicle (per shift)
2 shifts - 267 vehicles each

Trip Distribution:
Construction traffic is distributed onto the network according to the directional splits recorded by the 2019 traffic survey. Traffic continues straight along Nangor Road (R134).

KEY

Client
Vantage Data Centers Dub11 Limi

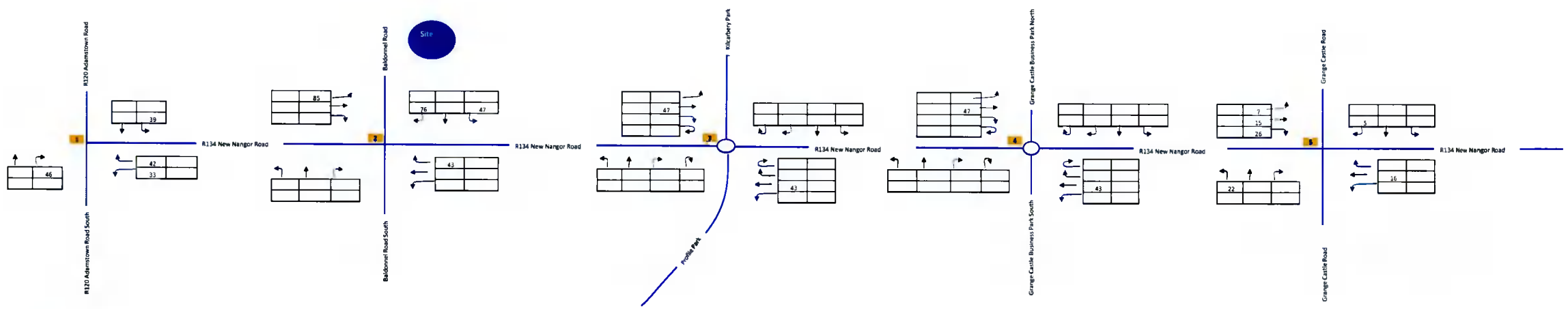
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "SD20A/0283" Construction Daily Traffic Flows

RAMBOLL

Date	Prepared by
06/12/2021	BVK
Figure No. 1620012232-005/EIAR/7.33	Revision 1



Cumulative Development: SD20A/0283
Operation Stage

Daily

Trip Generation Based on the "SD20A_0283" EIAR

	Daily	
	Arrv	Dep
Total Vehicles	128	123

Trip Distribution:
Development traffic is distributed onto the network according to the directional splits recorded by the 2019 traffic survey. Traffic continues straight along Nangor Road (R134)

KEY

Client
Vantage Data Centers Dub11 Limited

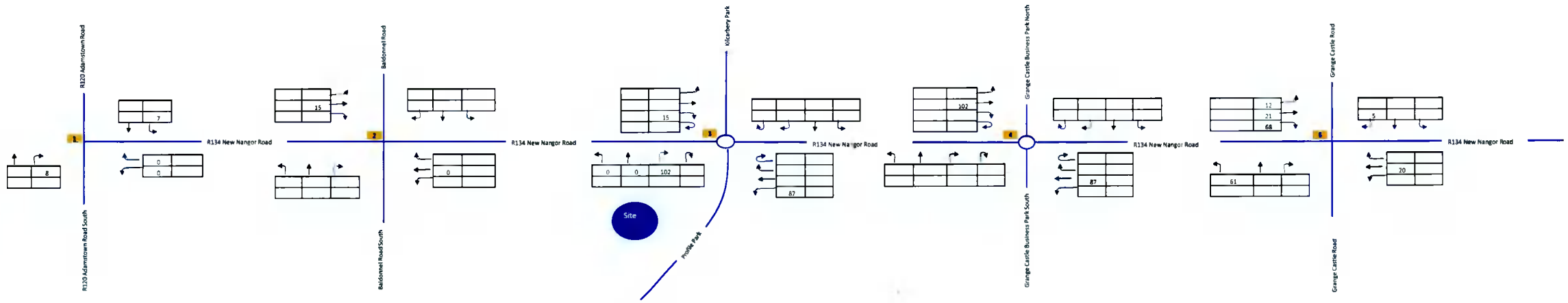
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "SD20A/0283" Operation Stage Daily Traffic Flows

RAMBOLL

Date	Prepared By
06/12/2021	BVK
Figure No.	Revision
1620012232-005/EIAR/7.34	1



Cumulative Development: SD21A/0186
Demolition and Construction Stage

Daily

Trip Generation

	Daily	
	Arrv	Dep
Total Vehicles	102	102

Trip Distribution
Light construction vehicles have been distributed across the surrounding network in the same manner as the 2019 traffic surveys
All heavy construction traffic travels to the site from the N7 National Road and from the M50 artrial motorway via the R34 and R136 and departs along the same routes

KEY

Client
Vantage Data Centers Dub11 Limi

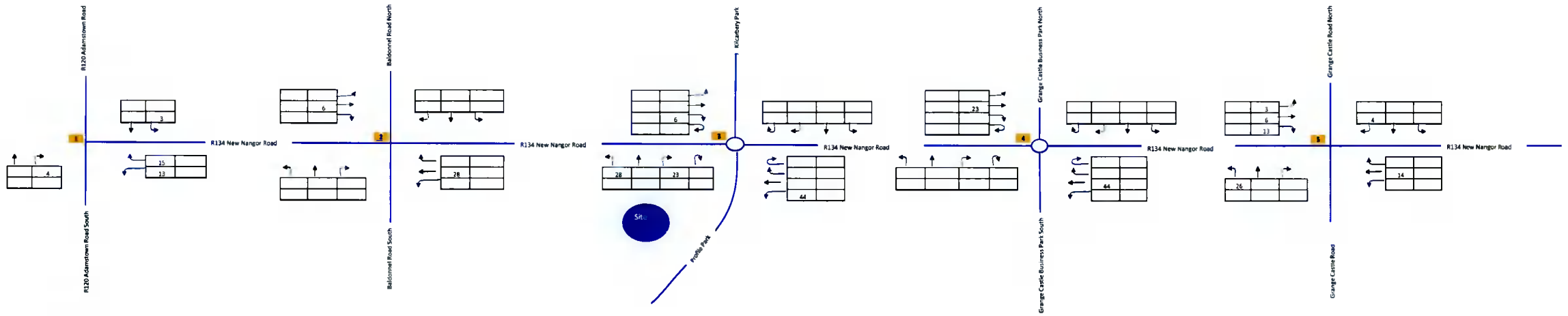
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "SD21A/0186" Construction Stage Daily Traffic Flows

RAMBOLL

Date	Prepared
06/12/2021	BVK
Figure No. 1620012232-005/EIAR/7.35	Revision 1



Cumulative Scheme: SD21A/0167
Construction Stage

Daily

Trip Generation

	Daily	
	Arriv	Dep
Total Vehicles	50	50

Trip Distribution:
Development traffic is distributed at Junction 3 based upon the survey data presented in SD21A/0167 EIAR and then distributed on the wider study area based upon the 2019 survey data presented in SD20A/0121 TIA

KEY

Client
Vantage Data Centers Dub11 Limited

Project Title
VDC DUB 1

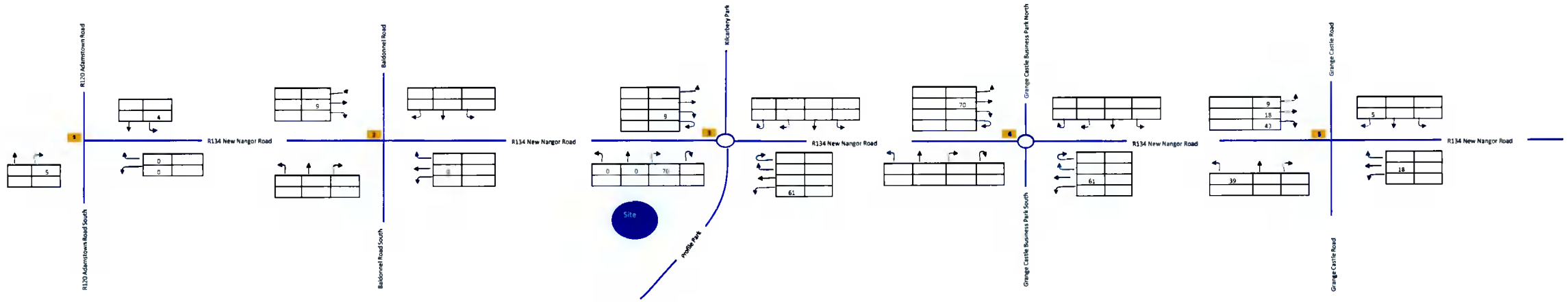
Project Number
1620012232-005

Figure Title
Cumulative Scheme "SD21A/0167" Operation Stage Daily Traffic Flows

RAMBOLL

Date	Prepared By
06/12/2021	BVK

Figure No.	Revision
1620012232-005/EIAR/7.36	1



Cumulative Scheme: SID VDC DUB 1
Demolition and Construction Stage

Daily

Trip Generation

	Daily	
	Arriv	Dep
Total Vehicles	70	70

Trip Distribution
Light construction vehicles have been distributed across the surrounding network in the same manner as the 2019 traffic surveys.
All heavy construction traffic travels to the site from the N7 National Road and from the M50 artrial motorway via the R34 and R136 and departs along the same routes

