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Royal Prince Alfred Hospital Redevelopment (RPAH Redevelopment)

Early Works - Construction Noise and Vibration Management Plan

RPA-ACO-ACL-MPL-EW5-000001 - Rev A

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1 INTRODUCTION

Acoustic Logic (AL) have been engaged to prepare a construction noise and vibration management plan for the early works construction phase and Temporary Helipad Construction, for the Royal Price Alfred Hospital (RPAH) redevelopment, located at 50 Missenden Road, Camperdown.

The key issues addressed within this report are as follows:

- Identification of the noise and vibration standards and statutory requirements which will be applicable to this project.
- Identification of potentially impacted nearby sensitive noise receivers to the development.
- Identify likely sources of noise and vibration generation during construction and predicted noise levels at nearby development.
- Formulation of a strategy to comply with the standards identified and mitigation treatments in the event that compliance is not achievable.

This report has been prepared to satisfy the requirements maintained within the project's development consent (Ref: SSD-47662959).

2 SITE DESCRIPTION

The site is maintained on Lot 1000 DP 1159799, and is bound by the existing operational RPA Hospital to the west, the Centenary Institute to the north, and University of Sydney's Bruce William Pavilion and Susan Wakil Health Building to the east and south respectively. The site is surrounded by various residential, commercial, hospital, university, research and active recreation noise sensitive receivers generally.

The works maintained within Early Works and Site Establishment pertain specifically to works along Lambie Dew Drive and John Hopkins Drive.

The closest affected sensitive receivers within the vicinity of the site are as follows:

Table 1 – Surrounding Noise Sensitive Receivers

ID No.	Receiver Description	Receiver Category
R1	St. John's College	Residential
R2	St Andrew's College	
R3	Queen Mary Building, 106-112 Church St	
R4	15 Church Street	
H1	Existing operational RPA Hospital - Main Building, Tissue Pathology and Diagnostic Oncology Building and Gloucester House	Hospital Ward
H2	Chris O'Brien Lifehouse	
H3	Building 12 – Anatomical Pathology Department	
H4	Professor Marie Bashir Centre	
H5	Radiation Oncology Department	
H6	Naamuru Parent and Baby Unit	
E1	CreateSpace and Susan Wakil Health Building, University of Sydney	Education
E2	Charles Perkins Centre	
E3	Surgical and Robotic Training Institute	
Re1	Centenary Institute	Research Facilities
Re2	ANSTO Cyclotron	
C1	7-Eleven Camperdown	Commercial
C2	King George V Building (hospital administration)	

See an aerial photo in Figure 1 below for detailed receiver locations and monitor locations.

Figure 1: Site Map with Nearest Sensitive Receivers (Sourced from Bing Maps)

3 DEVELOPMENT CONSENT – SSD-47662959

The following Construction Noise and Vibration Management Plan has been prepared to address the requirements of the following consent conditions (Ref: SSD-47662959):

> ***B26***. *Management plans required under this consent must be prepared having regard to the relevant guidelines, including but not limited to the Environmental Management Plan Guideline: Guideline for Infrastructure Projects (DPIE April 2020)…*
>
> ***B29***. *The Construction Noise and Vibration Management Sub-Plan must address, but not be limited to, the following:*
>
> *(a) be prepared by a suitably qualified and experienced noise expert;*
>
> *(b) describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009);*
>
> *(c) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;*
>
> *(d) include strategies that have been developed with the community for managing high noise generating works;*
>
> *(e) describe the community consultation undertaken to develop the strategies in condition B29(d);*
>
> *(f) include a complaints management system that would be implemented for the duration of the construction; and*
>
> *(g) include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition B26…*
>
> ***C14***. *The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures identified in 'Noise and Vibration Impact Assessment for SSDA AC07', (Revision K), prepared by ARUP and dated 27 June 2023.*
>
> ***C15***. *The Applicant must ensure construction vehicles (including concrete agitator trucks) do not arrive at the site or surrounding residential precincts outside of the construction hours of work outlined under conditions C4, C5, and C6.*
>
> ***C16***. *The Applicant must implement, where practicable and without compromising the safety of construction staff or members of the public, the use of 'quackers' to ensure noise impacts on surrounding noise sensitive receivers are minimised.*
>
> ***C17***. *Vibration caused by construction at any residence or structure outside the site must be limited to:*
>
> *(a) for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999); and*
>
> *(b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).*

***C18**. Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in condition C17.*

***C19**. The limits in conditions C17 and C18 apply unless otherwise outlined in a Construction Noise and Vibration Management Plan, approved as part of the CEMP required by condition B29 of this consent.*

4 PROPOSED CONSTRUCTION ACTIVITIES

This assessment is based upon the proposed construction activities associated with the early works and site establishment for the hospital extension, as well as the proposed works for the Temporary Helipad.

4.1 EARLY WORKS AND SITE ESTABLISHMENT

The information provided to this office of the primary noise producing activities associated with the site are as follows below:

- **Stage 1 – Lambie Dew Drive - 12/10/2023 – 08/04/2024:**
    - Demolition of road surface and Non-destructive digging to services level.
    - Laying new services, inclusive of Sewer, Stormwater, Electrical and Communications, Water and Fire Services.
    - Backfill / compaction / resurfacing roads.
    - Contamination investigation inclusive of using excavators and drill rigs.
    - Mobile cranes for site establishment.
    - Forklifts for material handling.
    - Demolition of existing buildings within Stage 1 work zone.
    - Site establishment works (Perimeter hoardings, gates, accommodation).
    - Trucks and articulated vehicles to move materials and components.
- **Stage 2 – John Hopkins Drive and Lambie Dew Drive – 23/11/2023 – 16/05/2024:**
    - Demolition of road surface and Non-destructive digging to services level.
    - Laying new services, inclusive of Sewer, Stormwater, Electrical and Communications, Water and Fire Services.
    - Backfill / compaction / resurfacing roads.
    - Contamination investigation inclusive of using excavators and drill rigs.

Note Stage 1 and Stage 2 works are to occur in tandem.

Vehicles are to access the site and deliver goods / remove material via John Hopkins Drive.

See Figure 2 below for an aerial view of the construction zone layout provided to this office.

Early Works Site Establishment

Stage 1: Lambie Dew Drive (service re-diversions and road realignment)
- To commence post SLHD enabling works activities.
- Demolition and site clearing to commence post SSDA Approval.
- Service re-alignment works to occur in tandem with site clearing works

Stage 2: John Hopkins Dr & Lambie Dew Dr (service re-diversions)
- Construction and public traffic to be managed under traffic control
- Works to be carried out in a staged approach to maintain traffic flow
- Works to occur in tandem with Stage 1 Works

LEGEND

- TIMBER HOARDING + JERSEY BARRIER
- CHAINWIRE FENCE + MESH
- TRAFFIC CONTROL
- PORTABLE TRAFFIC LIGHT
- CONSTRUCTION VEHICLE ACCESSWAY
- GATE — CONSTRUCTION VEHICLE ACCESS
- P — TURNSTILES / PEDESTRIAN WORKER ACCESS
- WORKFORCE PATH OF TRAVEL
- B-TYPE GANTRY + SITE ACCOMODATION
- MAINTAIN CRITICAL ACCESS POINTS
- STAGE 1 WORKS
- STAGE 2 WORKS - PROGRESSIVE STAGING
- PROJECT OFFICE

Note: Project Office to be based in Level 02 Carpark Area/Future expansion Area

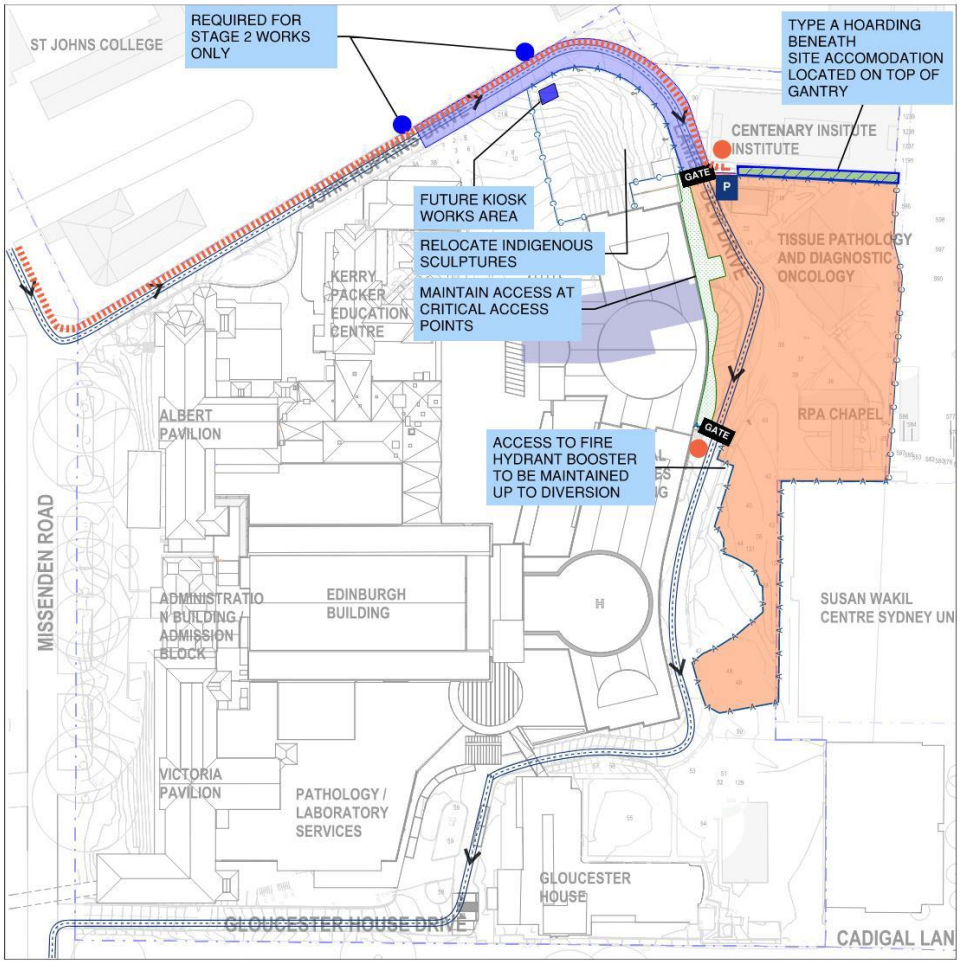


Figure 2: Early Works Site Establishment Plan

4.2 TEMPORARY HELIPAD WORKS

The following phases of work, and the associated timeframes of these works are proposed to be conducted during the construction of the Temporary Helipad:

- **Site establishment - 13/10/23 - 26/10/23:**
    - Use of Mobile Crane to lift in sheds on L5 carpark level.
    - Use of chainsaws and EWPs for tree trimming.
    - Use of Franna Cranes to move light poles.
- **In-ground works - 26/10/23 - 18/12/23:**
    - Pavement demolition using road saw and excavator with bucket.
    - Piling works.
    - Excavation of lift pits using excavator with bucket.
    - FRP of lift pits - line or boom pump to be used.
- **Fit out works - 26/10/23 - 21/03/24:**
    - Core drilling into carpark slab for drainage rough-in / structural steel installation.
- **Structural Works - 19/12/23 - 09/04/24:**
    - FRP of lift core and suspended lobby slabs using boom pump.
- **Facade/Roofing works - 26/03/24 - 22/04/24:**
    - Install structural steel canopy using crane.
    - EWPs such as boom or scissor lifts may be used as a means of access to install edge protection, structural steel etc.
- **Asphalting road - 15/05/24-20/05/23:**
    - Compact road base using roller.
    - Asphalting road surface using bitumen-spraying truck.

See Figure 3 below for an aerial indication of the works zone associated with the THLS works, as well as the stationary plant locations for the site.

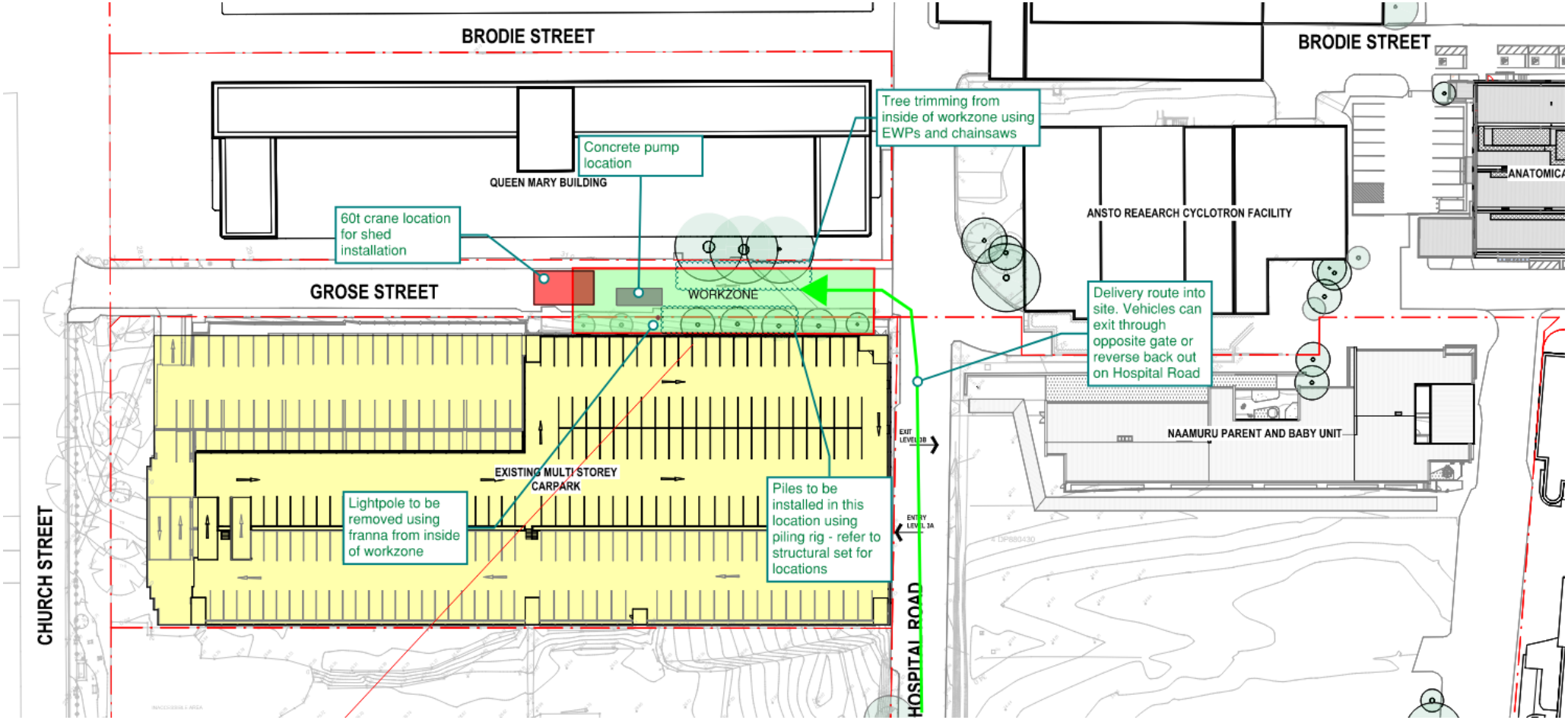


Figure 3: THLS Work Zone Plan

5 HOURS OF WORK

Conditions C4 through C9 outline the approved construction hours for the development, and these conditions are reciprocated below for reference (Ref: SSD-47662959).

