



Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction)

A Rooftop Helipad at the Proposed New Block of
Queen Mary Hospital - Operational Helicopter
Noise Mitigation Measures Plan

September 2020

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1 Introduction

1.1 Background

- 1.1.1 To meet the increasing demand and requirements for healthcare services in Hong Kong West Cluster, the existing Clinical Pathology Building, Houseman Quarters and University Pathology Building of Queen Mary Hospital (QMH) will be redeveloped into a single new hospital block at Pok Fu Lam. The construct and operation of the rooftop helipad (hereafter as “Proposed Helipad” or “the Project”) at the proposed new block (hereafter as “New Block”) at QMH is to enhance the overall efficiency and effectiveness of the emergency responses of QMH.
- 1.1.2 An Environmental Impact Assessment (EIA) study for the Project was conducted in accordance with the EIA Study Brief No. ESB-284/2015. The EIA report (Register No.: AEIAR-208/2017) was approved without conditions by the Environmental Protection Department (EPD) on 22 March 2017. Following the approval of the EIA report, the Environmental Permit (EP) (i.e. EP-522/2017) was subsequently issued by Director of Environmental Protection (DEP) on the same day.
- 1.1.3 As stipulated in the Condition 2.4 of the current EP, the Permit Holder shall, no later than one month prior to the installation of noise barriers of the Project, submit the DEP four hard copies and one electronic copy of an Operational Helicopter Noise Mitigation Measures Plan (OHNMMP) for approval. The Permit Holder and any person constructing or operating the Project shall fully implement all mitigation measures in this plan.
- 1.1.4 Mott MacDonald Hong Kong Limited (MMHK) was commissioned by the design and build contractor Paul Y. Able Joint Venture (PY-ABLE JV) to prepare the OHNMMP on behalf of the Hospital Authority / Food and Health Bureau (i.e. the Permit Holder) and support the construction works of New Block and Proposed Helipad as well as Environmental Team (ET) services. The location of the Project is shown in **Figure 1.1**.
- 1.1.5 The OHNMMP was certified by the Environmental Team (ET) Leader and verified by the Independent Environmental Checker (IEC) as conforming to the information and recommendations contained in the approved EIA report before submission to the DEP.

1.2 Objectives of the Operational Helicopter Noise Mitigation Measures Plan

- 1.2.1 As specified in Condition 2.4 of EP, this OHNMMP shall include an updated prediction of helicopter noise levels in accordance with the updated information and mitigation proposals in place.
- 1.2.2 The objectives of this OHNMMP are to present:
- (a) Updated information and proposed helicopter noise mitigation measures; and

- (b) Updated prediction of helicopter noise levels at representative Noise Sensitive Receivers (NSRs) in accordance with the updated information and mitigation proposals in place.

2 Updated Information Based on the Latest Design

2.1 Proposed Helipad Size and Location

2.1.1 The original helipad from the approved EIA report is proposed at the north-east of the Rooftop of New Block with size of about 40m in diameter and at 299.4mPD as shown in Figure 2.1 and Figure 2.2 of the approved EIA report. Based on the latest information, the proposed helipad centre has been shifted 4.06m southward and 0.28m westward as compared with the proposed location stated in the approved EIA report and the flight sectors in north-west and south have been slightly shifted based on the new centre of helipad accordingly. The size of the helipad has been revised to 20m in diameter and the height of helipad has been revised to 307.8mPD. A close view of the proposed helipad (overlap with the original helipad layout in the approved EIA report) is shown in **Figure 2.1**.

2.2 Proposed Building Layout

2.2.1 The main roof level of the New Block has been revised from 282.4mPD stated in the approved EIA report to 298.9mPD with 1.4m solid concrete parapet wall at four sides (+300.3mPD) in base case scenario. A section view of the proposed helipad is shown in **Figure 2.2**. The building footprint and arrangement of lift lobby, stair, walkway and roof equipment layout have been changed from the approved EIA report. In addition, Government Flying Service (GFS) has confirmed that the revised building footprint and rooftop arrangement do not affect approaching and departure operations of helicopters (see **Appendix A**).

3 Prediction of Helicopter Noise Levels

3.1 Review of Helicopter Noise Criteria

3.1.1 There is no change to the helicopter noise standards since the approval of the EIA report. Therefore, the noise standards stated in Section 4.2.3 the approved EIA report remain applicable as follows:

Daytime Period

3.1.2 The standards for the helicopter noise (between 07:00 and 19:00 hours) for planning purposes are stipulated in Table 1A, Annex 5 of the TM-EIAO. They are summarised in **Table 3-1** below.

Table 3-1 Helicopter Noise Standards for Planning Purpose

| Uses | Helicopter Noise L_{max} dB(A) 07:00 to 19:00 hours |
|---|--|
| All domestic premises including temporary housing accommodation; Hotel and hostels; Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required; Places of public worship and courts of law; and Hospitals, clinics, convalescences and home for the aged, diagnostic rooms, wards | 85 |
| Offices | 90 |

Notes:

- (1) The above standards apply to uses which rely on opened windows for ventilation.
- (2) The above standards shall be viewed as the maximum permissible noise levels assessed at 1m from the external façade.

Evening and Night-time Periods

3.1.3 As stated in the approved EIA report, there is no statutory noise criterion for emergency helicopter services during evening and night-time periods (i.e. between 19:00 and 07:00 hours on the next day). Based on the conclusion on the review of noise criterion during evening and night-time periods in the approved EIA report, the emergency helicopter operations were generally exempted from the flight restrictions (noise standards and helicopter operations during evening and nighttime periods) for the purposes such as medical emergencies, law enforcement, firefighting, military in those reviewed overseas countries as stated in the approved EIA report. The situation is similar to the Project taking into account the necessity of helicopter emergency medical services in Hong Kong and the benefits provided by the Proposed Helipad in QMH. Detail can refer to Section 4.2.3 of the approved EIA report.

3.2 Review of Noise Sensitive Receivers

3.2.1 The assessment points identified in the approved EIA report for helicopter noise impact assessment remain valid as no new representative NSRs are identified. The horizontal and vertical distances between NSRs and center of helipad have been updated based on the proposed helipad location as mentioned in **Section 2.1**. The assessment points for helicopter noise impact assessment are shown in **Figure 3.1** and summarized in **Table 3-2** below.

Table 3-2 Representative Noise Sensitive Receivers

| NSR ID | Description | Land Use | No. of Stories | Horizontal Distance (m) | Vertical Distance (m) | Existing / Planned |
|--------|--|--------------------|----------------|-------------------------|-----------------------|--------------------|
| NSR 1* | Jessville Tower | Residential | 19 | 523 | 61 | Planned |
| NSR 2 | Radcliffe | Residential | 23 | 471 | 91 | Existing |
| NSR 3 | Royalton | Residential | 25 | 419 | 91 | Existing |
| NSR 4 | Ebenezer School | School | 6 | 487 | 157 | Existing |
| NSR 5 | Royalton II | Residential | 19 | 387 | 94 | Existing |
| NSR 6 | 13 - 15 Northcote Close | Residential | 6 | 418 | 197 | Existing |
| NSR 7 | 9 - 11 Northcote Close | Residential | 6 | 437 | 187 | Existing |
| NSR 8 | Patrick Manson Building | Residential | 2 | 416 | 175 | Existing |
| NSR 9 | R.C. Lee Hall | Residential | 17 | 324 | 125 | Existing |
| NSR 10 | Wei Lun Hall | Residential | 17 | 269 | 120 | Existing |
| NSR 11 | Lee Hysan Hall | Residential | 17 | 321 | 122 | Existing |
| NSR 12 | Madam S.H. HO Residence for Medical Students | Residential | 9 | 299 | 151 | Existing |
| NSR 13 | 23 Bisney Road | Residential | 4 | 370 | 195 | Existing |
| NSR 14 | 21 Bisney Road | Residential | 4 | 355 | 196 | Existing |
| NSR 15 | 18 - 24 Bisney Road | Residential | 4 | 349 | 196 | Existing |
| NSR 16 | Glamour Court Blocks A-B | Residential | 4 | 334 | 199 | Existing |
| NSR 17 | Glamour Court Blocks C-E | Residential | 4 | 334 | 199 | Existing |
| NSR 18 | Victoria Garden, Block 1 | Residential | 40 | 532 | 136 | Existing |
| NSR 19 | Victoria Garden, Block 2 | Residential | 40 | 517 | 136 | Existing |
| NSR 20 | Cherry Court | Residential | 4 | 492 | 227 | Existing |
| NSR 21 | 3 Consort Rise, Blocks 7 – 8 | Residential | 4 | 453 | 230 | Existing |
| NSR 22 | TWGHs Jockey Club Care & Attention Home for the Elderly - Nurse's Quarters | Residential | 3 | 568 | 285 | Existing |
| NSR 23 | TWGHs Jockey Club Care & Attention Home for the Elderly | Homes for the aged | 4 | 571 | 281 | Existing |
| NSR 24 | English School Foundation - West Island School | School | 7-10 | 511 | 246 | Existing |
| NSR 25 | Greenvale, Block 5 | Residential | 2 | 523 | 219 | Existing |