KEY

Client
Vantage Data Centers Dub11 Limi

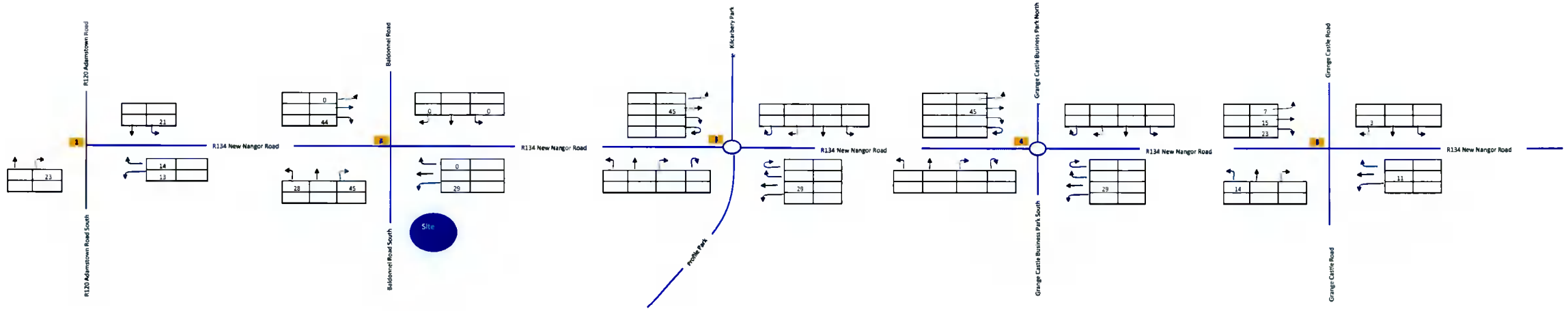
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "SID VDC DUB 1" Construction Stage Daily Traffic Flows

RAMBOLL

Date	Prepared
06/12/2021	BVK
Figure No.	Revision
1620012232-005/EIAR/7.37	1



Cumulative Development: VA06S.309146
Demolition and Construction Stage

Daily

Trip Generation

	Daily	
	Arriv	Dep
Total Vehicles	104	104

Trip Distribution:
Operation stage traffic is distributed onto the network based upon the VA06S 309146 EIAR

KEY

Client
Vantage Data Centers Dub11 Limited

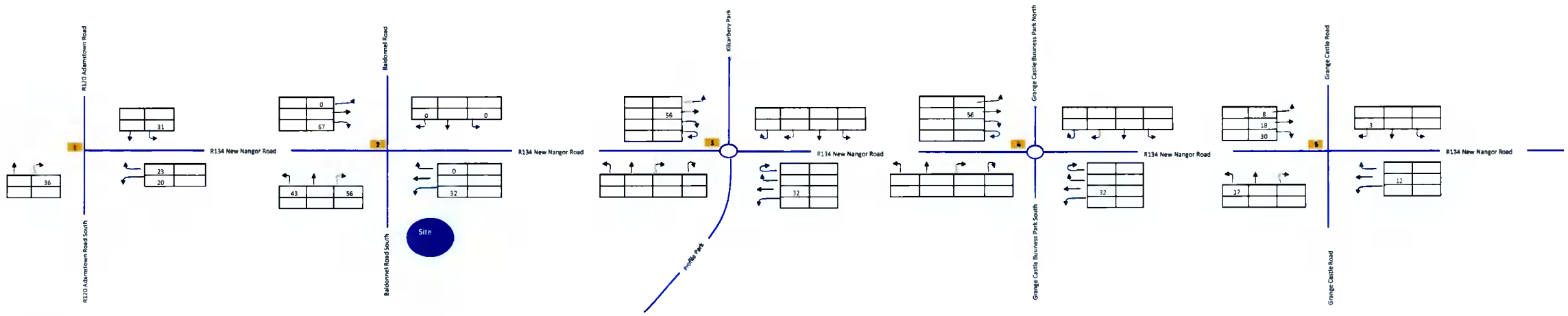
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "VA06S.309146" Construction Stage Daily Traffic Flows

RAMBOLL

Date	Prepared By
06/12/2021	BVK
Figure No.	Revision
1620012232-005/EIAR/7.38	1



Cumulative Development: VA06S.309146
Operation Stage

Daily

Trip Generation

		Daily	
		Arriv	Dep
Total Vehicles		142	142

Trip Distribution:
Operation stage traffic is distributed onto the network based upon the VA06S.309146 EIAR

KEY

Client
Vantage Data Centers Dub11 Limi

Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Cumulative Scheme "VA06S.309146" Operation Stage Daily Traffic Flows

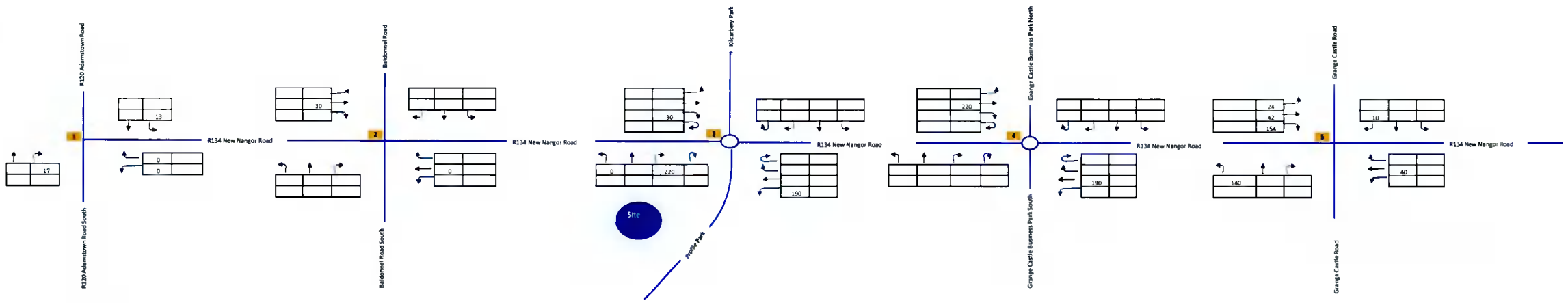
RAMBOLL

Date
06/12/2021

Prepared
BVK

Figure No.
1620012232-005/EIAR/7.39

Revision
1



Cumulative Development: SA21A/0241
Demolition and Construction Stage

Daily

Trip Generation

	Daily	
	Arriv	Dep
Total Vehicles	220	220

SD20A/0121 (80,269sqm)
10 HGVs per hour
up to 300 vehicles per direction for commuting

Proposed Development (41,105sqm)
5 HGVs per hour
157 vehicles per direction for commuting

Working hours: 07:00-19:00
12 hours

Trip Distribution
Light construction vehicles have been distributed across the surrounding network in the same manner as the 2019 traffic surveys
All heavy construction traffic travels to the site from the N7 National Road and from the M50 artrial motorway via the R34 and R136 and departs along the same routes

KEY

Client
Vantage Data Centers Dub11 Limited

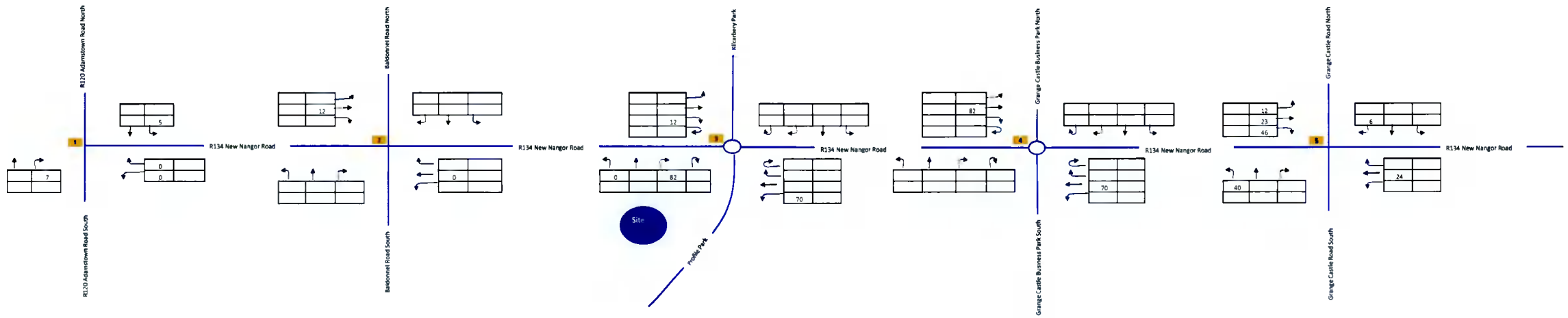
Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Proposed Development Construction Traffic Flows

RAMBOLL

Date	Prepared By
06/12/2021	BVK
Figure No.	**Revision**
1620012232-005/EIAR/7.40	1



Proposed Development
Operation Stage

Daily

Trip Generation

	Daily	
	Arriv	Dep
Total Vehicles	82	82

Trip Distribution:
Development traffic is distributed onto the network based upon the SD20A/0121 TIA and the directional splits recorded by the 2019 traffic survey. Traffic continues straight along Nangor Road (R134).

