Appendix 8 – Noise

Appendix 8.1 – Figures

Included within Appendix 8.2 Noise Assessment

Appendix 8.2 – Noise Assessment

West Riverside & Woodbank House, Balloch
Noise Assessment

May 2018

West Riverside & Woodbank House, Balloch
Noise Assessment

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Contents

Appendices

Tables

1 INTRODUCTION

1.1 Remit

EnviroCentre Ltd was commissioned by TSL Contractors to undertake a noise assessment for the proposed multipurpose development on the southern shores of Loch Lomond, Balloch, West Dunbartonshire.

This report presents the results of the noise assessment for the proposed development area. 3D computer noise modelling has been carried out, the outputs of which have been validated against the results of noise monitoring on site.

1.2 Site Description and 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 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
- 900m² brewery
- Leisure / pool /water park area up to approximately 2,500m²
- Restaurants/Cafe & Retail areas up to 1,100m² in total
- Visitor reception areas & hub building up to approximately 2,000m²
- 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 900m²
- 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

1.3 Potential Impacts

Due to the proximity of the site to dominant road noise sources of the A82 to the west, Balloch Road & A811 to the south, along with the local road network, there is the potential for road traffic noise to impact on future residents within resort accommodation at the proposed development. There is also the potential for road traffic noise associated with the increase in traffic flows generated by the proposed development to impact on existing residential receptors within the area surrounding the development.

There is the potential for commercial/entertainment noise from the proposed development to impact on future residents within resort accommodation, and on existing residents in the area surrounding the development. At the time of writing the development is at the masterplan stage, therefore detailed design information on proposed commercial/entertainment noise sources is not available. If required, an assessment of commercial/entertainment noise sources can be carried out at a later date when sufficient design information is available to allow this. This noise assessment shall therefore focus on road traffic noise.

2 NOISE ASSESSMENT METHODOLOGY

The noise assessment was undertaken to establish the existing and predicted future noise climate and to determine the suitability of the site for residential development. The assessment involved the following stages:

- Consultation with West Dunbartonshire Council's Environmental Health Department to agree the noise assessment methodology and criteria (refer to Section 2.2);
- Measurement of daytime and evening existing baseline noise levels for a period of 1 hour at each location, repeated at varying times over two separate dates;
- Measurement of existing road traffic noise at one position; in accordance with the shortened measurement procedure of The Calculation of Road Traffic Noise (CRTN);
- Use of CadnaA software to model road traffic noise on site and in surrounding areas using CRTN principles;
- Validation of the CadnaA model against results of noise monitoring carried out at the proposed development site by EnviroCentre in 2017.
- Assessment of road traffic noise impact for year of development completion (2020) in accordance with PAN 1/2011; and
- Report on the potential impact of road traffic noise on future and existing residents.

2.1 Noise Guidance

2.1.1 PAN 1/2011 Planning and Noise

Advice on the role of the planning system in helping to prevent and limit the adverse effects of noise is provided in *Planning Advice Note (PAN) 1/2011 'Planning and Noise'* (The Scottish Government, 2011a). The associated *Technical Advice Note (TAN) 1/2011 'Assessment of Noise*' (The Scottish Government, 2011b) provides guidance on Noise Impact Assessment methods.

The methodology provided in Technical Advice Note (TAN) 1/2011 *'Assessment of Noise'* (The Scottish Government, 2011b) is used to assess the suitability of the local noise environment for a residential development

2.1.2 Calculation of Road Traffic Noise (CRTN)

CRTN is the standard UK procedure which defines measurement and calculation methods for assessing road traffic noise.

The standard contains a shortened measurement procedure by which daytime $L_{A10,(18hour)}$ noise level can be calculated from the arithmetic average of three consecutive hourly $L_{A10,(1hour)}$ measurements. Daytime $L_{Aeq,(16hour)}$ are then calculated by subtracting a further 2dB(A) from the $L_{A10,(18hour)}$ value.

Night-time $L_{Aeq,(8hour)}$ values can be extrapolated from daytime $L_{Aeq,(16hour)}$ levels following guidance provided in the Highway Agencies publication, Design Manual for Roads and Bridges.

2.1.3 World Health Organisation (WHO) Guidelines for Community Noise 1999

In *Guidelines for Community Noise,* (World Health Organisation, 1999), 55dB(A) was indicated as a criteria threshold below which few people are seriously annoyed (for an outdoor living area), during daytime and evening and other circumstances. To avoid sleep disturbance night time noise events exceeding 45dB (A) at the outside

facades of living spaces should be avoided. In addition the guidance identifies that negative sleep impacts are avoided at 30dB for continuous noise sources. It also provides guidance on the attenuation provided to internal living areas when windows are partially opened i.e. up to 15dB reduction in external noise levels.

2.1.4 BS EN 12758:2011 'Glass in Building, Glazing and Sound Insulation; Product Descriptions and Determination of Properties'

BS EN 12758:2011 provides information on the acoustic properties of various glazing types and products. The Sound Reduction Indexes R_w (dB) provided for some commonly used double glazing types are shown in Table 2-1.

Table 2-1: Sound Reduction Indexes of Double Glazing Types

Glass Type and Thickness (mm)	Sound Reduction Index Rw (dB)
6/(6-16)/4	32
6/(6-16)/6	31
8/(6-16)/4	33
8/(6-16)/6	35

The minimum standard required by the Building Standards (Scotland) Regulations for thermal insulation is two layers of 6mm thick glass separated by a 16mm thick cavity. Where glazing has not yet been specified, this configuration may be assumed as a minimum standard; with a Sound Reduction Index, R_w of 31dB.

2.2 Consultation

Consultation was carried out in June 2017 with West Dunbartonshire council in order to confirm assessment methodology, noise monitoring locations and noise criteria to be applied to the site. The following was agreed upon;

- In order to establish the existing baseline noise levels within and surrounding the proposed development site, a number of daytime and evening noise monitoring locations are proposed. The noise shall be measured for a period of 1 hour at each location, repeated at varying times over two separate dates.
- The final site design has not yet been confirmed; therefore, the methodology to assess development generated (commercial/entertainment) noise shall, if required, be consulted on at a later date when sufficient information is available to carry out the assessment. The assessment of these noise sources shall use the baseline noise measurements collected before development where relevant.
- Measurement of existing road traffic noise at one position (close to the A82); in accordance with the shortened measurement procedure of The Calculation of Road Traffic Noise (CRTN). The results of the measurements will be used to calibrate the CadnaA road traffic noise model.
- Carry out a CadnaA noise modelling exercise to predict road traffic noise levels pre and post development. CadnaA software shall be used along with predicted average annual weekly traffic flows (AAWT) to produce noise contours showing the impact in the surrounding areas. The following scenarios shall be modelled;
    - Current year – 2017
    - Year of opening including committed developments; and
    - Year of opening including committed developments and development generated traffic

- Calculation of increase in road traffic noise at existing sensitive receptors with and without development for the future year of opening scenario; the significance of any impact shall be assessed in accordance with guidance provided in TAN 2011.
- PAN 1/2011 assessment of day and night-time noise levels at location of new proposed sensitive receptors within the development; assessed against WHO Guidelines for Community Noise external noise criteria of 55dB(A) during the day, and 45dB(A) at night.
- If the PAN 1/2011 magnitude of impact at night exceeds 'slight', undertake calculations of internal noise levels and compare to guidance provided in WHO Guidelines for Community Noise of 30dB(A) within bedrooms at night (assuming closed windows). Similarly, if daytime magnitude of impact exceeds 'slight', calculate external garden noise levels.
- If necessary advise on potential mitigation measures necessary to reduce the noise to within assessment criteria.

2.3 TAN 1/2011 Assessment

The methodology provided in Technical Advice Note (TAN) 1/2011*'Assessment of Noise'* (The Scottish Government, 2011b) is used to assess the suitability of the local noise environment for a residential development. This is a five stage process as follows:-

Stage 1: Initial Process

The development is categorised according to whether it has the potential to generate noise *i.e.* a Noise Generating Development (NGD) or be affected by the existing noise *i.e.* a Noise Sensitive Development (NSD).

All Noise Sensitive Receptors (NSRs) that have the potential to be impacted by the proposed development are identified and prioritised according to their level of sensitivity as detailed in Table 2-2. The NSR could include the proposed development itself if it has been categorised as a NSD.

Table 2-2: Level of Sensitivity Associated with Various Examples of NSRs

Sensitivity	Description	Examples of NSR
High	Receptors where people or operations are particularly susceptible to noise.	Residential, including private gardens where appropriate; Quiet outdoor areas used for recreation; Conference facilities; Theatres / Auditoria / Studios; Schools during daytime; Hospitals / residential care homes; and Places of worship.
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance.	Offices; Bars / Cafes / Restaurants where external noise may be intrusive; and Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls).
Low	Receptors where distraction or disturbance from noise is minimal.	Buildings not occupied during working hours; Factories and working environments with existing high noise levels; Sports grounds when spectator noise is a normal part of the event; and Night clubs.