| NSR ID | Description | Land Use | No. of Stories | Horizontal Distance (m) | Vertical Distance (m) | Existing / Planned |
|--------|------------------------------|----------------|----------------|-------------------------|-----------------------|--------------------|
| NSR 26 | Greenvale, Block 4 | Residential | 3 | 516 | 210 | Existing |
| NSR 27 | Greenvale, Block 3 | Residential | 3 | 480 | 213 | Existing |
| NSR 28 | Greenvale, Block 2 | Residential | 3 | 460 | 213 | Existing |
| NSR 29 | Greenvale, Block 1 | Residential | 3 | 455 | 207 | Existing |
| NSR 30 | Mount Davis Village House A7 | Residential | 2 | 490 | 192 | Existing |
| NSR 31 | The High House | Residential | 3 | 542 | 182 | Existing |
| NSR 32 | 7 Mount Davis Road | Residential | 3 | 416 | 203 | Existing |
| NSR 33 | Four Winds Apartments | Residential | 13 | 469 | 162 | Existing |
| NSR 34 | Mount Davis Garden | Residential | 3 | 398 | 201 | Existing |
| NSR 35 | Greenery Garden | Residential | 16 | 431 | 161 | Existing |
| NSR 36 | On Lee Blocks A-B | Residential | 3 | 476 | 176 | Existing |
| NSR 37 | On Lee Blocks C-E | Residential | 3 | 463 | 176 | Existing |
| NSR 38 | Kai Ming Temple | Public Worship | 4 | 342 | 183 | Existing |
| NSR 39 | Fook Wai Mansion | Residential | 5 | 498 | 179 | Existing |
| NSR 40 | Yue Yan Mansion Block C | Residential | 13 | 482 | 139 | Existing |
| NSR 41 | Yue Yan Mansion Block D | Residential | 13 | 470 | 139 | Existing |
| NSR 42 | Pokfulam Court | Residential | 13 | 513 | 136 | Existing |
| NSR 43 | Pokfulam Mansion | Residential | 13 | 517 | 137 | Existing |
| NSR 44 | 92E Pok Fu Lam Road | Residential | 4 | 545 | 176 | Existing |
| NSR 45 | La Clare Mansion, Block A | Residential | 13 | 605 | 138 | Existing |
| NSR 46 | La Clare Mansion, Block B | Residential | 13 | 610 | 139 | Existing |
| NSR 47 | La Clare Mansion, Block C | Residential | 13 | 623 | 138 | Existing |
| NSR 48 | La Clare Mansion, Block D | Residential | 13 | 628 | 139 | Existing |

Remark (*): The assessment point of Jessville Tower has been updated based on the building configuration in GeoInfp Map (<https://www.map.gov.hk/gm/map/>) as shown in **Figure 3.1**. Since no new information for the height of building and the number of stories, the height of building and the number of stories adopted in the approved EIA report remain unchanged in this study.

3.2.2 The shortest slant distances between the highest floors of the NSRs and the helicopter locations during different operation modes have been adopted for the helicopter noise impact assessment which is the same as the approved EIA report.

3.3 Review of Assessment Assumptions and Methodology

3.3.1 Noise will be generated from the helicopter emergency medical services associated with the Proposed helipad. Helicopter noise impact assessment has been conducted to evaluate the potential noise impact for different helicopter operation modes.

3.3.2 The helicopter noise impact assessment for daytime helicopter operations shall be assessed in terms of L_{max} which is the maximum noise level as stipulated in the TM-EIAO and presented in **Table 3-1**.

- 3.3.3 Helicopter operational modes (i.e. Non-lateral movements including hovering, touchdown, idling and lift-off; Lateral movements including approach and take-off) in the approved EIA report remain unchanged. Detailed operational modes can refer to Section 4.6.1.4 in the approved EIA report.
- 3.3.4 Based on the Section 4.6.1.5 in the approved EIA report, the flight sectors in north-west and south are recommended by the GFS for the proposed Helipad. As mentioned in **Section 2.1**, the updated flight sectors have been slightly shifted (i.e. 4.06m southward and 0.28m westward) comparing against the flight sectors proposed in approved EIA report based on the new centre of helipad. The extent of flight sectors and locations of representative NSRs are presented in **Figure 3.1**. The GFS confirmed that the updated flight sectors are still the best compromise with all factors and have been kept to a minimum in size so as to minimise the noise impact on the surroundings (see **Appendix A**).
- 3.3.5 As advised by the GFS, during the operation, the chosen flight paths may be altered slightly subject to the actual weather conditions and the obstacles clearance to the surroundings (e.g. movement of birds or unexpected localized turbulence) as stated in Section 4.6.1.5 of the of the approved EIA report.
- 3.3.6 The arrangement of trial flights remains unchanged as stated in Section 4.6.1.6 of the of the approved EIA report.
- 3.3.7 The flight profile and flight frequency in the approved EIA report remain unchanged. The approaching and departure angles are 10 degrees as in the mitigated scenario assessment of the approved EIA report.

Helicopter Noise Data

- 3.3.8 As confirmed by the GFS (see **Appendix A**), the full fleet replacement with new helicopter (i.e. Airbus H175) will be completed in mid-2020 and Airbus H175 are commissioned before the commencement date of the Proposed Helipad in 2024. As such, the Airbus H175 helicopter noise data for lateral movements in the approved EIA report remain valid. The noise data of Airbus H175 in lateral movements was provided by the helicopter manufacturer and the GFS with International Civil Aviation Organization (ICAO) Standard (Max) noise level as shown in the **Table 3-3** below.

Table 3-3 Helicopter Noise Data – Lateral Movements

| Mode of Operation | Reference Distance ¹ (m) | Noise Level ¹ | |
|-------------------|-------------------------------------|--------------------------|--------------------------|
| | | EPNL, EPNdB | L _{max} , dB(A) |
| Approach | 120 | 95.1 | 82.1 |
| Take-off | 150 | 89.8 | 76.8 |
| Flyover | 150 | 91.0 | 78.0 |

Note:

- (1) The helicopter information of Airbus H175 was provided by the GFS. The above helicopter noise levels are determined under conditions prescribed in Chapter 8 and Appendix 4 of Annex 16 of ICAO, and prescribed in 14 CFR 36 Appendix H. L_{max} = Effective Perceived Noise Level (ENPL) – 13 dB(A), with reference to the “Transportation Noise Reference Book” (Paul Nelson (1987). Transportation Noise Reference Book. England: Butterworths).