KEY

Client
Vantage Data Centers Dub11 Limi

Project Title
VDC DUB 1

Project Number
1620012232-005

Figure Title
Proposed Development Operational Traffic Flows Daily

RAMBOLL

Date	Prepared
06/12/2021	BVK
Figure No.	Revision
1620012232-005/EIAR/7.41	1

Technical Appendix 7.4: Proposed Development Trip Generation

VEHICLE MOVEMENTS STATEMENT

	Arrivals		Departures		Two-Way	
	Total Vehicles	Deliveries	Total Vehicles	Deliveries	Total Vehicles	Deliveries
00:00-01:00	0	0	0	0	0	0
01:00-02:00	0	0	0	0	0	0
02:00-03:00	0	0	0	0	0	0
03:00-04:00	0	0	0	0	0	0
04:00-05:00	0	0	0	0	0	0
05:00-06:00	0	0	0	0	0	0
06:00-07:00	4	0	4	0	8	0
07:00-08:00	0	0	0	0	0	0
08:00-09:00	60	0	10	0	70	0
09:00-10:00	0	1	0	0	0	1
10:00-11:00	0	1	0	1	0	2
11:00-12:00	0	1	0	1	0	2
12:00-13:00	0	0	0	1	0	1
13:00-14:00	0	1	0	0	0	1
14:00-15:00	4	1	4	1	8	2
15:00-16:00	0	1	0	1	0	2
16:00-17:00	0	0	0	1	0	1
17:00-18:00	10	0	60	0	70	0
18:00-19:00	0	0	0	0	0	0
19:00-20:00	0	0	0	0	0	0
20:00-21:00	0	0	0	0	0	0
21:00-22:00	0	0	0	0	0	0
22:00-23:00	4	0	4	0	8	0
23:00-24:00	0	0	0	0	0	0
Total	**82**	**6**	**82**	**6**	**164**	**12**

Worst Case Assumptions
Based on 132 FTE
Based on 27 Part-time employees
Based on 6 deliveries per day
Based on 3 shifts x 4 people

Technical Appendix 8.1: Air Quality Detailed Methodology, Modelling Approach and Data

1. DUST RISK ASSESSMENT METHODOLOGY

Table 1.1: Determining Dust Emission Magnitude

Large	Medium	Small
Demolition		
• total building volume >50,000 m^3 • potentially dusty construction material (e.g. concrete) • on-site crushing and screening • demolition activities >20 m above ground level	• total building volume 20,000m^3 – 50,000 m^3 • potentially dusty construction • demolition activities 10-20 m above ground level	• total building volume <20,000 m^3 • construction material with low potential for dust release (e.g. metal cladding or timber) • demolition activities <10 m above ground • during wetter months
Earthworks		
• total site area >10,000 m^2 • potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) • >10 heavy earth moving vehicles active at any one time • formation of bunds >8 m in height • total material moved >100,000 tonnes	• total site area 2,500 m^2 - 10,000 m^2 • moderately dusty soil type (e.g. silt) • 5-10 heavy earth moving vehicles active at any one time • formation of bunds 4 m – 8 m in height • total material moved 20,000 - 100,000 tonnes	• total site area <2,500 m^2 • soil type with large grain size (e.g. sand) • <5 heavy earth moving vehicles active at any one time • formation of bunds <4 m in height • total material moved <20,000 tonnes • earthworks during wetter months
Construction		
• total building volume >100,000 m^3 • piling • on-site concrete batching • sandblasting	• total building volume 25,000 m^3 - 100,000 m^3 • potentially dusty construction material (e.g. concrete) • piling • on-site concrete batching	• total building volume <25,000 m^3 • construction material with low potential for dust release (e.g. metal cladding or timber)
Trackout		
• >50 HGV (>3.5t) movements in any one day • potentially dusty surface material (e.g. high clay content) • unpaved road length >100 m	• 10-50 HGV (>3.5t) movements in any one day • moderately dusty surface material (e.g. high clay content) • unpaved road length 50 m – 100 m	• <10 HGV (>3.5t) movements in any one day • surface material with low potential for dust release • unpaved road length <50 m

Table 1.2: Determining Receptor Sensitivity

High	Medium	Low
Sensitivities of People to Dust Soiling Effects		
• users can reasonably expect enjoyment of a high level of amenity; or • the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. • indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.	• users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or • the appearance, aesthetics or value of their property could be diminished by soiling; or • the people or property would not reasonably be expected to be present continuously or regularly for extended periods as part of the normal pattern of use of the land. • indicative examples include parks and places of work.	• the enjoyment of amenity would not reasonably be expected; or • property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or • there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. • indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.
Sensitivities of People to the Health Effects of PM_{10}		
• locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • indicative examples include residential properties, hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	• locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • indicative examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	• Locations where human exposure is transient. • indicative examples include public footpaths, playing fields, parks and shopping streets.
Sensitivities of Receptors to Ecological Effects		

Table 1.2: Determining Receptor Sensitivity

• locations with an international or national designation *and* the designated features may be affected by dust soiling; or • locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain. • indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.	• locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or • locations with a national designation where the features may be affected by dust deposition. • indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.	• locations with a local designation where the features may be affected by dust deposition. • indicative example is a local Nature Reserve with dust sensitive features.

Table 1.3: Determining Sensitivity of the Area - Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 1.4: Determining Sensitivity of the Area – Human Health Impacts

	Annual Mean PM_{10} concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	>28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	>24-28 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium		>1	High	Medium	Low	Low	Low
Low		>1	Medium	Low	Low	Low	Low

Table 1.5: Determining Risk of Dust Impacts - Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 1.6: Determining Risk of Dust Impacts - Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 1.7: Determining Risk of Dust Impacts – Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 1.8: Determining Risk of Dust Impacts –Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

2. MODEL INPUTS AND RESULTS PROCESSING TOOLS

2.1 ADMS 5

2.1.1 The predicted impacts on local air quality associated with point source emissions associated with the operation of the scheme was assessed using Cambridge Environmental Research Consultants (CERC) atmospheric dispersion modelling system for roads (ADMS-Roads v5.2)[1]. ADMS 5 is used by several consultancies in the UK and across the world for air quality management and assessment studies of complex situations in large industrial areas.

2.1.2 The ADMS suite of models have been developed and validated by CERC. CERC was established in 1985 and has a leading position in environmental software development by encapsulating advanced scientific research into a number of computer models, providing user-friendly front-ends on PC based Windows platforms.

2.1.3 ADMS 5 model is an advanced dispersion model used to model the air quality impact of existing and proposed industrial installations. It was originally developed for regulatory authorities in the UK. Its many features include allowance for the impacts of buildings, complex terrain, coastlines and variations in surface roughness; dry and wet deposition; NOx chemistry schemes; short term releases (puffs); calculation of fluctuations of concentration on short timescales, odours and condensed plume visibility; and allowance for radioactive decay including γ-ray dose. It can predict long-term and short-term concentrations, as well as calculations of percentile concentrations. The science of ADMS 5 is significantly more advanced than that of most other air dispersion models in that it incorporates the latest understanding of the boundary layer structure and goes beyond the simplistic Pasquill-Gifford stability categories method with explicit calculation of important parameters.

2.1.4 The ADMS 5 model validation process includes comparisons against available measured data obtained from real world situations, field campaigns and wind tunnel experiments, with the results being published on CERC's model validation page[2]. Validation of the ADMS dispersion models has been performed using many experimental datasets that test different aspects of the models, for instance: ground/high level sources, passive and buoyant releases, buildings, complex terrain, chemistry, deposition and plume visibility. CERC is also involved in European programmes on model harmonisation, and their models were compared favourably against other EU and U.S. EPA systems. Further information in relation to this is available from the CERC web site at http://www.cerc.co.uk/environmental-software/modelvalidation.html.

2.2 Point Sources

2.2.1 The operation of the emergency generators has been assessed according to the methodology published by the UK Environmental Agency guidance[3, 4]. The UK guidance is a conservative probabilistic approach which uses the emergency generators maximum hourly emissions to determine the number of hours that all the generators could operate simultaneously in any one year with a 1% chance of exceeding the 1-hour mean objective based on the worst modelled meteorological year.

2.2.2 Following the UK Environmental Agency methodology, the hourly emissions and the allowable operating hours for emergency operation were estimated from a statistical analysis of the likelihood of breaching the 1-hour objective for NO_2 concentrations by using the hypergeometric distribution function. The allowable operating hours were calculated for a 1% probability of exceeding the one-hour mean objective at the most impacted receptor location. In accordance with the emissions from specified generators guidance, in an emergency when the operating period is greater than one hour, the calculated probability has been multiplied by 2.5. For compliance with the annual mean objectives, the predicted concentrations were scaled to the total annual operating hours that the generators were determined to run for the 1% probability of exceeding the one-hour mean objective.

2.2.3 The likelihood of exceeding the 1-hour mean objective also considers the baseline pollutant concentrations in the vicinity of the site. For the short-term assessment, the background concentration is assumed to be twice the annual mean background concentration. As the dispersion modelling was undertaken for NOx emissions, for estimating the number of exceedances of the hourly mean NO_2 objective, the exceedance concentration in the model was set as follows:

- Model exceedance concentration = (200 – twice annual mean background)/0.35.

2.2.4 For this assessment, the conversion of NOx to NO_2 has been estimated using the worst-case assumptions set out in the UK Environment Agency guidance:

- For the assessment of long term (annual mean) impacts at receptors 70% of NOx is converted to NO_2; and
- For the assessment of short term (hourly mean) impacts at receptors 35% of NOx is converted to NO_2.

2.2.5 For the annual average the PC is added to the baseline concentrations (process environmental contribution- PEC) and for the short-term assessment, the baseline concentrations are assumed to be twice the annual mean determined from the roads modelling assessment.

2.2.6 The dispersion modelling has been undertaken with five years of hourly sequenced meteorology data for the years 2015 to 2019 inclusive, from Casement Aerodrome which is approximately 1 km to the south of the site. The Casement Aerodrome windroses are presented in Table 2.1.