Stage 2: Quantitative Assessment

The quantitative assessment method depends on the type of development proposed *i.e.* Noise Sensitive Development (NSD) or Noise Generating Development (NGD) as follows:

- NSD – a quantitative assessment will be based on comparing an absolute noise level with an appropriate noise target, e.g. WHO guidelines etc.; and
- NGD – a quantitative assessment will be based on the change in noise climate before and after the new noise is introduced. This requires predictive calculations to be used to define post development noise.

In relation to the proposed development at Riverside West, this is considered to be both a noise sensitive and noise generating development as proposed sensitive receptors are susceptible to noise from the existing road network, whilst existing residential receptors are susceptible to any increase in noise level that may be result from the increase in traffic flows generated by the development.

Noise Sensitive Development

The magnitude of the impact is defined by assessing the amount the road traffic noise level exceeds the assessment criteria for either day or night time periods. The magnitude of impact classifications used in this assessment and shown in Table 2-3 are based on the consultation response from West Dunbartonshire Council and classifications provided in the Technical Advice Note of PAN 01/2011 (The Scottish Government, 2011a).

Table 2-3: Classification of Magnitude of Noise Impacts; Noise Sensitive Development

Night Noise Level[1], x = (Existing – 45) $L_{Aeq,8h}$	Day Noise Level[1], X = (Existing – 55) $L_{Aeq,16h}$	Magnitude of Impact
> 15	> 10	Major
10 ≤ x ≤ 15	5 ≤ x ≤ 10	Moderate
5 ≤ x ≤ 10	3 ≤ x ≤ 5	Minor
0 ≤ x ≤ 5	0 ≤ x ≤ 3	Negligible
x < 0	x < 0	No change

(1) Corresponding façade levels are 2.5 $dB(_A)$ higher

Stage 3: Qualitative Assessment

The qualitative assessment allows the magnitude of the impact established in Stage 2 to be adjusted accordingly to take into account additional factors. It is based on perception and how noticeable the noise impact is in affecting the amenity value of the NSR. As noise becomes more noticeable, the level of disruption increases leading to significant changes in behaviour with a subsequent loss in the amenities associated with the NSR as follows:-

- Where a new noise source is planned, the assessment will be based on the effect the new noise climate may have on the amenity value of the existing NSR; and
- Where a new NSD is planned the assessment will be based on the effect the existing noise climate may have on the amenity value of the proposed property.

Stage 4: Level of Significance

The level of significance of the noise impact at the NSR is obtained through the relationship of the receptor's sensitivity to noise and the magnitude of the noise impact. Table 2-4 provides a framework for determining the level of significance in relation to the magnitude of the impact and the sensitivity of the receptor.

Table 2-4: Significance of Effects

Magnitude of Impact	Level of Significance Relative to Sensitivity of Receptor		
	Low	**Medium**	**High**
Major	Slight / Moderate	Moderate / Large	Large / Very Large
Moderate	Slight	Moderate	Moderate / Large
Minor	Neutral / Slight	Slight	Slight / Moderate
Negligible	Neutral / Slight	Neutral / Slight	Slight
No Change	Neutral	Neutral	Neutral

The definitions of the levels of significance are described as below;

Slight: These effects may be raised but are unlikely to be of importance in the decision making process.

Moderate: These effects, if adverse, while important, are not likely to be key decision making issues.

Large: These effects are likely to be important considerations but where mitigation may be effectively employed such that resultant adverse effects are likely to have a Moderate or Slight significance.

Very large: These effects represent key factors in the decision making process. They are generally, but not exclusively associated with impacts where mitigation is not practical or would be ineffective.

Stage 5: The Decision Process.

Stages 2 to 4 are repeated for all identified NSRs and a Summary Table of Significance is completed which provides an overview of the level of significance of the noise impact on all NSRs.

Noise Generating Development

The magnitude of impact is defined by assessing the change in road traffic noise with vs without development during the day and night-time periods at existing noise sensitive receptors. The classification of the magnitude of impacts used in this assessment is shown in Table 2-5.

Table 2-5: Classification of Magnitude of Noise Impacts; Noise Generating Development

Change in Noise Level, x $L_{Aeq,T}$ dB	Magnitude of Impact
$x \geq 5$	Major adverse
$3 \leq x < 5$	Moderate adverse
$1 \leq x < 3$	Minor adverse
$0 < x < 1$	Negligible adverse
$x = 0$	No change
$-1 < x < 0$	Negligible beneficial
$-3 < x \leq -1$	Minor beneficial
$-5 < x \leq -3$	Moderate beneficial
$x \leq -5$	Major beneficial

2.4 Noise Definitions

The following definitions relating to noise are used in this report:-

$L_{Aeq, T}$: Equivalent continuous A-weighted sound pressure level. This is the single number that represents the average sound energy over that time period. It is the sound level of a notionally steady sound that has the same energy as a sound that fluctuates over a specified measurement period.

$L_{A10, T}$: The noise level exceeded for 10% of the measurement period.

Free-field: As sound propagates from the source it may do so freely, or it may be obstructed in some way by a wall, a fence, building, earth bund, etc. The former is known as free-field propagation.

Façade Effect: When sound is reflected back towards its source, off a surface, such a wall, the reflected and incident sound waves interfere constructively, causing what is known as façade effect, or pressure doubling. This increases the noise, compared to that which exists in free-field, by approximately 3 dB(A) for other sources.

Octave: A range of frequencies whose upper frequency limit is twice that of its lower frequency limit.

Octave Band: Sound pressure level is often measured in octave bands, the centre frequencies of the bands are defined by ISO – 31.5Hz, 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz, 16kHz to divide the audio spectrum into 10 equal parts. The sound pressure level of sound that has been passed through an octave band pass filter is termed the octave band sound pressure level.

3 ROAD TRAFFIC NOISE MONITORING

A noise survey was carried out at the site of the proposed development at West Riverside between 10:23hrs and 13:23hrs on Friday 22nd June 2017. The purpose of the survey was to establish the noise from road traffic on the A82, the results of which are used to validate outputs from the CadnaA noise modelling exercise. The monitoring was carried out in accordance with the shortened measurement procedure for The Calculation of Road Traffic Noise (CRTN).

3.1 Noise Monitoring Location

Details of the CRTN noise monitoring location is provided in Table 3-1 and shown in Drawing No 168659-048, Appendix A.

Table 3-1: Noise Monitoring Location

NML ID	Grid Reference	Location
01	NS 237950 681930	Adjacent to A82, 6m back from carriageway edge.

3.2 Noise Monitoring Details

A fully calibrated Type 1 sound level meter was used to undertake all the noise monitoring events as detailed in Table 3-2. The sound level meter was calibrated both before and after measurements were taken and no significant drift was noted.

Table 3-2: Investigative Equipment Utilised and Technical Details

Monitoring Period:	10:23hrs – 13:23hrs on 22/06/2017 at Position No. 1
Time Intervals:	3 x consecutive 1 hour intervals at each position.
Instrument:	Norsonic 140 sound analyser.
Calibration:	At the start and finish of each monitoring event calibration was completed using a Norsonic NOR-1251 Sound Calibrator.
Measurement Settings:	Environmental logging mode: A-weighted sound pressure level with time weighting F.
Measurement Positions:	Measurements were taken between 1.2m and 1.5m above the ground.

The weather conditions during the monitoring events were recorded and are summarised in Table 3-3.

Table 3-3: Monitoring Periods and Weather Conditions

Monitoring period/ event	Weather Conditions
12/06/2017; 12:00	Partially cloudy, 16^{o}C, wind speed between 0.0 m/s and 3.6 m/s in a westerly direction.

3.3 Observations

Notes of significant noise sources affecting the monitoring location were recorded and are summarised below in order of dominance (greatest first);

- Road traffic on A82;
- Light wind in trees; and
- Birdsong.

3.4 Results

A summary of the results can be found in Table 3-3.

Table 3-4: Noise Monitoring Results

Measurement Position	Start time/ Duration (hrs:mins:secs)	L_{Aeq} (dB_A)	L_{AF10} (dB_A)	L_{AFMax} (dB_A)
01	10:23/ 01:00:00	71.5	74.9	83.9
	11:24/ 01:00:00	71.8	74.9	90.4
	12:24/ 01:00:00	71.5	74.8	86.8

Following guidance provided in the *Calculation of Road Traffic Noise* (CRTN), 1dB(A) is subtracted from the average of the three hour L_{A10} levels at each position to provide the $L_{A10\,(18\ hour)}$, as shown in Table 3-5.

Table 3-5: L_{A10} Noise Monitoring Levels.

Measurement Position	$L_{A10,\ 1hr}$ (dB)			$L_{A10\ 3\ hour}$	$L_{A10\ 18hr}$
	1st hr	2nd hr	3rd hr		
01	74.9	74.9	74.8	74.9	73.9[1]

(1) According to Paragraph 43 of CRTN Manual

4 BASELINE NOISE MONITORING

Several noise surveys were carried out within and around the site of the proposed development at Riverside West during the daytime and evening of the 1st, 2nd, 20th, 21st February and 13th March 2018. The purpose of the survey was to determine the existing baseline noise environment in the area. The monitoring was carried out at each measurement location at varying times over two separate dates.