3.3.9 The ICAO standards do not include noise standards for non-lateral movements of helicopter (i.e. idling, hovering, touchdown and lift-off). As such, on-site joint noise measurement with Meinhardt Infrastructure and Environmental Limited (Meinhardt) on Airbus H175 were conducted at Ma Tso Lung helicopter landing site on 22 May 2019 to obtain supplementary noise data of helicopter for non-lateral movements. The noise survey involved measurement of the L_{max} noise levels for the non-lateral movements operation generated by Airbus H175. The measurements were taken at the far-field region (i.e. 150m apart from helicopter) to consist with the ICAO standard. The measured L_{max} noise levels are extracted from the Technical Note - Helicopter Noise Survey Report dated December 2019 (prepared by Meinhardt) (see **Appendix D**) and summarised in **Table 3-4** below.

Table 3-4 Helicopter Noise Data – Non-Lateral Movements

| Mode of Operation | Reference Distance (m) | Noise Level |
|-------------------|------------------------|-------------------|
| | | L_{max} , dB(A) |
| Idling | 150 | 75.4 |
| Hovering | 150 | 83.5 |
| Touchdown | 150 | 78.9 |
| Lift-off | 150 | 82.4 |

Assessment Methodology

3.3.10 All methodology adopted in the approved EIA report remain unchanged. The methodology of helicopter noise impact assessment are summarised as follows:

3.3.11 According to Table 1A, Annex 5 of the TM-EIAO, helicopter noise impacts shall be assessed in terms of A-weighted maximum sound pressure level L_{max} at a NSR. The helicopter noise level (L_{max}) at a NSR for different operational modes can be calculated using the following formula:

$$L_{max\ ij} = L_{max(ref)j} + C_D + C_F + C_B$$

where

- $L_{max\ ij}$ - Helicopter noise level at 1m from the external façade of NSR i for operational mode j, dB(A);
- $L_{max(ref)j}$ - Reference sound pressure level for operational mode j, dB(A);
- C_D - Distance correction, dB(A);
- C_F - Façade correction, dB(A);
- C_B - Barrier correction, dB(A);

3.3.12 Since all representative NSRs are located at considerable distances from the Proposed Helipad, helicopter noise can be considered as a ‘point’ source. Therefore, the sound pressure levels at NSRs have been evaluated based on standard acoustical principles and a ‘point’ source assumption. The sound pressure / intensity received at NSRs will be inversely proportional to the square of the distance between the noise source and the NSR. To estimate the noise impacts for the worst-case scenarios, the distance r_{ij} is determined by assuming that the proposed helicopter will fly directly over the representative NSRs for both approaching and departure within the recommended flight

sectors. For NSRs located outside the recommended flight sectors, it is assumed that the helicopter will fly at the nearest flight path within the recommended flight sectors for the helicopter noise assessment. The distance correction for the corresponding operational mode can be calculated using the following formula:

$$C_D = -20 \log_{10} (r_{ij} / r(\text{ref})_j)$$

where

- r_{ij} - Shortest distance from a noise source for operational mode j to NSR i , m ;
- $r(\text{ref})_j$ - Reference distance from a noise source to a measurement point for operational mode j , m ;

- 3.3.13 Barrier correction of -5dB(A) shall be applied where the representative NSRs are being marginally screened with no direct line of sight by a substantial barrier. For the NSRs which totally shielded by a substantial barrier, barrier correction of -10dB(A) should be considered in the calculation.
- 3.3.14 A façade correction of +3dB(A) has been considered at the representative NSRs in order to account for the façade reflection effect.
- 3.3.15 As stated in Section 4.6.2.5 and 4.6.2.6 of the approved EIA report, the adoption of wind correction is not considered and the effect of noise reflection from the ground surface of nearby hill is expected to be negligible.
- 3.3.16 As confirmed by GFS, there is no other existing helipad and regular helicopter flight routes identified in the vicinity of the proposed helipad that would cause cumulative helicopter noise impacts (see **Appendix A**).

3.4 Proposed Helicopter Noise Mitigation Measures

- 3.4.1 To reduce the noise impact and direct lines of sight at NSRs, the Proposed Helipad is intentionally moved to the north-eastern side of the rooftop of the New Block of QMH. The separation distances between the helipad and nearby NSRs are also maximised.
- 3.4.2 Installation of noise barriers at rooftop of the New Block of the QMH can provide noise screening to the Proposed Helipad. The noise barriers can reduce the direct lines of sight between NSRs and the helicopter during hovering, touchdown, lift-off and idling on the helipad, and can achieve up to 10dB(A) noise screening at NSRs. In order to further improve the noise shielding effect, noise reducers should be installed at the top and edges of the noise barriers as designed in the approved EIA report.
- 3.4.3 As stated in the approved EIA report, obstacle protection for helicopters shall be provided below the helipad level in the immediate vicinity of an elevated helipad to ensure the flight safety of helicopter operations based on ICAO Annex 14 Volume II (see Appendix 1.1 of the approved EIA report). As confirmed by GFS, a provision of a minimum vertical clearance from the hovering position of the helicopter remains 10 m for flight safety reasons that is same as the approved EIA report (see **Appendix A**).
- 3.4.4 According to the approved EIA report, the height of noise barrier shall be considered in order to maintain the overall building height of the New Block and top level of the

Proposed Helipad as well as effective operation of the essential A/C plant locating at roof floor of New Block.

3.4.5 Having considered the mentioned factors, proposed helipad and parapet walls top levels have been optimized to enhance the noise shielding effect. The proposed noise barriers and noise reducers are summarized in **Table 3-5** below. Details of the noise mitigation measures for the proposed helipad are shown in **Figure 3.2**.

Table 3-5 Summary of Noise Barriers and Noise Reducers

| Location ⁽¹⁾ | Top Level ⁽²⁾ (mPD) | Noise Barrier Height and Width (m) | Noise Mitigation Measure |
|-------------------------|-----------------------------------|---|-------------------------------|
| Roof edge at north | 300.3 | No further noise barrier ⁽³⁾ | Noise Reducers ⁽⁴⁾ |
| Roof edge at east | 300.3 | No further noise barrier ⁽³⁾ | Noise Reducers ⁽⁴⁾ |
| Roof edge at south | 300.3 | No further noise barrier ⁽³⁾ | Noise Reducers ⁽⁴⁾ |
| Roof edge at west | 300.3 | No further noise barrier ⁽³⁾ | Noise Reducers ⁽⁴⁾ |

Notes:

- (1) Detail locations of noise reducers are presented in **Figure 3.2**.
- (2) Top level of parapet wall at 10m below the hovering position of helicopter (i.e. 310.3mPD).
- (3) 1.4m solid concrete parapet walls with 150mm thick (at least 10kg/m²) to provide noise screening to the proposed helipad (i.e. acting as noise barrier) at four sides of roof floor. No noise barrier is further proposed in this study since the top levels of parapet walls have been optimized to 10m below the hovering position of helicopter (i.e. 300.3mPD). The parapet wall can reduce the direct lines of sight between NSRs and the helicopter during hovering, touchdown, lift-off and idling on the helipad, and can achieve up to 10dB(A) noise screening at NSRs.
- (4) Noise reducers will be installed at all top edges of the parapet walls in order to further improve the noise shielding effect.

3.4.6 GFS has confirmed that the noise mitigation measures at the rooftop can fulfill the minimum vertical clearance requirement (i.e. 10m below the hovering position of helicopter (307.8mPD +2.5m) and do not affect approaching and departure operations of helicopters. In addition, the 1.4m parapet wall (i.e. top level at 300.3mPD) fulfill the effective operation of the essential A/C plant at roof floor of New Block. Furthermore, all other operation assumptions from relevant government departments (i.e. ArchSD, Hospital Authority, GFS and Civil Aviation Department) remain valid as stated in Appendix 1.1 of the approved EIA report.

3.4.7 Quiet approaching / departure procedures in Section 4.6.4.7 to 4.6.4.8 of the approved EIA report remain unchanged. A quiet approaching and departure technique would be employed to further alleviate the noise impact. Applying steeper glide slope and larger take-off angle during approaching and departure operations can increase the distances between NSRs and helicopter flight profile, and thus reduce the noise impact. Both approaching and departure angles are increased from 4.6 degrees to 10 degrees.