***C4**. Construction, including the delivery of materials to and from the site, may only be carried out between the following hours:*

(a) between 7am and 6pm, Mondays to Fridays inclusive.

(b) between 8am and 1pm, Saturdays.

No work may be carried out on Sundays or public holidays.

***C5**. Notwithstanding condition C4, provided noise levels do not exceed the highly noise affected construction noise management levels at any residential receiver as outlined in Table 27 of 'Noise and Vibration Impact Assessment for SSDA AC07', (Revision K), prepared by ARUP and dated 27 June 2023, works may also be undertaken during the following hours:*

(a) between 7am and 8am, and 1pm and 7pm, Saturdays.

***C6**. Construction activities may be undertaken outside of the hours in condition C4 and C5 if required:*

(a) where the works relate to construction activities 3a, 3b, 3c, 3d, 5 and 7a as identified in Table 39 of 'Noise and Vibration Impact Assessment for SSDA AC07', (Revision K), prepared by ARUP and dated 27 June 2023; or

(b) by the Police or a public authority for the delivery of vehicles, plant or materials; or

(c) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or

(d) where the works are inaudible at the nearest sensitive receivers; or

(e) for the delivery, set-up and removal of construction cranes, where notice of the crane-related works is provided to affected residents at least seven days prior to the works; or

(f) where a variation is approved in advance in writing by the Planning Secretary or her nominee if appropriate justification is provided for the works.

***C7**. Construction activities relating to internal fit-out works may be undertaken outside of the hours in condition C4 and C5 if required, provided that:*

(a) management and mitigation measures are implemented in accordance with the practices outlined in Table 44 of 'Noise and Vibration Impact Assessment for SSDA AC07', (Revision K), prepared by ARUP and dated 27 June 2023;

(b) the façade near where the works are being conducted is entirely closed during extended construction hours; and

(c) deliveries for the internal fit-out works are undertaken during the approved construction hours in condition C4.

***C8**. Notification of such construction activities as referenced in conditions C5(a) and C7 must be given to affected residents before undertaking the activities or as soon as is practical afterwards.*

***C9**. Rock breaking, rock hammering, sheet piling, pile driving and similar activities may only be carried out between the following hours:*

(a) 9am to 12pm, Monday to Friday;

(b) 2pm to 5pm Monday to Friday; and

(c) 9am to 12pm, Saturday.

The approved construction noise hours applicable to works on the site are summarised within the table below:

Table 2 – Approved Construction Hours (Ref: SSD-47662959)

Works	Note	Approved Construction Hours
Rock breaking, hammering, sheet piling, pile driving and similar construction activities	Implementation of respite periods in line with Condition C9	Monday – Friday 9am-12pm & 2pm-5pm Saturday 9am-12pm
Internal fit-out works	Comply with the requirements of Condition C7	Unrestricted Construction Hours
All other works	All other works generally	Monday – Friday 7am-6pm Saturday 8am-1pm
	Works which result in an external noise level below the Highly Noise Affected Management Level at all residential receivers	Monday – Friday 7am-6pm Saturday 7am-7pm
	Works which adhere to one of the conditional requirements outlined within Condition C6	Unrestricted Construction Hours

6 AMBIENT NOISE SURVEY

This assessment makes reference to the unattended noise monitoring conducted for the project site at DA, collated by ARUP (Ref: RPA-ACO-ARP-RPT-MW-SSDA-K). The following table summarises the results of the unattended noise monitoring.

Table 3 – Environmental Noise Survey Results (RPA-ACO-ARP-RPT-MW-SSDA-K)

Location	Time Period	Rating Background Noise Levels (dB(A) L_{90})
St John's College	Day (7am-6pm)	52
	Evening (6pm-10pm)	51
	Night (10pm-7am)	49
St Andrew's College	Day (7am-6pm)	51
	Evening (6pm-10pm)	51
	Night (10pm-7am)	50
Queen Mary Building	Day (7am-6pm)	48
	Evening (6pm-10pm)	48
	Night (10pm-7am)	43

6.1 SUPPLEMENTARY INTERNAL BACKGROUND NOISE MEASUREMENTS

Acoustic Logic attended site on Friday 3rd of March and Friday 10th of March 2023 to conduct supplementary internal noise measurements within a variety of noise-sensitive spaces surrounding the project site. The results of this attended noise survey within sensitive spaces has been used in the establishing of internal noise criteria for construction works within surrounding sensitive spaces. Internal noise measurements were conducted within the following receivers:

- The existing operational hospital.
- Centenary Institute.

6.1.1 Equipment Used

Attended noise monitoring was conducted using a Norsonic N-140 Type 1 sound level meter.

The sound level meters were calibrated at the beginning and the end of the measurement; no significant drift was detected. Measurements were taken on fast time response.

6.1.2 Locations Monitored

The attended measurements were conducted on Friday 03rd of March and Friday 10th of March 2023 from 9:00am to 3:00pm. Individual measurements were conducted in spaces nominated within the table below.

6.1.3 Results

The attended measurement results are presented in the table below.

Table 4 – Measured Background Noise Levels at Attended Measurement Locations

Building	Level	Measurement Location	Time of day	Measured Background Noise Level dB(A)L_{90}
RPA Main Building and Gloucester House	Level 02	Education Centre - Lab	Friday 03rd of March 2023 & Friday 10th of March 2023 9:00am - 3:00pm	47
	Level 03	Delivery Room		44
		Neonatal Ventilated Nursery		55
		ICU Room		44
		Cyclotron		61
	Level 04	Anaesthetics Engineering Lab		47
		Molecular Biology Lab		43
	Level 05	Investigational Drug Research		53
		Radiology – CT Scanner		46
		Haematology - Microscopes		58
	Level 06	Microbiology – Microscopes		56
	Level 07	Pathology Laboratory		59
	Level 11	Sleep Lab – Observation Room 1		44
		Sleep Lab – Observation Room 2		40
Centenary Institute	Level 01	Laser Scanning Microscope		53
	Level 04	Breeding Room 1		59
		Rat Operating Room		41
		Breeding Room 4		64
		Experimentation Room 1		65

7 NOISE AND VIBRATION MANAGEMENT LEVELS

7.1 SSDA ACOUSTIC ASSESSMENT (REF: RPA-ACO-ARP-RPT-MW-SSDA-K)

The SSDA Acoustic Assessment for the development, prepared by ARUP, outlines preliminary construction noise management levels and construction vibration criteria to surrounding sensitive noise receivers (Ref: RPA-ACO-ARP-RPT-MW-SSDA-K). The requirements presented within Section 6 are formulated with reference to the preliminary requirements presented within the SSDA Acoustic Assessment. AL note that the SSDA Assessment calls for iteration to the requirements presented within the Preliminary Assessment throughout the Design Development process, stating specifically with respect to noise sensitive spaces:

> *Baseline noise levels should be measured to inform the establishment of appropriate criteria.*

As such, AL have conducted a detailed investigation of existing internal background noise levels and ambient vibration profiles of spaces within the existing operational hospital and Centenary Institute animal houses to appropriately assess the impacts of construction on these facilities, and the results of this investigation are presented throughout Section 6.

7.2 NOISE MANAGAMENT LEVELS

7.2.1 EPA Interim Construction Noise Guideline

Given the scale of the proposed works, the "quantitative" assessment procedure, as outlined in the Interim Construction Noise Guideline (ICNG) will be used.

The quantitative assessment method requires:

- Determination of noise generation management levels (based on ambient noise monitoring).
- Prediction of operational noise levels at nearby development.
- If necessary, recommendation of noise controls strategies in the event that compliance with noise emission management levels is not possible.

7.2.1.1 Residential Receivers

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- *"Noise affected" level*. Where construction noise is predicted to exceed the "noise effected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise effected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than 10dB(A)$L_{eq(15min)}$.
- "*Highly noise affected level"*. Where noise emissions are such that nearby properties are "highly noise effected", noise controls such as respite periods should be considered. For residential properties, the "highly noise effected" level occurs when construction noise exceeds 75dB(A)$L_{eq(15min)}$ at nearby residences.

7.2.1.2 Commercial Receivers

"The external noise levels should be assessed at the most-affected occupied point of the premises:

- *Offices and retail outlets – External $L_{Aeq(15\ min)}$ = 70 dB(A)."*

7.2.1.3 Education Receivers

"The internal noise levels should be assessed at the centre point of an occupied room…

- *Classrooms at schools and other educational institutions – Internal $L_{Aeq(15\ min)}$ = 45 dB(A)."*

7.2.1.4 Noise Sensitive Receivers – Hospital and Research Buildings

For general hospital wards and operating theatres, the Interim Construction Noise Guideline 2009 (ICNG) denotes an internal noise management level of 45dB(A). Exclusive of these two spaces, the ICNG does not denote criteria for other spatial uses within a hospital or research building, however, does note the following with regards to other noise sensitive land uses:

> *"Other noise-sensitive businesses… The proponent should undertaken a special investigation to determine suitable noise on a project-by-project basis…"*

Acoustic Logic attended the project site to measure the existing background noise levels in particular locations within the existing hospital building to establish appropriate criteria for these spaces, and the results of this internal ambient noise testing have been presented within Section 5.1.3 of this report. An internal noise management level of the measured background noise level + 5dB(A) for the spaces presented will be adopted for this assessment.

7.2.2 Outside of Hours Works – SSDA Acoustic Assessment (Ref: SSD-47662959)

The SSDA Acoustic Assessment, prepared by ARUP, notes that for out-of-hours work, the ICNG uses a noise level 5 dB above the background noise level as a threshold where the proponent should negotiate with the community. Further, whilst a highly noise affected level not being mandated within the ICNG, the SSDA Assessment adopts a 'highly-noise affected level' of 5 dB above the noise affected level for residential receivers. These requirements are reciprocated within this assessment.

7.2.3 Summarised Construction Noise Management Levels

A summary is presented within Table's 5 and 6 below.

Table 5 – Noise Management Levels

Receiver Type	Receiver / Room Usage	Noise Management Level dB(A) $L_{eq(15min)}$	OOH Noise Management Levels dB(A) $L_{eq(15min)}$
Residential	R1	*Noise Affected Level* - 62 (Externally) *Highly Noise Affected Level* - 75 (Externally)	*Noise Affected Level* - 54 (Externally) *Highly Noise Affected Level* - 59 (Externally)
	R2	*Noise Affected Level* - 61 (Externally) *Highly Noise Affected Level* - 75 (Externally)	*Noise Affected Level* - 55 (Externally) *Highly Noise Affected Level* - 60 (Externally)
	R3 and R4	*Noise Affected Level* - 58 (Externally) *Highly Noise Affected Level* - 75 (Externally)	*Noise Affected Level* - 48 (Externally) *Highly Noise Affected Level* - 53 (Externally)
Commercial	C1 and C2	70 (Externally)	
Education	E1, E2 and E3	45 (Internally) 55 (Externally)	
Hospital and Research	H1 and Re1	See Table 6 for Detailed Assessment	
	H2 – H6 and Re2	45 (Internally) 55 (Externally)	

Table 6 – Detailed Internal Noise Management Levels – H1 and Re1

Receiver	Level	Location	Internal Construction Noise Management Level dB(A)$L_{eq(15min)}$
H1 RPA Main Building and Gloucester House	Level 03	Delivery Room	49
		Neonatal Ventilated Nursery	60
		ICU Room	49
		Cyclotron	66
	Level 04	Anaesthetics Engineering Lab	52
		Molecular Biology Lab	48
	Level 05	Investigational Drug Research	58
		Radiology – CT Scanner	51
		Haematology - Microscopes	63
	Level 06	Microbiology – Microscopes	61
	Level 07	Pathology Laboratory	64
	Level 11	Sleep Lab – Observation Rooms	45
Re1 Centenary Institute	Level 01	Laser Scanning Microscope	58
	Level 04	Animal Housing / Breeding / Observation Rooms	64
		Rat Operating Room	46

If noise levels exceed the management levels identified in the table above, reasonable and feasible noise management techniques will be reviewed.

7.3 CONSTRUCTION VIBRATION CRITERIA

Vibration criteria for the nearest receivers will be based on the following documents:

- DIN 4150, *'Vibration in Buildings (1999-02).'*
- EPA *"Assessing Vibration: A technical guideline."*
- ASHRAE Handbook 2019.
- Project SSDA Noise and Vibration Impact Assessment, prepared by ARUP (Ref: RPA-ACO-ARP-RPT-MW-SSDA-K).

7.3.1 DIN 4150

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in the table below.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 7 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

7.3.2 Assessing Amenity

Table 2.2 of EPA "Assessing Vibration: A technical guideline" specified the following vibration goal for human comfort:

Table 8 – Preferred and Maximum Weighted RMS Values for Vibration Acceleration (m/s^2) 1-80 Hz

Location	Assessment Period	Preferred Values Z-axis	Preferred Values X & Y-axis	Maximum Values Z-axis	Maximum Values X & Y-axis
Continuous Vibration					
Critical Areas	Day time	0.005	0.0036	0.010	0.0072
Residences	Day time	0.010	0.0071	0.020	0.014
Office	Day time	0.020	0.014	0.040	0.028
Impulsive Vibration					
Critical Areas	Day time	0.005	0.0036	0.010	0.0072
Residence	Day time	0.3	0.21	0.6	0.42
Office	Day time	0.64	0.46	1.28	0.92

Acceptable values for intermittent vibration shall comply with the requirements in Table 2.4 of EPA "Assessing Vibration: A technical guideline" detailed as below.

Table 9 - Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Day time preferred value	Day time maximum value
Critical Areas	0.10	0.20
Residences	0.20	0.40
Office	0.40	0.80

7.3.3 Hospital Specific Vibration Limits

This office has been advised that vibration sensitive equipment is located within the existing hospital.

No specific allowable vibration levels have been provided to this office for vibration-sensitive equipment maintained within either the existing hospital, or surrounding sensitive receivers. Given this, the appropriate vibration curve from the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook based on the equipment type will be used.

Where existing vibration limits for sensitive equipment are set and provided by the manufacturer, these vibration limits supersede the requirements listed as part of this management plan, and should be provided to Acoustic Logic for review and incorporation into the requirements provided within this plan.