4.1 Noise Monitoring Locations and Periods

Seven measurement locations were chosen to represent the residual background noise levels within and surrounding the proposed development site. The monitoring locations, periods and durations were agreed through consultation with West Dunbartonshire Council. The location of the noise monitoring locations, and periods monitored for each is summarised in Table 4-1, and shown in Drawing No 168659-048, Noise Monitoring Locations, Appendix A.

Table 4-1: Noise Monitoring Locations

NML ID	Description	Period Monitored	Grid reference
02	Off Lower Stoneymollan Rd	Daytime	E: 238167 N: 681643
03	Off Old Russ Road-Behind two Residential Properties	Evening	E: 238303 N: 681833
04	Land between Ben Lomond Shores Car Park and Clairinsh	Daytime	E: 238616 N: 681920
05	Off Ben Lomond Way, adjacent to Loch Lomond Shores	Daytime & Evening	E: 238587 N: 682190
06	On land between Pier Road and River Leven	Daytime & Evening	E: 238787 N: 682295
07	Land behind Anchorage Guest House and adjacent to Pier Road	Daytime & Evening	E: 238940 N: 681960
08	Off Old Luss Road	Evening	E: 238082 N: 682085

4.2 Noise Monitoring Details

A fully calibrated Type 1 sound level meter was used to undertake all the noise monitoring events as detailed in Table 4-2. The sound level meter was calibrated both before and after measurements were taken and no significant drift was noted.

Table 4-2: Investigative Equipment Utilised, Technical Details, Monitoring Periods and Durations

Instrument:	**Norsonic 140 sound analyser.**
Calibration:	At the start and finish of each monitoring event calibration was completed using a Norsonic NOR-1251 Sound Calibrator.
Measurement Settings:	Environmental logging mode: A-weighted sound pressure level with time weighting F.
Measurement Positions:	Measurements were taken between 1.2m and 1.5m above the ground.
Monitoring Period:	Daytime : 07:00hrs – 19:00hrs Evening : 19:00hrs – 23:00hrs
Time Intervals:	Time intervals were 1 hour both Daytime and Evening monitoring

The weather conditions during the monitoring events were recorded and are summarised in Table 4-3.

Table 4-3: Monitoring Periods and Weather Conditions

Monitoring period/ event	Weather Conditions
01/02/2018; Afternoon	Partially cloudy, between 4 and 7^{o}C, wind speed between 0.0 m/s and 4.5 m/s
01/02/2018; Evening	Partially cloudy, between 3 and 4^{o}C, wind speed between 2 m/s and 3.0 m/s.
02/02/2018: Morning & Afternoon	Partially cloudy, between 4 and 10°C, wind speed between 0.0 m/s and 1.0 m/s.
20/02/2018: Daytime	Partially cloudy, between 8 and 13°C, wind speed < 1.0 m/s.
20/02/2018: Evening	Partially cloudy, between 1 and 3°C, wind speed < 1.0 m/s.
21/02/2018: Evening	Partially cloudy, between 4 and 8°C, wind speed < 1.0 m/s.
13/03/2018: Evening	Overcast, between 4 and 7°C, wind speed < 1.0 m/s.

4.2.1 Observations

During the monitoring periods, notes of the general noise climate at each of the monitoring locations were recorded. Background noise was observed at each location as follows:

Table 4-4: Observations

Period	Monitoring Location	ID	Date	Observations
Weekday - Daytime	Off Lower Stoneymollan Rd	02	01/02/2018	• Road traffic on A82 • Dogs barking at local kennels • Birds chirping • Trees rustling
			02/02/2018	• Road traffic on A82 • Distant music within Loch Lomond Shores
	Land between Ben Lomond Shores Car Park and Clairinsh	04	01/02/2018	• Traffic on local road network • Leaves rustling • Birds chirping
			02/02/2018	• Traffic on local road network • Leaves rustling • Birds chirping • Intermittent distant sawing activity
	Off Ben Lomond Way, adjacent to Loch Lomond Shores	05	01/02/2018	• Traffic on local road network • Kids playing in playground • Mechanical services noise from Loch Lomond Shores • Infrequent dog barks

Period	Monitoring Location	ID	Date	Observations
			20/02/2018	• Traffic on local road network • Kids playing in playground • Mechanical services noise from Loch Lomond Shores
	Land between Pier Road and River Leven	06	01/02/2018	• Traffic on local road network • Birds chirping • Infrequent shouting in distance
			02/02/2018	• Traffic on local road network • Boating activity on River Leven • Paddle Steamer starting up
	Land behind Anchorage Guest House and adjacent to Pier Road	07	02/02/2018	• Traffic on local road network • Boating activity on River Leven • Overhead light aircraft
			20/02/2018	• Traffic on local road network • Infrequent distant indistinct industrial/commercial noise • Birds chirping
Week Day – Night-Time	Off Old Russ Road-Behind two Residential Properties	03	01/02/2018	• Road traffic on A82 • Water in stream nearby • Very Infrequent passing cars on Old Luss Road
			13/03/2018	• Road traffic on A82 • Water in stream nearby • Very Infrequent cars accelerating loudly in surrounding area
	Off Ben Lomond Way, adjacent to Loch Lomond Shores	05	01/02/2018	• Traffic on local road network • Leaves and trees rustling • Mechanical services noise from Loch Lomond Shores
			21/02/2018	• Traffic on local road network • Mechanical services noise from Loch Lomond Shores • Van in Loch Lomond Shores delivery area idling for less than 10 mins
	Land between Pier Road and River Leven	06	20/02/2018	• Traffic on local road network • Distant intermittent dog bark • Lorry pulling up on Pier Road and idling for less than 10 mins • Low to mid frequency drone suspected to be from mechanical services at Drumkinnon Tower
			21/02/2018	• Traffic on local road network • Low to mid frequency drone suspected to be from mechanical services at Drumkinnon Tower • Single HGV passing on Pier Road

Period	Monitoring Location	ID	Date	Observations
	Land behind Anchorage Guest House and adjacent to Pier Road	07	20/02/2018	• Traffic on local road network • Music from property on Pier Road • Diesel car idling in adjacent car park
			13/03/2018	• Traffic on local road network • Music from property on Pier Road • Infrequent lorry movements and doors closing in adjacent car park
	Off Old Luss Road	08	20/02/2018	• Road traffic on A82 and local road network • Water in nearby stream • Infrequent, distant cars revving engines
			21/02/2018	• Road traffic on A82 and local road network • Water in nearby stream • Very infrequent bird calls

4.2.2 Results

A summary of the noise monitoring results can be found below in Table 4-5.

Table 4-5: Noise Monitoring Results

Period	Date	Monitoring Location	Start Time – End Time (hrs:mins)	Noise Levels (dB(A))		
				L_{Aeq}	L_{A90}	L_{AFMax}
Position 2						
Daytime	01/02/2018	02	14:50 – 15:50	52.6	50.2	67.4
Daytime	02/02/2018	02	14:28 – 15:28	51.5	48.7	70.0
Position 3						
Evening	01/02/2018	03	20:49 – 21:49	45.7	42.3	58.3
Evening	01/02/2018	03	20:47 – 21:47	47.7	43.7	67.5
Position 4						
Daytime	01/02/2018	04	13:27 – 14:27	49.1	44.9	62.2
Daytime	02/02/2018	04	09:48 – 10:48	49.3	44.4	72.1
Position 5						
Daytime	01/02/2018	05	16:03 – 17:03	59.0	45.3	79.7
	20/02/2018	05	15:23 – 16:23	57.0	41.7	84.5
Evening	01/02/2018	05	19:39 – 20:39	53.3	40.3	80.7

Period	Date	Monitoring Location	Start Time – End Time (hrs:mins)	Noise Levels (dB(A))		
				L_{Aeq}	L_{A90}	L_{AFMax}
	21/02/2018	05	20:41 – 21:41	53.2	37.2	81.1
Position 6						
Daytime	01/02/2018	06	17:13 – 18:13	45.2	42.1	71.1
	02/02/2018	06	12:28 – 13:28	44.0	36.6	66.5
Evening	20/02/2018	06	19:00 – 20:00	42.7	39.5	67.8
	21/02/2018	06	19:33 - 20:.33	42.0	36.3	68.8
Position 7						
Daytime	02/02/2018	07	11:06 – 12:06	46.6	41.4	67.5
	20/02/2018	07	16:31 – 17:31	47.3	42.3	66.4
Evening	20/02/2018	07	20:11 – 21:11	44.4	40.3	64.5
	13/03/2018	07	19:30 – 20:30	45.0	41.7	69.4
Position 8						
Evening	20/02/2018	08	21:22 – 22:22	41.8	37.8	61.9
	21/02/2018	08	21:45 – 22:45	41.0	37.0	64.7

5 NOISE MODEL INPUT PARAMETERS

CadnaA uses the principle methodologies as set out in the Calculation of Road Traffic Noise 1988 (CRTN), for determining the L_{A10} basic road noise level. In order to consider the noise data in a comparable form to PAN 01/2011, the output from CadnaA is converted into a $L_{Aeq,T}$ within the program.

