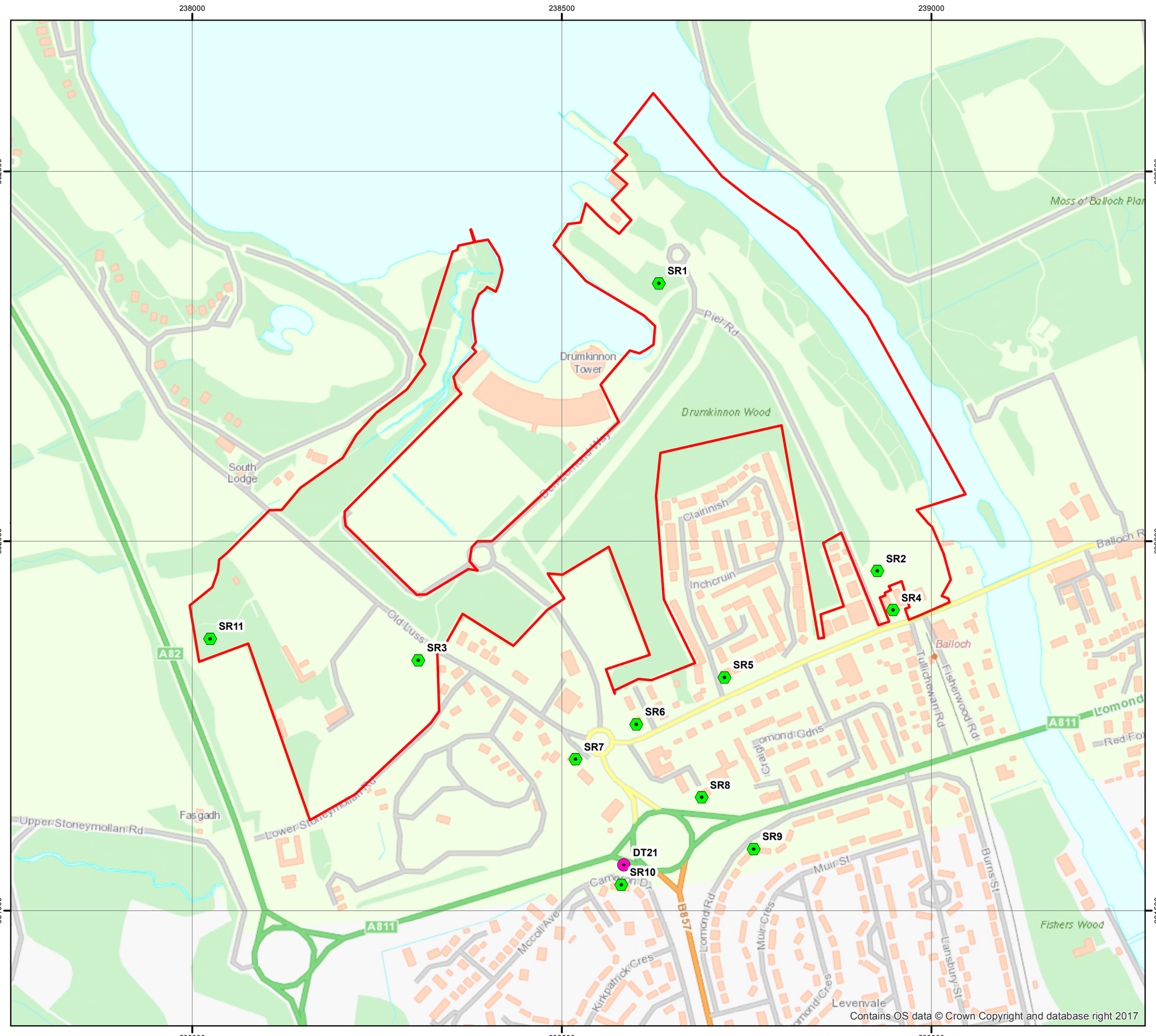
Appendix 9 – Air Quality

Appendix 9.1 – Figures



Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Air Quality Sensitive Receptor Plan

Status
FINAL

Drawing No.
168659 - 007

Revision

Scale
1:5,000

A3

Date
07 June 2017

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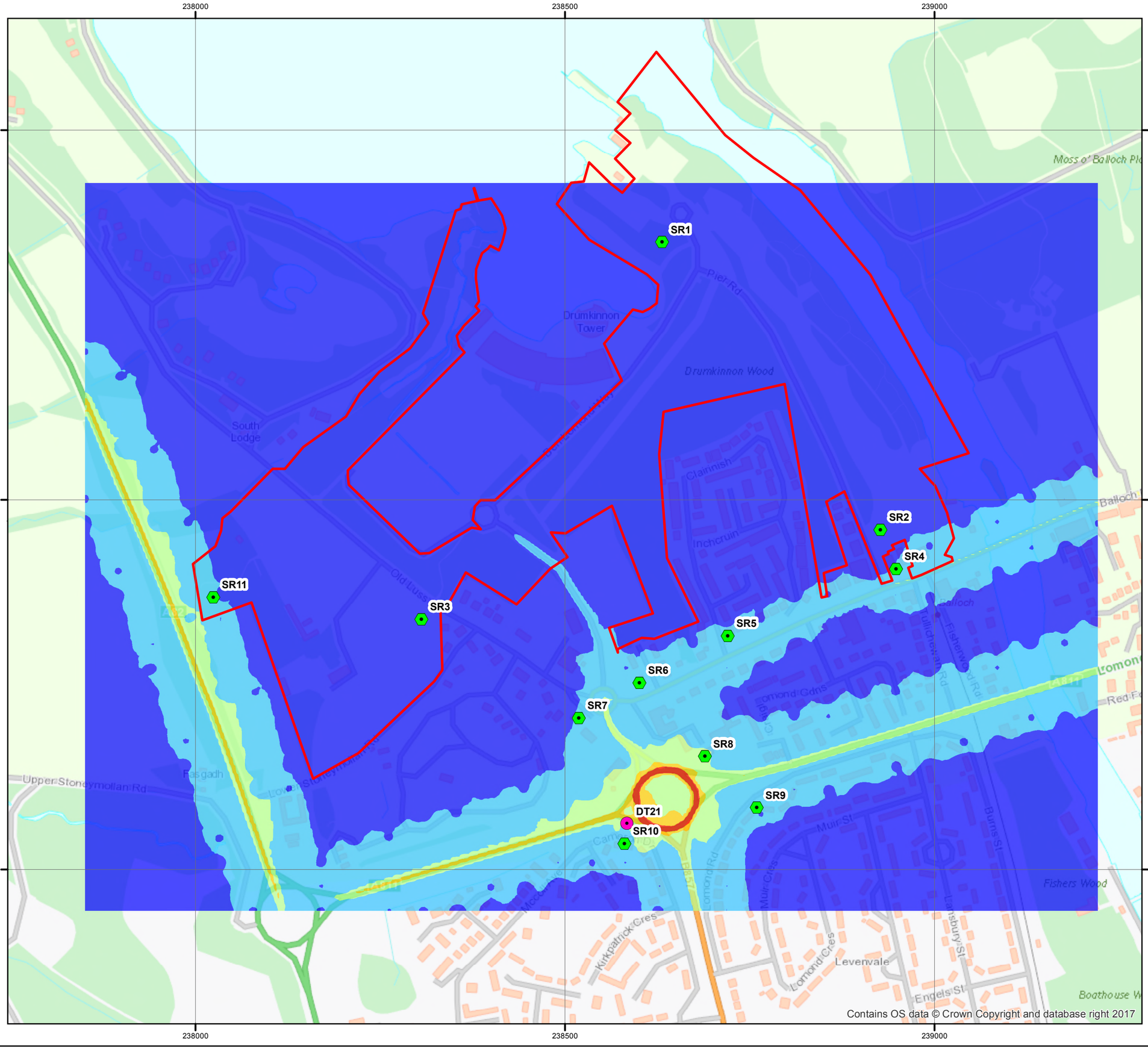

Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

NO2 Concentration (µg/m3)

- <10
- 10 - 20
- 20 - 30
- 30 - 40
- >40

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted N02 Concentrations
2016 Baseline