As no specific manufacturer equipment vibration limits have been provided to this office currently, the ASHRAE Handbook specifies vibration levels associated with potential disruption to the use of sensitive equipment within a building have been used to establish criteria. The maximum vibration velocities [$mm.s^{-1}$] recommended from 1-100Hz is given in Figure 37 of the ASHRAE used in conjunction with recommended equipment requirements curves given in table 46. Figure 37 and table 46 from the 2019 ASHRAE document is presented below in Figure 4 and Table 10 respectively.

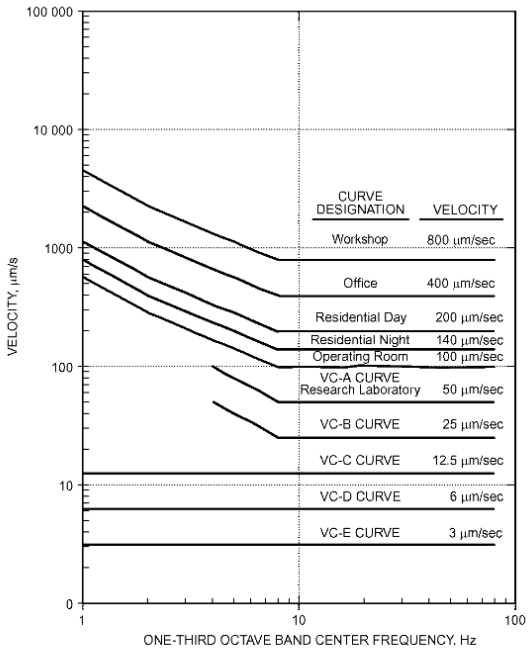


Fig. 42 Building Vibration Criteria for Vibration Measured on Building Structure

Figure 4 – Fig. 42 from 2019 ASHRAE Handbook: Vibration Criteria Curves

Table 10 – Tab. 46 from 2019 ASHRAE Handbook: Equipment Vibration Criteria

Equipment Requirements	Curve * (μms^{-1})
Adequate for computer equipment, probe test equipment, and microscopes less than 40x magnification	200 (Residential – day)
Bench Microscopes up to 100x magnification; laboratory robots	100 (Operating Room)
Bench microscopes up to 400x magnification; optical and other precision balances; coordinate measuring machines; metrology laboratories; optical comparators; microelectronics manufacturing equipment; proximity and projection aligners, etc.	50 (VC – A)
Microsurgery, eye surgery, neurosurgery; bench microscopes at magnification greater than 400x magnification; optical equipment on isolation tables; microelectronic manufacturing equipment, such as inspection and lithography equipment (including steppers) to 3mm line widths	25 (VC – B)
Electron microscopes up to 30,000x magnification; microtomes; magnetic resonance imagers; microelectronics manufacturing equipment, such as lithography and inspection equipment to 1mm detail size	12.5 (VC – C)
Electron microscopes at magnification greater than 30,000x magnification; mass spectrometers; cell implant equipment; microelectronic manufacturing equipment such as, aligners, steppers and other critical equipment for photolithography with line widths of 1/2μm; includes electron beam systems	6 (VC – D)
Un-isolated laser and optical research systems; microelectronics manufacturing equipment, such as aligners, steppers and other critical equipment for photolithography with line widths of 1/4μm; includes electron beam systems	3 (VC – E)

a. See Figure 4 for corresponding vibration curve.

All vibration monitoring results recorded on site are presented against the vibration curves listed above. The appropriate level of vibration will ultimately be determined by the staff operating the equipment and whether or not the level of distortion created by the excavation works is acceptable. We note that the VC curves are a representation of the level of disruption to the activities and/or operations undertaken by the machine and not the limit where damage would be expected to occur to the unit.

7.3.4 H1 and Re1 Specific Vibration Limits

Site investigations and attended ambient vibration measurements were carried out by this office on Friday 03rd of March and Friday 10th of March 2023 within the existing operational RPA Hospital (H1) and the Centenary Institute (Re1). The following table provides spaces which were identified to contain vibration sensitive equipment, and the associated ambient RMS velocity measured within the spaces within the z-direction:

Table 11 – Measured Ambient Vibration Levels – H1 and Re1

Receiver	Level	Location	Maximum Measured Z-Direction Ambient RMS Velocity (μms^{-1})
H1 RPA Main Building and Gloucester House	Level 03	Cyclotron	4 (VC-E)
	Level 05	Radiology – CT Scanners	25 (VC-B)
		Radiology – MRI Machines	20 (VC-C)
		Radiology – X-Ray Machines	30 (VC-B)
		Haematology - Microscopes	60 (VC-A)
Re1 Centenary Institute	Level 01	Laser Scanning Microscope	20 (VC-C)

7.3.5 Animal Houses - Noise and Vibration Impact Assessment (Ref: RPA-ACO-ARP-RPT-MW-SSDA-K)

The Noise and Vibration Impact Assessment outlines construction vibration criteria for the animal houses maintained within the Centenary Institute (Re1), and was formulated with reference to the US National Institutes of Health Guideline, "*Design Requirements Manual for NIH Biomedical and Animal Research Facilities,*" and this criteria will be adopted for the experimental and breeding rooms maintained on Level 4 of the Centenary Institute building.

Similar criteria will be adopted for the animal houses maintained on Basement 1 of the Charles Perkins Centre.

The Animal House criteria nominated is as follows:

Table 12 – Animal House Vibration Criteria - Re1 and E2

Receiver	Level	Location	Nominated Vibration Criteria
Re1 Centenary Institute	Level 04	Breeding / Experimental / Holding Rooms	Curve 1 of AS2670.2 (1/3rd Octave band RMS velocity < 0.1mm/s) and Transient Peak Velocity > 1.0mm/s
E2 Charles Perkins Centre	Basement 1		

7.3.6 E2 - Charles Perkins Centre Vibration Sensitive Equipment

A list of vibration sensitive equipment maintained within the Basement 1 floorplate of Receiver E2 has been provided to this office, and the vibration limits of these items of equipment have been provided within the table below. Note the vibration limits within receiver E2 are subject to change based upon a baseline monitoring site attendance to be conducted by this office, similar to that conducted for H1 and Re1.

Table 13 – Recommended Vibration Limits*

Receiver	Location	Recommended Vibration Limits PPV (μms^{-1})
E2 Charles Perkins Centre	Light Surgical Microscopes (Nikon SMZ800N and similar)	VC-B (ASHRAE Handbook)
	Stria Tech Optodrum	VC-A (ASHRAE Handbook)
	EchoMRI and 7T MRI	VC-C (ASHRAE Handbook)
	Kuka Surgery Robot	100*
	CT Scanners and Ultrasound Scanners	VC-B (ASHRAE Handbook)
	Intravital Microscope AZ100	VC-B (ASHRAE Handbook)
	Faxitron DEXA X-ray Scanner	
	PET/CT Si78 X ray Scanner	
	IVIS Spectrum Scanner	VC-C (ASHRAE Handbook)

**To be assessed based upon site attendance to be conducted by Acoustic Logic.*

7.3.7 Summarised Recommended Vibration Limits

The summarised vibration criteria are presented in the table below.

Table 14 – Recommended Vibration Limits

Receiver	Location	Recommended Vibration Limits PPV (mms^{-1})
Residential (R1 – R4)	All	5
Commercial (C1 and C2)		20
Hospital Receivers (H2 – H6)		Operating Theatres – 0.1 All other areas - 20
Educational Receivers (E1 and E3)		20
H1 RPA Main Building and Gloucester House	Operating Theatres	0.1
	Cyclotron	VC-E (ASHRAE Handbook)
	Radiology – CT Scanners	VC-B (ASHRAE Handbook)
	Radiology – MRI Machines	VC-C (ASHRAE Handbook)
	Radiology – X-Ray Machines	VC-B (ASHRAE Handbook)
	Haematology - Microscopes	VC-A (ASHRAE Handbook)
	Bench Microscopes <400x Magnification	VC-A (ASHRAE Handbook)
	Bench Microscopes >400x Magnification	VC-B (ASHRAE Handbook)
	All non-vibration sensitive spaces within H1	20
Re1 Centenary Institute & E2 Charles Perkins Centre	Laser Scanning Microscope	VC-C (ASHRAE Handbook)
	Breeding and Experimental Rooms	1/3rd Octave band RMS velocity < 0.1mm/s and Transient Peak Velocity > 1.0mm/s
E2 Charles Perkins Centre*	Light Surgical Microscopes (Nikon SMZ800N and similar)	VC-B (ASHRAE Handbook)
	Stria Tech Optodrum	VC-A (ASHRAE Handbook)
	EchoMRI and 7T MRI	VC-C (ASHRAE Handbook)
	Kuka Surgery Robot	0.1*
	CT Scanners and Ultrasound Scanners	VC-B (ASHRAE Handbook)
	Intravital Microscope AZ100	VC-B (ASHRAE Handbook)
	Faxitron DEXA X-ray Scanner	
	PET/CT Si78 X ray Scanner	
	IVIS Spectrum Scanner	VC-C (ASHRAE Handbook)

**To be assessed based upon site attendance to be conducted by Acoustic Logic.*

8 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Noise impacts will be determined from primary processes and equipment. The sound power levels of these activities are presented below.

Table 15 - Sound Power Levels of the Proposed Equipment

Work Zone	Stage	Equipment/Process	Sound Power Level dB(A)	Operational Load (% of 15-min period)
Main Hospital – Site Establishment	Stage 1 and Stage 2 Works	Excavator with Hydraulic Hammer Attachment*	118	75
		Excavator with Bucket Attachment	105	75
		Excavator with Drill Attachment	112	100
		Concrete Saw*	118	75
		Articulated Truck Movement	105	8 Movements per hour
		Truck Idle	95	100
		Compactor	106	100
		Bored Piling Rig	103	75
		Concrete Trucks	109	4 Movements per hour
		Concrete Pumps	109	100
		Road Scraper	113	100
		Diesel Mobile Crane	113	25
		Roller	109	100
		Forklift	97	50
		Vacuum Truck – Non-Destructive Digger	109	75

**A tonality correction factor of 5dB(A) has been applied in line with the requirements of EPA documentation.*

The noise levels presented in the above table are derived from the following sources, namely:

- Table A1 of Australian Standard 2436-2010.
- Data held by this office from other similar studies.

Table 16 - Sound Power Levels of the Proposed Equipment

Work Zone	Stage	Equipment/Process	Sound Power Level dB(A)	Operational Load (% of 15-min period)
Temporary Helipad Works	Site Establishment	Diesel Mobile Crane	113	25
		Chainsaw	114	50
		Elevated Work Platform	98	10
		Material Handling Trucks	105	4 Movements per hour
	In-Ground Works and Fit-Out Works	Concrete Saw*	118	75
		Excavator with Bucket Attachment	105	75
		Bored Piling Rig	103	75
		FRP Pumps	109	100
		Material Handling Trucks	105	4 Movements per hour
		Drill	105	75
	Structural / façade / roofing works	FRP Pumps	109	100
		Material Handling Trucks	105	4 Movements per hour
		Diesel Mobile Crane	113	25
		Elevated Work Platform	98	10

Note the stages presented above are representative of the currently proposed concurrent works to be undertaken at the THLS work zone.

**A tonality correction factor of 5dB(A) has been applied in line with the requirements of EPA documentation.*

The noise levels presented in the above table are derived from the following sources, namely:

- Table A1 of Australian Standard 2436-2010.
- Data held by this office from other similar studies.

9 NOISE EMISSION ASSESSMENT

The following simultaneous construction scenarios have been modelled in order to assess the construction noise impacts associated with the proposed Site Establishment and THLS works for the RPA Hospital redevelopment, based upon the cumulative proposed scheduling for the site:

- Construction Scenario 1:
    - Stage 1 and Stage 2 of Main Hospital Site Establishment Works.
    - Site Establishment works within the THLS works zone.
- Construction Scenario 2:
    - Stage 1 and Stage 2 of Main Hospital Site Establishment Works.
    - In-Ground Works and Fit-Out Works within the THLS works zone.
- Construction Scenario 3:
    - Stage 1 and Stage 2 of Main Hospital Site Establishment Works.
    - Structural, façade and roofing works within the THLS works zone.

SoundPlan Environmental Noise Modelling Software has been used to predict the impact of airborne noise from the construction works within the above scenarios on surrounding noise sensitive receivers, and this is detailed within the following section.

9.1 PREDICTED NOISE EMISSIONS

An assessment of the principal sources of noise emissions has been undertaken to identify the activities that may produce noise and/or vibration impacts so that appropriate ameliorative measures can be formulated. SoundPlan noise modelling has been conducted based on information provided to this office of construction methodology and activities likely to be undertaken and presents the cumulative predicted external noise levels to the nearest surrounding receivers.

Noise levels from construction works have been predicted at the nearby development and assessed against EPA the “Noise Management Level”, as identified in section 6.

With regard to the noise level generated at the nearest receivers, noise levels will vary depending where on the construction site the work in undertaken. To address this, a range of predicted noise levels is provided. Predicted noise levels are presented below.

The predicted noise levels are based on the assumption that the recommendations in section 9 have implemented/observed.

9.2 SOUNDPLAN MODELLING

Noise levels have been predicted at the receiver locations using SoundPlan™ 8.0 modelling software implementing the ISO 9613-2:1996 "Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation" noise propagation standard.

Noise enhancing meteorological effects have been adopted as recommended by the NPfI, noting that the ISO 9613 modelling approach assumes that all receivers are 'downwind' (i.e., that noise enhancing wind and temperature inversion conditions are in effect at all times).

Ground absorption was conservatively calculated with a ground factor of 0 for all areas except for localised lawns and greenery with a ground factor of 0.6 as recommended in *Engineering Noise Control* (Bies & Hanson).

In line with Factsheet C of the NPfI, penalties for annoying noise characteristics should be applied at the receiver, where applicable. Based on the predicted noise levels, no penalty should be applied (either for tonality, intermittency, or otherwise).

Figure's 5 through 7, in conjunction with the façade noise levels provided within Appendix A of this document, present the results of the SoundPlan Noise modelling, and they are summarised in Table's 17 and 18 below.