5.1 Noise Sources

This noise assessment considers the impact of road traffic noise on future residents within the proposed development site, as well as the impact of development generated traffic on existing residents within the surrounding areas. The dominant sources of noise affecting the proposed development site have been identified as being the A82, A811, Old Luss Road and Balloch Road.

Eighteen hour Annual Average Weekly Traffic (AAWT) flows for the above roads have been provided by Peter Brett Associates LLP and input to the CadnaA noise model.

5.2 Noise Sensitive Receptors

The noise assessment considered the most exposed residential resort accommodation within the development site to road noise. A sample of noise sensitive receptors has been chosen, considered as being representative of the locations of the most exposed proposed resort accommodation, as shown in Drawing Nos. 168659-043, in Appendix A. In addition a sample of eleven existing noise sensitive receptors within the surrounding areas (refer to Drawing No. 168659-042, Appendix A for locations) were also considered in the noise assessment. All existing noise sensitive receptors were agreed with West Dunbartonshire Council Environmental Health Department through consultation.

5.3 Modelled Scenarios

Three different scenarios have been considered within the CadnaA model, as shown in Table 5-1.

Table 5-1: Modelled Scenarios

Scenario	Year	Description
1	2017	Baseline road traffic, for noise model validation purposes against measured road traffic data.
2	2020	Baseline + future committed developments
3	2020	Baseline + future committed developments + proposed development generated traffic.

5.4 Other Input Parameters

Site specific input parameters established during the CadnaA modelling exercise are detailed below:

- The 2017 and 2020 models use a combination of existing site topography, sourced from Lidar 1m resolution terrain height data and site topography supplied by the client;
- One storey buildings have been taken to be 6m high, two storey as 8m high:
- Receptor heights at garden and ground floor level have been taken as being 1.5m above ground level;

- Receptors at first floor level i.e. bedrooms have been taken to be 4m above ground level;
- Ground absorption has been set to 1 for soft ground for the 2017 and 2020 models, which comprises the majority of land, apart from areas:
    - Drumkinnon Gate housing – Modelled as 0.5 (mixed hard and soft ground)
    - Loch Lomond and River Leven – Modelled as 0 (reflective surface)
    - Ben Lomond car and coach park – Modelled as 0 (reflective surface)
    - Car park west of Drumkinnon Gate housing and adjacent to Ben Lomond Way– Modelled as 0 (reflective surface)
    - Housing between Balloch Road and the A811– Modelled as 0.5 (mixed hard and soft ground)
    - Housing south of the A811– Modelled as 0.5 (mixed hard and soft ground)
    - Lomond Woods Holiday Park– Modelled as 0.5 (mixed hard and soft ground)

5.5 Calibration and Validation of CadnaA Noise Model

A CadnaA noise model was run for 2017 at a receptor height of 1.5m, with the results being compared to the noise monitoring results recorded at the site for validation purposes, as summarised in Table 5-2.

Table 5-2: CandaA results and model validation.

Monitoring position ID	Modelled period	$L_{A10,18hrs}$ Noise Level (dBA) in accordance with CRTN	CadnaA results	Variance
01	Daytime	73.9	74.9	1.0

The analysis of the CadnaA validation results (as shown in Drawing No 168659-044, Appendix A) shows a good agreement between modelled results and monitoring data. The model is therefore considered to reflect the current situation at the site.

6 NOISE MODEL RESULTS AND NOISE ASSESSMENT

6.1 Existing Residential Receptors

The proposed residential development is predicted to increase traffic flows on the local road network surrounding the site. In order to assess how the noise levels will increase in these areas, noise models with and without development generated traffic have been compared.

6.1.1 Existing Noise Sensitive Receptor Heights

The receptor heights for the existing noise sensitive receptors have been set to 1.5m during the daytime (i.e gardens), and 4m at night (i.e 1st floor bedrooms).

6.1.2 Comparison of Daytime Predicted Noise Levels

Daytime noise levels in the gardens of the noise sensitive receptors with vs without development generated traffic are compared in Table 6-1.

Table 6-1: Comparison of Daytime Noise Levels With vs Without Development; 1.5m Receptor Height.

Noise Sensitive Receptor ID	2017 Without Development $L_{Aeq,T}$ dB(A)	2020 With Development $L_{Aeq,T}$ dB(A)	Differences dB(A)	TAN 2011 Magnitude of Impact	TAN 2011 Level of Significance
01	53.7	53.9	0.2	Negligible	Slight
02	49.1	49.6	0.5	Negligible	Slight
03	52.2	53.6	1.4	Minor	Slight
04	59.2	59.5	0.3	Negligible	Slight
05	57.2	59.2	2.0	Minor	Slight
06	49.2	50.6	1.4	Minor	Slight
07	41.3	42.2	0.9	Negligible	Slight
08	42.8	43.4	0.6	Negligible	Slight
09	66.8	67.1	0.3	Negligible	Slight
10	55.5	56.6	1.1	Minor	Slight
11	66.6	66.7	0.1	Negligible	Slight

The results show that the increase in daytime noise levels when comparing between the with vs without development scenarios for the year of development completion (2020) varies between 0.1dB(A) and 2.0dB(A), the TAN 2011 significance of which is *slight*. The existing properties at which the greatest increase in noise levels are predicted are located on, or close to Old Luss Road, Ben Lomond Way and Balloch Road (NSR 03, 05 & 06, refer to Drawing No. 168659-042, Appendix A). This is due to the current traffic flows increasing due to development generated traffic. An increase in noise levels of around 2dB(A) shall be barely perceptible to the listener, and is therefore considered as insignificant.

6.1.3 Comparison of Night-time Predicted Noise Levels

Night time noise levels have been calculated to be 10dB(A) lower than daytime levels following guidance provided in the Design Manual for Roads and Bridges.

Night time noise levels at the facades of the noise sensitive receptors with vs without development generated traffic are compared in Table 6-2.

Table 6-2: Comparison of Night-time Noise Levels With vs Without Development; 4m Receptor Height

Noise Sensitive Receptor ID	2017 Without Development $L_{Aeq,T}$ dB(A)	2020 With Development $L_{Aeq,T}$ dB(A)	Differences dB(A)	TAN 2011 Magnitude of Impact	TAN 2011 Level of Significance
01	55.7	55.8	0.1	Negligible	Slight
02	40.3	41.4	1.1	Minor	Slight
03	42.3	43.7	1.4	Minor	Slight
04	53.9	54.3	0.4	Negligible	Slight
05	49.1	51.3	2.2	Minor	Slight
06	54.7	56.2	1.5	Minor	Slight
07	49.7	51.1	1.4	Minor	Slight
08	53.7	55.3	1.6	Minor	Slight
09	55.9	56.2	0.3	Negligible	Slight
10	52.1	52.2	0.1	Negligible	Slight
11	56.8	56.9	0.1	Negligible	Slight

The results show that the increase in night-time noise levels when comparing between the with vs without development scenarios for the year of development completion (2020) varies between 0.1dB(A) and 2.2dB(A), the TAN 2011 significance of which is *slight*. The existing properties at which the greatest increase in noise levels are predicted are located on, or close to Old Luss Road, Ben Lomond Way and Balloch Road (NSR 03, 05, 06, 07 & 08, refer to Drawing No. 168659-042, Appendix A). This is due to the current traffic flows increasing due to development generated traffic. An increase in noise levels of around 2dB(A) shall be barely perceptible to the listener, and is therefore considered as insignificant.

6.2 Proposed Resort Accommodation

6.2.1 Year of Development Completion Predicted Noise Levels

In order to assess the impact of road traffic noise on proposed sensitive receptors within the development, the CadnaA noise model considering the 2020 base + committed + development scenario has been used for assessment purposes.

6.2.2 Design Mitigation

As part of the masterplan design process EnviroCentre used CadnaA noise modelling software to inform the design of any mitigation measures if necessary for the year of development opening scenario (2020). The results were assessed in accordance with TAN 2011. A TAN exceedance of *moderate* significance was identified in one of the gardens of the most exposed properties (NSR 19).

The level of significance of any TAN 2011 exceedance within the current masterplan is now *slight*. The design mitigation features incorporated into the final masterplan design is of one stretch of 2m high close boarded timber garden fencing at the garden/terrace boundary of NSR 19, as shown in Drawing No. 168658-049, Appendix A. This site design mitigation feature has been incorporated into the noise model.

6.2.3 Daytime Predicted Noise Levels

The noise model results for the 1.5m receptor height are summarised in Table 6-3, the free-field noise contours are shown in Drawing No. 168659-046, Appendix A.