Status
FINAL

Drawing No.
168659 - 033

Revision

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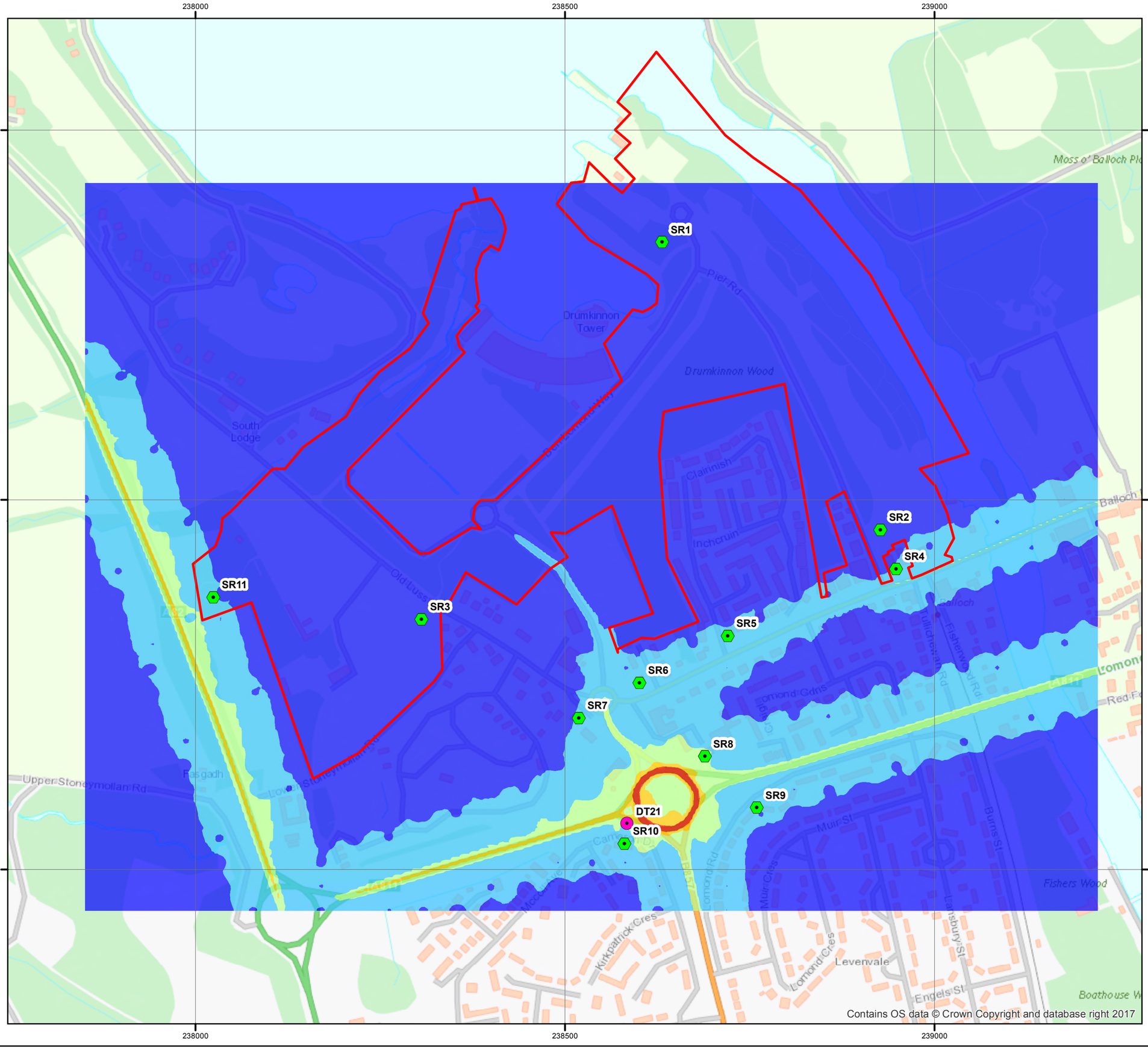

Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

NO2 Concentration (µg/m3)

- <10
- 10 - 20
- 20 - 30
- 30 - 40
- >40

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted N02 Concentrations
2019 Baseline

Status
FINAL

Drawing No.
168659 - 034

Revision

Scale
1:5,000

A3

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Appendix 9.2 – Air Quality Assessment

West Riverside & Woodbank House, Balloch
Air Quality Assessment

April 2018

West Riverside & Woodbank House, Balloch
Air Quality Assessment

Client:	TSL Contractors Limited
Document number:	8098
Project number:	168659
Status:	FINAL
Author:	Bryan Cassidy
Reviewer:	Ann Jobson
Date of issue:	6 April 2018
Filename:	168659_WestRiversideBalloch_AQA

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EXECUTIVE SUMMARY

EnviroCentre Ltd have been commissioned by TSL Contractors Limited to undertake an Air Quality Assessment for a proposed mixed use development at West Riverside & Woodbank House, Balloch, West Dunbartonshire.

The site is located to the north of Balloch, West Dunbartonshire on the southern shores of Loch Lomond at OS grid reference 238500 682000. The proposal for the site is for a tourism and leisure-led mixed used development including but not limited to a hotel, self-catering lodges and housing.

The primary long-term concern in relation to air quality is the emissions generated by traffic and the subsequent impact on the local ambient air quality at residential and public areas located within the vicinity of the main road network. The three main pollutant concentrations of concern from this source are nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$). As such an ADMS-Roads model was utilised to assess the potential for air quality to be impacted at residential areas located within the vicinity of the main road network.

Consultation was carried out with West Dunbartonshire Council Environmental Health during June 2017 during which the scope and methodology of the assessment was confirmed.

The model predicts no significant change in NO_2, PM_{10} or $PM_{2.5}$ concentrations at all Sensitive Receptors on the comparison of the 'with and without' development scenarios.

The impact magnitude for all Sensitive Receptors was categorised as **NEGLIGIBLE** for NO_2, PM_{10} and $PM_{2.5}$.

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Appendices

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Tables

1 INTRODUCTION

EnviroCentre Ltd was commissioned by TSL Contractors Ltd to undertake an Air Quality Assessment for the proposed multipurpose development on the southern shores of Loch Lomond in Balloch, West Dubartonshire; refer to Drawing No. 168659-012 Appendix A for site location.

1.1 Legislative Background

Air quality is protected by national and regional legislation. In the UK, Part IV of the Environment Act 1995 places a statutory duty on local authorities to periodically review and assess the air quality within their area. This involves consideration of present and likely future air quality against air quality standards and objectives. Guidelines of the "Review and Assessment" process of local air quality were published in the 1997 National Air Quality Strategy (NAQS) and associated guidance and technical guidance. In 2000, the Government reviewed the 1997 Strategy and produced a revised Air Quality Strategy for England, Scotland, Wales and Northern Ireland, which resulted in the production of air quality standards and objectives. The most current revision of the Strategy available is dated March 2011 (DEFRA, 2011).

The objectives adopted in Scotland are contained within the Air Quality (Scotland) Regulations 2000 and Air Quality (Scotland) Amendment Regulations 2002 for the purpose of Local Air Quality Management and consolidate the provisions of the previous Air Quality Regulations. The Air Quality Standards (Scotland) Regulations 2010 introduce objectives for Particles (PM_{10}, $PM_{2.5}$), Polycyclic Aromatic Hydrocarbons and lead with the Air Quality (Scotland) Amendment Regulations 2016 amending the Air Quality (Scotland) Regulations 2000 to bring into statute an objective for $PM_{2.5}$.

1.2 Air Quality Standards & Objectives

1.2.1 Air Quality Definitions

Standards for air pollution are concentrations over a given time period that are considered to be acceptable in light of what is known about the effects of each pollutant on health and on the environment. They can also be used as a benchmark to see if air pollution is getting better or worse.

An exceedance of a standard is a period of time (which is defined in each standard) where the concentration is higher than that set down by the standard. In order to make useful comparisons between pollutants, for which the standards may be expressed in terms of different averaging times, the number of days on which an exceedance has been recorded is often reported.

1.2.2 National Air Quality Objectives

Table 1-1 provides a summary of the air quality objectives from the Air Quality (Scotland) Regulations 2000, as amended 2002. An objective is the target date on which exceedances of a standard must not exceed a specified number. The results of air quality modelling will be compared against these objectives.

Table 1-1: Summary of Objectives of the UK Air Quality Strategy

Pollutant	Objective	Measured as	To be achieved by
Benzene (All Authorities)	16.25 µg/m^3	Running Annual Mean	31 December 2003
Benzene (Scotland and Northern Ireland Only)	3.25 µg/m^3	Running Annual Mean	31 December 2010
1,3 Butadiene	2.25 µg/m^3	Running Annual Mean	31 December 2003
Carbon Monoxide (Authorities in Scotland Only)	10.0 µg/m^3	Running 8-Hour Mean	31 December 2003
Lead	0.5 µg/m^3	Annual Mean	31 December 2004
	0.25 µg/m^3	Annual Mean	31 December 2008
Nitrogen Dioxide	200 µg/m^3 Not to be exceeded more than 18 times per year	1 Hour Mean	31 December 2005
	40 µg/m^3	Annual Mean	31 December 2005
Particles (PM_{10}) (gravimetric) All authorities	50 µg/m^3 Not to be exceeded more than 35 times per year	24 Hour Mean	31 December 2004
	40 µg/m^3	Annual Mean	31 December 2004
Particles (PM_{10}) (gravimetric) Scotland Only	50 µg/m^3 Not to be exceeded more than 7 times per year	24 Hour Mean	31 December 2010
	18 µg/m^3	Annual Mean	31 December 2010
Particles ($PM_{2.5}$) (gravimetric)* All authorities	25 µg/m^3 (target)	Annual Mean	2020
	15% cut in urban background exposure	Annual Mean	2010 – 2020
Particles ($PM_{2.5}$) (gravimetric) Scotland Only	10 µg/m^3 (Limit)	Annual Mean	2020
Sulphur Dioxide	350 µg/m^3 not to be exceeded more than 24 times a year	1-Hour Mean	31 December 2004
	125 µg/m^{3}not to be exceeded more than 3 times a year	24 Hour Mean	31 December 2004
	266 µg/m^3 not to be exceeded more than 35 times a year	15-Minute Mean	31 December 2005
PAH *	0.25 ng/m^3	Annual Mean	31 December 2010
Ozone *	100 µg/m^3	8 hourly running or hourly mean *	31 December 2005
* not currently assessed by Scottish Local Authorities			

1.2.3 Air Quality Guidance

LAQM.TG16 and LAQM.PG16

Technical Guidance (LAQM.TG(09)) was issued on behalf of the Department of Environment, Food and Rural Affairs (DEFRA) in February 2009 (DEFRA, 2009a). A Policy Guidance (LAQM.PG09) was also issued at the same time (DEFRA, 2009b). This guidance is designed to guide local authorities through the Review and Assessment process and will also be adhered to for the purpose of the air quality assessment.