2.2.7 To undertake the assessment, each generator of the MGP was allocated its own flue. The emergency generators and MGP engines were allocated their own flues which were combined in ADMS in triples or quadruples when adjacent, according to the plans configuration. The location and flues parameters used in the model are shown are shown in Technical Appendix 8.1 in the EIAR Volume 3.

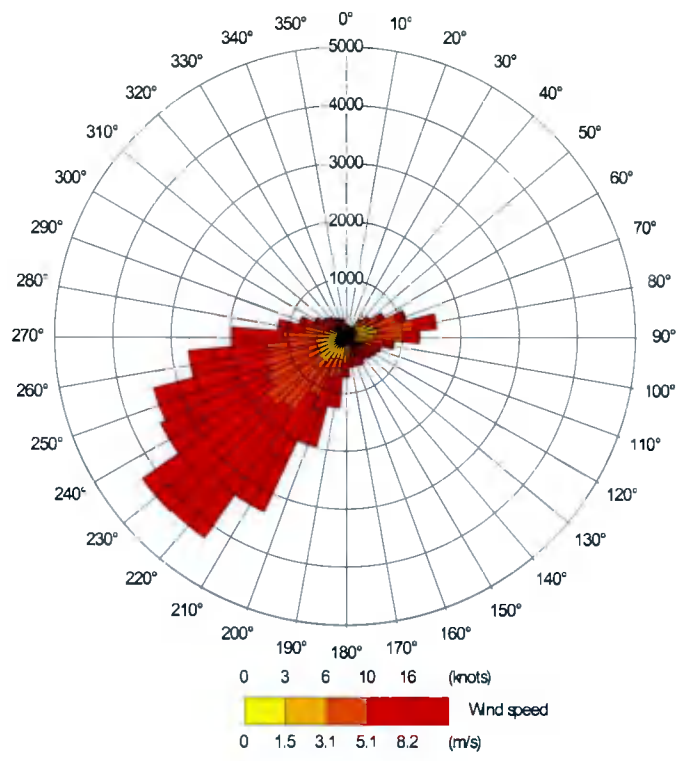
2.2.8 Further information on the model set up is provided in Table 2.1 and shown in Figure 2.1 and Figure 2.2.

[1] http://www.cerc.co.uk/environmental-software/ADMS-model.html

[2] http://www.cerc.co.uk/environmental-software/model-validation.html

[3] Guidance Specified generators: dispersion modelling assessment. Available at: https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment [Accessed on 04/08/2021]

[4] UK Environmental Agency. Guidance Specified generators: dispersion modelling assessment. Available at: https://consult.environment-agency.gov.uk/psc/mcp-and-sg-regulations/supporting_documents/Specified%20Generators%20Modelling%20GuidanceINTERIM%20FINAL.pdf [Accessed on 04/08/2021]

Table 2.1: Roads Emissions Model Inputs	
Meteorological Data	2015-2019 Hourly meteorological data from Casement Aerodrome Station has been used in the model. The 2015-2019 combined wind rose is shown below. 
ADMS	ADMS Roads version 5, ADMS5 version 5.2
Latitude	53.3
Surface Roughness	Topographic features, buildings or vegetation increase the ground's surface roughness which impact son the vertical mixing of a plume and changes the wind-speed profile at elevated heights due to mechanical turbulence generated as the air moves over the ground. Given the rural setting of the study area, a value of 0.3 m for Agricultural areas was used to represent the modelled area and the meteorological station site.
Minimum Monin-Obukhov length	The Minimum Monin-Obukhov provides a measure of the stability of the atmosphere and allows for the effect of heat production in cities, which is not represented by the meteorological data. The minimum standard value of 10 for small towns was used to represent the modelled area and the meteorological station site.

2.3 Terrain

2.3.1 The terrain in the vicinity of the site is flat with no slopes more than 10% and no large changes in surface roughness are expected. Following ADMS 5 manual recommendation, the terrain effects have not been included within the modelling.

2.4 Buildings

2.4.1 Tall buildings can have a substantial impact on the dispersion of pollutants from stacks, as a result of building downwash i.e., pollutants being drawn down in the wake of a building, giving rise to high concentrations close to the base of the buildings. Buildings within five times the stacks height have been considered in the assessment. The nearby buildings may also have an impact on the dispersion, and therefore these have also been included. The buildings set out in Table 2.2 and shown in Figure 2.1 and Figures 2.2 have been included within the ADMS 5 model.

Table 2.2: Buildings Dimensions

Name	X (m)	Y (m)	Height (m)	Length (m) / Diameter (m)	Width (m)	Angle (Degrees)
Phase 1/Scenario 1						
DUB 11.1 & 11.2	14.2	85.4	127.0	67.0	14.2	85.4
DUB11 Vent Shaft	20.0	104.5	3.3	156.8	20.0	104.5
DUB11 dock area	7.0	17.1	20.5	157.0	7.0	17.1
DUB11 B	14.2	63.7	43.7	67.0	14.2	63.7
DUB11.1 ChillerA	18.5	53.0	21.2	67.0	18.5	53.0
DUB11.1 ChillerB	18.5	22.7	36.4	157.0	18.5	22.7
DUB11 Elc Stor	19.1	9.3	123.1	67.0	19.1	9.3
Power Plant DUB 11	14.0	22.1	63.2	83.5	14.0	22.1
DUB11.2 ChillerA	18.5	53.0	21.2	67.0	18.5	53.0
DUB11.2 ChillerB	18.5	22.7	36.4	157.0	18.5	22.7
Kilcarbery Park	19.0	291.7	84.6	280.6	19.0	291.7
Kilcarbery BP A	12.0	26.5	87.0	93.1	12.0	26.5
Kilcarbery BP B	12.0	19.4	76.0	93.1	12.0	19.4
Google DC	12.0	138.5	123.6	115.1	12.0	138.5
AWS	12.0	258.3	68.2	104.5	12.0	258.3
Dub 11.1 Lift Shaft	21.6	13.3	9.3	67.4	21.6	13.3

Table 2.2: Buildings Dimensions

RadiatorScreen	18.0	41.9	18.4	353.2	18.0	41.9
Phase 2/Scenario 2						
DUB 11.1 & 11.2	703658	730776	14.2	85.4	127.0	67.0
DUB 12 A	703671	730668	14.2	83.0	62.0	78.0
DUB11 Vent Shaft	703602	730752	20.0	104.5	3.3	156.8
DUB12 Vent Shaft	703612	730650	20.0	3.2	51.9	78.0
DUB11 B	703653	730832	14.2	63.7	43.7	67.0
DUB12 B	703683	730632	14.2	74.1	13.0	258.0
DUB11.1 ChillerA	703642	730822	18.5	53.0	21.2	67.0
DUB11.1 ChillerB	703643	730797	18.5	22.7	36.4	157.0
DUB11 Elc Stor	703631	730766	19.1	9.3	123.1	67.0
Power Plant DUB 11	703582	730712	14.0	22.1	63.2	83.5
DUB11.2 ChillerA	703667	730761	18.5	53.0	21.2	67.0
DUB11.2 ChillerB	703668	730736	18.5	22.7	36.4	157.0
DUB12 Chiller A	703679	730654	18.5	53.0	21.2	78.0
DUB12 ChillerB	703666	730674	18.5	22.7	36.4	168.0
DUB12 Elc Stor	703645	730662	19.1	8.7	63.1	78.0
Kilcarbery Park	703773	730990	19.0	291.7	84.6	280.6
Kilcarbery BP A	703995	730955	12.0	26.5	87.0	93.1
Kilcarbery BP B	704038	730943	12.0	19.4	76.0	93.1
Google DC	703206	730497	12.0	138.5	123.6	115.1
AWS	702910	730677	12.0	258.3	68.2	104.5
Power Plant DUB 12	703578	730610	14.0	23.1	50.1	103.9

Table 2.2: Buildings Dimensions

Dub 11.1 Lift Shaft	703622	730834	21.6	13.3	9.3	67.4
DUB 12 Life Shaft	703669	730631	21.6	13.1	9.1	78.6
radiatorscreen1	703580	730721	18.0	18.4	42.7	82.9
radiatorscreen2	703578	730610	18.0	18.5	35.4	104.1