Table 6-3: CadnaA daytime model results. Receptor height: 1.5 metres; Gardens/Terraces

Noise Sensitive Receptor ID	Modelled Garden $L_{Aeq,T}$ dB(A)	Meet External Noise Criteria? Target = 55 dB(A)	Excess dB(A)	TAN 2011 Magnitude of Impact	TAN 2011 Level of Significance
12	53.9	**YES**	-1.1	No Change	Neutral
13	54.1	**YES**	-0.9	No Change	Neutral
14	54.2	**YES**	-0.8	No Change	Neutral
15	53.5	**YES**	-1.5	No Change	Neutral
16	53.9	**YES**	-1.1	No Change	Neutral
17	52.8	**YES**	-2.2	No Change	Neutral
18	56.0	**NO**	1.0	Minor	Slight
19	57.2	**NO**	2.2	Minor	Slight
20	57.7	**NO**	2.7	Minor	Slight
21	55.0	**NO**	0.0	Negligible	Slight
22	55.5	**NO**	0.5	Negligible	Slight
23	53.4	**YES**	-1.6	No Change	Neutral
24	52.6	**YES**	-2.4	No Change	Neutral
25	52.3	**YES**	-2.7	No Change	Neutral
26	53.2	**YES**	-1.8	No Change	Neutral
27	50.4	**YES**	-4.6	No Change	Neutral
28	56.3	**NO**	1.3	Minor	Slight
29	57.9	**NO**	2.9	Minor	Slight
30	52.1	**YES**	-2.9	No Change	Neutral
31	50.6	**YES**	-4.4	No Change	Neutral
32	51.8	**YES**	-3.2	No Change	Neutral
33	54.3	**YES**	-0.7	No Change	Neutral
34	54.2	**YES**	-0.8	No Change	Neutral
35	54.0	**YES**	-1	No Change	Neutral
36	53.3	**YES**	-1.7	No Change	Neutral
37	54.3	**YES**	-0.7	No Change	Neutral

The gardens/terraces of the above noise receptors were chosen as they are considered to be the most exposed to noise from road traffic on the A82 and the local road network. The results show that the noise in these gardens/terraces, with the exception of seven properties, are predicted to be within the target external noise criteria of 55dB(A). The amount by which the noise is exceeded within the gardens/terraces of the most exposed seven proposed properties varies between 0.0dB(A) at NSR 21 to 2.9dB(A) at NSR 29. An exceedance of less that 3dB(A) is considered as barely perceptible to a listener. When assessed to TAN 2011, the significance of the daytime noise varies between *Neutral* and *Slight*, which are defined as;

Neutral: No effect, not significant, noise need to be considered as a determining factor in the decision making process.

Slight: These effects may be raised but are unlikely to be of importance in the decision making process.

As the greatest TAN 2011 level of significance within the gardens/terraces of the most exposed properties is *Slight*, the noise is considered as acceptable in line with the consultation response received from West Dunbartonshire Council.

As the noise is acceptable at these, the most exposed properties; it shall also be at other, less exposed parts of the development. The external daytime noise is therefore considered acceptable at the proposed development site and does not need to be reduced further.

6.2.4 Night Time Predicted Noise Levels

Night time noise levels have been calculated to be 10dB(A) lower than daytime levels following guidance provided in the Design Manual for Roads and Bridges.

As part of the consultation carried out with West Dunbartonshire Council (refer to Section 1.6) it was agreed that if the TAN 2011 significance of the external night-time noise within some parts of the development exceeds *Slight*, internal noise calculations shall be carried out to confirm that the target internal noise criteria of 30dB(A) shall be met within bedrooms with closed windows.

External free-field noise levels at one of the most exposed properties of the development (NSR19) is predicted to exceed 49.9dB(A), (as shown in Table 6-4), and Drawing No. 168659-047, in Appendix A), the TAN 2011 significance of which is *slight/moderate*. In order to confirm if noise levels shall be met at the most exposed properties throughout the development, levels within ground floor bedrooms with windows facing towards the roads have been predicted using closed windows. At the time of writing the glazing configuration has not been specified, therefore the minimum standard of double glazing required for thermal insulation by the Building Standards (Scotland) Regulations of 6/16/6mm glazing, with a sound reduction index of 31dB, as described in Section 2.1.4, has been used. A façade correction of +2.5dB(A) in accordance with CRTN has been used for the calculation of internal noise levels.

A summary of the CadnaA night-time noise model results, TAN 2011 assessment and predicted internal noise levels are shown in Table 6-4. Night-time free-field noise contours for the 4m receptor height are shown in Drawing No. 168659- 047, in Appendix A.

Table 6-4: CadnaA night-time model results and assessment. Receptor height: 4 metres

Noise Sensitive Receptor ID	Modelled Free-field External $L_{Aeq,T}$ dB(A)	Meet External Noise Criteria? Target = 45 dB(A)	Excess dB(A)	TAN 2011 Magnitude of Impact	TAN 2011 Level of Significance	Predicted Internal Bedrooms $L_{Aeq,T}$ dB	Meet noise criteria? Internal 30dB(A) night time
12	41.7	**YES**	-3.3	*No change*	Neutral	13.2	YES
13	41.8	**YES**	-3.2	*No change*	Neutral	13.3	YES
14	42.2	**YES**	-2.8	*No change*	Neutral	13.7	YES
15	42.0	**YES**	-3.0	*No change*	Neutral	13.5	YES
16	43.1	**YES**	-1.9	*No change*	Neutral	14.6	YES
17	42.4	**YES**	-2.6	*No change*	Neutral	13.9	YES
18	45.4	**NO**	0.4	*Negligible*	Slight	16.9	YES
19	50.0	**NO**	5.0	*Minor*	Slight/ Moderate	21.5	YES

Noise Sensitive Receptor ID	Modelled Free-field External $L_{Aeq, T}$ dB(A)	Meet External Noise Criteria? Target = 45 dB(A)	Excess dB(A)	TAN 2011 Magnitude of Impact	TAN 2011 Level of Significance	Predicted Internal Bedrooms $L_{Aeq, T}$ dB	Meet noise criteria? Internal 30dB(A) night time
20	47.0	**NO**	2.0	*Negligible*	Slight	18.5	YES
21	47.4	**NO**	2.4	*Negligible*	Slight	18.9	YES
22	45.0	**NO**	0.0	*Negligible*	Slight	16.5	YES
23	41.1	**YES**	-3.9	*No change*	Neutral	12.6	YES
24	41.2	**YES**	-3.8	*No change*	Neutral	12.7	YES
25	39.6	**YES**	-5.4	*No change*	Neutral	11.1	YES
26	40.9	**YES**	-4.1	*No change*	Neutral	12.4	YES
27	41.0	**YES**	-4.0	*No change*	Neutral	12.5	YES
28	45.2	**NO**	0.2	*Negligible*	Slight	16.7	YES
29	45.5	**NO**	0.5	*Negligible*	Slight	17.0	YES
30	44.6	**YES**	-0.4	*No change*	Neutral	16.1	YES
31	46.0	**NO**	1.0	*Negligible*	Slight	17.5	YES
32	43.7	**YES**	-1.3	*No change*	Neutral	15.2	YES
33	44.5	**YES**	-0.5	*No change*	Neutral	16.0	YES
34	44.8	**YES**	-0.2	*No change*	Neutral	16.3	YES
35	45.6	**NO**	0.6	*Negligible*	Slight	17.1	YES
36	41.7	**YES**	-3.3	*No change*	Neutral	13.2	YES
37	44.8	**YES**	-0.2	*No change*	Neutral	16.3	YES

According to these results, night time internal noise levels at the properties around the periphery of the proposed development and therefore most exposed to the main noise sources (*i.e.*A82, Old Luss Road, Ben Lomond Way, Pier Road and Balloch Road) are predicted to meet the noise criteria agreed during consultation with West Dunbartonshire Council: 30dB(A) within bedrooms during the night-time periods with closed windows. The minimum standard of double glazing required in the *Building Standards (Scotland) Regulations* for thermal insulation, of 2 panes of 6mm thick glass separated by a 16mm wide cavity shall provide the sound reduction required.

7 CONCLUSIONS

A noise assessment has been carried out to assess the impact of the increase in traffic noise as a result of a proposed development at Riverside West in Balloch. The impact of road traffic noise on both existing and proposed residential receptors has been assessed against noise criteria agreed with West Dunbartonshire council.

3D computer noise modelling using CadnaA software has been carried out and validated against measured on-site road traffic noise data. The modelling considered current year (2017), and year of development completion (2020) scenarios.

7.1.1 Existing Noise Sensitive Receptors

A TAN 2011 assessment of the day and night-time noise impact from future (2020) development generated road traffic at existing noise sensitive receptors within the surrounding areas, through comparison between with vs without development scenarios has been carried out.

The amount by which day and night-time road traffic noise levels are predicted to increase varies between 0.1dB(A) and 2.2dB(A), the TAN 2011 level of significance of which is *Slight*. The greatest increase in road traffic noise is predicted to occur at properties located at Old Luss Road, Ben Lomond Way and Balloch Road. This is due to the largest percentage increase in road traffic as a result of the proposed development occurring around these areas.