3.4.8 The recommended flight profile of a quiet helicopter operation is indicated in **Figure 3.1**. Helicopter operations are expected to be in one-way-direction within the selected flight sectors to minimise the overall exposure of helicopter noise at NSRs. In other words, the arrival flight and departure flight shall be from north to south and vice versa. Using same flight path for approaching and departure of each operation is not preferred.

3.4.9 As mentioned in **Section 3.3.8**, the full fleet replacement with new helicopter (i.e. Airbus H175) will be completed in mid-2020 and Airbus H175 are commissioned before the commencement date of the Proposed Helipad in 2024. Airbus H175 helicopters will be

equipped with more advanced engines and provide a quieter flight compared with the existing GFS's helicopter Super Puma AS332 L2.

3.4.10 All practicable noise mitigation measures as mentioned in the approved EIA report have been exhausted and adopted in the proposed helipad in this OHNMMP to minimize the helicopter noise impact. The design and selection of flight sectors have been optimized to avoid flying over the high population density area. Detailed implementation schedule of the recommended helicopter noise mitigation measures please refer to **Appendix E**.

3.5 Helicopter Noise Prediction

3.5.1 With the implementation of the exhausted noise mitigation measures as mentioned in **Section 3.4**, the predicted helicopter noise levels (L_{max}) of the worst-case operation mode at the representative NSRs under mitigated scenario are summarised in **Table 3-6** below based on the updated helicopter noise data. Detailed calculations please refer to **Appendix B**. Barrier effect for each NSR please refer to **Appendix C**.

Table 3-6 Predicted Helicopter Noise Levels (L_{max}) of the Worst-case Operation Mode (Mitigated)

| NSR ID | Description | Worst-case Operation Mode | L_{max} , dB(A) | Compliance? (Y/N) |
|--------|--|---------------------------|-------------------|-------------------|
| NSR 1 | Jessville Tower | Approaching | 83 | Y |
| NSR 2 | Radcliffe | Approaching | 82 | Y |
| NSR 3 | Royalton | Approaching | 82 | Y |
| NSR 4 | Ebenezer School | Approaching | 79 | Y |
| NSR 5 | Royalton II | Approaching | 83 | Y |
| NSR 6 | 13 - 15 Northcote Close | Approaching | 78 | Y |
| NSR 7 | 9 - 11 Northcote Close | Approaching | 78 | Y |
| NSR 8 | Patrick Manson Building | Approaching | 78 | Y |
| NSR 9 | R.C. Lee Hall | Approaching | 80 | Y |
| NSR 10 | Wei Lun Hall | Approaching | 81 | Y |
| NSR 11 | Lee Hysan Hall | Approaching | 79 | Y |
| NSR 12 | Madam S.H. HO Residence for Medical Students | Approaching | 79 | Y |
| NSR 13 | 23 Bisney Road | Approaching | 76 | Y |
| NSR 14 | 21 Bisney Road | Approaching | 76 | Y |
| NSR 15 | 18 - 24 Bisney Road | Approaching | 77 | Y |
| NSR 16 | Glamour Court Blocks A-B | Approaching | 77 | Y |
| NSR 17 | Glamour Court Blocks C-E | Approaching | 78 | Y |
| NSR 18 | Victoria Garden, Block 1 | Approaching | 78 | Y |
| NSR 19 | Victoria Garden, Block 2 | Approaching | 78 | Y |
| NSR 20 | Cherry Court | Approaching | 76 | Y |
| NSR 21 | 3 Consort Rise, Blocks 7 – 8 | Approaching | 77 | Y |
| NSR 22 | TWGHs Jockey Club Care & Attention Home for the Elderly - Nurse's Quarters | Approaching | 75 | Y |
| NSR 23 | TWGHs Jockey Club Care & Attention Home for the Elderly | Approaching | 75 | Y |

| NSR ID | Description | Worst-case Operation Mode | L _{max} , dB(A) | Compliance? (Y/N) |
|--------|--|---------------------------|--------------------------|-------------------|
| NSR 24 | English School Foundation - West Island School | Approaching | 76 | Y |
| NSR 25 | Greenvale, Block 5 | Approaching | 77 | Y |
| NSR 26 | Greenvale, Block 4 | Approaching | 77 | Y |
| NSR 27 | Greenvale, Block 3 | Approaching | 77 | Y |
| NSR 28 | Greenvale, Block 2 | Approaching | 77 | Y |
| NSR 29 | Greenvale, Block 1 | Approaching | 78 | Y |
| NSR 30 | Mount Davis Village House A7 | Approaching | 78 | Y |
| NSR 31 | The High House | Approaching | 78 | Y |
| NSR 32 | 7 Mount Davis Road | Approaching | 78 | Y |
| NSR 33 | Four Winds Apartments | Approaching | 79 | Y |
| NSR 34 | Mount Davis Garden | Approaching | 78 | Y |
| NSR 35 | Greenery Garden | Approaching | 79 | Y |
| NSR 36 | On Lee Blocks A-B | Approaching | 79 | Y |
| NSR 37 | On Lee Blocks C-E | Approaching | 79 | Y |
| NSR 38 | Kai Ming Temple | Approaching | 79 | Y |
| NSR 39 | Fook Wai Mansion | Approaching | 78 | Y |
| NSR 40 | Yue Yan Mansion Block C | Approaching | 80 | Y |
| NSR 41 | Yue Yan Mansion Block D | Approaching | 80 | Y |
| NSR 42 | Pokfulam Court | Approaching | 80 | Y |
| NSR 43 | Pokfulam Mansion | Approaching | 80 | Y |
| NSR 44 | 92E Pok Fu Lam Road | Approaching | 78 | Y |
| NSR 45 | La Clare Mansion, Block A | Approaching | 79 | Y |
| NSR 46 | La Clare Mansion, Block B | Approaching | 79 | Y |
| NSR 47 | La Clare Mansion, Block C | Approaching | 79 | Y |
| NSR 48 | La Clare Mansion, Block D | Approaching | 78 | Y |

3.5.2 The predicted helicopter noise levels (L_{max}) of the worst-case operation mode at all representative NSRs under mitigated scenario are below the relevant day-time noise criterion of L_{max} 85 dB(A). The comparison of predicted helicopter noise levels of the worst-case operation mode between approved EIA report and this OHNMMP are shown in **Table 3-7** below.

Table 3-7 Comparison of Predicted Helicopter Noise Levels of the Worst-case Operation Mode between Approved EIA Report and this OHNMMP (Mitigated)

| NSR ID | Description | Worst-case Operation Mode in EIA / OHNMMP | EIA Prediction L _{max} , dB(A) | OHNMMP Prediction L _{max} , dB(A) | Noise Reduction L _{max} , dB(A) |
|--------|-------------------------|---|---|--|--|
| NSR 1 | Jessville Tower | Hovering / Approaching | 83.2 | 82.8 | 0.3 |
| NSR 2 | Radcliffe | Hovering / Approaching | 83.7 | 81.9 | 1.8 |
| NSR 3 | Royalton | Hovering / Approaching | 84.7 | 82.4 | 2.3 |
| NSR 4 | Ebenezer School | Hovering / Approaching | 83.2 | 79.1 | 4.1 |
| NSR 5 | Royalton II | Hovering / Approaching | 85.4 | 82.6 | 2.8 |
| NSR 6 | 13 - 15 Northcote Close | Hovering / Approaching | 84.1 | 78.0 | 6.1 |
| NSR 7 | 9 - 11 Northcote Close | Hovering / Approaching | 83.8 | 77.9 | 5.9 |
| NSR 8 | Patrick Manson Building | Hovering / Approaching | 79.3 | 77.7 | 1.6 |