DEFRA and The Scottish Government have recently updated LAQM Technical Guidance (LAQM.TG16) (The Scottish Government, 2016). The main change is in the approach with a greater emphasis on action planning to bring forward improvements in air quality and to include local measures as part of EU reporting requirements. The reporting requirements for Local Authorities also changed with the adoption of an Annual Progress Report. Local Authorities continue to appraise pollutant concentrations of Nitrogen Dioxide (NO_2), Particulate Matter (PM_{10}) and Sulphur Dioxide (SO_2). Local Authorities are also required to work towards reducing levels of $PM_{2.5}$.

Land-use Planning & Development Control: Planning for Air Quality

The document "Land-Use Planning & Development Control: Planning for Air Quality" produced by Environmental Protection UK and Institute of Air Quality Management (EPUK & IAQM, 2017) provides guidance on dealing with air quality issues within the development control process. This guidance provides an assessment approach to defining whether the impact on air quality associated with the proposed development should be of material concern.

The methodology used in the change in pollutant concentrations used the change in pollutant concentrations taking into account the air quality objectives to assess the impacts of proposed developments on air quality. It also states that the effects on the residents of a proposed development need to be assessed as significant if the air quality objectives at the façade are not met. The assessed effect can be reduced if provision is made to reduce the exposure.

1.2.4 Air Quality Management Area

The process of review and assessment has raised the profile of air quality assessment as a material planning consideration in development-related projects. For example, where it is known through the review and assessment process that problems in the achievement of air quality standards and objectives exist, the declaration of an Air Quality Management Area (AQMA) can conflict with permissions to develop. That is, the local authority is under a duty to improve air quality within an AQMA due to further breaches of air quality standards and objectives.

West Dunbartonshire Council have not currently declared any AQMA's within their boundary area.

2 DESCRIPTION & POTENTIAL IMPACTS

2.1 Site Location & Proposed Development

The site is located immediately to the north of Balloch, West Dunbartonshire on the southern shores of Loch Lomond at OS grid reference 238500 682000

The proposal for the site is for a tourism and leisure-led mixed used development including:

- Refurbished tourist information building
- 60-bedroom Apart-hotel
- 32-bedspace budget accommodation
- Up to 105 self-catering lodges
- 20 houses
- 900m^2 brewery
- Leisure / pool /water park area up to approximately 2,500m^2
- Restaurants/Cafe & Retail areas up to 1,100m^2 in total
- Visitor reception areas & hub building up to approximately 2,000m^2
- External activity areas including tree top walk, events/ performance areas, children's play areas, monorail, forest adventure rides, picnic / play areas
- Staff and service area of up to approximately 900m^2
- Associated parking (up to 320 additional spaces), landscaping and infrastructure development works
- Access to be taken from the surrounding road network including Ben Lomond Way and Pier Road

2.2 Air Quality Impacts

The primary long-term concern in relation to air quality is the emissions generated by traffic and the subsequent impact on the local ambient air quality at residential areas located within the vicinity of the main road network. The main pollutants of concern from this source are Nitrogen Dioxide and Particulate Matter.

2.3 Consultation

Consultation was undertaken with West Dunbartonshire Council in June 2017 during which the scope and methodology of the assessment was confirmed.

2.4 Assessment Criteria

The document "Land-Use Planning & Development Control: Planning for Air Quality" produced by Environmental Protection UK and Institute of Air Quality Management (EPUK & IAQM, 2017) provides guidance on dealing with air quality issues within the development control process. This guidance provides an assessment approach to defining whether the impact on air quality associated with the proposed development should be of material concern.

The magnitude of the impact is determined by assessing the amount a pollutant concentration at a sensitive receptor is predicted to change on comparison of the 'without development' scenario against the 'with development' scenario (see Table 2-1 for impact descriptors). These criteria will be used for assessment purposes.

Table 2-1: Impact Descriptors for Individual Receptors

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	≤ 1	**2 – 5**	**6 – 10**	**> 10**
≤ 75% of AQAL	Negligible	Negligible	Slight	Moderate
76 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
102 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
≥ 110% of AQAL	Moderate	Substantial	Substantial	Substantial

Explanation

1. AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
2. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5% will be described as Negligible.
3. The Table is only designed to be used with annual mean concentrations.
4. Descriptors for individual receptors only; the overall significance is determined using professional judgement. For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.
5. When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme;' concentration for an increase.
6. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.
7. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

3 ADMS-ROADS DISPERSION MODELLING

The ADMS Dispersion model is approved for use in detailed assessment dispersion modelling studies in technical guidance LAQM.TG16 (DEFRA, 2016). The model has been subject to extensive validation and inter-model comparison studies.

3.1 Assessed Years and Scenarios

The air dispersion modelling exercise considered the impact on future and existing residents in areas where traffic movements will alter. The following scenarios were therefore considered;

- 2016 Baseline;
- 2019 Baseline;
- 2019 Baseline + Development.

3.2 Sensitive Receptors

The development is likely to alter traffic movements on the road network in the vicinity of the site. Therefore the sensitive receptors used in the model were selected due to their proximity to the roads most likely to be subject to traffic increases as a result of the development. The location of each receptor along with the local road network system was input to the air dispersion model using the GIS software ArcMap 10.5 on a digital OS tile of the surrounding area (Refer to Drawing No. 168659- 007 Appendix A for receptor locations). The sensitive receptors used in the model are listed in Table 3-1 below.

Table 3-1: Air Quality Sensitive Receptors

SR I.D	SR Description
1.	Site of proposed boutique hotel
2.	Site of proposed hostel
3.	South Eastern corner of Woodbank site
4.	Anchorage B&B
5.	2 Clairinsh
6.	8 Drumkinnon Road
7.	Arbor Travel Lodge
8.	27 Laudervale Gardens
9.	28 Lomond Road
10.	Cameron Drive
11.	North Western corner of Woodbank site

3.3 Modelled Roads

For local impact assessments the roads included in the calculations should be all those expected to make a significant contribution to pollution at the receptor locations in question. In practise, roads more than 200m away from the receptor can be excluded. Minor roads can also be excluded even when they are closer than 200m to receptors due to their relatively small pollutant contributions. No Industrial sources were modelled.

The road links included in the model are listed below:

- A811;

- Old Luss Rd;
- Ben Lomond Way;
- Balloch Rd;
- Pier Rd;
- A813 Carrochan Rd;
- B857; and
- A82.

Emissions for the road sources were calculated by inputting traffic figures provided by Peter Brett Associates (PBA) for the years 2017 and 2019. The traffic information supplied consisted of Annual Average Daily Traffic (AADT) flows which were then divided by 24 to provide traffic flows per hour, as required by the ADMS-Roads model. The traffic figures from PBA also included values for Light Duty Vehicles (LDV) <3.5t and Heavy Duty Vehicles (HDV) >3.5t.

The figures provided to EnviroCentre were taken from Automatic Traffic Count (ATC) surveys undertaken by PBA in September 2017 specifically for use in this air quality assessment. As agreed with Transport Scotland, the traffic data provided for the 2019 baseline scenario assumed no interim growth from 2017. There were also no committed developments considered within the assessment.

The widths of the roads (calculated using ArcMap 10.5) and all other road input data can be found in Appendix B. The Traffic Distribution by time of day on all roads: 2016 table in the National Statistics of the Department for Transport (2017) Statistic Bulletin was also used to derive a diurnal variation pattern for all roads considered in the assessment, see Table 3-2.