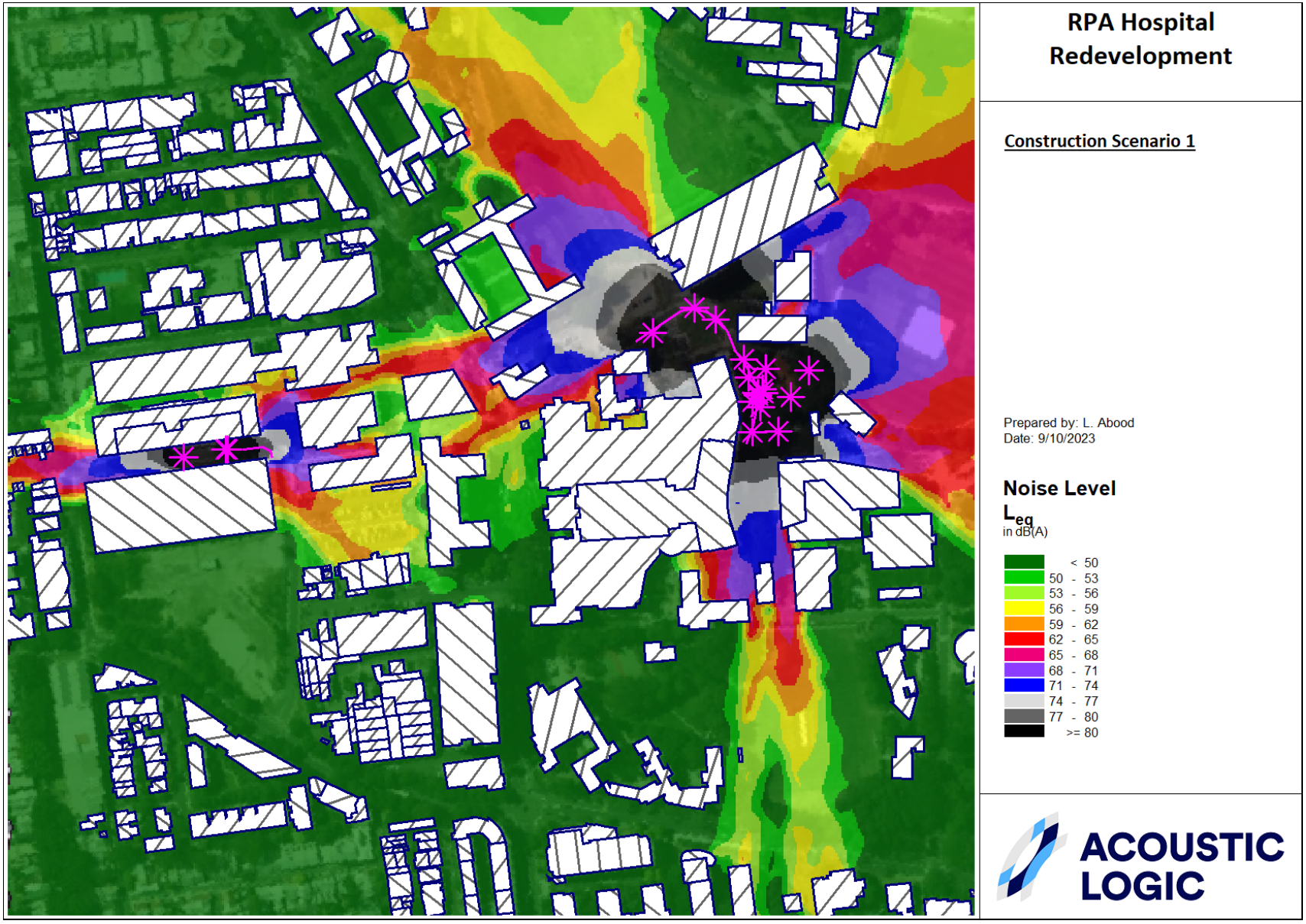


Figure 5: RPA Hospital Redevelopment – Construction Scenario 1

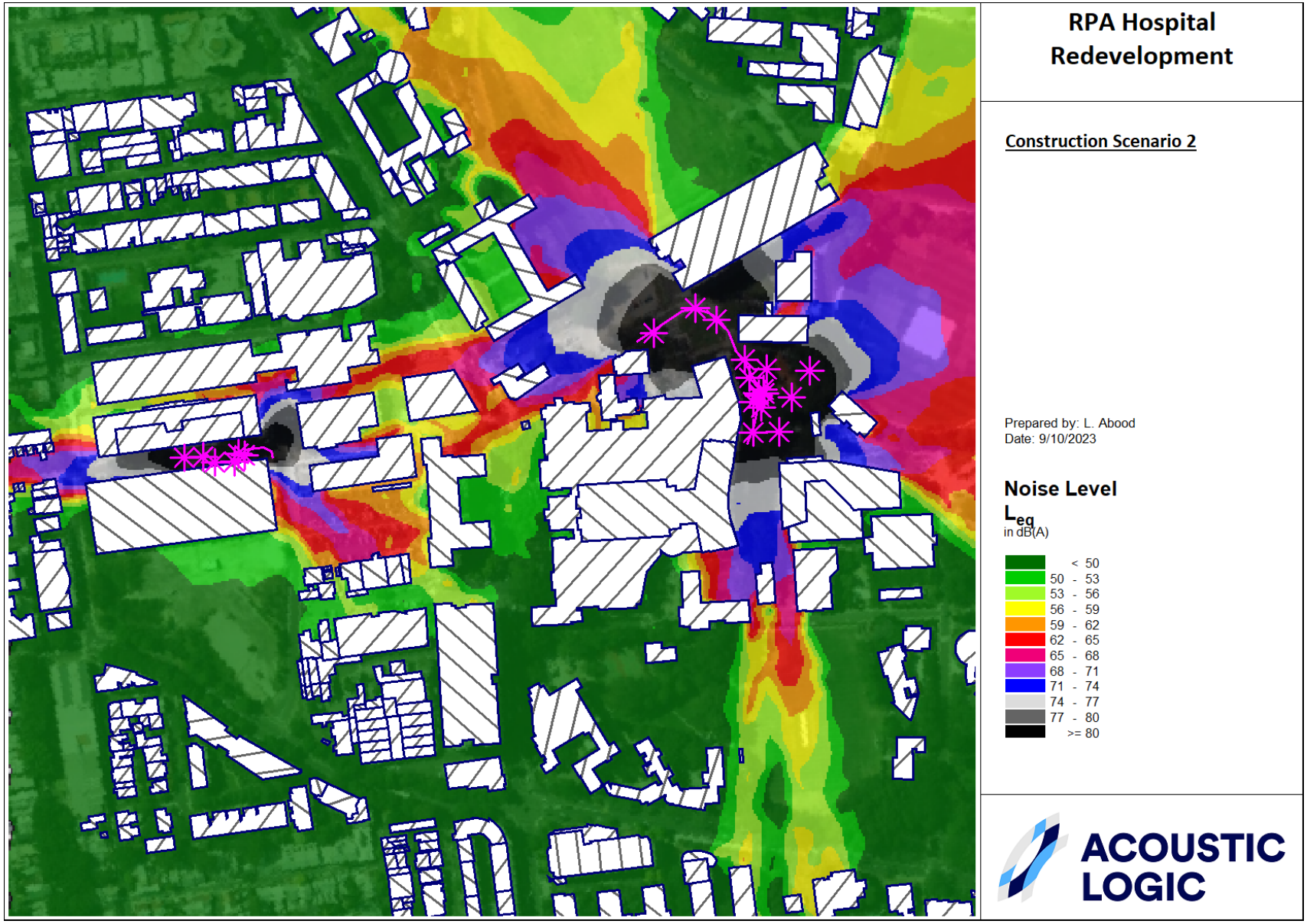


Figure 6: RPA Hospital Redevelopment – Construction Scenario 2

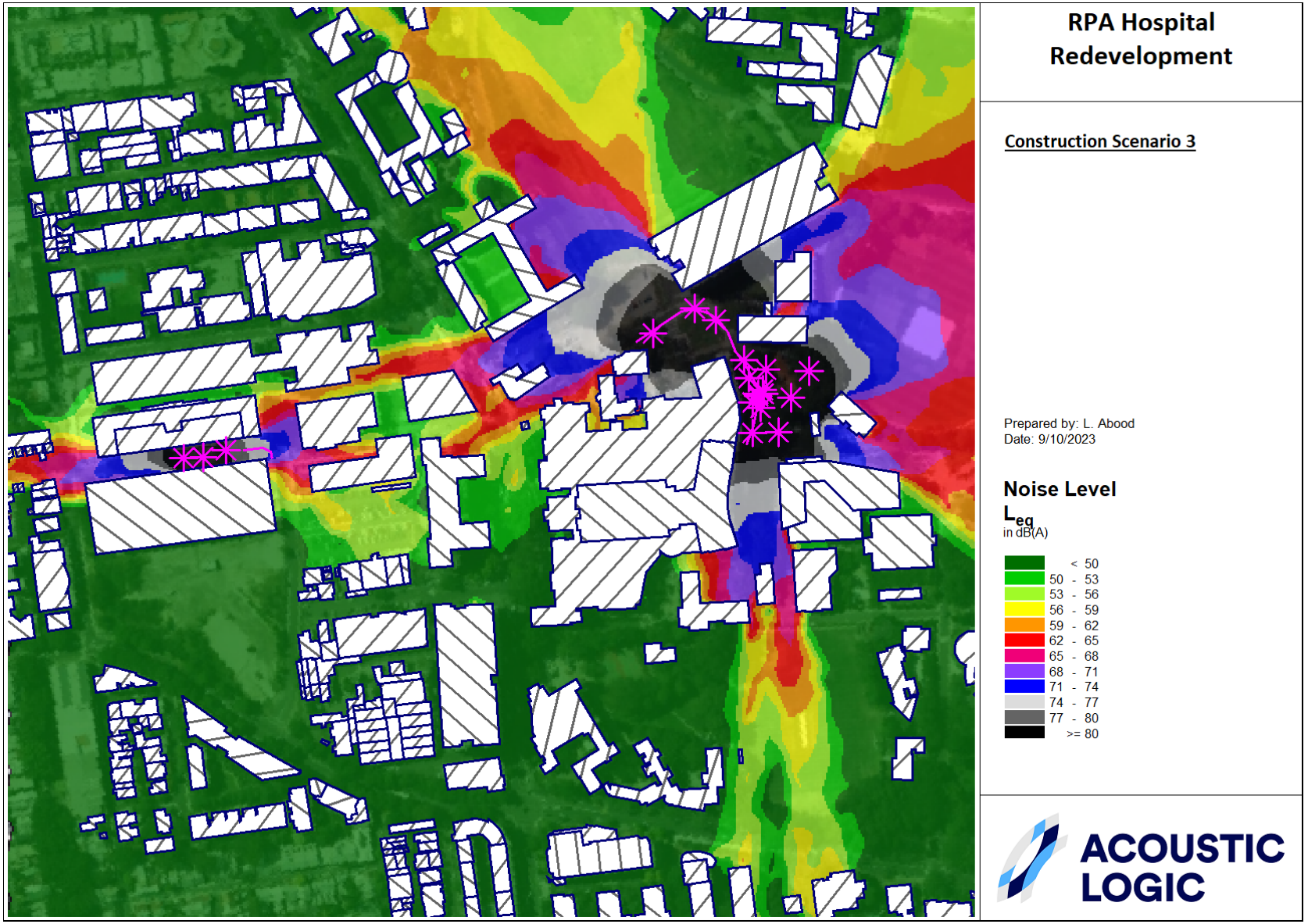


Figure 7: RPA Hospital Redevelopment – Construction Scenario 3

9.3 PREDICTED NOISE LEVELS AT SENSITIVE RECEIVERS

The predicted external and internal noise levels at nearest sensitive receivers are presented in the Table's 17 and 18 respectively below. Note that a façade correction of 20dB(A) has been applied to internal spaces connected to a façade to account for the reduction through façade elements. This assumes that the façade is closed, and provides a conservative estimate of the acoustic performance of the façade. In practice, higher reductions (and correspondingly lower internal noise levels) may be achieved.

For spaces which are not directly connected to the façade, noise reduction will be significantly greater. Further, the noise level for the adjacent space which is connected to the façade will be determinative of the noise impact (i.e. management controls to mitigate impacts to these spaces will also mitigate impacts to spaces remote from the façade). For this reason, noise levels in the tables below are only presented for spaces which are located on the façade.

Table 17 –Predicted External Noise Levels at Nearest Sensitive Receivers

Receiver	Construction Scenario 1 Predicted External Noise Level dB(A) $L_{eq(15min)}$	Construction Scenario 2 Predicted External Noise Level dB(A) $L_{eq(15min)}$	Construction Scenario 3 Predicted External Noise Level dB(A) $L_{eq(15min)}$	Affected Noise Level / Highly Affected Noise Level dB(A) $L_{eq(15min)}$	Recommendations
R1	45-75			62 / 75	Potential to exceed Highly Affected Noise Management Level, see Section 9 for recommendations
R2	≤50			61 / 75	Below Noise Management Level
R3 (Max. External Noise Level at Residential façade)	46-80	50-87	40-74	58 / 75	Potential to exceed Highly Affected Noise Management Level, see Section 9 for recommendations
R4	≤50				Below Noise Management Level
C1	53-73			70/n.a.	Potential to exceed Affected Noise Management Level, see Section 9 for recommendations
C2	<50-68				Below Noise Management Level
E1	46-80 (Externally)			*Noise Affected:* 45 (Internally) 55 (Externally) *Highly Noise Affected:* n.a.	Potential to exceed Affected Noise Management Level, see Section 9 for recommendations
E2	46-86 (Externally)				
E3	40-56	48-62	<50		Potential to exceed Affected Noise Management Level during some construction scenarios, see Section 9 for recommendations
H2	<40-57 (Externally)				
H3	43-68 (Externally)				
H4	38-66 (Externally)				
H5	<50	47-60	<50		
H6	50-69	50-73	40-62		
Re2	51-71 (Externally)	51-78 (Externally)	51-69 (Externally)		

Table 18 –Predicted Maximum Internal Noise Levels at H1 and Re1 (All Construction Scenarios)

Receiver	Level	Location	Construction Scenario 1, 2 and 3 Maximum Predicted Internal Noise Level dB(A) $L_{eq(15min)}$	Internal Construction Noise Management Level dB(A) $L_{eq(15min)}$	Recommendations
H1 RPA Main Building and Gloucester House	Level 03	Delivery Room	65	49	Potential to exceed Affected Noise Management Level, see Section 9 for recommendations
		Neonatal Ventilated Nursery	66	60	
		ICU Room	54	49	
		Cyclotron	38	66	Below Noise Management Level
	Level 04	Molecular Biology Lab	<30	48	
	Level 05	Investigational Drug Research	<30	58	
		Haematology - Microscopes	<30	63	
	Level 11	Sleep Lab – Observation Rooms	<30	45	
Re1 Centenary Institute	Level 04	Animal Housing / Breeding / Observation Rooms	63	64	Below Noise Management Level
		Rat Operating Room	<40	46	

10 DISCUSSION AND RECOMMENDATIONS

10.1 NOISE IMPACTS

With regards to the above presented predicted external noise impacts associated with the Early Works construction Noise impacts, AL note that the modelled scenario is a combination of all sources within the Stage 1 and Stage 2 construction activities occurring simultaneously. We note that, in reality, it is extremely unlikely that all construction equipment presented within this management plan will be operated simultaneously, however, as scheduling of activities has not yet been provided to this office, this scenario is modelled as an absolute worst-case.