| NSR ID | Description | Worst-case Operation Mode in EIA / OHNMMP | EIA Prediction | OHNMMP Prediction | Noise Reduction |
|--------|--|---|--------------------------|--------------------------|--------------------------|
| | | | L _{max} , dB(A) | L _{max} , dB(A) | L _{max} , dB(A) |
| NSR 9 | R.C. Lee Hall | Hovering / Approaching | 81.6 | 79.8 | 1.8 |
| NSR 10 | Wei Lun Hall | Approaching / Approaching | 80.8 | 80.5 | 0.3 |
| NSR 11 | Lee Hysan Hall | Hovering / Approaching | 81.7 | 79.2 | 2.4 |
| NSR 12 | Madam S.H. HO Residence for Medical Students | Approaching / Approaching | 78.9 | 78.7 | 0.2 |
| NSR 13 | 23 Bisney Road | Hovering / Approaching | 84.9 | 76.1 | 8.8 |
| NSR 14 | 21 Bisney Road | Hovering / Approaching | 80.2 | 76.4 | 3.7 |
| NSR 15 | 18 - 24 Bisney Road | Hovering / Approaching | 80.3 | 77.2 | 3.2 |
| NSR 16 | Glamour Court Blocks A-B | Hovering / Approaching | 80.6 | 77.4 | 3.2 |
| NSR 17 | Glamour Court Blocks C-E | Hovering / Approaching | 80.6 | 77.9 | 2.8 |
| NSR 18 | Victoria Garden, Block 1 | Hovering / Approaching | 82.6 | 77.7 | 4.8 |
| NSR 19 | Victoria Garden, Block 2 | Hovering / Approaching | 82.8 | 78.1 | 4.7 |
| NSR 20 | Cherry Court | Hovering / Approaching | 82.7 | 76.3 | 6.3 |
| NSR 21 | 3 Consort Rise, Blocks 7 – 8 | Hovering / Approaching | 83.3 | 76.5 | 6.7 |
| NSR 22 | TWGHs Jockey Club Care & Attention Home for the Elderly - Nurse's Quarters | Hovering / Approaching | 81.3 | 75.1 | 6.2 |
| NSR 23 | TWGHs Jockey Club Care & Attention Home for the Elderly | Hovering / Approaching | 81.3 | 75.2 | 6.1 |
| NSR 24 | English School Foundation - West Island School | Hovering / Approaching | 82.3 | 76.3 | 6.0 |
| NSR 25 | Greenvale, Block 5 | Hovering / Approaching | 82.3 | 76.9 | 5.4 |
| NSR 26 | Greenvale, Block 4 | Hovering / Approaching | 82.5 | 77.2 | 5.3 |
| NSR 27 | Greenvale, Block 3 | Hovering / Approaching | 83.0 | 77.3 | 5.7 |
| NSR 28 | Greenvale, Block 2 | Hovering / Approaching | 83.3 | 77.4 | 5.9 |
| NSR 29 | Greenvale, Block 1 | Hovering / Approaching | 83.5 | 77.6 | 5.8 |
| NSR 30 | Mount Davis Village House A7 | Hovering / Approaching | 83.0 | 77.9 | 5.1 |
| NSR 31 | The High House | Hovering / Approaching | 82.3 | 77.9 | 4.3 |
| NSR 32 | 7 Mount Davis Road | Hovering / Approaching | 84.2 | 78.0 | 6.2 |
| NSR 33 | Four Winds Apartments | Hovering / Approaching | 83.5 | 79.0 | 4.5 |
| NSR 34 | Mount Davis Garden | Hovering / Approaching | 84.5 | 78.1 | 6.4 |
| NSR 35 | Greenery Garden | Hovering / Approaching | 84.2 | 79.3 | 4.9 |
| NSR 36 | On Lee Blocks A-B | Hovering / Approaching | 83.3 | 78.5 | 4.8 |
| NSR 37 | On Lee Blocks C-E | Hovering / Approaching | 83.6 | 78.6 | 5.0 |
| NSR 38 | Kai Ming Temple | Hovering / Approaching | 84.8 | 79.1 | 5.7 |
| NSR 39 | Fook Wai Mansion | Hovering / Approaching | 83.0 | 78.3 | 4.7 |
| NSR 40 | Yue Yan Mansion Block C | Hovering / Approaching | 83.5 | 79.8 | 3.7 |
| NSR 41 | Yue Yan Mansion Block D | Hovering / Approaching | 83.7 | 79.9 | 3.8 |
| NSR 42 | Pokfulam Court | Hovering / Approaching | 83.0 | 79.7 | 3.3 |
| NSR 43 | Pokfulam Mansion | Hovering / Approaching | 82.9 | 79.6 | 3.3 |
| NSR 44 | 92E Pok Fu Lam Road | Hovering / Approaching | 82.3 | 78.1 | 4.2 |
| NSR 45 | La Clare Mansion, Block A | Hovering / Approaching | 81.6 | 78.8 | 2.7 |
| NSR 46 | La Clare Mansion, Block B | Hovering / Approaching | 81.5 | 78.7 | 2.7 |
| NSR 47 | La Clare Mansion, Block C | Hovering / Approaching | 81.3 | 78.6 | 2.7 |

| NSR ID | Description | Worst-case Operation Mode in EIA / OHNMMP | EIA Prediction | OHNMMP Prediction | Noise Reduction |
|--------|---------------------------|---|--------------------------|--------------------------|--------------------------|
| | | | L _{max} , dB(A) | L _{max} , dB(A) | L _{max} , dB(A) |
| NSR 48 | La Clare Mansion, Block D | Hovering / Approaching | 81.2 | 78.5 | 2.7 |

3.5.3 Based on the proposed noise mitigation measures as mentioned in **Table 3-5**, the predicted noise levels at all representative NSRs are decreased (up to 8.8 dB(A)) as compared against the approved EIA report. Hence, the updated noise mitigation measures are acceptable with reference to the updated prediction of noise levels.

3.5.4 All practicable noise mitigation measures as mentioned in the approved EIA report have been exhausted and adopted in the proposed helipad in this OHNMMP to minimize the helicopter noise impact. The design and selection of flight sectors has been optimized to avoid flying over the high population density area. In addition, quieter Airbus H175 are came into operation. Since there are no relevant noise criteria in the TM-EIAO and overseas/ international guidelines applicable to emergency helicopter operation in evening and night-time periods, the helicopter noise impact during such time periods would not be quantitatively assessed.

4 Conclusion

- 4.1.1 The helicopter noise impact assessment under the worst-case scenario has been conducted based on the updated information and mitigation proposals in place. The height (i.e. top level at 300.3mPD) of the solid concrete parapet walls have been maximized with the consideration of flight safety based on the GFS's advice. All practicable noise mitigation measures as mentioned in the approved EIA report have been exhausted and adopted in the proposed helipad in this OHNMMP to minimize the helicopter noise impact. With the implementation of the exhausted noise mitigation measures, the predicted helicopter noise levels at all representative NSRs will comply with the relevant day-time noise criterion of L_{max} 85 dB(A). The predicted helicopter noise levels in this OHNMMP are reduced comparing against the approved EIA report. Thus, the conclusion in the approved EIA report remains unchanged. Helicopter noise impacts on nearby NSRs have been minimized and exceedance of the helicopter noise criteria is not anticipated.

Appendices

Appendix A. Correspondence between Mott MacDonald and GFS

Appendix B. Helicopter Noise Impact Assessment

Appendix C. The Illustration of Noise Screening (NSR1 to NSR48)

Appendix D. Helicopter Noise Survey Report

Appendix E. Implementation Schedule

Appendix A. Correspondence between Mott MacDonald and GFS

Leung, Henry

From: victorlau@gfs.gov.hk
Sent: Friday, April 3, 2020 2:35 AM
To: Leung, Henry
Cc: Vincent Chow_QMH; Tang, Steven; karlchan@gfs.gov.hk; jamessze@gfs.gov.hk; martinyu@gfs.gov.hk
Subject: RE: Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction) - Operational Helicopter Noise Mitigation Measures Plan (OHNMMP) (Correspondence between Mott and GFS)

Dear Henry,

You can expect all the L2's will be phased out mid 2020. At the moment all the Emergency Response flights, i.e. those resulting in landing in Eastern Hospital are already conducted by our new H175 helicopters. After the last varification scheduled this April, all GFS tasks can be taken over by H175.