Table 3-2: Diurnal Time Varying Emission Factors

Local Time (Hrs)	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
00:00 – 01:00	0.16	0.15	0.16	0.16	0.18	0.23	0.25
01:00 – 02:00	0.1	0.11	0.12	0.12	0.13	0.16	0.16
02:00 – 03:00	0.09	0.1	0.1	0.11	0.11	0.12	0.11
03:00 – 04:00	0.11	0.12	0.12	0.12	0.13	0.12	0.09
04:00 – 05:00	0.21	0.2	0.2	0.2	0.2	0.15	0.1
05:00 – 06:00	0.53	0.49	0.48	0.47	0.45	0.25	0.15
06:00 – 07:00	1.17	1.18	1.16	1.12	1.04	0.43	0.25
07:00 – 08:00	1.76	1.87	1.86	1.8	1.68	0.67	0.38
08:00 – 09:00	1.76	1.89	1.88	1.82	1.69	0.98	0.56
09:00 – 10:00	1.48	1.54	1.54	1.5	1.45	1.3	0.92
10:00 – 11:00	1.46	1.4	1.42	1.41	1.52	1.58	1.3
11:00 – 12:00	1.5	1.4	1.43	1.44	1.64	1.72	1.54
12:00 – 13:00	1.5	1.42	1.45	1.48	1.72	1.7	1.6
13:00 – 14:00	1.51	1.45	1.49	1.52	1.78	1.61	1.55
14:00 – 15:00	1.56	1.53	1.58	1.62	1.85	1.5	1.52
15:00 – 16:00	1.68	1.71	1.76	1.78	1.96	1.44	1.54
16:00 – 17:00	1.9	1.99	2.02	2.01	2.05	1.42	1.58
17:00 – 18:00	1.93	2.02	2.04	2.01	1.96	1.38	1.46
18:00 – 19:00	1.48	1.57	1.61	1.62	1.63	1.18	1.29
19:00 – 20:00	0.98	1.02	1.08	1.14	1.25	0.9	1.09
20:00 – 21:00	0.69	0.71	0.75	0.81	0.9	0.7	0.9
21:00 – 22:00	0.51	0.53	0.56	0.6	0.65	0.5	0.62
22:00 – 23:00	0.37	0.41	0.42	0.44	0.49	0.43	0.41
23:00 – 00:00	0.23	0.26	0.26	0.28	0.35	0.35	0.26

3.4 Background Air Quality

Background air quality conditions were assessed using data available from Air Quality Scotland (2017) and DEFRA (2017) using the methods set out in LAQM.TG (16). The background concentrations of nitrogen oxides (NO_X), NO_2, PM_{10} and $PM_{2.5}$ are all available for a base year of 2015 and for all other years up to 2030. The concentrations are available in OS 1 kilometre grid squares.

For NO_X, PM_{10} and $PM_{2.5}$ these background pollutant concentrations are split into contributions from various sectors and therefore background levels can be obtained and the risk of "double counting" concentrations can be avoided. Only minor roads were removed during the adjustment process. In order to assume a worst-case assessment scenario no improvement in background concentrations was assumed for the 'future year' scenarios.

The proposed development is located in OS 1 kilometre grid square 238500 681500. The background pollutant concentrations for this square are outlined in Table 3-3 below:

Table 3-3: Development Site Background Air Quality Concentrations (238500 681500)

Year	Pollutant Concentration (µg/m³)							
	NO_2		NO_x		PM_{10}		$PM_{2.5}$	
	Total	Adjusted	Total	Adjusted	Total	Adjusted	Total	Adjusted
2016	7.23	5.30	9.36	6.82	7.60	7.54	4.90	4.85

3.5 Weather Conditions

Meteorology data purchased from ADM Ltd specifically for use in ADMS-Roads was utilised in this assessment. The data was for the year 2016 and was obtained from the nearest meteorological weather station to the site recording a full suite of meteorological parameters, which is located at Glasgow Bishopton.

This weather station has an altitude of 59m and is located in a rural area approximately 11km south-east of the proposed development site. The data provided by the meteorological station was fully ratified and validated for the year 2016 and included all the meteorological parameters required by the model comprising hourly sequential recordings of:

- Surface Temperature;
- Precipitation;
- Wind speed;
- Wind direction;
- Relative humidity; and
- Cloud cover.

The corresponding wind rose for this year is provided in Figure 1. It indicated 3 prominent wind directions: 200-220°, 250-270°, and 300-310°. It also indicates the greatest percentage wind speed lies between 10-16 knots.

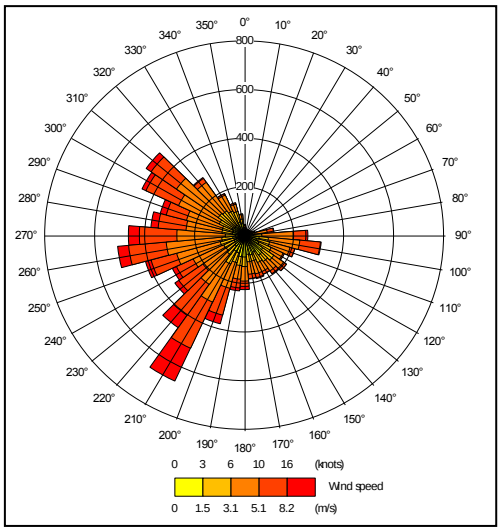


Figure 1: Windrose for 2016 from Bishopton Weather Station

3.6 Model Verification

The model is verified for the year 2016 against the diffusion tube detailed in Table 3-4 below:

Table 3-4: Air Quality Monitoring Location

Site Name	Site Type	OS Grid Reference	Orientation to Site	NO_2 2016 Annual Mean Concentration ($\mu g/m^3$)
DT21 (Balloch 1)	Urban Traffic	238584 681562	South West	19.6

3.7 Additional Input Data

Additional input data was confirmed through a validation process designed to result in a model which most closely represented conditions at the existing monitoring locations and therefore gave a conservative indication of the pollutant concentrations the assessed sensitive receptors would be exposed to. The following additional input data were therefore utilised in the model:

The chemical reaction scheme option was utilised in the assessment so that the model took into account photochemical reactions between NO, NO_2 and O_3.

As no background concentration for West Dunbartonshire could be obtained the model was run using the 2016 annual average O_3 concentration for Glasgow Waulkmillglen Reservoir (classed as rural). The respective value is 49$\mu g/m^3$.

A surface roughness length is used in the dispersion modelling study to characterise the land use of the surrounding area in terms of frictional effect that will occur due to the interaction of wind with the surface; this is a key component in the generation of atmospheric turbulence, which influences dispersion. A surface roughness length of 0.5 was used to characterise the proposed development site which is representative of Parkland, open suburbia. A surface roughness of 0.3 was used to characterise the meteorological site. This is representative of agricultural areas (max).

A minimum Monin-Obukhov length is used in the dispersion model to represent the effects of buoyancy on turbulent flows as a result of the surface temperature and mechanical mixing in the lower atmosphere. The minimum Monin-Obukhov length used for both the proposed development and dispersion sites was 10m which is considered representative of small towns <50,000 residents.

No improvement in emission factors was assumed for the 'future year' scenarios in order to provide a 'worst case' assessment scenario.

Both gridded and specified points output were selected in the model so that emissions could be displayed as both contour plots and as values at particular sensitive receptors in the surrounding area. For a full list of the sensitive receptors refer to Section 3.2.

The annual average concentrations of NO_2, PM_{10} and $PM_{2.5}$ were modelled in this assessment.

4 MODELLED RESULTS

4.1 Model Validation

The model was validated against the measured NO_2 concentration as detailed in Table 3-4 above. Table 4-1 below details the percentage difference of the concentration measured at the monitoring location and the concentrations predicted by the ADMS-Roads model.

Table 4-1: Measured and Modelled NO_2 Concentration for 2016

Site ID	Site Type	Measured Concentration (µg/m³)	Modelled Concentration (µg/m³)	% Difference [(modelled-measured)/measured]*
DT21	Urban Traffic	19.6	21.02	7.24

Note: *Positive numbers indicate an over prediction and negative numbers an under prediction by the model

Table 4-1 shows that the model proved to be a good representation of NO_2 concentrations at the monitoring location. The model resulted in an over prediction of 7.24 at the monitoring location and therefore, in accordance with LAQM.TG16 (DEFRA, 2016) no adjustment factor need be applied as the modelled results are within 10% of the measured results.

4.2 Model Results

The following sections detail the modelled results for each of the investigated scenarios for the pollutants NO_2, PM_{10} and $PM_{2.5}$.

4.2.1 2016 Baseline Results

Table 4-2 below summarises the results from the ADMS-Roads model for the '2016 Baseline' scenario for NO_2, PM_{10} and $PM_{2.5}$.

Table 4-2: 2016 Baseline Results

ID	Receptor Description	Pollutant Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
SR1	Site of proposed boutique hotel	5.86	7.63	4.90
SR2	Site of proposed hostel	7.39	7.85	5.04
SR3	South Eastern corner of Woodbank site	6.85	7.79	5.00
SR4	Anchorage B&B	10.32	8.26	5.28
SR5	2 Clairinsh	8.94	8.12	5.20
SR6	8 Drumkinnon Road	10.99	8.46	5.40
SR7	Arbor Travel Lodge	9.79	8.26	5.28
SR8	27 Laudervale Gardens	15.91	9.27	5.88
SR9	28 Lomond Road	10.35	8.35	5.33
SR10	Cameron Drive	12.06	8.62	5.50
SR11	North Western corner of Woodbank site	9.91	8.36	5.34
DT21	Diffusion Tube – Balloch 1	21.02	10.14	6.40

The predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all Sensitive Receptors were found to meet the relevant Air Quality Objectives of 40, 18 and 10 µg/m^3 respectively.

4.2.2 2019 Baseline

Table 4-3 summarises the results from the ADMS-Roads model for the '2019 Baseline' scenario for NO_2, PM_{10} and $PM_{2.5}$.