Generally, the construction noise levels predicted within the existing hospital, as well as the surrounding noise sensitive receivers, are able to meet the affected noise management levels within many of the spaces within the receivers, in most construction scenarios, exclusive of high generating noise activities such as concrete sawing and hydraulic hammering.

When high noise generating works, such as the activities presented above, are proposed to be conducted, this should be conducted with a direct line of communication with the operational areas of the RPA Hospital which are likely to be worst-affected by the works, i.e. spaces which are directly connected to the façade of the hospital facing the Stage 1 and Stage 2 works areas. Spaces which are predicted to be worst-affected by construction activities within the Stage 1 and Stage 2 construction within the hospital are inclusive of, but not exclusive to, Delivery Rooms, Neonatal Ventilated Nursery and ICU Room, as presented within Table 18. Implementation of various specific strategies such as respite hours or scheduling of works in specific periods may be required in order to reduce the construction impacts of the Stage 1 and Stage 2 early works construction activities, which should be developed between the contractor and the hospital.

Predicted noise levels are a maximum of all operating simultaneously, in practice the impact is likely to be less, however this assessment has presented the expected worst case scenario.

10.2 VIBRATION IMPACTS

Typically, excavation in rock/pneumatic hammering, rolling and piling will be the activities with the greatest potential for generation of vibration.

Demolition of the existing road surfaces may require use of a rock hammer, however alternative methods (such as sawing and lifting) would also be possible and should be implemented wherever feasible to avoid vibration impacts on surrounding receivers.

Given the distance between the building site and hospital, as well as the Centenary Institute, it is likely that vibration levels approaching or exceeding those detailed in Section 6.3 would be experienced. As such, vibration monitoring will be required within the operational RPA Hospital, as well as the Centenary Institute. The exact location of vibration monitors required to be installed to investigate vibration exceedances are to be developed in consultation with the affected receivers.

Acoustic Logic recommend vibration monitoring be undertaken throughout the duration of early works.

10.3 SITE SPECIFIC RECOMMENDATIONS

The following recommendations are made to mitigate the impacts.

- Community consultation/notification:
    - An open line of communication is to be established and maintained throughout the construction process, in particular with RPA Hospital and the Centenary Institute, as well as the Susan Wakil Health Building.
- Demolition:
    - Wherever feasible, hydraulic hammering should be minimised in favour for the use of saw cutting and removal to avoid significant vibration impacts on surrounding sensitive receivers.
- High Noise Generating Works:
    - Where high noise generating works are proposed to be undertaken, respite hours should be implemented to reduce the impact on surrounding receivers. Respite hours should be developed in consultation with the worst-affected noise receivers, in particular, the existing hospital.
    - Respite hours for the works outlined within Condition C9 are to be adhered to for the activities listed within the condition. Refer to Section 5 of this document.
- Vehicle Noise - Trucks to turn off their engines during idling to reduce impacts on nearby receivers (unless truck ignition needs to remain on during concrete pumping). Minimise truck reversing. Plant and equipment should be off when not in use.
- Deliveries and waste removal should use straps in place of chains for handling materials wherever possible. Deliveries should be scheduled during less sensitive time periods (After 9am) wherever practical.
- When selecting construction equipment to be used on the project, the noise levels of plant and equipment should be considered, whereby equipment selected has an equivalent or lower sound power level than the predictive sound power levels of equipment maintained within this report.
- A conscientious effort should be made to avoid works near the nearest sensitive receivers, particularly the existing hospital, wherever feasible. Compounding various high generating activities simultaneously near receivers should be avoided where possible.
- Unnecessary shouting should be avoided on site, and appropriate signage should be installed to remind workers of their responsibility to reduce noise impacts where feasible. Loud music from radios and stereos should not be permitted.
- Materials should be placed gently and not thrown to avoid making crashing noises.
- Non-tonal reversing beepers should be implemented on all construction equipment and mobile plant used regularly on site.
- In the event of a complaint, noise management procedure identified in section 10 of this report are to be followed. Notwithstanding above, general management techniques and acoustic treatments are included below which may be implemented on a case-by-case basis to reduce noise emissions to surrounding receivers.

10.4 ASSESSMENT OF VIBRATION

10.4.1 Vibration Producing Activities

Proposed activities that have the potential to produce significant ground vibration include:

- Demolition.
- Excavation Work.
- Rolling activities.

10.4.2 Safeguards to Protect Sensitive Structures

It is impossible to predict the vibrations induced by the excavation operations on site at potentially affected receivers. This is because vibration levels are principally proportional to the energy impact which is unknown, the nature of the terrain in the area (type of soil), drop weight, height etc.

10.4.3 Vibration Monitoring

AL recommends that vibration monitoring be undertaken where vibratory rolling is proposed to occur within 30m of a residential development, in line with the requirements of Condition C18 of the development consent (Ref: SSD-47662959).

AL also recommends that vibration monitoring be conducted within the operational hospital throughout the early works construction period, as well as during any high vibration generating construction activities, such as piling, demolition and rolling. This recommendation is made to monitor vibration levels experienced by the vibration-sensitive equipment discussed within this report.

Number of vibration monitors to be confirmed concluding consultation with the existing hospital, as well as the Centenary Institute, as well as the head contractor and acoustic consultant.

AL also recommends that if complaints regarding vibration impacts from construction activity arise at other nearby sensitive receivers, vibration monitoring be conducted to manage construction vibration levels at said receiver. Any vibration monitor is to have SMS notification capability to enable contractor to be immediately informed when 75% of the vibration criteria has been measured.

10.4.4 Downloading of Vibration Monitor Data

Downloading of the vibration monitor data will be conducted on a regular basis. In the event of exceedance of the vibration criteria, downloading of the vibration monitor data will be conducted more frequently. Results obtained from the vibration monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed that reports are provided fortnightly with any exceedances in the vibration criteria reported as detailed in this report.

10.4.5 Presentation of Vibration Monitor Results

A fortnightly report will be submitted to the client via email summarising the vibration events. The vibration exceedance of criteria is recorded, and the report shall be submitted within 24 hours. Complete results of the continuous vibration logging will be presented in fortnight reports including graphs of the collected data.

10.4.5.1 Equipment

Vibration monitoring at receiver facades or site boundaries are to be conducted using Texcel ETM type monitors with externally mounted tri-axial geophones.

The monitors are to be set to send an SMS message when alert levels have been reached/exceeded at the location of the geophone.

10.4.5.2 Vibration Monitoring Alerts

The following personnel will receive alarms in the event that the nominated vibration trigger levels are exceeded at the site:

1. Acoustic consultant/advisor.
2. Project site foreman.
3. Project Manager.

10.5 GENERAL RECOMMENDATIONS

Other noise management practices which may be adopted are discussed below. In addition, notification, reporting and complaints handling procedures should be adopted as recommended in later sections of this report.

10.5.1 Acoustic Barrier

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be affected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers.

10.5.2 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

10.5.3 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

10.5.4 Treatment of Specific Equipment

In certain cases, it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

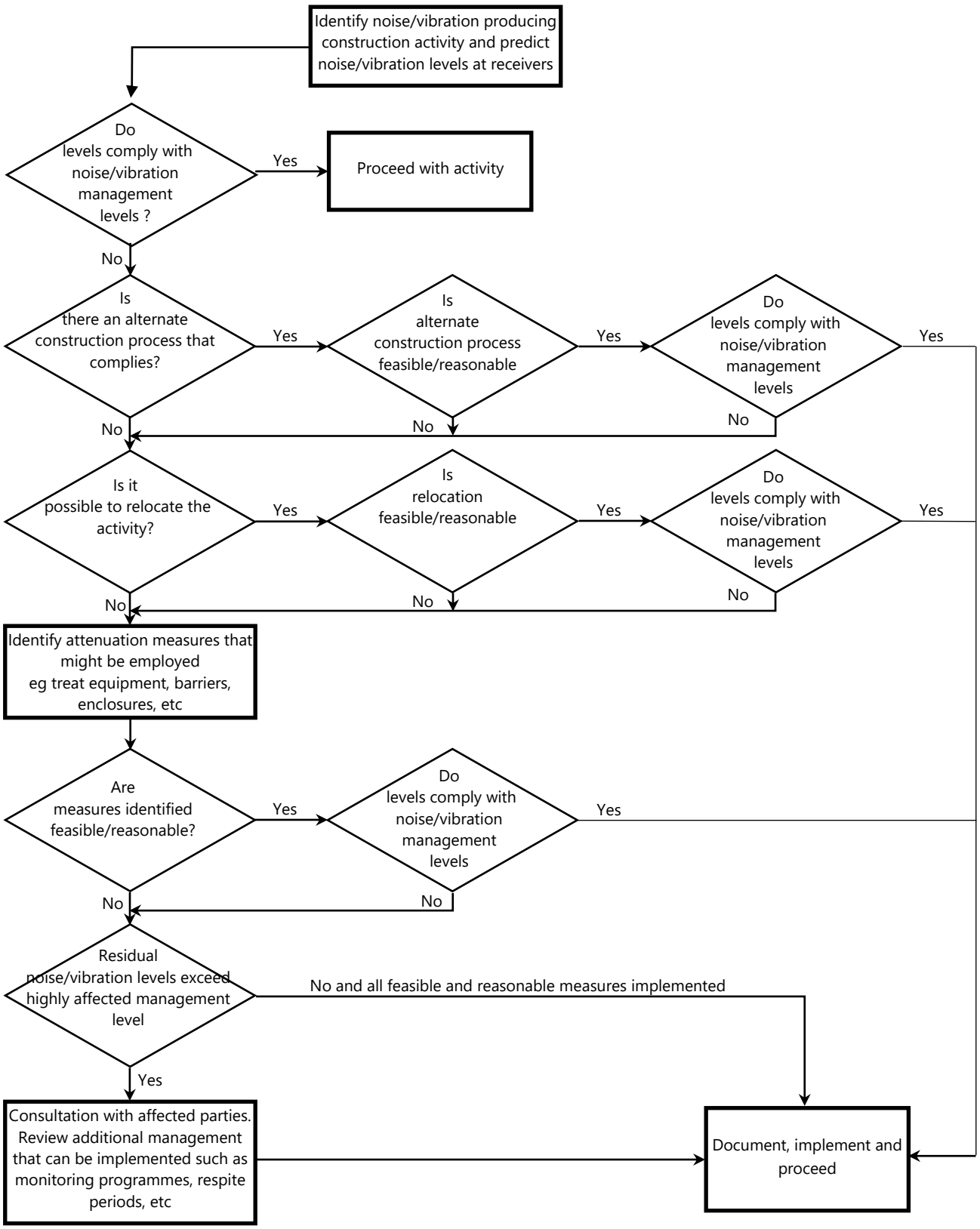
10.5.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers. Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

11 ASSESSMENT METHODOLOGY AND MITIGATION METHODS

The flow chart that follows illustrates the process to be followed to minimise the impact associated with these activities.

Noise sources with the potential to exceed the criteria set out in Section 7 have been identified and discussed in section 8.



12 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

12.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continuous communication is required between; all parties which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

- Inform and educate the groups about the project and the noise controls being implemented.
- Increase understanding of all acoustic issues related to the project and options available.
- Identify group concerns generated by the project, so that they can be addressed.
- Ensure that concerned individuals or groups are aware of and have access to the Site Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings may be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

12.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise, vibration or dust occur, immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration and dust limits, all work potentially producing vibration or dust shall cease until the exceedance is investigated. The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided).
- The time and date the complaint was received.
- The nature of the complaint and the time and date the noise was heard.
- The name of the employee who received the complaint.
- Actions taken to investigate the complaint, and a summary of the results of the investigation.
- Required remedial action, if required.
- Validation of the remedial action.
- If necessary, setup vibration monitoring at the location representing the nearest affected vibration receiver, with alarm device which can inform the project manager on site if the vibration exceedance happened.
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable:

- Noise measurements at the affected receiver.
- An investigation of the activities occurring at the time of the incident.
- Inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

13 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc where practical.
4. Selecting alternative equipment/processes where practical
5. If necessary, setup noise and vibration monitoring devices at locations representing the nearest noise/vibration and dust affected receivers and provide data for each complain time period. Analysis is required to determine suitable mitigation measures.

Complaints associated with noise and vibration generated by site activities shall be recorded on a Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

14 CONCLUSION

This report presents a construction noise and vibration management plan for the associated early-works Stage's 1 and 2 construction activities proposed to be conducted for the Royal Prince Alfred Hospital Redevelopment.

Provided that the practices and recommendations in this report are implemented, the noise and vibration impacts during the early works construction stages will be minimised.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Lachlan Abood