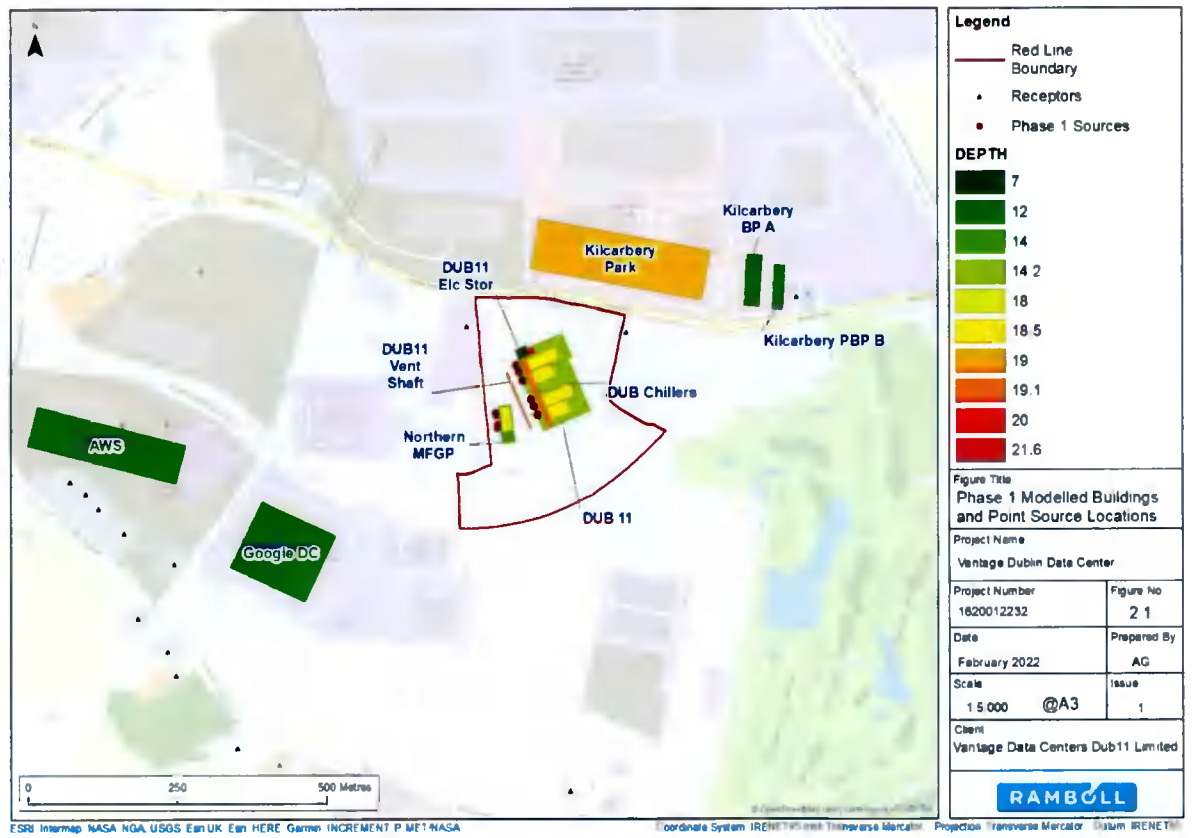


Figure 2.1: Phase 1/Scenario 1 Modelled Buildings and Point Source Locations

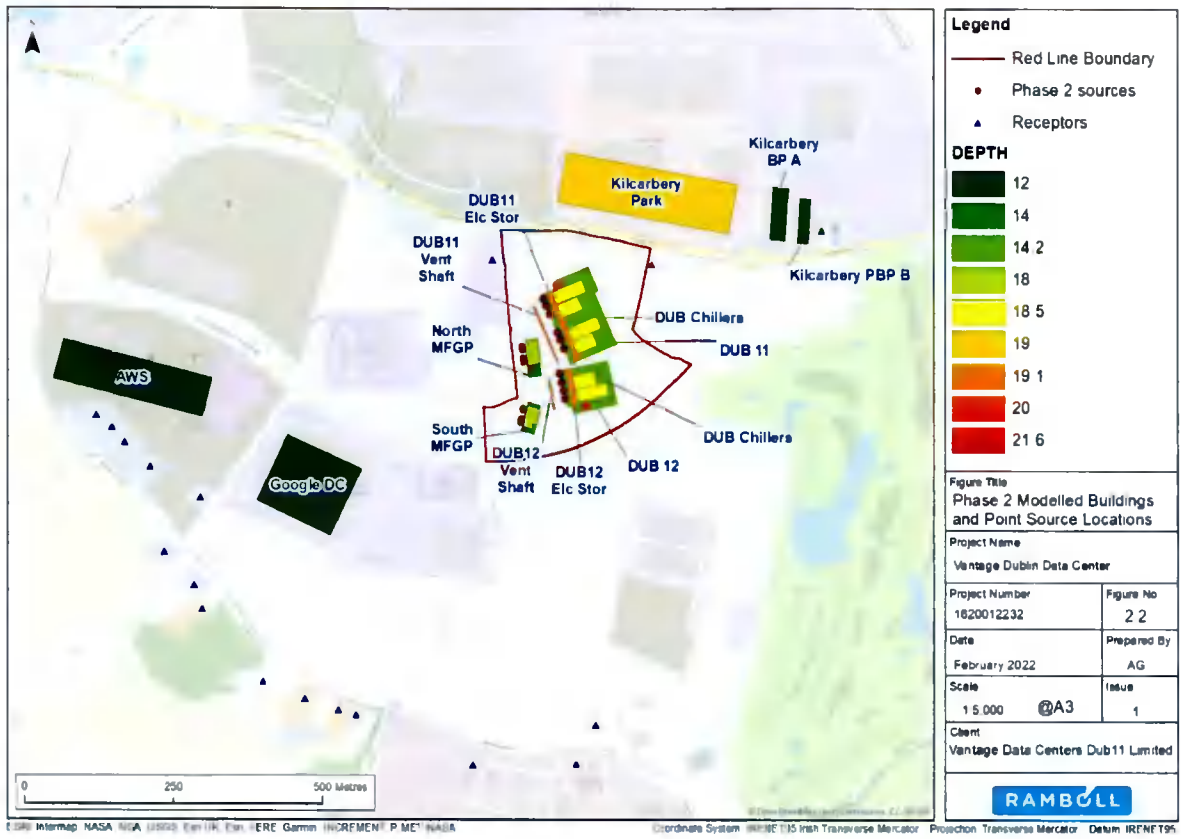


Figure 2.2: Phase 2/Scenario 2 Modelled Buildings and Point Source Locations

2.5 Grid

2.5.1 Concentrations were predicted at three grids. These consist of numerous receptors modelled at a height of 4.5m. The contour plots are centred at the coordinates 703610, 730726 with the spacing as defined in Table 2.3. Contours were modelled at 4.5m height. This was the height which modelled receptors experiences the highest concentration, and represent the second or top floor of a building. full receptor results are shown in Appendix 8.2 in Volume 3.

Table 2.3: Modelled Grids

Outer Grid 5x5 km				
Ref	Start	Finish	No. points	Spacing (m)
x	708610	698610	21	500
y	735726	725726	21	500
z	4.5	4.5	1	
Middle Grid 3x3 km				
x	706610	700610	61	100
y	733726	727726	61	100
z	4.5	4.5	1	
Inner Grid 500x500m				
x	708610	698610	500	20
y	735726	725726	500	20
z	4.5	4.5	1	
Middle Grid 3x3 km				
x	706610	700610	61	100
y	733726	727726	61	100
z	4.5	4.5	1	
Inner Grid 500x500m				
x	708610	698610	500	20
y	735726	725726	500	20
z	4.5	4.5	1	

[5] Caterpillar, 2021. 3,000 ekW, 60 Hz Generator Set: Diesel & HVO Test

2.6 Hypergeometric Distribution Function

Specified generators: air dispersion modelling example short term statistical analysis

2.6.1 The applicant applies for an environmental permit to operate:

- an aggregated diesel specified generator site with a capacity of 40 MWth
- any time of the year for up to a maximum of 400 hours per year

2.6.2 Operations are expected to last up to 4 hours when needed.

Therefore, the operating envelope is all 8760 hours in the year. There are 400 operational hours within the operating envelope.

2.6.3 Dispersion modelling over the full year shows that the Predicted Environmental Concentration (PEC) exceeds the hourly mean limit value of 200mg/m^3 for 300 hours at a sensitive receptor over the worst modelled meteorological year.

2.6.4 This gives:

- 400 operational hours - the sample size denoted by 'N'
- an 8760 hour operating envelope - the population size denoted by 'M'
- 300 exceedance hours - or the number of failures in the population denoted by 'e'
- 8460 non-exceedance hours - the number of successes in the population denoted by 'K', where K = M - e = 8760 - 300 = 8460

2.6.5 The probability of randomly selecting 19 or more exceedance hours (failures) in 400 sample trials, is the same as selecting at most 'N' minus 19 non-exceedance hours (successes) in 400 sample trials (N - 19 = 400 - 19 = 381). The probability of an exceedance, 'P' can be calculated using the cumulative hypergeometric distribution.

$$P = \sum_{i=0}^{N-19} \frac{\binom{K}{i}\binom{M-K}{N-i}}{\binom{M}{N}}$$

2.6.6 Based on these data the cumulative hypergeometric distribution is 9.3%. As the continuous operations can be up to 4 hours, you multiply this probability by 2.5, giving a probability of exceedance of 23.25%. This indicates there is potential for an exceedance of the hourly standard.

2.6.7 The cumulative hypergeometric distribution calculates the probability to be less than 1.8% when there are 330 operational hours. Again multiplying this by the 2.5 factor gives a probability of 4.6%, indicating short term exceedances are unlikely.

2.6.8 Therefore, we would propose to permit the generator and restrict the operational hours to 330 hours per year.

2.7 HVO

Data on HVO NOx emission performance was extracted from a Caterpillar paper[5] describing back-to-back tests performed at Caterpillar's Large Engine Center on a Cat® 3516E, 3,000 ekW, 60 Hz diesel generator set running on diesel and hydrotreated vegetable oil (HVO). The test was not performed in a development/certification test cell, automotive NOx sensors and smoke sensors were installed and

recorded to document changes with the different fuels. The findings of the tests, can be summarized as follows:

For the NOx sensors, a 5% error bar has been added to all measured test points and shows there is no significant difference at high loads. At a 50% load and lower, the HVO shows a NOx reduction of up to approximately 40%. The NOx test results for 12 steady-state points are shown in Figure 7 below.