Table 4-3: 2019 Baseline Results

ID	Receptor Description	Pollutant Concentration (µg/m^3)		
		NO_2	PM_{10}	$PM_{2.5}$
SR1	Site of proposed boutique hotel	5.86	7.63	4.90
SR2	Site of proposed hostel	7.39	7.85	5.04
SR3	South Eastern corner of Woodbank site	6.85	7.79	5.00
SR4	Anchorage B&B	10.32	8.26	5.28
SR5	2 Clairinsh	8.94	8.12	5.20
SR6	8 Drumkinnon Road	10.99	8.46	5.40
SR7	Arbor Travel Lodge	9.79	8.26	5.28
SR8	27 Laudervale Gardens	15.91	9.27	5.88
SR9	28 Lomond Road	10.35	8.35	5.33
SR10	Cameron Drive	12.06	8.62	5.50
SR11	North Western corner of Woodbank site	9.91	8.36	5.34
DT21	Diffusion Tube – Balloch 1	21.02	10.14	6.40

As with the '2016 Baseline' scenario, the predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all Sensitive Receptors were found to meet the relevant Air Quality Objectives of 40, 18 & 10µg/m^3 respectively.

4.2.3 2019 Baseline + Development

Table 4-4 summarises the results from the ADMS-Roads model for the '2019 Baseline + Development' scenario.

Table 4-4: 2019 Baseline + Development Results

ID	Receptor Description	Pollutant Concentration (µg/m^3)		
		NO_2	PM_{10}	$PM_{2.5}$
SR1	Site of proposed boutique hotel	5.9	7.63	4.91
SR2	Site of proposed hostel	7.67	7.89	5.06
SR3	South Eastern corner of Woodbank site	7.02	7.82	5.01
SR4	Anchorage B&B	10.79	8.33	5.32
SR5	2 Clairinsh	9.17	8.16	5.22
SR6	8 Drumkinnon Road	11.48	8.54	5.44
SR7	Arbor Travel Lodge	10.29	8.34	5.33
SR8	27 Laudervale Gardens	16.49	9.37	5.94
SR9	28 Lomond Road	10.6	8.39	5.35

ID	Receptor Description	Pollutant Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
SR10	Cameron Drive	12.58	8.71	5.55
SR11	North Western corner of Woodbank site	10.07	8.39	5.36
DT21	Diffusion Tube – Balloch 1	22.18	10.35	6.52

As with the previous two scenarios, the predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all Sensitive Receptors were found to meet the relevant Air Quality Objectives of 40, 18 & 10µg/m³ respectively.

5 AIR QUALITY ASSESSMENT

5.1 Assessment of Impacts

The predicted pollutant concentrations for the 2019 scenarios were assessed against the criteria provided in Table 2-1, Section 2.4 of this document.

5.1.1 NO_2 Assessment

The percentage of the objective level and the impact descriptors for the predicted NO_2 concentrations as a result of the development for each sensitive receptor are provided in Table 5-1 below.

Table 5-1: NO_2 Percentage of Objective Level & Impact Magnitude

ID	Receptor Description	2019 Baseline + Committed (% of objective)	2019 Baseline + Committed +Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR1	Site of proposed boutique hotel	15	15	0	Negligible
SR2	Site of proposed hostel	18	19	1	Negligible
SR3	South Eastern corner of Woodbank site	17	18	1	Negligible
SR4	Anchorage B&B	26	27	1	Negligible
SR5	2 Clairinsh	22	23	1	Negligible
SR6	8 Drumkinnon Road	27	29	2	Negligible
SR7	Arbor Travel Lodge	24	26	2	Negligible
SR8	27 Laudervale Gardens	40	41	1	Negligible
SR9	28 Lomond Road	26	27	1	Negligible
SR10	Cameron Drive	30	31	1	Negligible
SR11	North Western corner of Woodbank site	25	25	0	Negligible
DT21	Diffusion Tube – Balloch 1	53	55	2	Negligible

The assessment concludes that in relation to NO_2 the impact of the development is considered to be **Negligible** for all of the assessed Sensitive Receptors.

5.1.2 PM_{10} Assessment

The percentage of the objective level and the impact descriptors for the predicted PM_{10} concentrations as a result of the development for each sensitive receptor are provided in Table 5-2 below.

Table 5-2: PM_{10} Percentage of Objective Level & Impact Magnitude

ID	Receptor Description	2019 Baseline + Committed (% of objective)	2019 Baseline + Committed +Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR1	Site of proposed boutique hotel	42	42	0	Negligible
SR2	Site of proposed hostel	44	44	0	Negligible
SR3	South Eastern corner of Woodbank site	43	43	0	Negligible
SR4	Anchorage B&B	46	46	0	Negligible
SR5	2 Clairinsh	45	45	0	Negligible
SR6	8 Drumkinnon Road	47	47	0	Negligible
SR7	Arbor Travel Lodge	46	46	0	Negligible
SR8	27 Laudervale Gardens	51	52	1	Negligible
SR9	28 Lomond Road	46	47	1	Negligible
SR10	Cameron Drive	48	48	0	Negligible
SR11	North Western corner of Woodbank site	46	47	1	Negligible
DT21	Diffusion Tube – Balloch 1	56	58	2	Negligible

The assessment concludes that in relation to PM_{10} the impact of the development is considered to be **Negligible** for all of the assessed Sensitive Receptors.

5.1.3 $PM_{2.5}$ Assessment

The percentage of the objective level and the impact descriptors for the predicted $PM_{2.5}$ concentrations as a result of the development for each Sensitive Receptor are provided in Table 5-3 below.

Table 5-3: $PM_{2.5}$ Percentage of Objective Level & Impact Magnitude

ID	Receptor Description	2019 Baseline + Committed (% of objective)	2019 Baseline + Committed +Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR1	Site of proposed boutique hotel	49	49	0	Negligible
SR2	Site of proposed hostel	50	51	1	Negligible
SR3	South Eastern corner of Woodbank site	50	50	0	Negligible
SR4	Anchorage B&B	53	53	0	Negligible
SR5	2 Clairinsh	52	52	0	Negligible
SR6	8 Drumkinnon Road	54	54	0	Negligible
SR7	Arbor Travel Lodge	53	53	0	Negligible
SR8	27 Laudervale Gardens	59	59	0	Negligible
SR9	28 Lomond Road	53	54	1	Negligible
SR10	Cameron Drive	55	55	0	Negligible

ID	Receptor Description	2019 Baseline + Committed (% of objective)	2019 Baseline + Committed +Development (% of objective)	Difference (% of objective)	Impact Magnitude
SR11	North Western corner of Woodbank site	53	54	1	Negligible
DT21	Diffusion Tube – Balloch 1	64	65	1	Negligible

The assessment concludes that in relation to $PM_{2.5}$ the impact of the development is considered to be **Negligible** for all of the assessed Sensitive Receptors.

5.2 Conclusions

An air quality assessment was undertaken using an ADMS-Roads air quality model to investigate if there was potential for traffic emissions to impact sensitive receptors in the vicinity of the road network surrounding the development site as a result of the proposed development.

The model predicts no significant change in NO_2, PM_{10} or $PM_{2.5}$ concentrations at all Sensitive Receptors on comparison of the 'with and without' development scenarios. The impact magnitude for all Sensitive Receptors was categorised as **Negligible** for NO_2, PM_{10} or $PM_{2.5}$.

In view of the above, no significant air quality impact is predicted on future or existing residents as a result of the development.

REFERENCES

Air Quality In Scotland (2017, January). Data for Local Authority Review and Assessment purposes. Air Quality in Scotland. Retrieved from http://www.scottishairquality.co.uk/data/mapping?view=data

DEFRA (2009a). Local Air Quality Management; Technical Guidance (TG09) (No. LAQM.TG(09)). London: Department for Environment, Food and Rural Affairs.

DEFRA (2009b). Local Air Quality Management; Policy Guidance (PG09) (No. LAQM.PG(09)). London: Department for Environment, Food and Rural Affairs.

DEFRA (2011). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 2). Norwich: Department for Environment, Food and Rural Affairs.

DEFRA (2016). Local Air Quality Management - Technical Guidance (TG16). London: DEFRA.

Department For Transport (2017, May). Traffic distribution on all roads by time of day in Great Britain, annual from 2006. Department For Transport. Retrieved from https://www.gov.uk/government/collections/road-traffic-statistics

West Dunbartonshire Council (2017) 2017 Air Quality Progress Report (APR) for West Dunbartonshire Council. West Dunbartonshire Council (June 2017).