APPEDNIX A1 – FAÇADE NOISE LEVELS – CONSTRUCTION SCENARIO 1

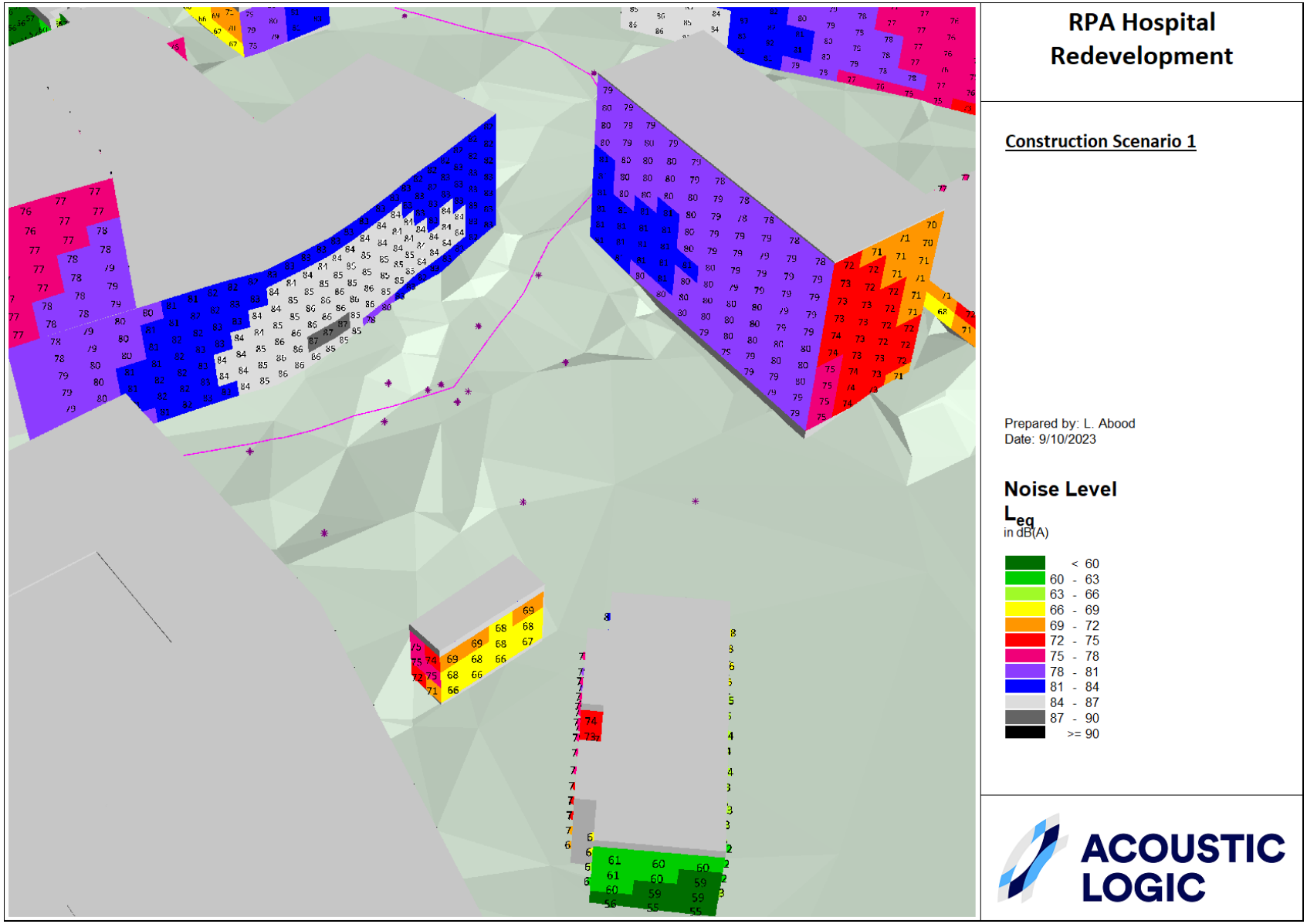


Figure 8: Construction Scenario 1 – H1 and Re1

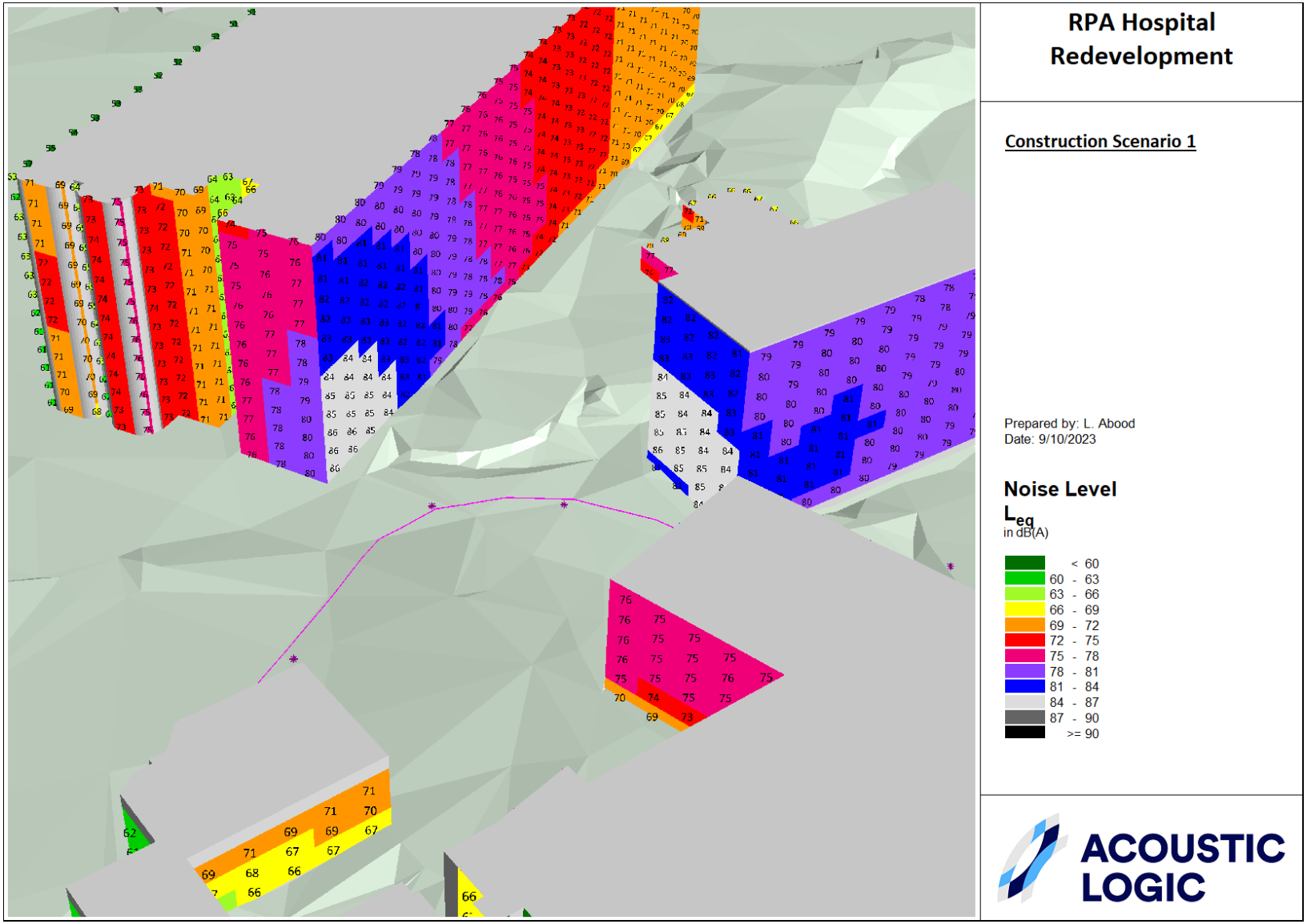


Figure 9: Construction Scenario 1 – Re1 and E2

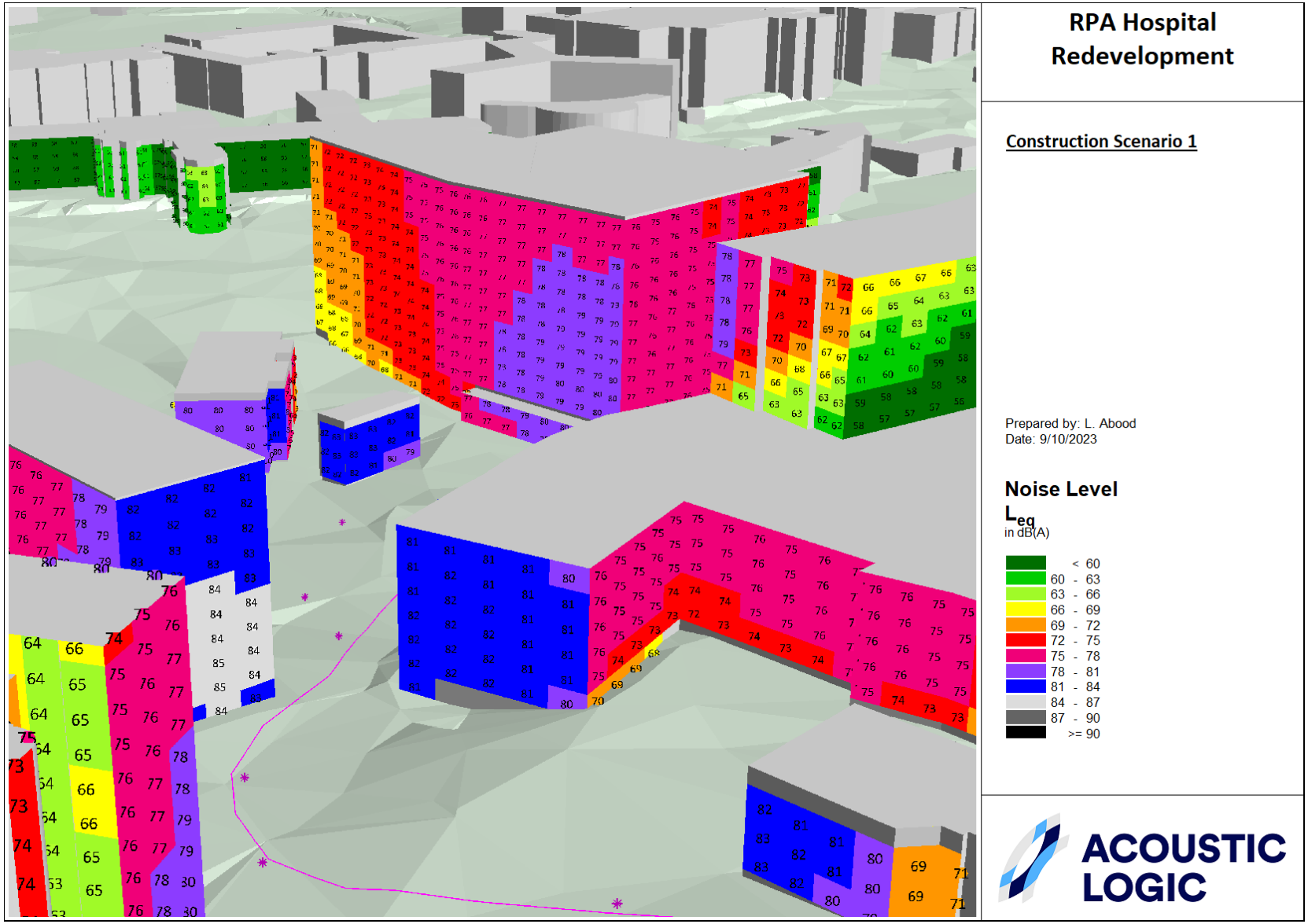


Figure 10: Construction Scenario 1 – H1 and E1

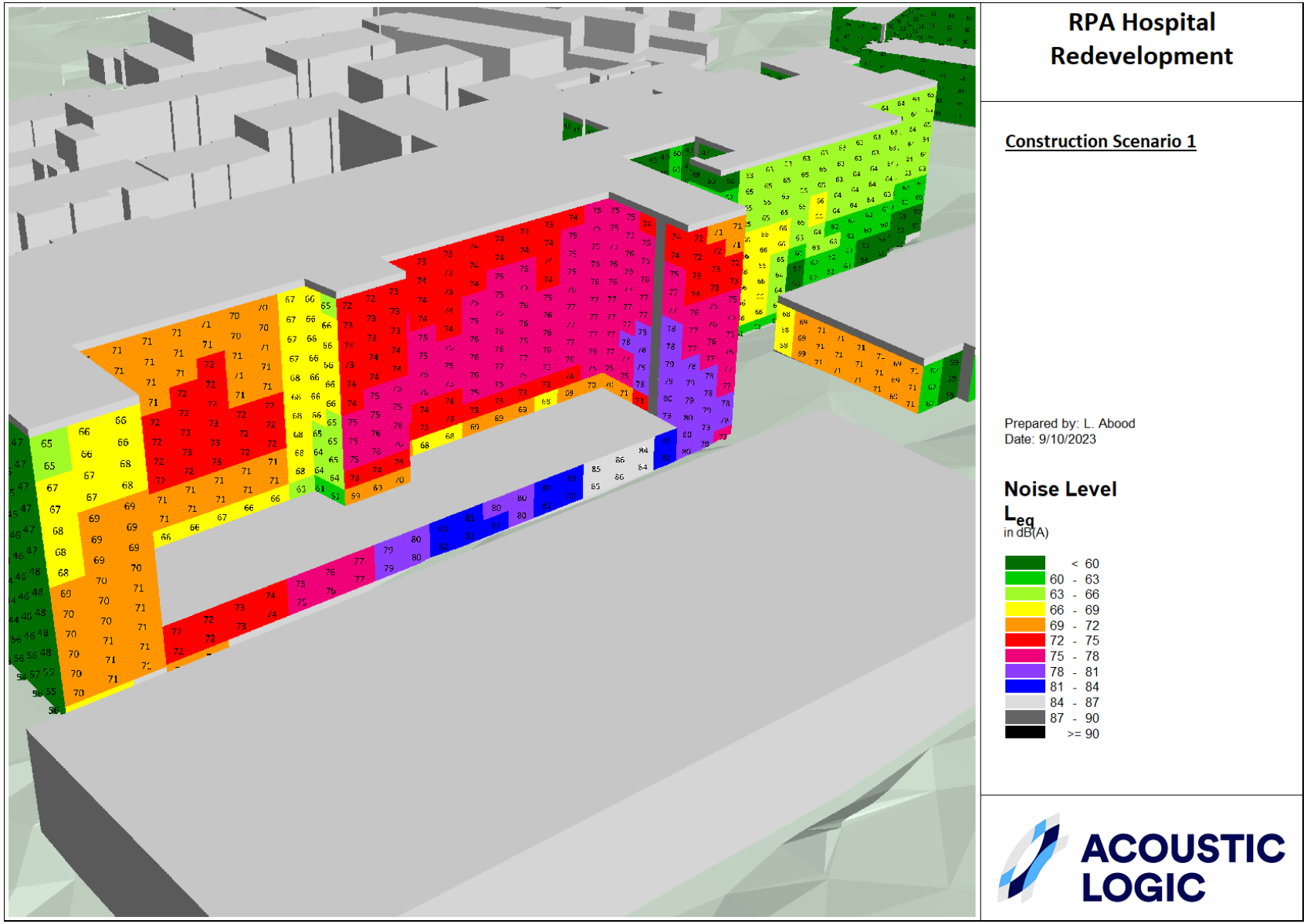


Figure 11: Construction Scenario 1 – R3 and Re2