7.1.2 Proposed Noise Sensitive Receptors

A TAN 2011 assessment of the day and night-time noise impact from road traffic at proposed future noise sensitive receptors, for the year of development completion scenario (2020) has been carried out. The assessment includes the use of design mitigation.

Daytime external noise levels are predicted to meet West Dunbartonshire Council's noise target of 55dB(A) at the majority of locations modelled. The target noise criteria were exceeded in some locations by up to 2.9dB(A). The TAN 2011 level of significance of the exceedances is *Slight*. In line with consultation carried out with West Dunbartonshire Council, the daytime external noise, when incorporating the site design mitigation features, is within acceptable limits and does not need to be reduced further.

A TAN 2011 assessment of night-time external noise at proposed future noise sensitive receptors for the year of development completion scenario has been carried out. At one of the most exposed properties, the TAN 2011 level of significance of the night-time noise is predicted to exceed *Slight,* therefore, in line with consultation carried out with West Dunbartonshire Council, internal noise levels have been calculated to confirm that internal noise criteria of 30dB(A) within bedrooms shall be met with closed windows. At all locations throughout the proposed development internal noise levels are predicted to meet the target noise criteria of 30dB(A) with closed windows. The minimum standard of double glazing required in the *Building Standards (Scotland) Regulations* for thermal insulation, of 2 panes of 6mm thick glass separated by a 16mm wide cavity shall provide the sound reduction required.

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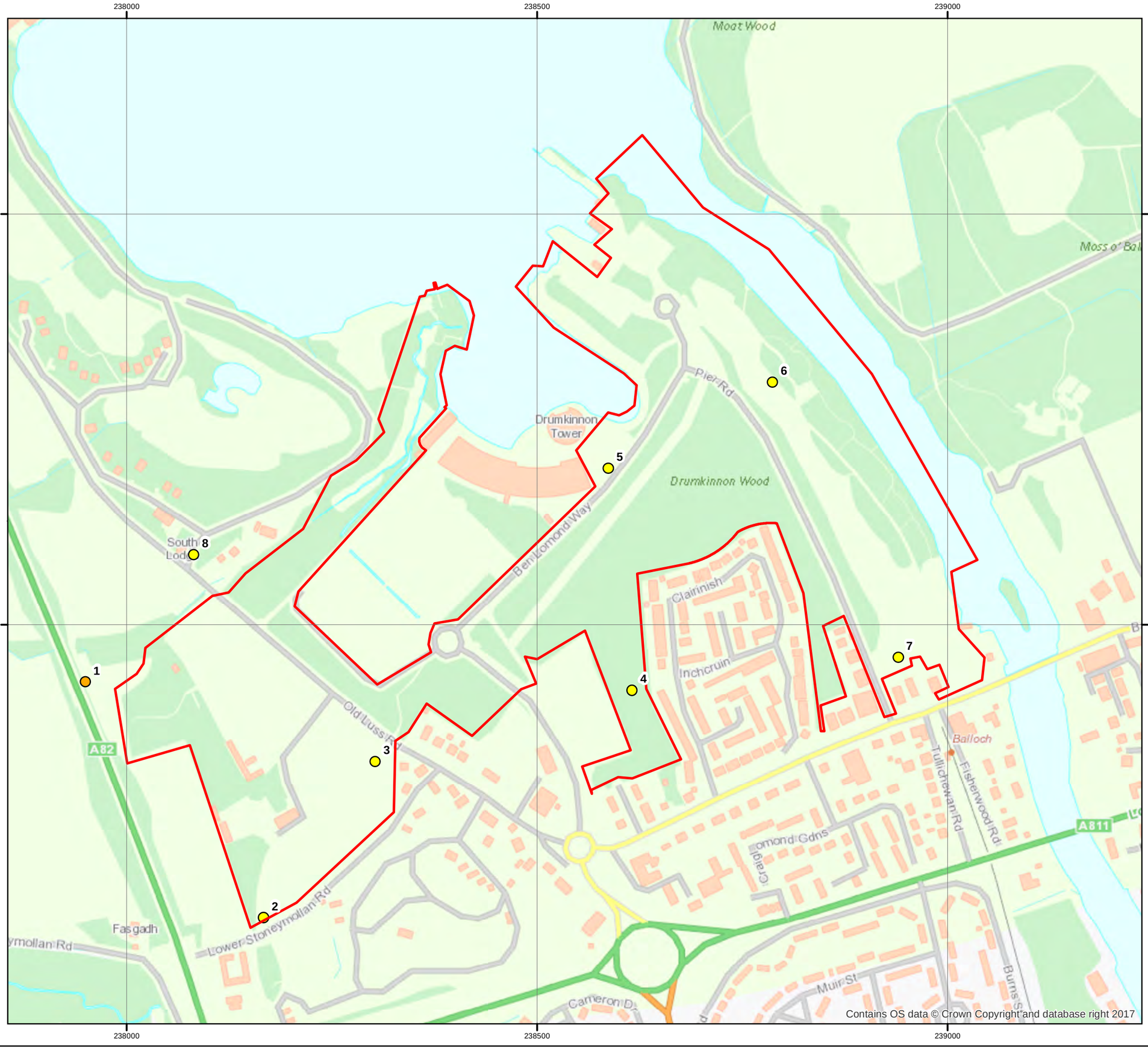
APPENDICES

A DRAWINGS



Legend

- Site Boundary
- CRTN Measurement Position
- Noise Monitoring Locations

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
Noise Monitoring Locations

Status
FINAL

Drawing No.
168659 - 048

Revision

Scale
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A3

Date
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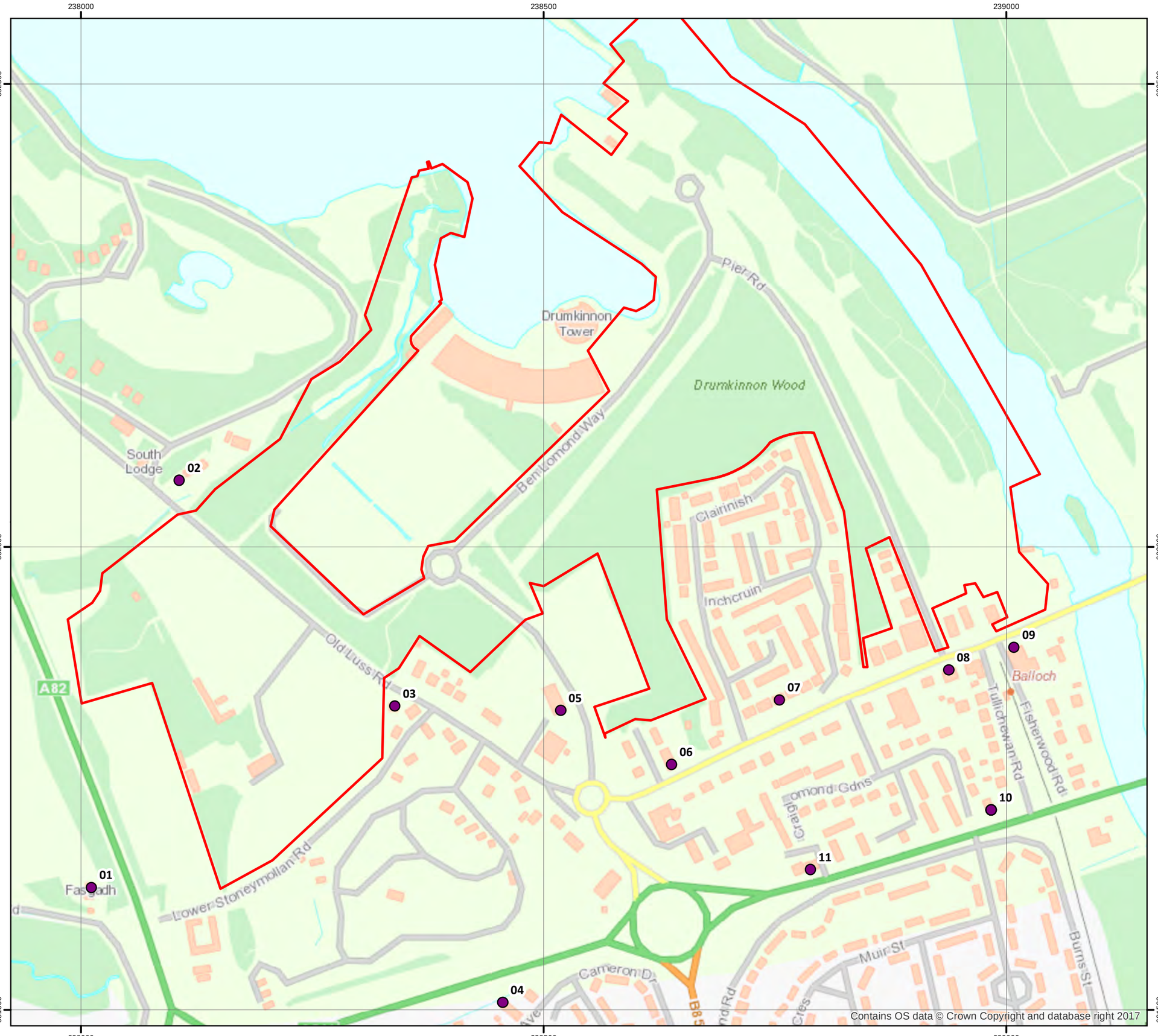