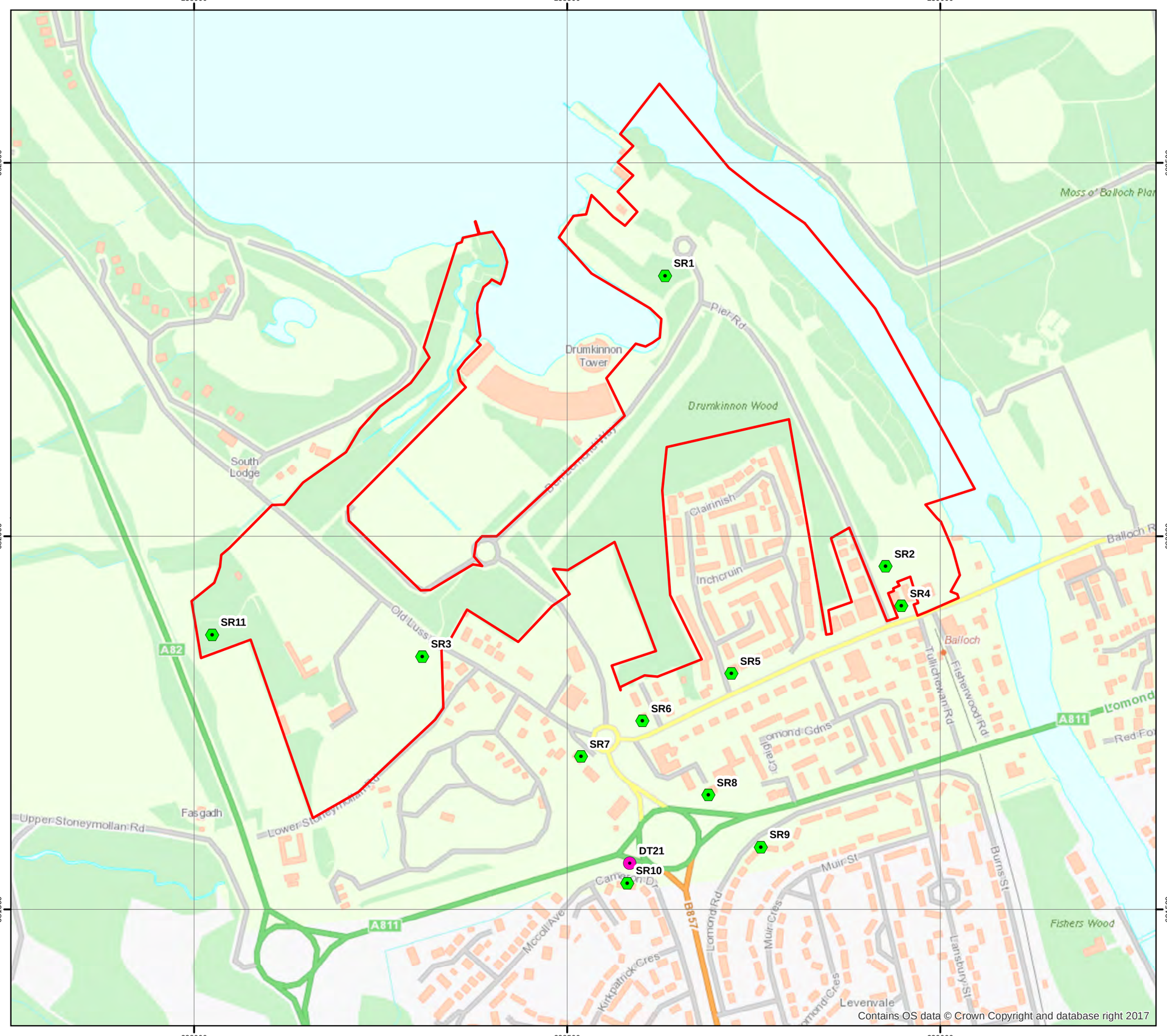
EPUK, & IAQM (2015). Land-Use Planning & Development Control: Planning For Air Quality. London: Environmental Protection UK and Institute of Air Quality Management

EPUK, & IAQM (2017). Land-Use Planning & Development Control: Planning For Air Quality. London: Environmental Protection UK and Institute of Air Quality Management

The Scottish Government (2016). Part IV of the Environment Act 1995, Local Air Quality Management, Policy Guidance, PG(S) (16). The Scottish Government.

APPENDICES

A DRAWINGS



Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Air Quality Sensitive Receptor Plan

Status
FINAL

Drawing No.
168659 - 007

Revision

Scale
1:5,000

A3

Date
07 June 2017

Drawn	Checked	Approved
BC	EC	IB

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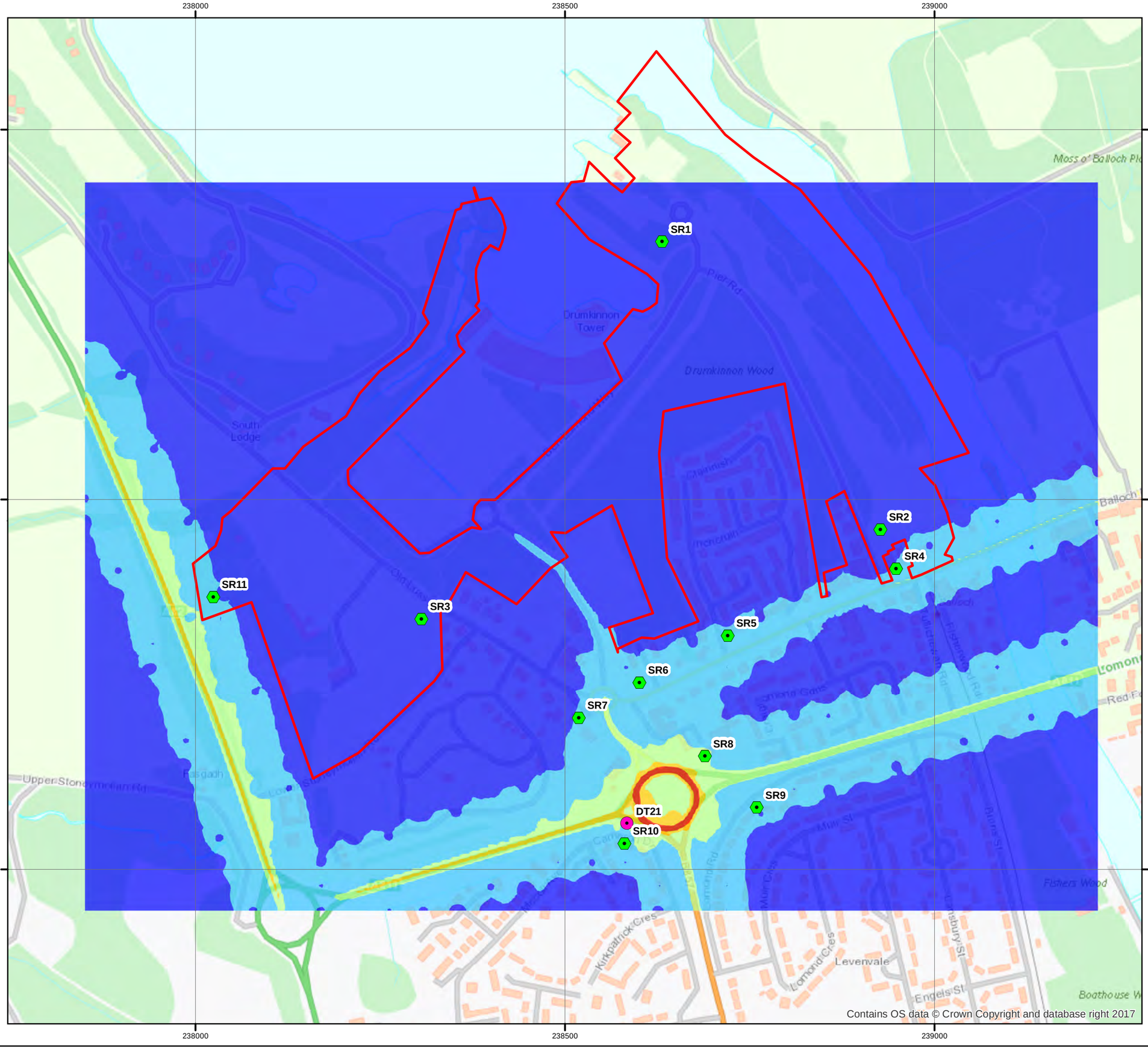

Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

NO2 Concentration (µg/m3)

- <10
- 10 - 20
- 20 - 30
- 30 - 40
- >40

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted N02 Concentrations
2016 Baseline