APPENDIX A2 – FAÇADE NOISE LEVELS – CONSTRUCTION SCENARIO 2

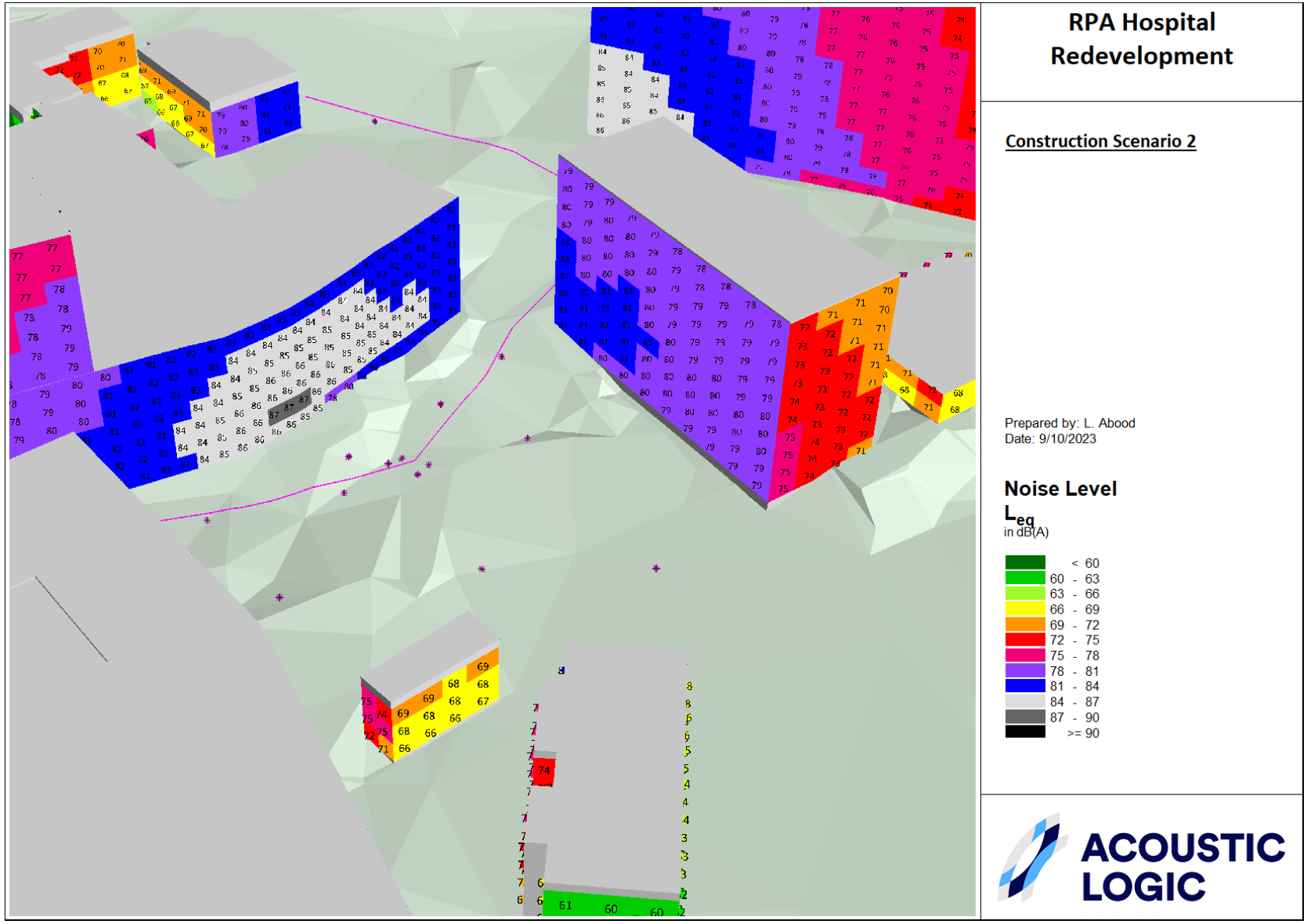


Figure 12: Construction Scenario 2 – H1 and Re1

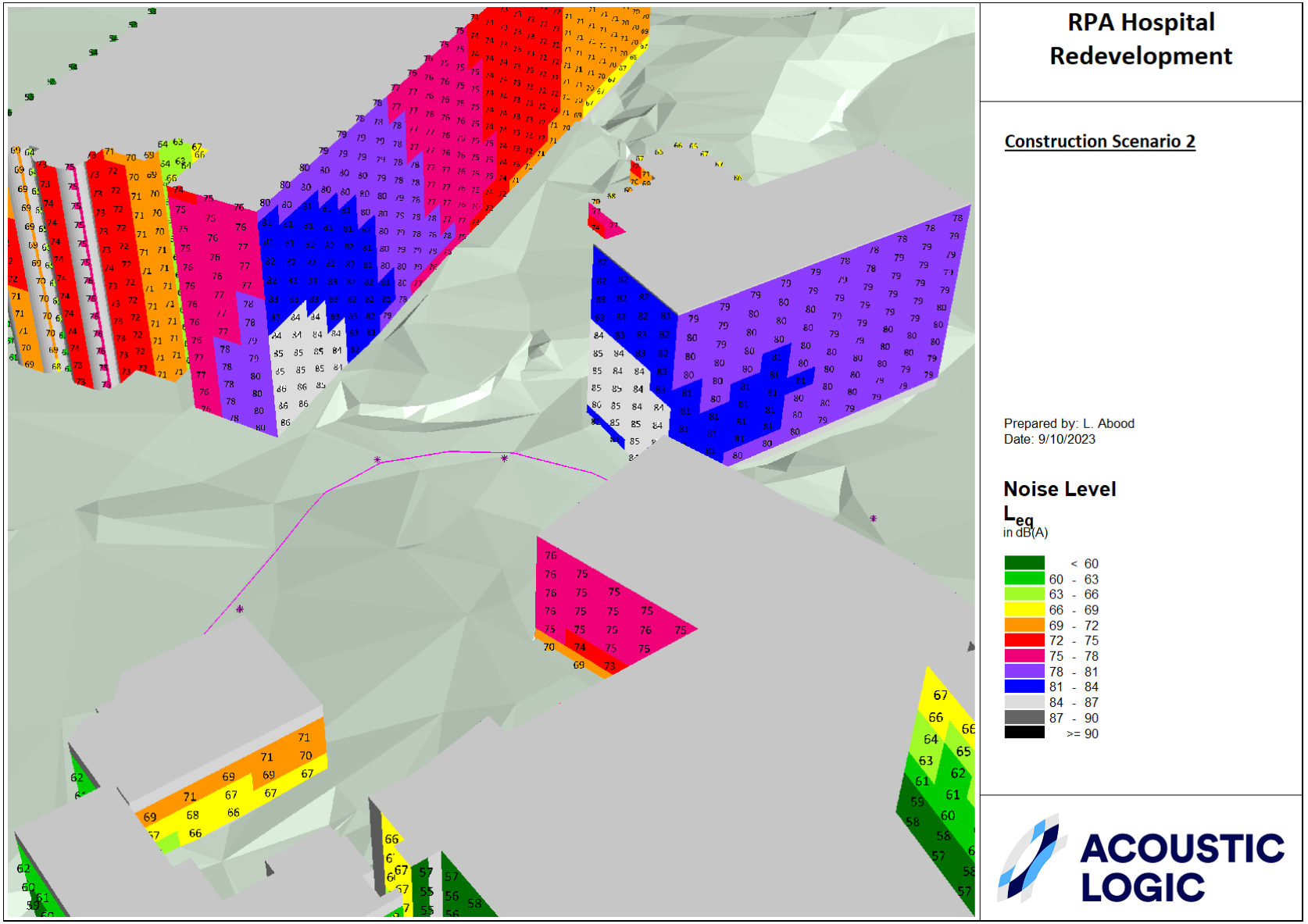


Figure 13: Construction Scenario 2 – Re1 and E2

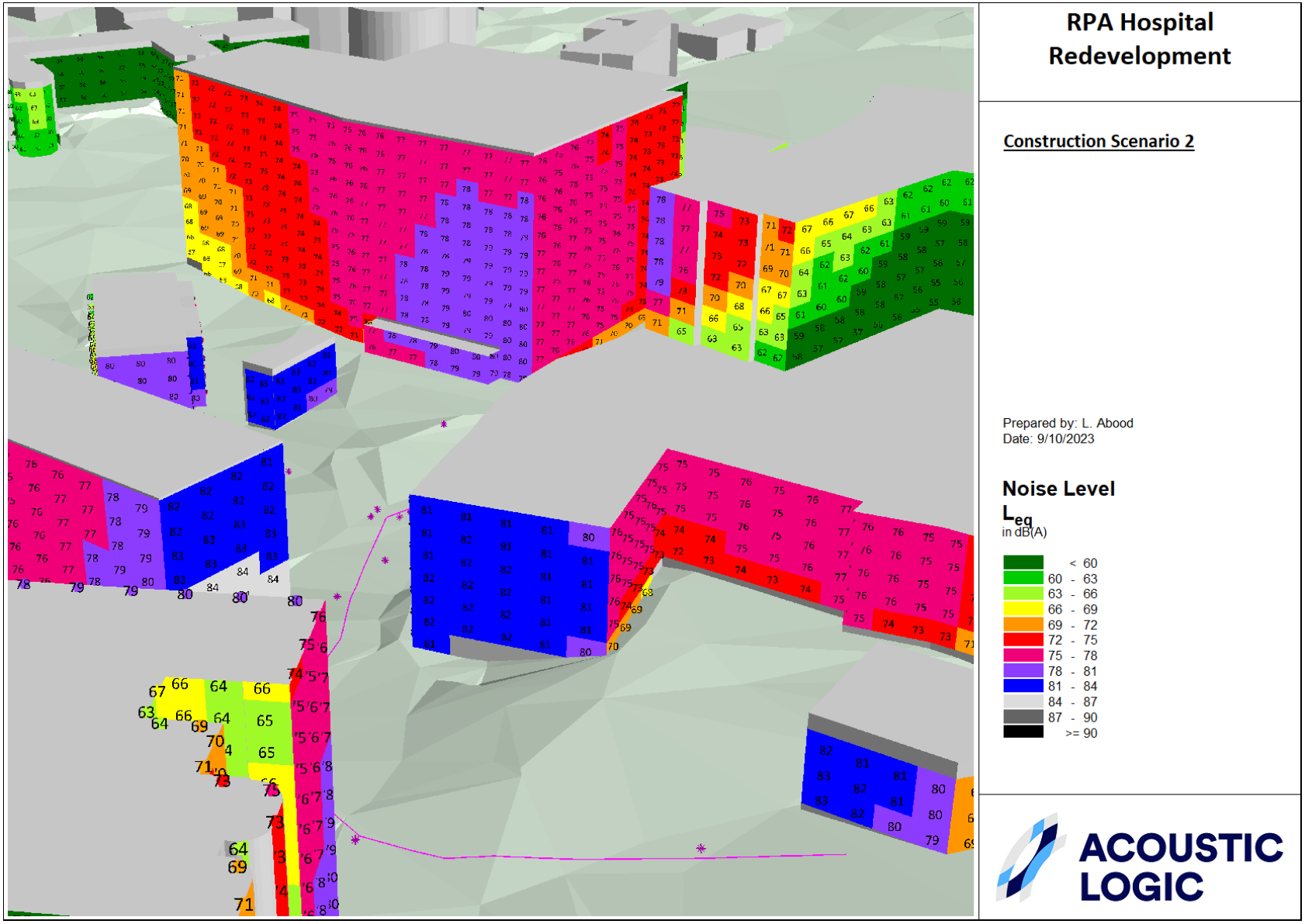


Figure 14: Construction Scenario 2 – H1 and E1

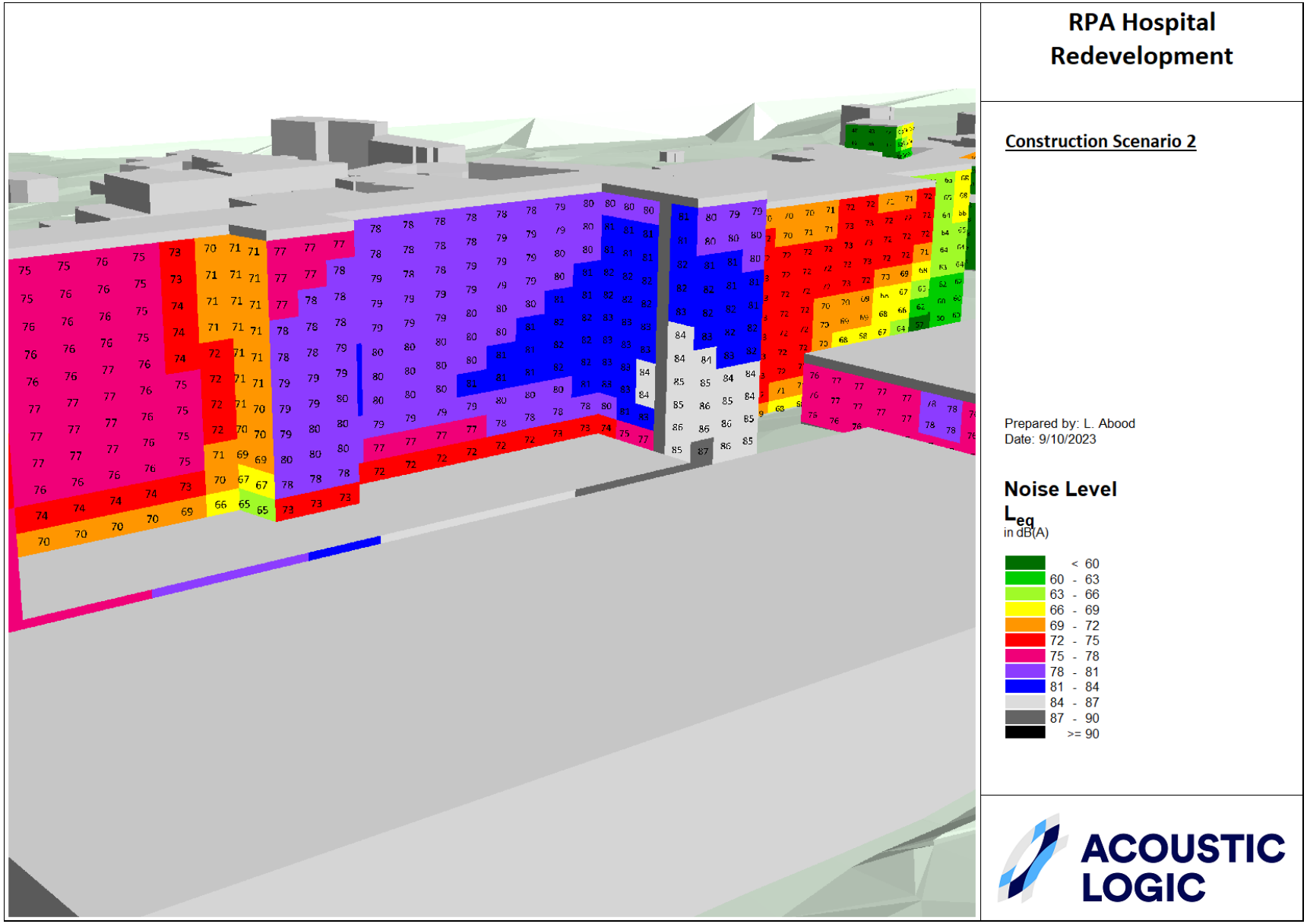


Figure 15: Construction Scenario 2 – R3 and Re2