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- Site Boundary
- Existing Noise Sensitive Receptors

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Project
West Riverside Balloch

Title
Existing Noise Sensitive Receptor Plan

Status
FINAL

Drawing No.
168659 - 042

Revision

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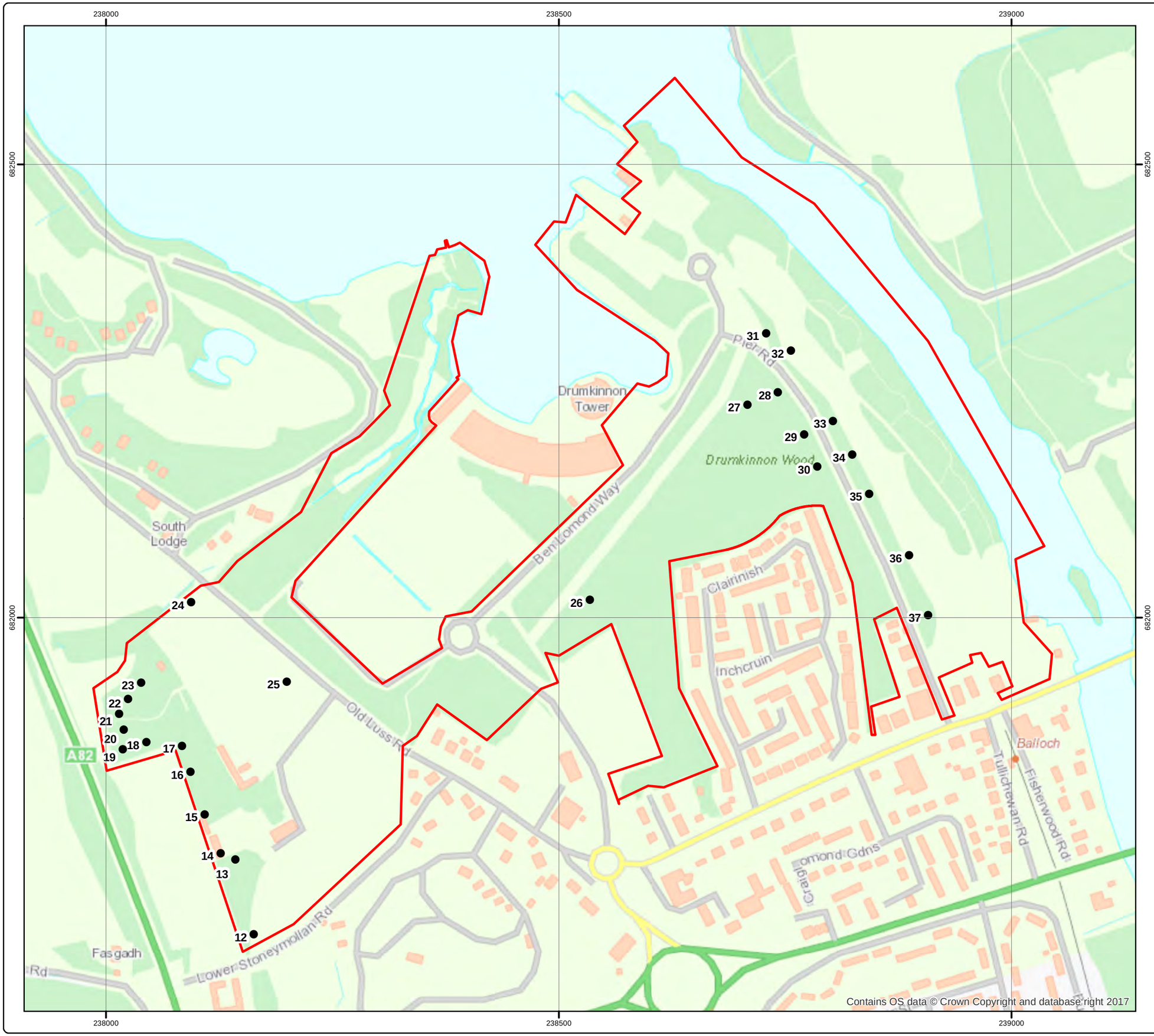

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Title
Proposed Noise Sensitive Receptor Plan

Status
FINAL

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168659 - 043	

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1:4,000	A3	06 April 2018

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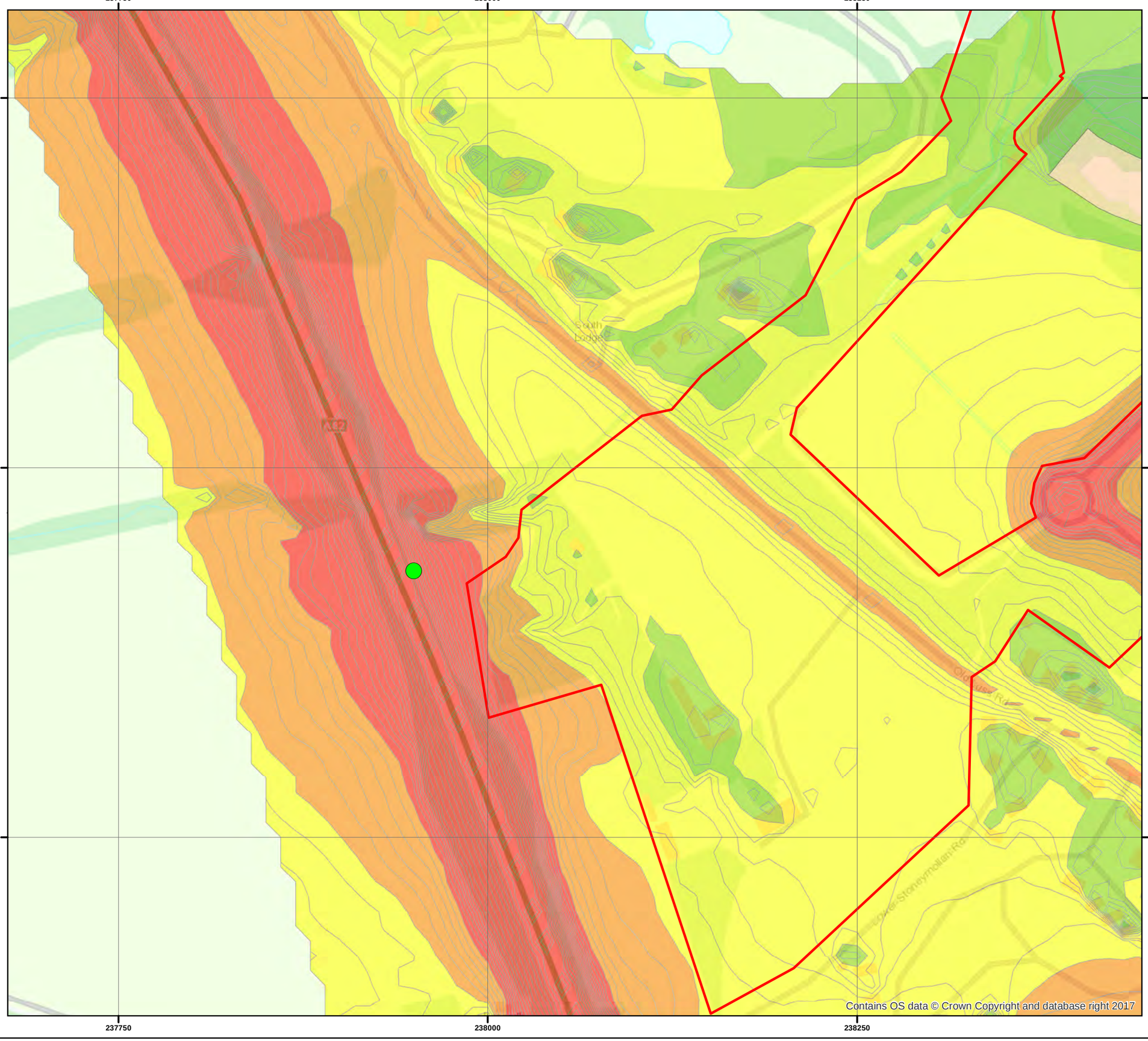

Legend

- Site Boundary
- CRTN Monitoring Position

L10 dB(A)

- < 45
- 45 - 50
- 50 - 55
- 55 - 60
- > 60

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Project
West Riverside Balloch