Regards,

Captain Victor Lau
Senior Pilot (Operations)
Government Flying Service
Tel: (852) 2305 8318
Fax: (852) 2753 9327

From: "Leung, Henry" <Henry.Leung@mottmac.com>
To: "victorlau@gfs.gov.hk" <victorlau@gfs.gov.hk>
Cc: Vincent Chow_QMH <qmh_design@pyablejv.com>, "Tang, Steven" <Steven.Tang@mottmac.com>
Date: 02/04/2020 11:37
Subject: RE: Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction) - Operational Helicopter Noise Mitigation Measures Plan (OHNMMP) (Correspondence between Mott and GFS)

Dear Victor,

As spoken today morning, please advise us the expected completion date of the full fleet replacement with the new helicopter Airbus H175.

Should you have any queries, please feel free to contact me. It would be grateful if you can reply us in these two days. Thanks for your help in advance.

Regards,
Henry Leung
MEng BEng (Hons) MHKIOA MHKIQEP
Senior Environmental Consultant

T +852 2828 5757 D +852 2828 5876 F +852 2827 1823 henry.leung@mottmac.com

-----Original Message-----

From: victorlau@gfs.gov.hk <victorlau@gfs.gov.hk>

Sent: Thursday, March 12, 2020 6:17 PM

To: Leung, Henry <Henry.Leung@mottmac.com>

Cc: Vincent Chow_QMH <qmh_design@pyablejv.com>; Tang, Steven <Steven.Tang@mottmac.com>

Subject: Re: Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction) - Operational Helicopter Noise Mitigation Measures Plan (OHNMMP) (Correspondence between Mott and GFS)

Dear Henry,

Thank you for the update information on the QMH helipad. We consider the change in the location of the helipad is minor and do not pose any safety concern to our operations. Therefore GFS do not have any comment on the changes.

Meanwhile please keep GFS informed on any update on the helipad.

Regards,

Captain Victor Lau
Senior Pilot (Operations)
Government Flying Service
Tel: (852) 2305 8318
Fax: (852) 2753 9327

From: "Leung, Henry" <Henry.Leung@mottmac.com>
To: "victorlau@gfs.gov.hk" <victorlau@gfs.gov.hk>
Cc: Vincent Chow_QMH <qmh_design@pyablejv.com>, "Tang, Steven" <Steven.Tang@mottmac.com>
Date: 26/02/2020 10:30
Subject: Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction) - Operational Helicopter Noise Mitigation Measures Plan (OHNMMP) (Correspondence between Mott and GFS)

[attachment "Figure 3.2 - Mitigation Measures for the Proposed Helipad.pdf"

deleted by Victor WT LAU/GFS/HKSARG]

[attachment "Figure 2.2 - Section View of Proposed Helipad.pdf" deleted by Victor WT LAU/GFS/HKSARG]

[attachment "Figure 2.1 - Close View of Proposed Helipad.pdf" deleted by Victor WT LAU/GFS/HKSARG] Dear Victor Lau (GFS),

Based on the latest design information of the rooftop helipad at the proposed new block at QMH, the proposed helipad centre has been shifted 4.06m southward and 0.28m westward as compared with the proposed location stated in the approved EIA (see attached Figure 2.1) and the flight sectors in north-west and south have been slightly shifted based on the new centre of helipad accordingly. Please confirm the updated flight sectors are still the best compromise with all factors and have been kept to a minimum in size so as to minimise the noise impact on the surroundings as in the approved EIA study.

In addition, the main roof level of the New Block has been revised from 282.4mPD stated in the approved EIA report to 298.8mPD with 1.45m parapet wall at four sides (+300.25mPD). The height of helipad has been revised to 307.8mPD. A section view of the proposed helipad is shown in Figure 2.2.

The building footprint and arrangement of lift lobby, stair, walkway and roof equipment layout have been changed from the approved EIA report. The top level of proposed noise mitigation measures (+300.3mPD) for the proposed

helipad (see attached Figure 3.2) is still fulfill the minimum 10m vertical clearance from the hovering position of the helicopter (+307.8mPD + 2.5m hovering height = 310.3mPD) for flight safety reasons as stated + in the approved EIA report. Please confirm the revised building footprint, rooftop arrangement and the proposed noise mitigation measures do not affect approaching and departure operations of helicopters.

Furthermore, all other operation assumptions of the proposed helipad are remain unchanged as stated in Appendix 1.1 of the approved EIA report.

Should you have any queries, please feel free to contact me. Thanks for your kind attention.

Regards,
Henry Leung
MEng BEng (Hons) MHKIOA MHKIQEP
Senior Environmental Consultant

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2827 1823

henry.leung@mottmac.com

Environmental Impact Assessment for A Rooftop Helipad at the Proposed New Block of Queen Mary Hospital

Background Information for GFS's New Helicopter

- The model of the New Helicopters for the replacement of the current GFS helicopter fleet is Airbus H175
- Starting in first quarter of 2018 and the full fleet replacement of new helicopters will be completed before 2024

Noise data for GFS's New Helicopter

- Type certified noise level during approach, take-off and flyover of the Airbus H175:
 - Approach Mode: 95.1 EPNdB
 - Overflight Mode: 91.0 EPNdB
 - Take-off Mode: 89.8 EPNdB
- Reference Measurement Distances:

With reference to the ICAO Annex 16, the reference distance with the round up figures are:

- Approach Mode: Reference distance 120 metres;
- Overflight Mode: Reference distance 150 metres;
- Take-off Mode: Reference distance 150 metres.

Selection of Flight Sectors

- GFS will be the operator of the proposed QMH helipad in conveying patients/survivors from lifesaving missions to the hospital in a safe, efficient and effective manner. At the same time, it is always the GFS's aim to minimize any disturbance to the surrounding areas during the course of actions, for day and night operations alike.
- The choice of helicopter approach and departure paths depends on the terrain/obstacles clearance as well as any ambient conditions such as wind and turbulence. The aim is to avoid any downwind operations and to minimizing crosswind operations which could undermine safety of the flight. As the actual wind conditions will vary from time to time, the proposed flight sectors are essential to offer sufficient flexibility to the flight crew in deciding the most suitable and safe flight path for approach and departure. Also, from flight operations point of view, the chosen flight path may need to be altered slightly subject to the conditions in order to cope with some in-flight situations e.g. movement of birds or unexpected localized turbulence. For departure, on the other hand, GFS internal procedures will require the aircraft to climb to 1500 feet above mean sea level and turn away from any build-up areas as soon as practicable. The flight trials at the later stage will further refine the operational procedure to ensure flight safety and minimize the noise impact to the NSRs further regardless of day or night operations.
- Taking the noise impact to the surroundings into considerations, GFS would however like to emphasize that the proposed flight sectors are the best compromise with all factors and have been kept to a minimum in size. For instance, based on the geographical locations of the high ground and build up areas in the vicinity of the helipad, the eastern sector as well as most of the southern sector will not be considered in order to balance the flight safety concerns and any possible disturbance to the neighbourhood.