Status
FINAL

Drawing No.
168659 - 033

Revision

Scale
1:5,000

A3

Date
29 March 2017

Drawn	Checked	Approved
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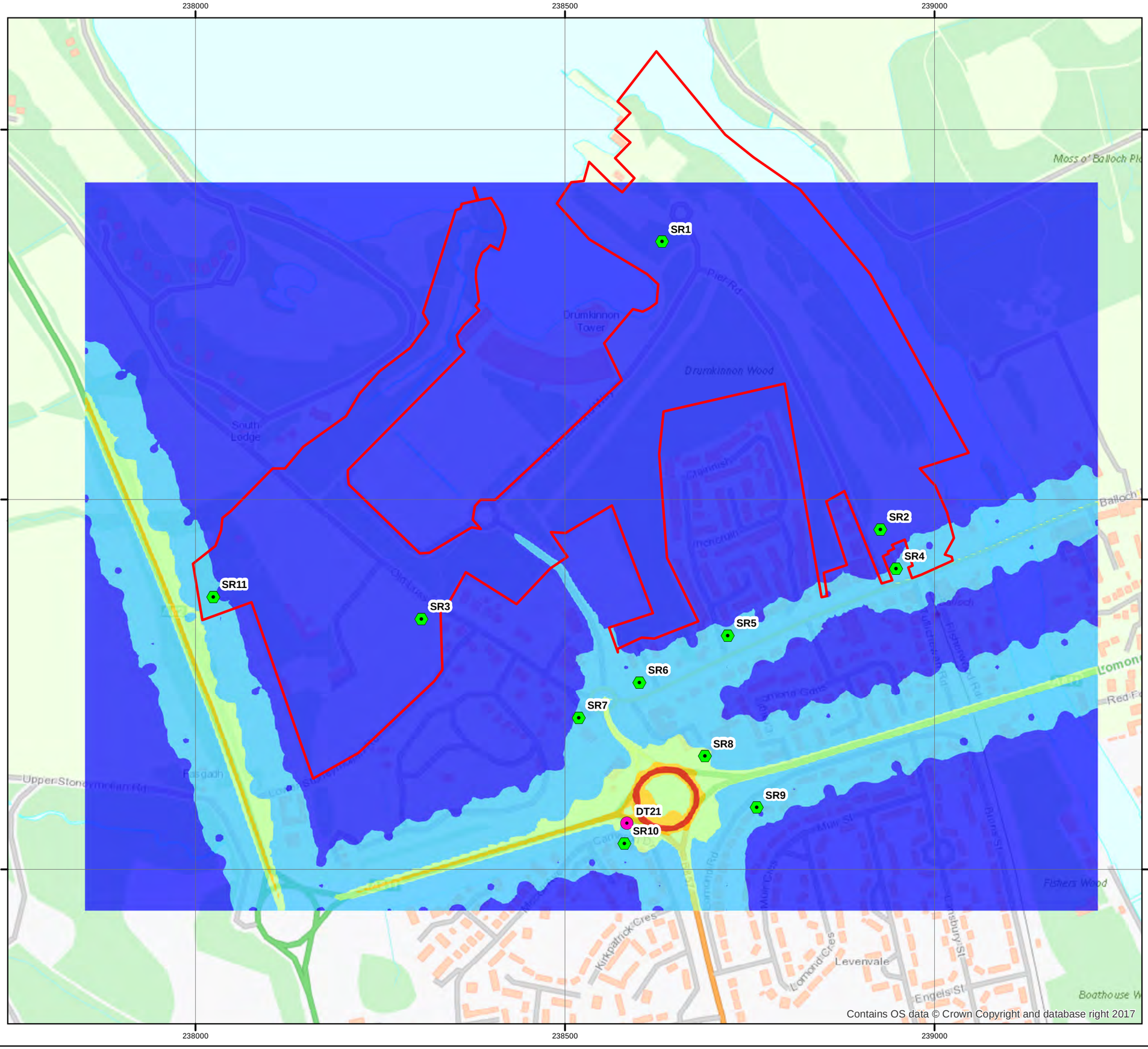

Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

NO2 Concentration (µg/m3)

- <10
- 10 - 20
- 20 - 30
- 30 - 40
- >40

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted N02 Concentrations
2019 Baseline

Status
FINAL

Drawing No.
168659 - 034

Revision

Scale
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A3

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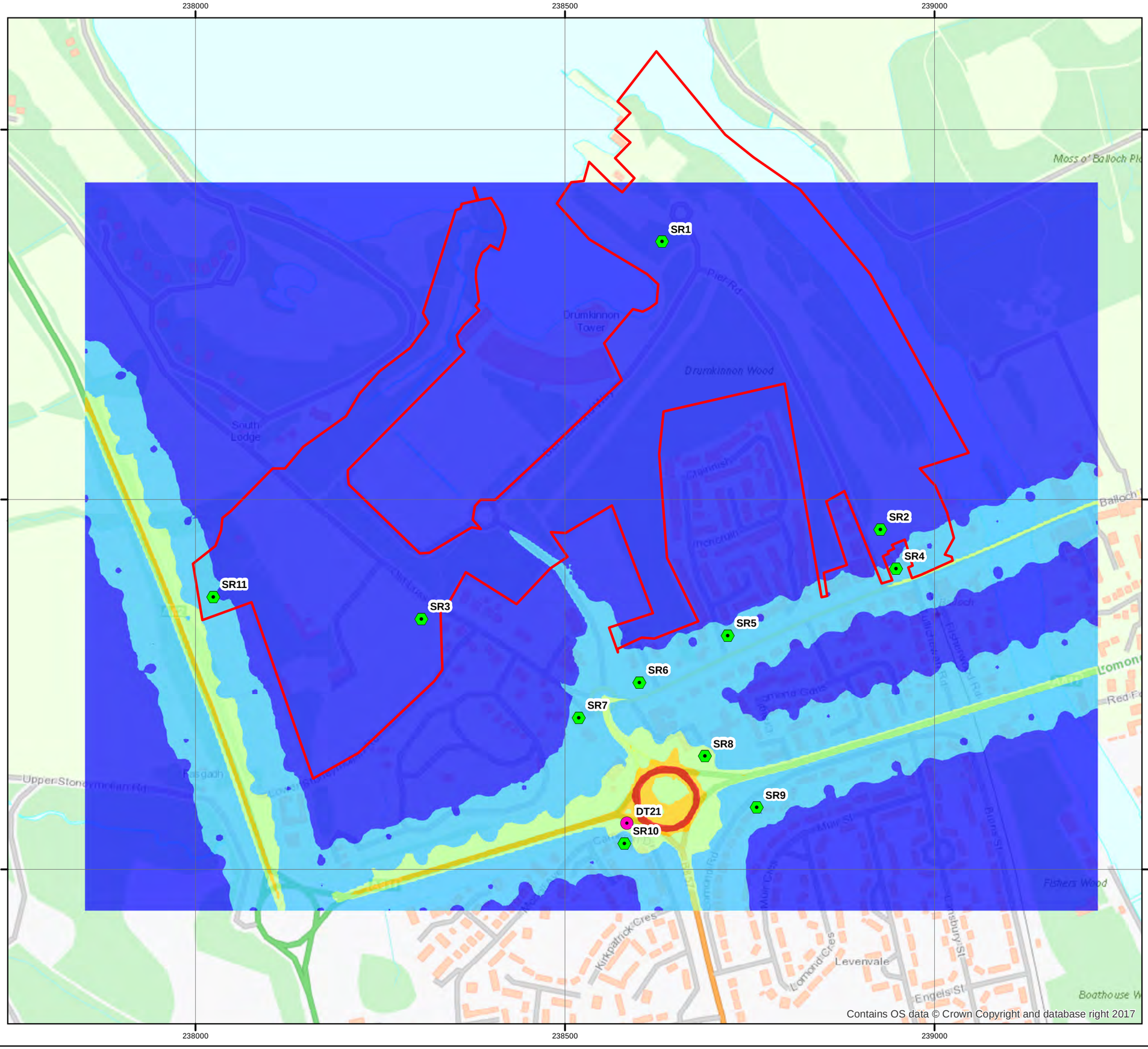

Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

NO2 Concentration (µg/m3)

- <10
- 10 - 20
- 20 - 30
- 30 - 40
- >40

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted N02 Concentrations
2019 Baseline + Development

Status
FINAL

Drawing No.
168659 - 035

Revision

Scale
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A3

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29 March 2017

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Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

PM10 Concentration (µg/m3)

- <9
- 9 - 11
- 11 - 13
- 13 - 15
- >15

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted PM10 Concentrations
2016 Baseline

Status
FINAL

Drawing No.
168659 - 036

Revision

Scale
1:5,000

A3

Date
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Drawn	Checked	Approved
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Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

PM10 Concentration (µg/m3)

- <9
- 9 - 11
- 11 - 13
- 13 - 15
- >15

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted PM10 Concentrations
2019 Baseline

Status
FINAL

Drawing No.
168659 - 037

Revision

Scale
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A3

Date
29 March 2017

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Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

PM10 Concentration (µg/m3)

- <9
- 9 - 11
- 11 - 13
- 13 - 15
- >15

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted PM10 Concentrations
2019 Baseline + Development