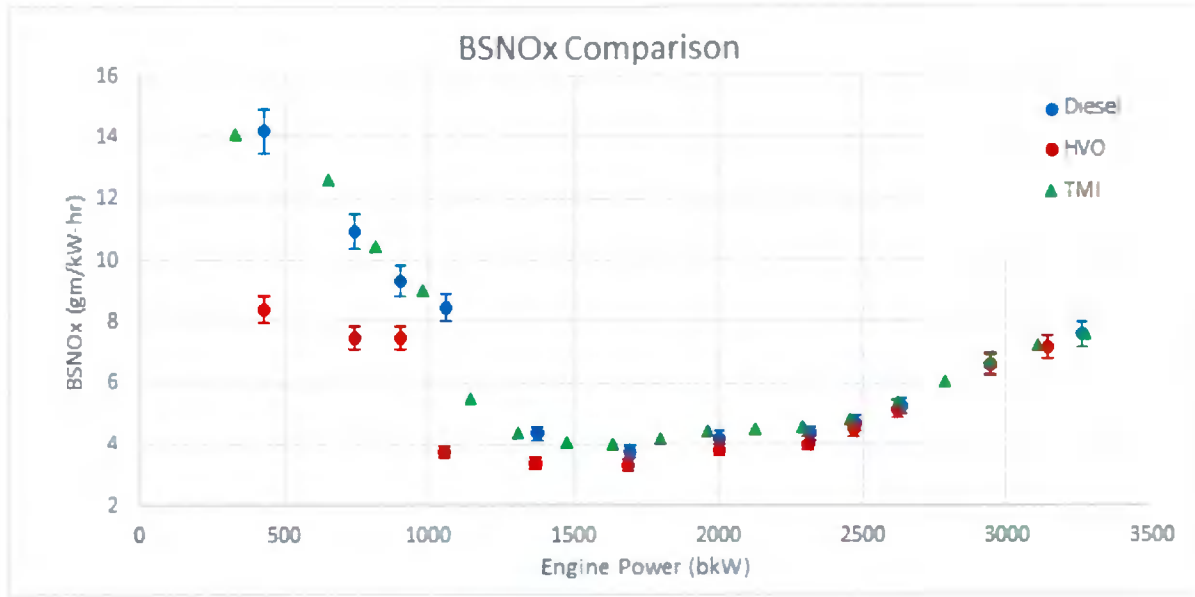


Figure 7

2.8 Cumulative Impacts

2.8.1 Figure 2.3 and 2.4 represent a reproduction of the Microsoft - Grange Castle Business Park, Nangor Road, Clondalkin, Dublin 22, Planning Application reference SD20A/0283[6] contours.

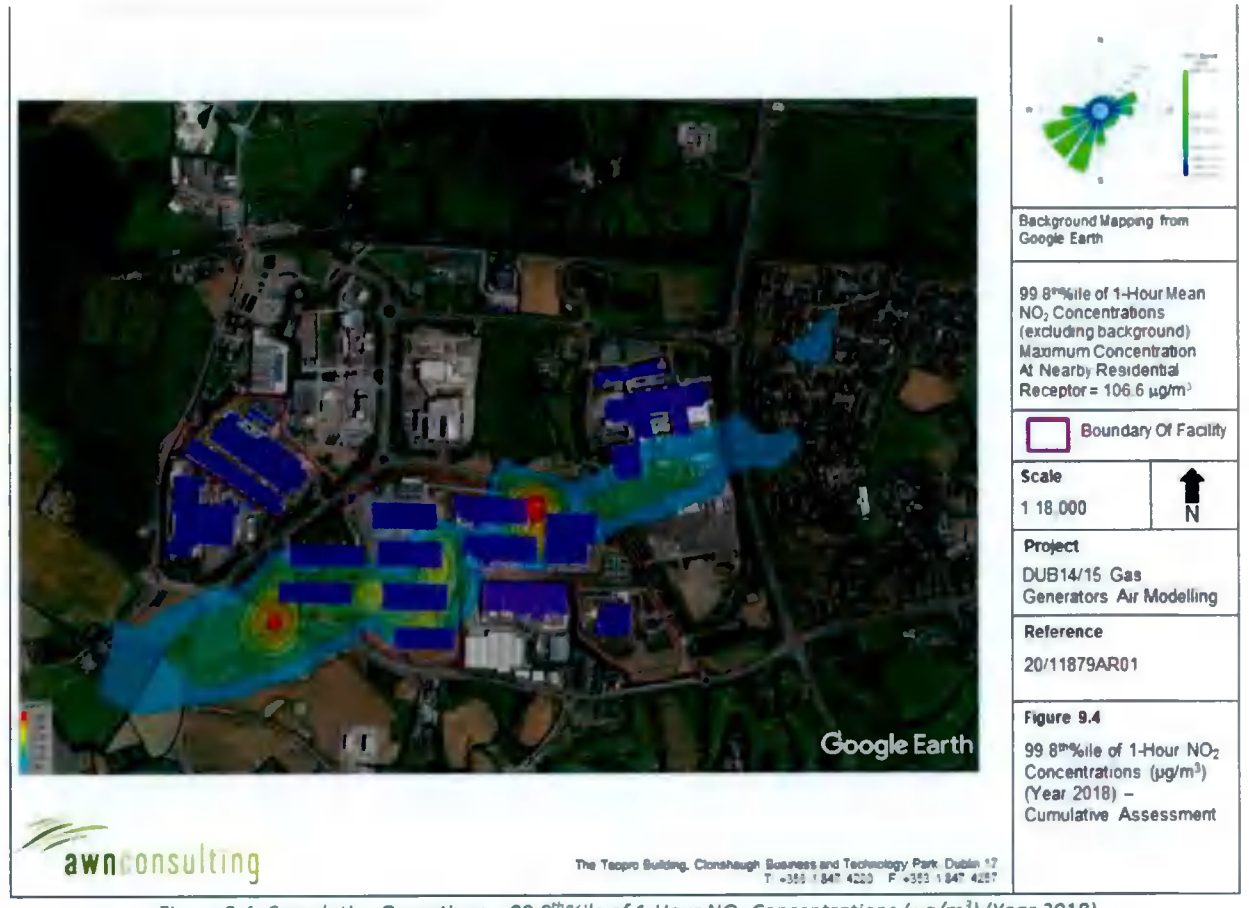


Figure 9.4: Cumulative Operations – 99.8th%ile of 1-Hour NO_2 Concentrations (µg/m³) (Year 2018)

Figure 2.3: Microsoft application 99.8th %ile NO_2 cumulative geographical variations (contours)

2.8.2 Figure 2.5 and 2.6 represent a reproduction of the Centrica Business Solutions Profile Park, Baldonnel, Dublin 22 planning application reference SD21A/0167[7] contours.

[6] South Dublin County Council, 2021. Microsoft, 2020. Microsoft Operations Ireland Ltd Grange Castle Business Park Dub14 & Dub15 Data Centres & Central Administration Building Environmental Impact Assessment Report Volume I Written Statement. Available at: http://www.sdublincoco.ie/Planning/Details?p=1&r=SD20A%2F0283&regref=SD20A%2F0283 [Accessed on 04/08/2021]

[7] South Dublin County Council, 2021. Tobin Consulting Engineers, 2021. Profile Park Power Plant Environmental Impact Assessment report (EIAAR). Available at: http://www.sdublincoco.ie/Planning/Details?p=1&r=SD21A%2F0167&regref=SD21A%2F0167 [Accessed on 04/08/2021