Typical Flight Profile

- Cruise / Flyover: Typical flight height 1500ft above mean sea level with flight speed 140kts, descends 500ft/min with flight speed 100kts until 300ft above the helipad;
- Approach: From 300ft above the helipad, flight speed reduces from 60kts to 0kts with approach angle of 4.6 degrees within 60 sec for both North-west flight sector and South flight sector;
- Hovering (Approach): Achieve desirable orientation for touchdown within 5 sec., around 2.5m above helipad;
- Touchdown: Descends on to the helipad within 3 sec.;
- Idling: 5 minutes for casualty handover under normal circumstances;
- Lift-off: Ascends from helipad to achieve a hover before departure within 3 sec.;
- Hovering (Departure): Achieve desirable orientation for take-off within 5 sec., around 2.5m above helipad;
- Take-off: Flight speed increases from 0kts to 60kts with departure angle of 4.6 degrees within 60 sec up to 300ft above the helipad; and
- Cruise/Flyover: Ascends 500ft/min with flight speed 100kts until achieved typical flight height 1500ft above mean sea level, at typical flight height, the flight speed increases to 140kts (approximate 2 - 3 seconds for travelling over each NSR).

Note: It is approximate 2 – 3 seconds for helicopter travelling over each NSR during flyover/cruise mode. The minimum distance to the nearest NSR (i.e. 90m) could be achieved during cruise/flyover mode.

Quiet Approaching / Departure Procedures

- The approach and departure angles can be increased to 10 degrees for the north-west and south flight sector.

Safety Consideration During Take-off

- To ensure the flight safety of helicopter operations, accordingly to ICAO Annex 14 Volume II, in the immediate vicinity of an elevated helipad, obstacle protection for helicopters shall be provided below the helipad level. As confirmed previously, a provision of a minimum vertical clearance from the hovering position of helicopter is 10 m for flight safety reasons.

Helicopter Landing Light

- Landing lights will be switched on to illuminate the helipad only during approaching and departure. The overall operation of landing lights takes 2 minutes approximately.

Other Information

- There is no registered helicopter landing site located in the vicinity.
- There is no regular GFS helicopter flight route within the study area.
- GFS does not have any record of emergency helicopter operations within the study area.
- GFS's Helicopter is seldom operated in full load condition.

Appendix B. Helicopter Noise Impact Assessment

M M **Appendix B**
Helicopter Noise Impact Assessment (Mitigated Scenario)
Maximum Sound Pressure Level (Lmax)