Status
FINAL

Drawing No.
168659 - 038

Revision

Scale
1:5,000

A3

Date
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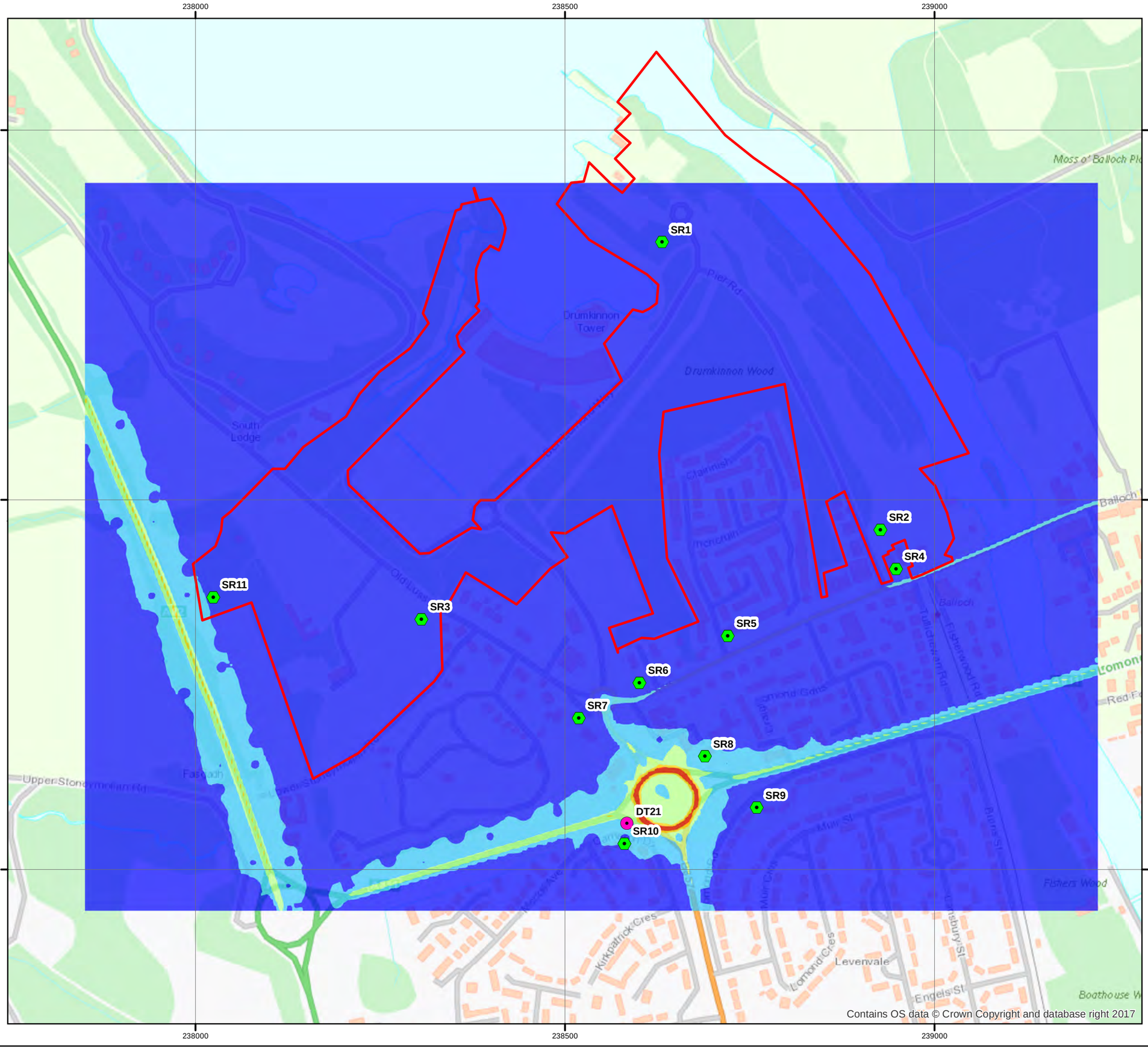

Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

PM2.5 Concentration (µg/m3)

- <6
- 6 - 7
- 7 - 8
- 8 - 9
- >9

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted PM2.5 Concentrations
2016 Baseline

Status
FINAL

Drawing No.
168659 - 039

Revision

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A3

Date
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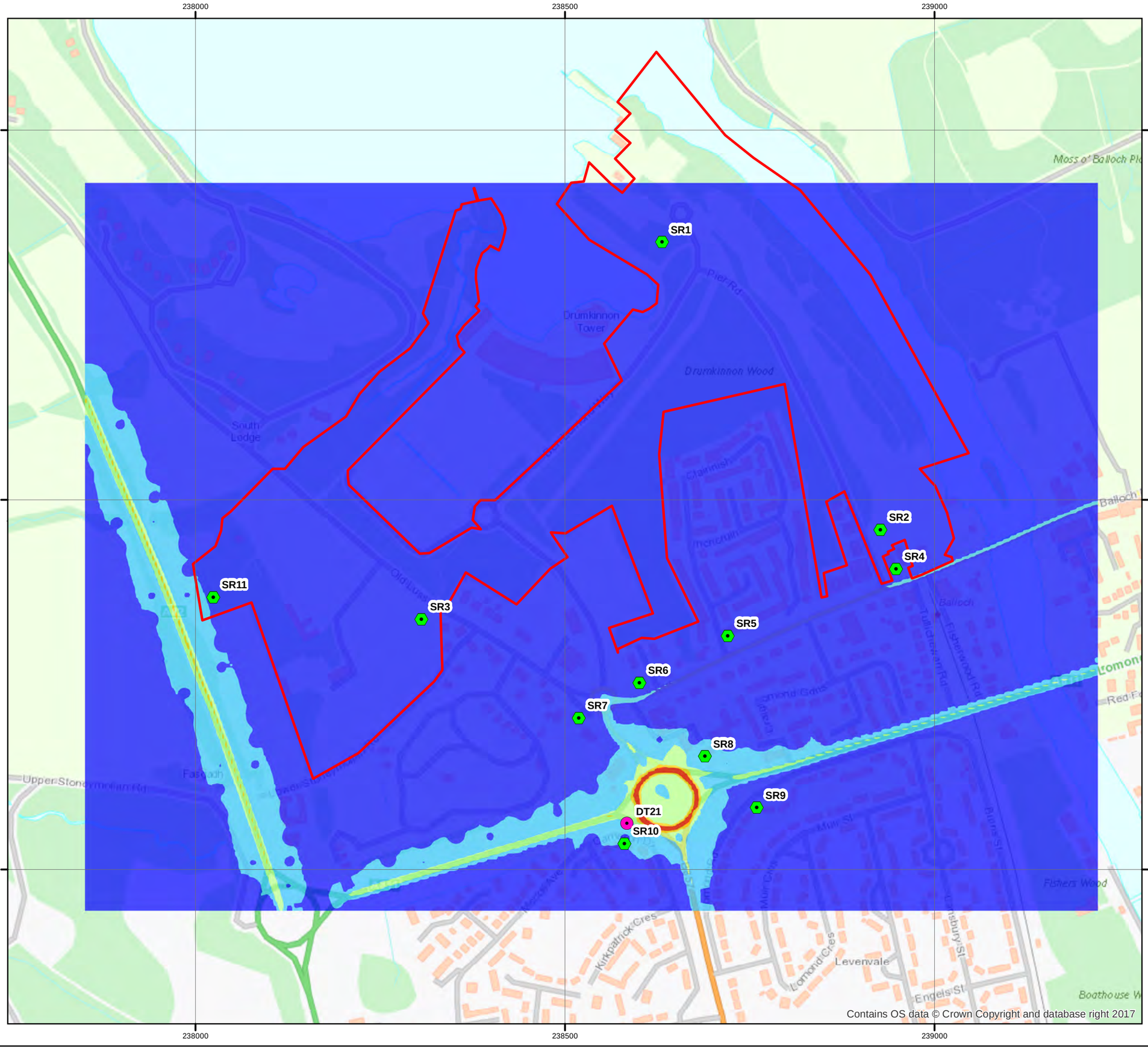

Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

PM2.5 Concentration (µg/m3)

- <6
- 6 - 7
- 7 - 8
- 8 - 9
- >9

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted PM2.5 Concentrations
2019 Baseline

Status
FINAL

Drawing No.
168659 - 040

Revision

Scale
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A3

Date
29 March 2017

Drawn	Checked	Approved
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Legend

- Site Boundary
- Sensitive Receptor
- Diffusion Tube

PM2.5 Concentration (µg/m3)

- <6
- 6 - 7
- 7 - 8
- 8 - 9
- >9

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Predicted PM2.5 Concentrations
2019 Baseline + Development

Status
FINAL

Drawing No.
168659 - 041

Revision

Scale
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A3

Date
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B TRAFFIC DATA

Road Name	Road Type	Canyon Height	Road Width (m)	Vehicle Speed (km/h)		2016 Baseline		2019 Baseline		2019 Baseline + Development	
				LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
A811 *(A82 – B857 Luss Rd)*	Urban	0	4	49	49	689	75	689	75	757	83
Old Luss Road (A811 – Balloch Rd)	Urban	0	4	49	49	391	31	391	31	473	38
Ben Lomond Way	Urban	0	4	49	49	111	12	111	12	125	14
Balloch Road *(Old Luss Road – Pier Road)*	Urban	0	4	49	49	207	18	207	18	222	19
Pier Road	Urban	0	4	49	49	12	1	12	1	26	3
Balloch Road *(Pier Road – Carrochan Road)*	Urban	0	4	49	49	170	52	170	52	185	57

A811 Lomond Rd/Stirling Rd *(Eastbound from A813 Carrochan Road)*	Urban	0	4	49	49	250	58	250	58	264	61
A813 Carrochan Road	Urban	0	4	49	49	337	26	337	26	353	28
A811 Lomond Road *(A813 Carrochan Road – B857 Luss Road)*	Urban	0	4	49	49	532	56	532	56	535	56
B857 Luss Road	Urban	0	4	49	49	518	49	518	49	533	51
A82 *(North of A811)*	Urban	0	4	80	80	837	119	837	119	859	123
Old Luss Road *(North of Balloch Road)*	Urban	0	4	49	49	10	2	10	2	21	3
Roundabout *(Junction of A811, Old Luss Rd & B857 Luss Road)*	Urban	0	4	49	49	1065	106	1065	106	1149	114
A811 - Roundabout on/off slips *(A82 – B857 Luss Road)*	Urban	0	4	49	49	345	38	345	38	379	41

Old Luss Road – Roundabout on/off slips *(A811 – Balloch Road)*	Urban	0	4	49	49	195	16	195	16	237	19
A811 – Roundabout on/off slips *(Carrochan Road –B857 Luss Rd)*	Urban	0	4	49	49	266	28	266	28	267	28
B857 – Roundabout on/off slips	Urban	0	4	49	49	259	25	259	25	266	25