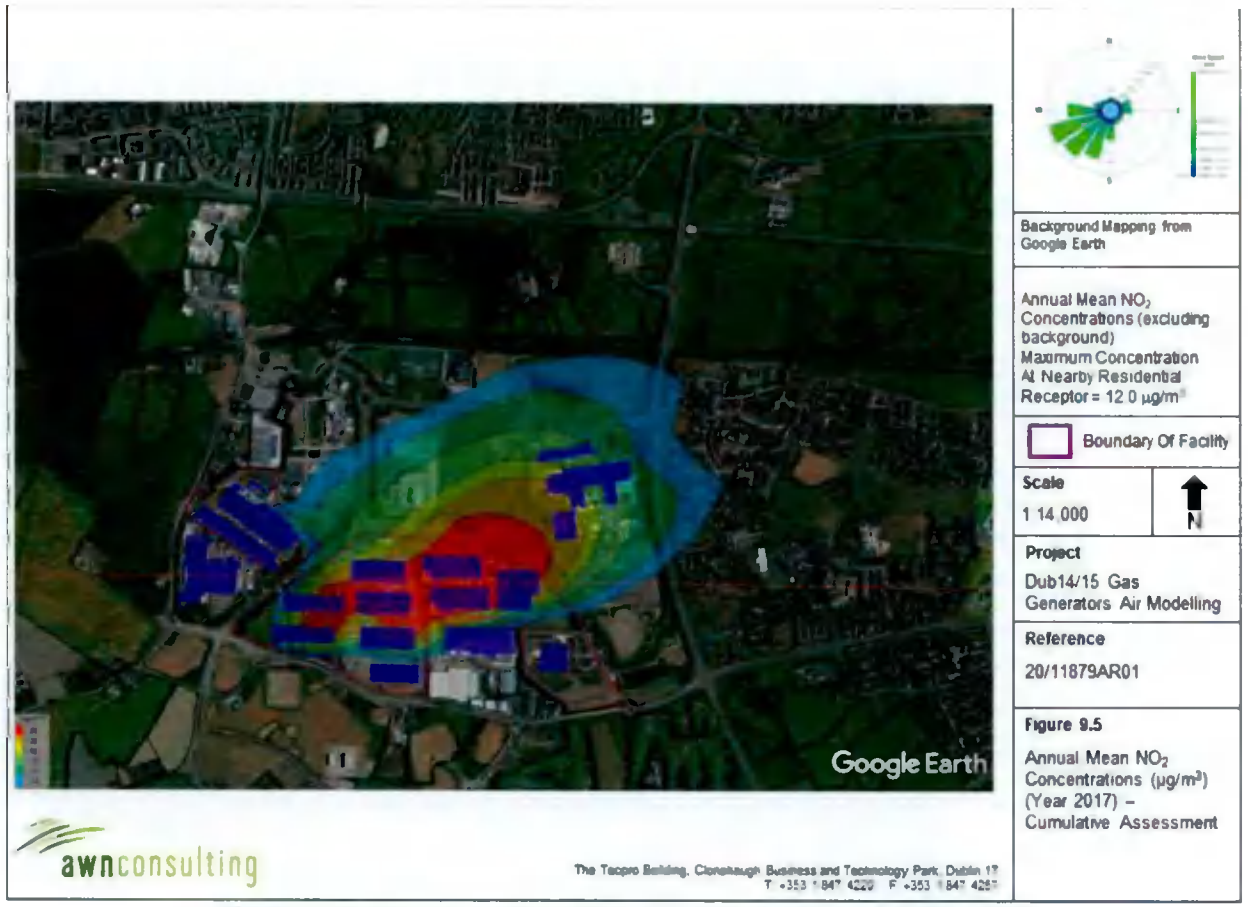


Figure 9.5: Gas Generators – Annual Mean NO_2 Concentrations ($\mu g/m^3$) (Year 2017)

Figure 2.4: Microsoft application annual average NO_2 cumulative geographical variations (contours)

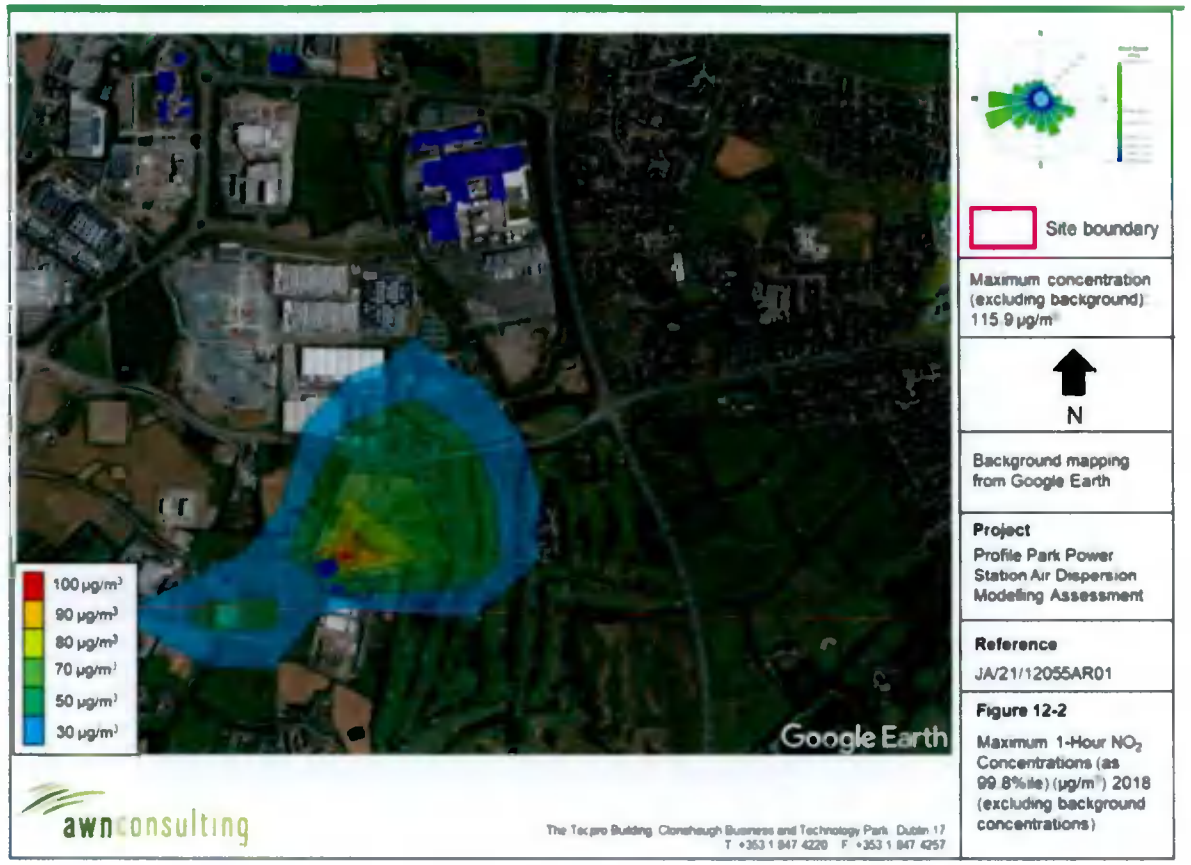


Figure 10-2: Profile Park Power Plant: Predicted NO_2 99.8th Percentile of Hourly Concentrations (2018)

Figure 2.5: Centrica application 99.8th %ile NO_2 cumulative geographical variations (contours)

Figure 10-3: Profile Park Power Plant: Predicted Annual Mean NO_2 Concentrations (2020)

Figure 2.6 Centrica application annual average NO_2 cumulative geographical variations (contours)

Technical Appendix 8.2: Air Quality Results

1. PHASE 1/SCENARIO 1 EMERGENCY GENERATORS MODEL RESULTS

1.1 Scenario 1 DUB11 Emergency Generators

Table 8.2.1: Scenario 1 Emergency Generators Maximum Annual Mean Concentrations for 780 hours Operation

Receptor	Height (m)	NO_2 PC (µg/m³)	PC % AQS	NO_2 Average Background (µg/m³)	Annual Mean PEC (µg/m³)	PEC % AQS	Number Exceeding Hours*	Probability Exceedance for 780h operation
R1	1.5	6.4	16.1	17.4	23.8	59.6	15.4	0.0%
R2	1.5	0.9	2.2	17.4	18.3	45.7	90.6	0.1%
R3	1.5	4.7	11.7	17.4	22.1	55.2	35.2	0.0%
R4	1.5	1.5	3.6	17.4	18.9	47.1	0.0	0.0%
R5	1.5	1.6	4.1	17.4	19.0	47.6	0.0	0.0%
R6	1.5	1.7	4.1	17.4	19.1	47.6	0.0	0.0%
R7	1.5	0.2	0.6	17.4	17.6	44.1	0.0	0.0%
R8	1.5	0.2	0.5	17.4	17.6	44.0	0.0	0.0%
R9	1.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R10	1.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R11	1.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R12	1.5	0.2	0.5	17.4	17.6	44.0	0.0	0.0%
R13	1.5	0.3	0.6	17.4	17.7	44.1	0.0	0.0%
R14	1.5	0.4	1.0	17.4	17.8	44.5	0.0	0.0%
R15	1.5	0.5	1.2	17.4	17.9	44.7	0.0	0.0%
R16	1.5	0.6	1.5	17.4	18.0	45.0	0.0	0.0%
R17	1.5	0.9	2.1	17.4	18.3	45.6	0.0	0.0%
R18	1.5	1.0	2.5	17.4	18.4	46.0	0.0	0.0%
R19	1.5	1.1	2.7	17.4	18.5	46.2	0.0	0.0%
R20	1.5	1.1	2.7	17.4	18.5	46.2	0.0	0.0%
R21	1.5	1.0	2.6	17.4	18.4	46.1	0.0	0.0%
R1	4.5	6.7	16.8	17.4	24.1	60.3	25.7	0.0%
R2	4.5	1.0	2.5	17.4	18.4	46.0	111.0	1.0%
R3	4.5	4.7	11.7	17.4	22.1	55.2	36.2	0.0%
R4	4.5	1.5	3.6	17.4	18.9	47.1	0.0	0.0%
R5	4.5	1.6	4.1	17.4	19.0	47.6	0.0	0.0%
R6	4.5	1.7	4.1	17.4	19.1	47.6	0.0	0.0%
R7	4.5	0.2	0.6	17.4	17.6	44.1	0.0	0.0%
R8	4.5	0.2	0.5	17.4	17.6	44.0	0.0	0.0%
R9	4.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R10	4.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R11	4.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R12	4.5	0.2	0.5	17.4	17.6	44.0	0.0	0.0%
R13	4.5	0.3	0.6	17.4	17.7	44.1	0.0	0.0%
R14	4.5	0.4	1.0	17.4	17.8	44.5	0.0	0.0%
R15	4.5	0.5	1.2	17.4	17.9	44.7	0.0	0.0%
R16	4.5	0.6	1.5	17.4	18.0	45.0	0.0	0.0%
R17	4.5	0.9	2.1	17.4	18.3	45.6	0.0	0.0%
R18	4.5	1.0	2.5	17.4	18.4	46.0	0.0	0.0%
R19	4.5	1.1	2.7	17.4	18.5	46.2	0.0	0.0%
R20	4.5	1.1	2.7	17.4	18.5	46.2	0.0	0.0%
R21	4.5	1.0	2.6	17.4	18.4	46.1	0.0	0.0%
AQS		**40**					-	

PC: process contribution
PEC: predicted environmental concentration (i.e. including background)

2. PHASE 2/SCENARIO 2 EMERGENCY GENERATORS MODEL RESULTS

2.1 Scenario 2 DUB11 and DUB12 Emergency Generators

Table 8.2.2: Scenario 2 and 3 DUB11 and DUB12 Emergency Generators Maximum Annual Mean Concentrations for 82 hours Operation