Title
CadnaA Free-field LA10 Noise Contours
2017, Daytime, 1.5m Receptor Height

Status
FINAL

Drawing No.	Revision
168659 - 044	

Scale		Date
1:2,500	A3	06 April 2018

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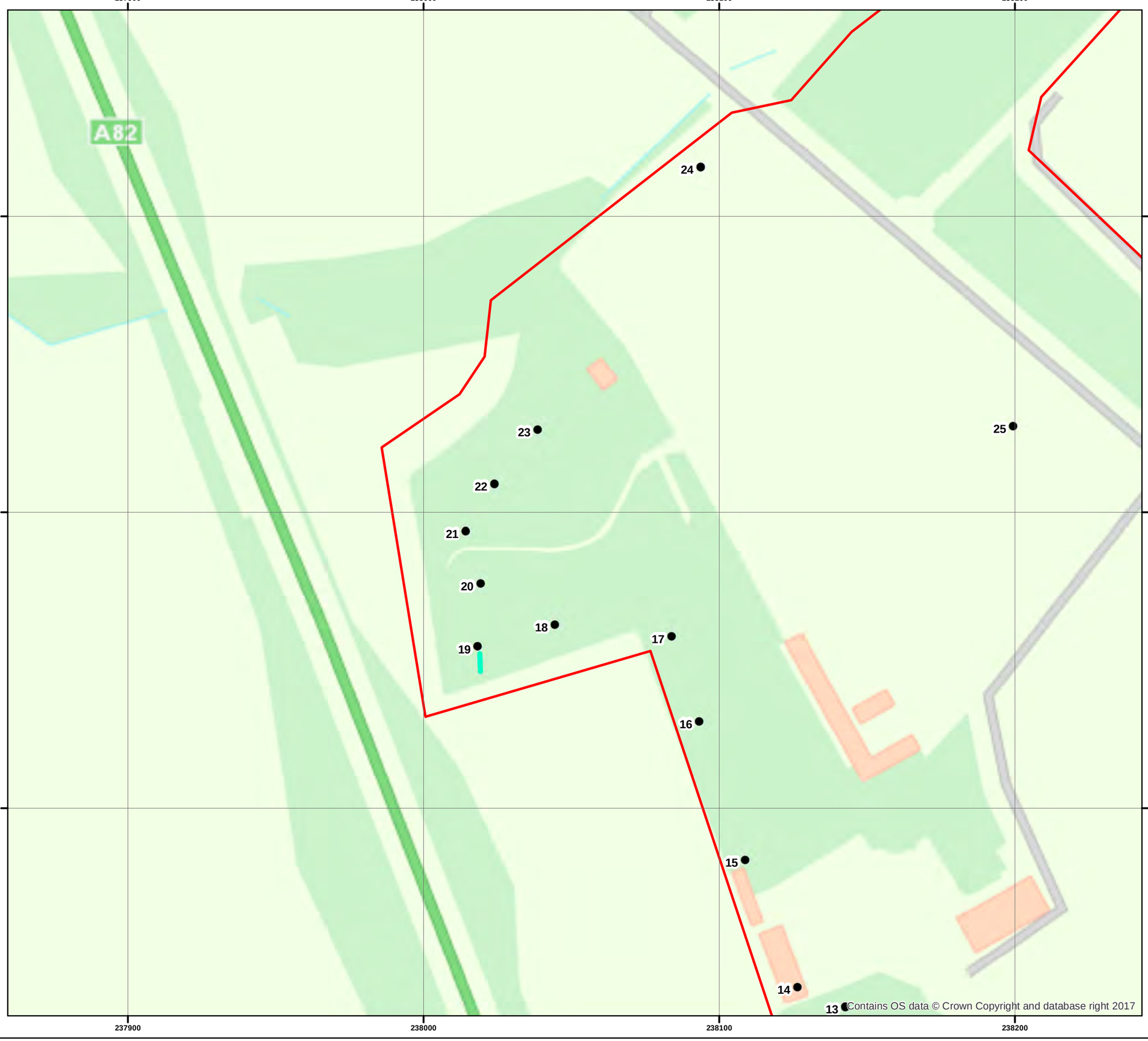

Legend

- Site Boundary
- Proposed Receptors
- 2m High Acoustic Barrier

Do not scale this map

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Project
West Riverside Balloch

Title
Site Design Noise Mitigation

Status
FINAL

Drawing No.
168659 - 049

Revision

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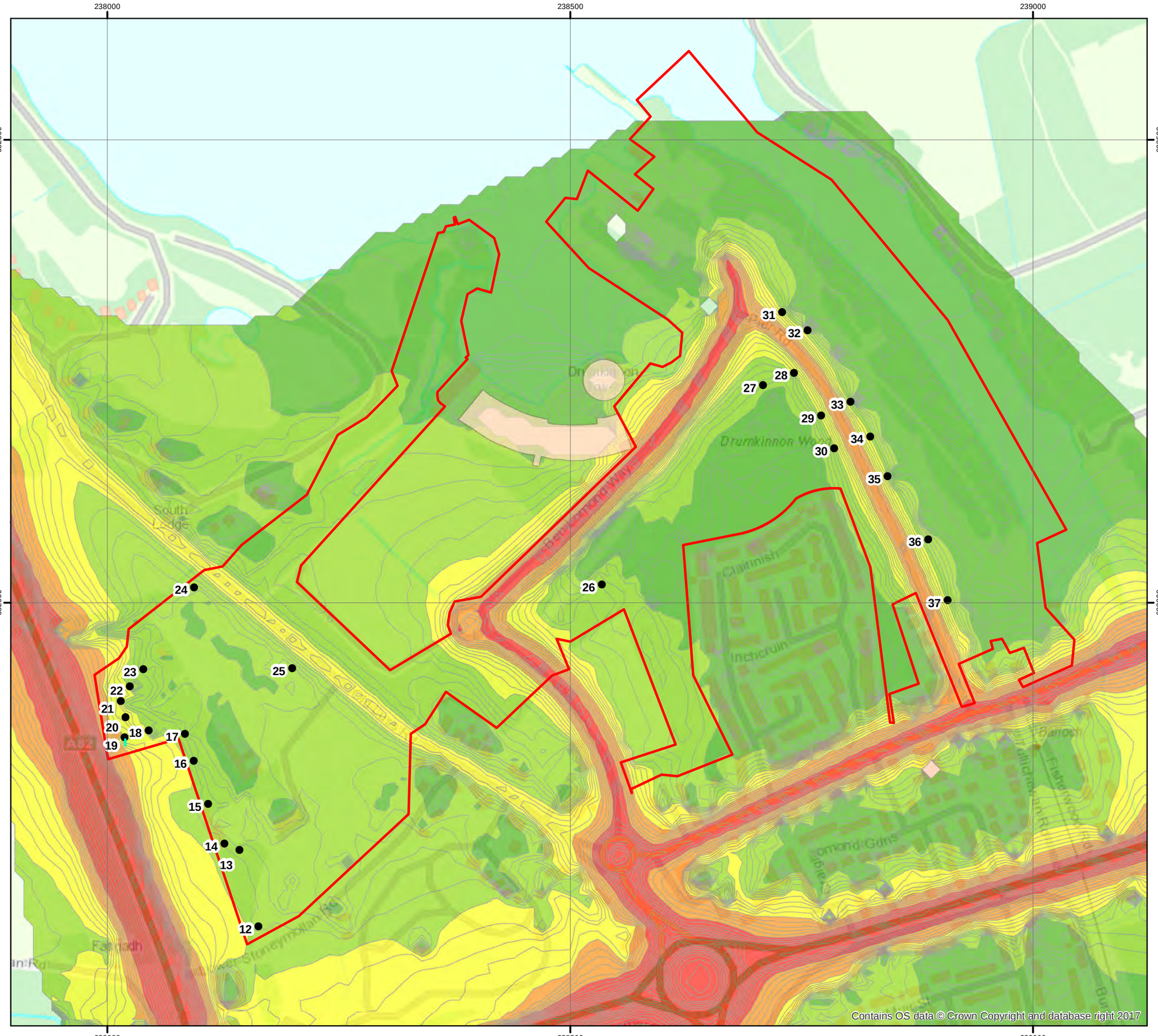

Legend

- Acoustic Barrier
- Site Boundary
- Proposed Receptors

LAeq dB(A)

- < 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65

Do not scale this map

Client
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Project
West Riverside Balloch

Title
CadnaA Free-field Noise Contours
2020, Daytime, 1.5m Receptor Height

Status
FINAL

Drawing No.
168659 - 046

Revision

Scale
1:4,000

A3

Date
06 April 2018

Drawn	Checked	Approved
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Legend

- Site Boundary
- Proposed Receptors
- Acoustic Barrier

LAeq dB(A)

- < 40
- 40 - 45
- 45 - 50
- 50 - 55
- > 55

Do not scale this map

Client
TSL Contractors Limited

Project
West Riverside Balloch

Title
CadnaA Free-field Noise Contours
2020, Night-time, 1.5m Receptor Height

Status
FINAL

Drawing No.	Revision
168659 - 047	

Scale		Date
1:4,000	A3	06 April 2018

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