APPENDIX A3 – FAÇADE NOISE LEVELS – CONSTRUCTION SCENARIO 3

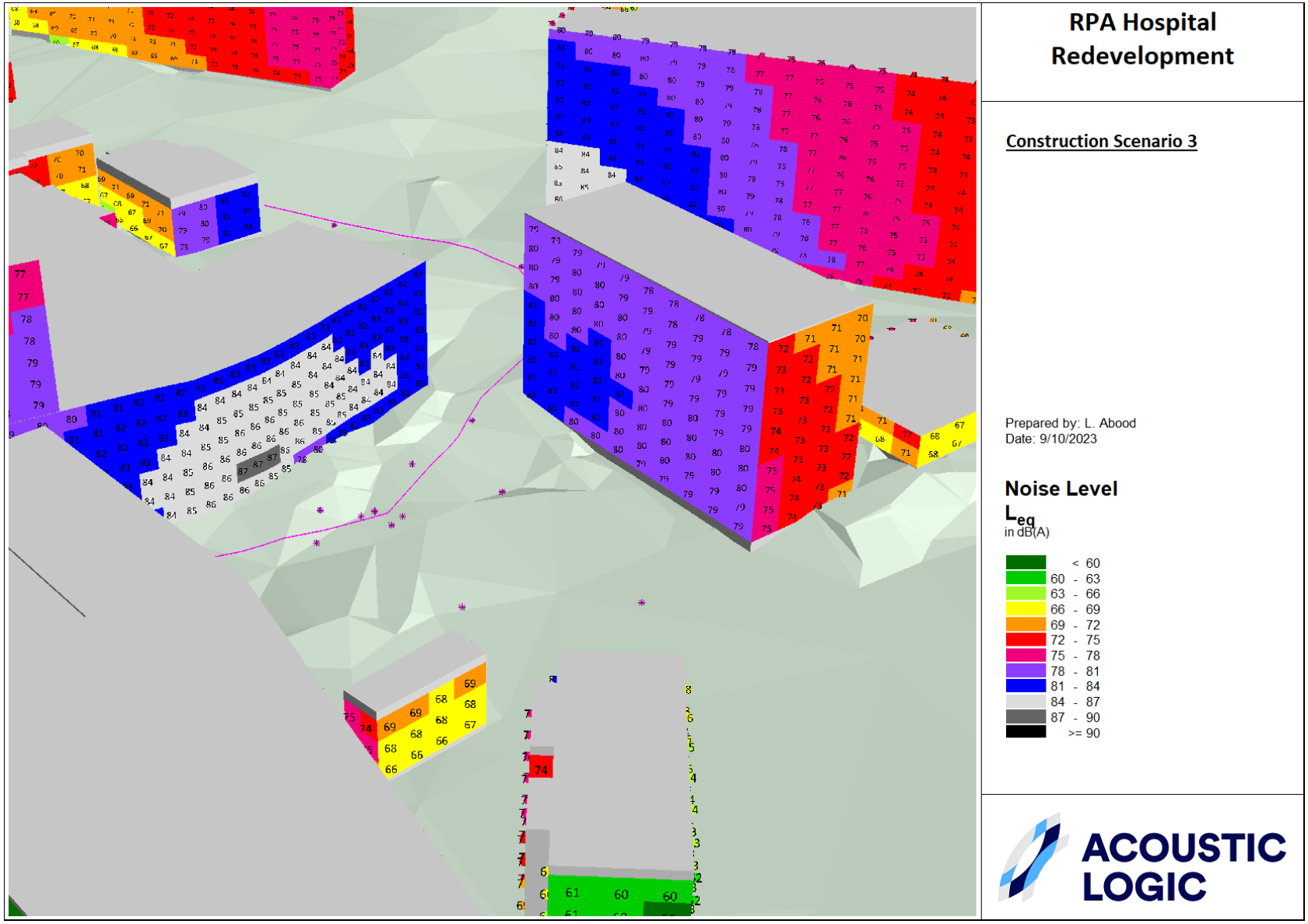


Figure 16: Construction Scenario 3 – H1 and Re1

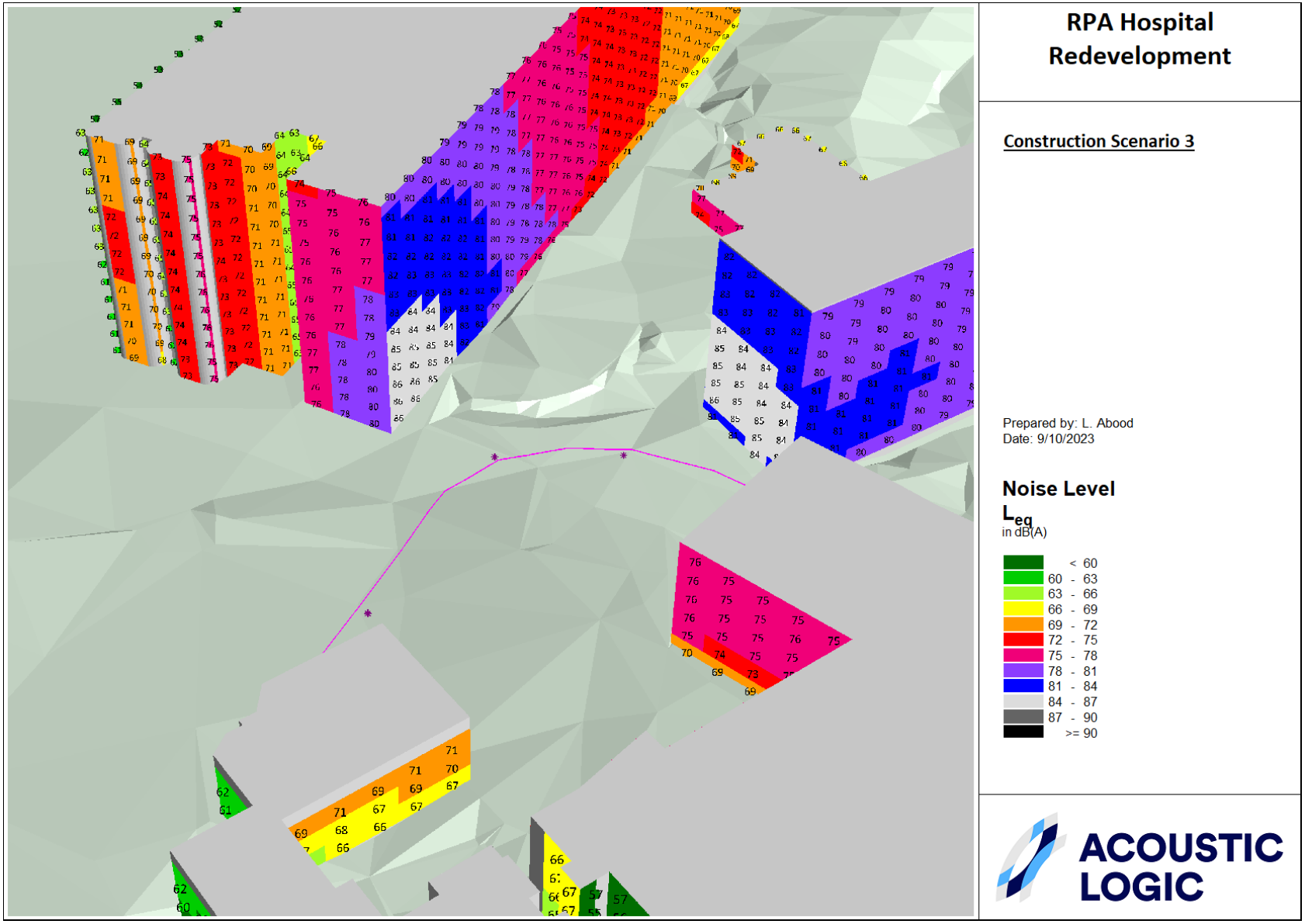


Figure 17: Construction Scenario 3 – Re1 and E2

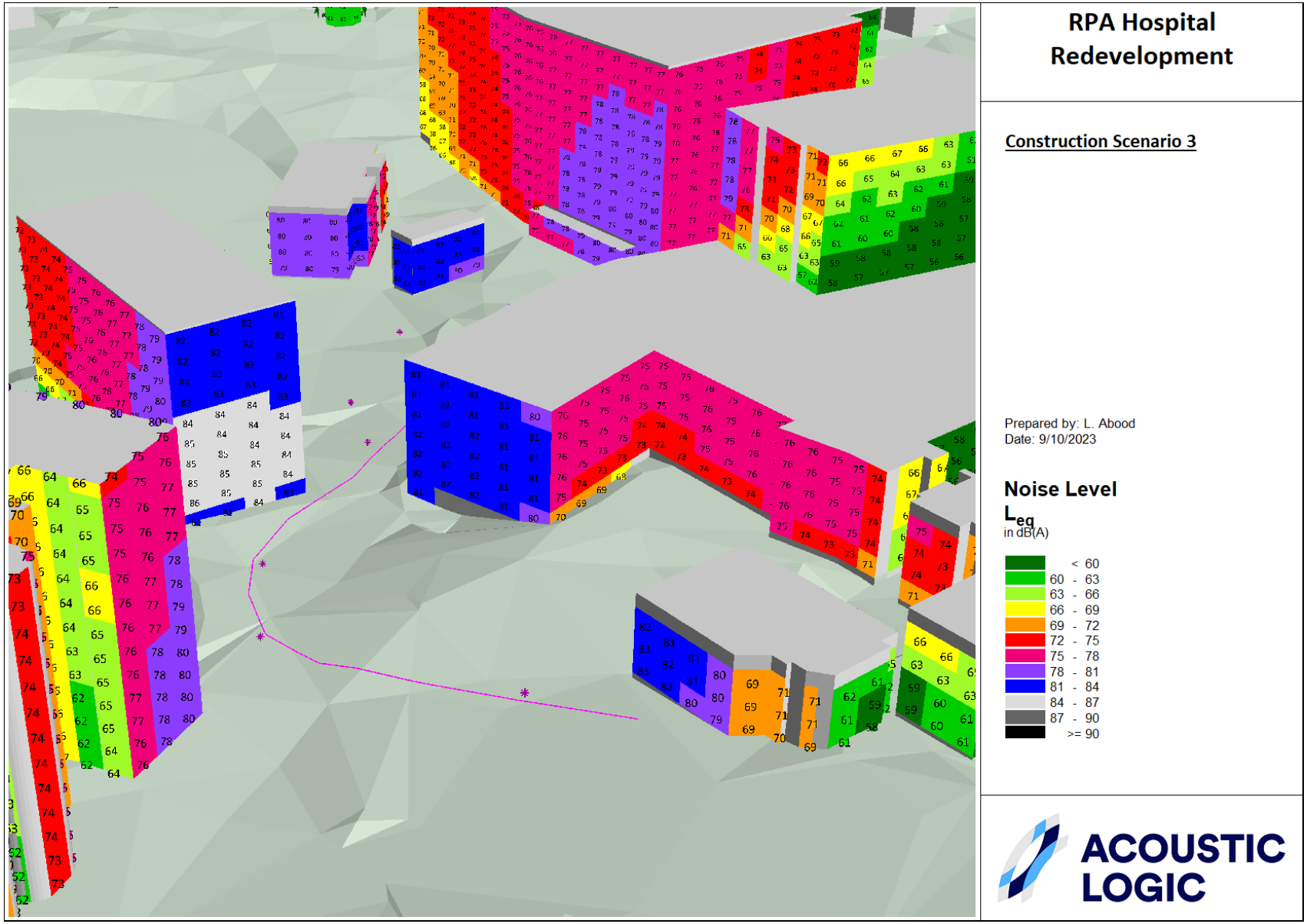


Figure 18: Construction Scenario 3 – H1 and E1

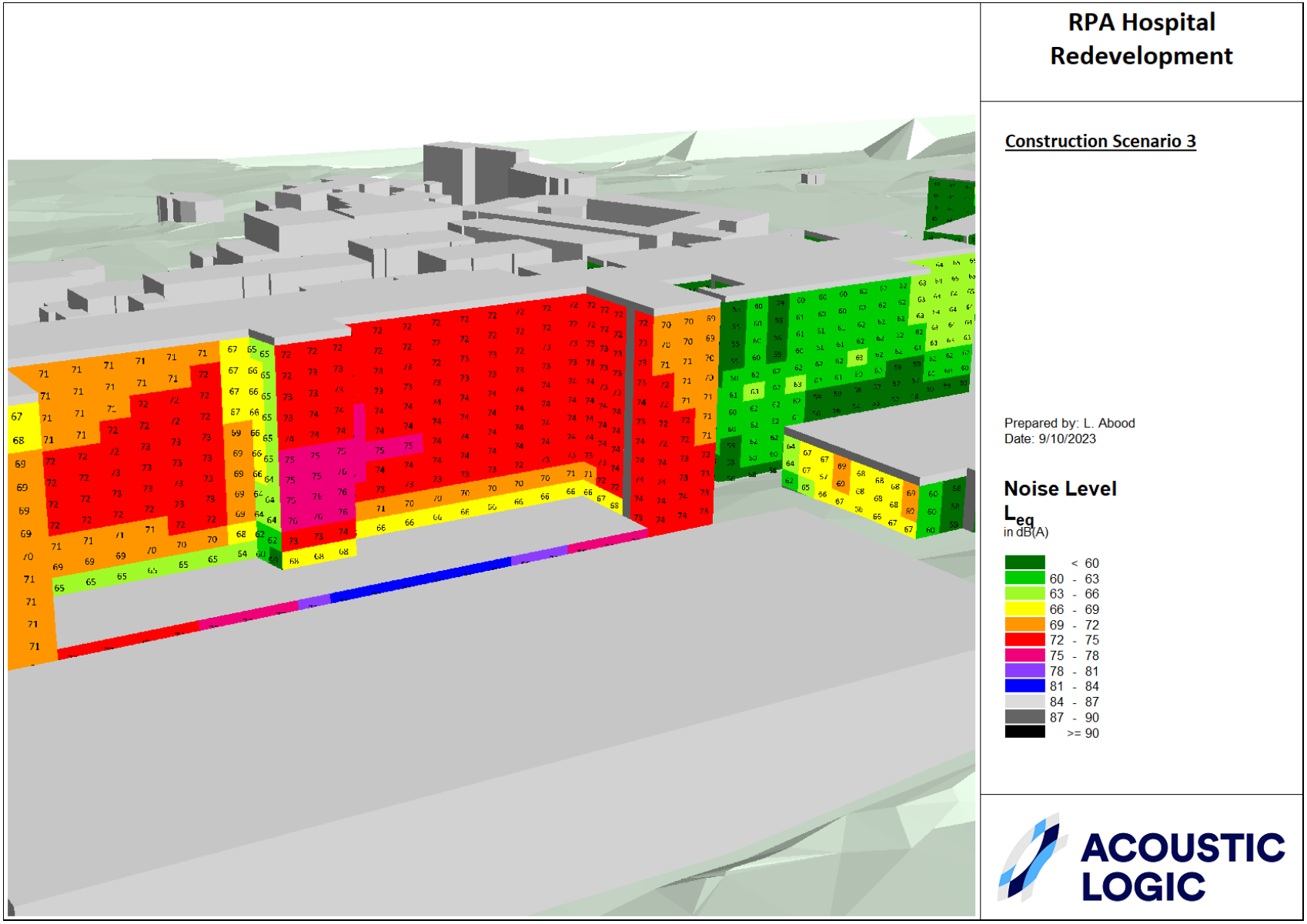


Figure 19: Construction Scenario 3 – R3 and Re2