Receptor	Height (m)	NO_2 PC (µg/m³)	PC % AQS	NO_2 Average Background (µg/m³)	Annual Mean PEC (µg/m³)	PEC % AQS	Number Exceeding Hours*	Probability Exceedance for 82h operation
R1	1.5	1.1	3	17	18.5	46	904.0	0.1%
R2	1.5	0.2	0.4	17.4	17.6	43.9	176.1	0.0%
R3	1.5	0.8	1.9	17.4	18.2	45.4	750.6	0.0%
R4	1.5	0.2	0.6	17.4	17.6	44.1	0.0	0.0%
R5	1.5	0.3	0.6	17.4	17.7	44.1	0.0	0.0%
R6	1.5	0.3	0.7	17.4	17.7	44.2	0.0	0.0%
R7	1.5	0.0	0.1	17.4	17.4	43.6	16.1	0.0%
R8	1.5	0.0	0.1	17.4	17.4	43.6	1.0	0.0%
R9	1.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R10	1.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R11	1.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%

Table 8.2.2: Scenario 2 and 3 DUB11 and DUB12 Emergency Generators Maximum Annual Mean Concentrations for 82 hours Operation

Receptor	Height (m)	NO_2 PC (µg/m³)	PC % AQS	NO_2 Average Background (µg/m³)	Annual Mean PEC (µg/m³)	PEC % AQS	Number Exceeding Hours*	Probability Exceedance for 82h operation
R12	1.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R13	1.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R14	1.5	0.1	0.2	17.4	17.5	43.7	0.0	0.0%
R15	1.5	0.1	0.2	17.4	17.5	43.7	0.0	0.0%
R16	1.5	0.1	0.3	17.4	17.5	43.8	0.0	0.0%
R17	1.5	0.2	0.4	17.4	17.6	43.9	3.0	0.0%
R18	1.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R19	1.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R20	1.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R21	1.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R1	4.5	1.1	2.9	17.4	18.5	46.4	1063.4	0.9%
R2	4.5	0.2	0.4	17.4	17.6	43.9	199.5	0.0%
R3	4.5	0.8	1.9	17.4	18.2	45.4	753.6	0.0%
R4	4.5	0.2	0.6	17.4	17.6	44.1	0.0	0.0%
R5	4.5	0.3	0.6	17.4	17.7	44.1	0.0	0.0%
R6	4.5	0.3	0.7	17.4	17.7	44.2	0.0	0.0%
R7	4.5	0.0	0.1	17.4	17.4	43.6	17.1	0.0%
R8	4.5	0.0	0.1	17.4	17.4	43.6	1.0	0.0%
R9	4.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R10	4.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R11	4.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R12	4.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R13	4.5	0.0	0.1	17.4	17.4	43.6	0.0	0.0%
R14	4.5	0.1	0.2	17.4	17.5	43.7	0.0	0.0%
R15	4.5	0.1	0.2	17.4	17.5	43.7	0.0	0.0%
R16	4.5	0.1	0.3	17.4	17.5	43.8	0.0	0.0%
R17	4.5	0.2	0.4	17.4	17.6	43.9	3.0	0.0%
R18	4.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R19	4.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R20	4.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
R21	4.5	0.2	0.4	17.4	17.6	43.9	0.0	0.0%
AQS		**40**					-	

PC: process contribution
PEC: predicted environmental concentration (i.e. including background)

Technical Appendix 9.1: Glossary of Noise and Vibration Terminology

1. TERMINOLOGY RELATING TO NOISE

Table 1.1: Noise Terminology

Term	Definition
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa ($20x10^{-6}$ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 ($_{s1}/_{s2}$). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the time period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$ or Background Noise Level	A noise level index defined as the noise level exceeded for 90% of the time over the time period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
ree-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 metres
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS5969.
BNL	The Basic Noise Level is the road traffic noise at a reference distance of 10 m from the road edge, expressed in terms of the L_{A10} statistical level (18-hour or one-hour), and calculated according by Calculation of Road Traffic Noise (CRTN) based on the traffic flow.
AAWT	Annual Average Weekday Traffic is the total number of vehicles annually (on Monday – Fridays) divided by the total number of weekdays in this period.
Rating Level ($L_{Ar,Tr}$)	To BS 4142:2014+A1:2019, the rating level is defined as the equivalent continuous A-weighted sound pressure level produced by the specific sound source over a given reference time interval, Tr plus any adjustment for the characteristic features of the sound (tonality, impulsivitys, etc).
NSR	A Noise Sensitive Receiver is any receiver that is classed as being sensitive to noise sources, (residential properties, churches, music studios etc).

Table 1.1: Noise Terminology

Term	Definition
$R_w + C_{tr}$	Weighted Sound Reduction index (R_w) with low frequency sound correction factor (C_{tr}). $R_w + C_{tr}$ is used when increased control of low frequency sound sources is required such as amplified music, and traffic or aircraft noise

2. TERMINOLOGY RELATING TO VIBRATION

Table 2.1: Noise Terminology

Term	Definition
VDV	Vibration Dose Value
Displacement, Acceleration and Velocity Root Mean Square (r.m.s.) and Peak Values Peak Particle Velocity (PPV)	Vibration is an oscillatory motion. The magnitude of vibration can be defined in terms of displacement (how far from the equilibrium position that something moves), velocity (how fast something moves), or acceleration (the rate of change of velocity). When describing vibration, one must specify whether peak values are used (i.e. the maximum displacement or maximum velocity) or r.m.s. / r.m.q. values (effectively an average value) are used. Standards for the assessment of building damage are usually given in terms of peak velocity (usually referred to as Peak Particle Velocity, or PPV), whilst human response to vibration is often described in terms of r.m.s. or r.m.q. acceleration.

Technical Appendix 9.2: Preliminary Construction Noise Assessment

1. PLANT ITEMS AND NOISE LEVELS USED IN THE ASSESSMENT

Table 1.1: Construction Noise Plant and Sound Power Levels Used in Assessment

Activity	Plant	Sound Power Level L_{WA} dB	No. of plant	Overall L_{WA} dB	On-time (% of hour)	Reference
Site enabling works	Wheeled excavator	94	2	97	50	BS 5228 Table C4.no.10
	Dumper	111	2	114	20	BS 5228 Table C.2 ave no.s 30-31
	Loading lorries	106	2	109	10	BS 5228 Table C1. no.7
	Scaffold erection	108	1	108	20	BS 5228 Table C.2 ave no.s 26-28
	Generator	102	1	102	100	BS 5228 Table D.7 no.1
	Electric drills	104	2	107	10	BS 5228 Table C.4 no. 32
	Metal cutter	107	2	110	5	BS 5228 Table D.6 no.54
	Electric bolter	104	2	107	10	BS 5228 Table C.1 no.18
	Road sweeper	104	1	104	10	BS 5228 Table D.6 no.54
	Telescopic handler	102	1	102	20	BS 5228 Table C.4 no.45
Demolition	Dozer	106	1	106	20	BS 5228 Table C.8 no. 6
	Pneumatic breaker	116	2	119	50	BS 5228 Table D.2 ave 7-10
	Excavator (tracked)	110	2	113	50	BS 5228 Table D.3 ave no.s 34-40
	Dumper	101	2	104	33	BS 5228 Table D.7 ave no.s 81-92
	Generator	102	1	102	10	BS 5228 Table C.4 no. 32
Substructure	Excavator (tracked)	110	2	113	50	BS 5228 Table D.3 ave no.s 34-40
	Lorry mounted concrete pump	107	2	110	80	BS 5228 Table D.6 ave no.s 34 & 36
	Dumper	101	2	104	50	BS 5228 Table D.7 ave no.s 81-92

Table 1.1: Construction Noise Plant and Sound Power Levels Used in Assessment

Activity	Plant	Sound Power Level L_{WA} dB	No. of plant	Overall L_{WA} dB	On-time (% of hour)	Reference
	Road sweeper	104	2	107	30	BS 5228 Table C.4 no.90
	Generator	102	1	102	10	BS 5228 Table C.4 no. 32
	Crane	97	1	97	100	BS 5228 Table C.3 ave no.s 28-30
Superstructure	Lorry mounted concrete pump	107	2	110	50	BS 5228 Table D.6 ave no.s 34 & 36
	Crane	106	1	106	50	BS 5228 Table C.4 no. 38
	Generator	102	1	102	100	BS 5228 Table C.4 no. 32
	Electric drills	104	2	107	30	BS 5228 Table D.6 no.54
	Metal cutter	107	2	110	20	BS 5228 Table C.1 no.18
	Electric bolter	104	2	107	20	BS 5228 Table D.6 no.54
	Hydraulic access platforms	95	2	98	70	BS 5228 Table C.4 no. 57
	Road sweeper	104	2	107	10	BS 5228 Table C.4 no.90
Internal works / Fit-out	Generator	102	1	102	100	BS 5228 Table C.4 no. 32
	Welding plant	102	2	105	30	BS 5228 Table C.3 no. 31
	Electric drills	104	3	109	10	BS 5228 Table D.6 no. 54
External works	Generator	102	1	102	100	BS 5228 Table C.4 no. 32
	Excavator (tracked)	110	2	113	50	BS 5228 Table D.3 ave no.s 34-40
	Road sweeper	104	2	107	10	BS 5228 Table C.4 no.90
	Dumper	101	2	104	33	BS 5228 Table D.7 ave no.s 81-92
	Cement mixer truck	105	2	108	10	BS 5228 Table C.4 ave no.s 18 & 20