| NSR ID i | Description | Distance r_{ij} , m | | | | | | | | | | Distance Corrected Maximum Sound Pressure Level $L_{max}(C_D)_{ij}$, dB(A) | | | | | | | | | |
|----------|--|-----------------------|-------------|----------|-----------|--------|----------|----------|----------|---------|---------|---|----------|-----------|--------|----------|----------|----------|---------|--|--|
| | | Operation Mode j | | | | | | | | | | Operation Mode j | | | | | | | | | |
| | | Flyover | Approaching | Hovering | Touchdown | Idling | Lift-off | Hovering | Take-off | Flyover | Flyover | Approaching | Hovering | Touchdown | Idling | Lift-off | Hovering | Take-off | Flyover | | |
| NSR 1 | Jessville Tower | 156.7 | 155.6 | 517.2 | 517.2 | 516.9 | 517.2 | 517.2 | 155.6 | 156.7 | 77.6 | 79.8 | 72.7 | 68.1 | 64.7 | 71.6 | 72.7 | 76.5 | 77.6 | | |
| NSR 2 | Radcliffe | 188.0 | 172.5 | 470.2 | 470.2 | 469.7 | 470.2 | 470.2 | 172.5 | 188.0 | 76.0 | 78.9 | 73.6 | 69.0 | 65.5 | 72.5 | 73.6 | 75.6 | 76.0 | | |
| NSR 3 | Royalton | 206.1 | 163.4 | 419.8 | 419.8 | 419.3 | 419.8 | 419.8 | 163.4 | 206.1 | 75.2 | 79.4 | 74.6 | 70.0 | 66.5 | 73.5 | 74.6 | 76.1 | 75.2 | | |
| NSR 4 | Ebenezer School | 250.2 | 240.1 | 502.9 | 502.9 | 502.1 | 502.9 | 502.9 | 240.1 | 250.2 | 73.6 | 76.1 | 73.0 | 68.4 | 64.9 | 71.9 | 73.0 | 72.7 | 73.6 | | |
| NSR 5 | Royalton II | 224.8 | 159.9 | 388.7 | 388.7 | 388.1 | 388.7 | 388.7 | 159.9 | 224.8 | 74.5 | 79.6 | 75.2 | 70.6 | 67.1 | 74.1 | 75.2 | 76.2 | 74.5 | | |
| NSR 6 | 13 - 15 Northcote Close | 310.4 | 272.3 | 454.1 | 454.1 | 453.0 | 454.1 | 454.1 | 272.3 | 310.4 | 71.7 | 75.0 | 73.9 | 69.3 | 65.8 | 72.8 | 73.9 | 71.6 | 71.7 | | |
| NSR 7 | 9 - 11 Northcote Close | 304.9 | 274.2 | 467.6 | 467.6 | 466.6 | 467.6 | 467.6 | 274.2 | 304.9 | 71.8 | 74.9 | 73.6 | 69.0 | 65.5 | 72.5 | 73.6 | 71.6 | 71.8 | | |
| NSR 8 | Partrick Manson Building | 328.0 | 281.3 | 444.1 | 444.1 | 443.1 | 444.1 | 444.1 | 281.3 | 328.0 | 71.2 | 74.7 | 74.1 | 69.5 | 66.0 | 73.0 | 74.1 | 71.3 | 71.2 | | |
| NSR 9 | R.C. Lee Hall | 335.3 | 219.6 | 339.5 | 339.5 | 338.6 | 339.5 | 339.5 | 219.6 | 335.3 | 71.0 | 76.8 | 76.4 | 71.8 | 68.3 | 75.3 | 76.4 | 73.5 | 71.0 | | |
| NSR 10 | Wei Lun Hall | 369.4 | 203.5 | 288.0 | 288.0 | 287.0 | 288.0 | 288.0 | 203.5 | 369.4 | 70.2 | 77.5 | 77.8 | 73.2 | 69.8 | 76.7 | 77.8 | 74.2 | 70.2 | | |
| NSR 11 | Lee Hysan Hall | 360.0 | 235.6 | 336.3 | 336.3 | 335.4 | 336.3 | 336.3 | 235.6 | 360.0 | 70.4 | 76.2 | 76.5 | 71.9 | 68.4 | 75.4 | 76.5 | 72.9 | 70.4 | | |
| NSR 12 | Madam S.H. HO Residence for Medical Students | 390.5 | 250.3 | 328.3 | 328.3 | 327.1 | 328.3 | 328.3 | 250.3 | 390.5 | 69.7 | 75.7 | 76.7 | 72.1 | 68.6 | 75.6 | 76.7 | 72.4 | 69.7 | | |
| NSR 13 | 23 Bisney Road | 435.9 | 337.7 | 412.4 | 412.4 | 411.2 | 412.4 | 412.4 | 337.7 | 435.9 | 68.7 | 73.1 | 74.7 | 70.1 | 66.6 | 73.6 | 74.7 | 69.8 | 68.7 | | |
| NSR 14 | 21 Bisney Road | 428.2 | 324.9 | 399.9 | 399.9 | 398.7 | 399.9 | 399.9 | 324.9 | 428.2 | 68.9 | 73.4 | 75.0 | 70.4 | 66.9 | 73.9 | 75.0 | 70.1 | 68.9 | | |
| NSR 15 | 18 - 24 Bisney Road | 393.9 | 299.5 | 394.2 | 394.2 | 392.9 | 394.2 | 394.2 | 299.5 | 393.9 | 69.6 | 74.2 | 75.1 | 70.5 | 67.0 | 74.0 | 75.1 | 70.8 | 69.6 | | |
| NSR 16 | Glamour Court Blocks A-B | 393.0 | 291.1 | 382.5 | 382.5 | 381.2 | 382.5 | 382.5 | 291.1 | 393.0 | 69.6 | 74.4 | 75.4 | 70.8 | 67.3 | 74.3 | 75.4 | 71.0 | 69.6 | | |
| NSR 17 | Glamour Court Blocks C-E | 370.3 | 275.1 | 381.5 | 381.5 | 380.2 | 381.5 | 381.5 | 275.1 | 370.3 | 70.1 | 74.9 | 75.4 | 70.8 | 67.3 | 74.3 | 75.4 | 71.5 | 70.1 | | |
| NSR 18 | Victoria Garden, Block 1 | 284.1 | 279.7 | 540.2 | 540.2 | 539.6 | 540.2 | 540.2 | 279.7 | 284.1 | 72.5 | 74.7 | 72.4 | 67.8 | 64.3 | 71.3 | 72.4 | 71.4 | 72.5 | | |
| NSR 19 | Victoria Garden, Block 2 | 275.1 | 268.4 | 525.6 | 525.6 | 525.0 | 525.6 | 525.6 | 268.4 | 275.1 | 72.7 | 75.1 | 72.6 | 68.0 | 64.5 | 71.5 | 72.6 | 71.7 | 72.7 | | |
| NSR 20 | Cherry Court | 341.3 | 329.0 | 534.6 | 534.6 | 533.5 | 534.6 | 534.6 | 329.0 | 341.3 | 70.9 | 73.3 | 72.5 | 67.9 | 64.4 | 71.4 | 72.5 | 70.0 | 70.9 | | |
| NSR 21 | 3 Consort Rise, Blocks 7 - 8 | 345.8 | 321.2 | 500.7 | 500.7 | 499.5 | 500.7 | 500.7 | 321.2 | 345.8 | 70.7 | 73.5 | 73.0 | 68.4 | 65.0 | 71.9 | 73.0 | 70.2 | 70.7 | | |
| NSR 22 | TWGHs Jockey Club Care & Attention Home for Elderly, Nurses Quarters | 379.7 | 381.0 | 627.6 | 627.6 | 626.5 | 627.6 | 627.6 | 381.0 | 379.7 | 69.9 | 72.1 | 71.1 | 66.5 | 63.0 | 70.0 | 71.1 | 68.7 | 69.9 | | |
| NSR 23 | TWGHs Jockey Club Care & Attention Home for Elderly | 375.1 | 376.9 | 628.9 | 628.9 | 627.8 | 628.9 | 628.9 | 376.9 | 375.1 | 70.0 | 72.2 | 71.1 | 66.5 | 63.0 | 70.0 | 71.1 | 68.8 | 70.0 | | |
| NSR 24 | English School Foundation - West Island School | 337.8 | 332.1 | 559.6 | 559.6 | 558.5 | 559.6 | 559.6 | 332.1 | 337.8 | 70.9 | 73.3 | 72.1 | 67.5 | 64.0 | 71.0 | 72.1 | 69.9 | 70.9 | | |
| NSR 25 | Greenvale, Block 5 | 310.5 | 307.1 | 558.7 | 558.7 | 557.7 | 558.7 | 558.7 | 307.1 | 310.5 | 71.7 | 73.9 | 72.1 | 67.5 | 64.0 | 71.0 | 72.1 | 70.6 | 71.7 | | |
| NSR 26 | Greenvale, Block 4 | 301.3 | 297.1 | 549.0 | 549.0 | 548.1 | 549.0 | 549.0 | 297.1 | 301.3 | 71.9 | 74.2 | 72.2 | 67.6 | 64.1 | 71.1 | 72.2 | 70.9 | 71.9 | | |
| NSR 27 | Greenvale, Block 3 | 305.9 | 293.5 | 517.2 | 517.2 | 516.1 | 517.2 | 517.2 | 293.5 | 305.9 | 71.8 | 74.3 | 72.7 | 68.1 | 64.7 | 71.6 | 72.7 | 71.0 | 71.8 | | |
| NSR 28 | Greenvale, Block 2 | 308.9 | 289.9 | 498.6 | 498.6 | 497.6 | 498.6 | 498.6 | 289.9 | 308.9 | 71.7 | 74.4 | 73.1 | 68.5 | 65.0 | 72.0 | 73.1 | 71.1 | 71.7 | | |
| NSR 29 | Greenvale, Block 1 | 303.9 | 283.2 | 491.5 | 491.5 | 490.5 | 491.5 | 491.5 | 283.2 | 303.9 | 71.9 | 74.6 | 73.2 | 68.6 | 65.1 | 72.1 | 73.2 | 71.3 | 71.9 | | |
| NSR 30 | Mount Davis Village, House A7 | 284.6 | 275.0 | 517.9 | 517.9 | 517.0 | 517.9 | 517.9 | 275.0 | 284.6 | 72.4 | 74.9 | 72.7 | 68.1 | 64.7 | 71.6 | 72.7 | 71.5 | 72.4 | | |
| NSR 31 | The High House | 274.1 | 273.6 | 562.6 | 562.6 | 561.8 | 562.6 | 562.6 | 273.6 | 274.1 | 72.8 | 74.9 | 72.0 | 67.4 | 63.9 | 70.9 | 72.0 | 71.6 | 72.8 | | |
| NSR 32 | 7 Mount Davis Road | 310.8 | 273.0 | 454.7 | 454.7 | 453.6 | 454.7 | 454.7 | 273.0 | 310.8 | 71.7 | 75.0 | 73.9 | 69.3 | 65.8 | 72.8 | 73.9 | 71.6 | 71.7 | | |
| NSR 33 | Four Winds Apartments | 257.7 | 242.1 | 488.0 | 488.0 | 487.2 | 488.0 | 488.0 | 242.1 | 257.7 | 73.3 | 76.0 | 73.3 | 68.7 | 65.2 | 72.2 | 73.3 | 72.6 | 73.3 | | |
| NSR 34 | Mount Davis Garden | 314.7 | 267.7 | 438.1 | 438.1 | 436.9 | 438.1 | 438.1 | 267.7 | 314.7 | 71.6 | 75.1 | 74.2 | 69.6 | 66.1 | 73.1 | 74.2 | 71.8 | 71.6 | | |
| NSR 35 | Greenery Garden | 265.4 | 233.8 | 451.8 | 451.8 | 450.9 | 451.8 | 451.8 | 233.8 | 265.4 | 73.0 | 76.3 | 73.9 | 69.3 | 65.8 | 72.8 | 73.9 | 72.9 | 73.0 | | |
| NSR 36 | On Lee, Blocks A-B | 269.8 | 256.5 | 499.2 | 499.2 | 498.3 | 499.2 | 499.2 | 256.5 | 269.8 | 72.9 | 75.5 | 73.1 | 68.5 | 65.0 | 72.0 | 73.1 | 72.1 | 72.9 | | |
| NSR 37 | On Lee, Blocks C-E | 272.4 | 254.6 | 487.1 | 487.1 | 486.2 | 487.1 | 487.1 | 254.6 | 272.4 | 72.8 | 75.6 | 73.3 | 68.7 | 65.2 | 72.2 | 73.3 | 72.2 | 72.8 | | |
| NSR 38 | Kai Ming Temple | 324.2 | 240.3 | 380.1 | 380.1 | 378.9 | 380.1 | 380.1 | 240.3 | 324.2 | 71.3 | 76.1 | 75.4 | 70.8 | 67.4 | 74.3 | 75.4 | 72.7 | 71.3 | | |
| NSR 39 | Fook Wai Mansion | 271.2 | 263.8 | 521.0 | 521.0 | 520.1 | 521.0 | 521.0 | 263.8 | 271.2 | 72.9 | 75.3 | 72.7 | 68.1 | 64.6 | 71.6 | 72.7 | 71.9 | 72.9 | | |
| NSR 40 | Yue Yan Mansion, Block C | 232.7 | 221.4 | 493.1 | 493.1 | 492.4 | 493.1 | 493.1 | 221.4 | 232.7 | 74.2 | 76.8 | 73.2 | 68.6 | 65.1 | 72.1 | 73.2 | 73.4 | 74.2 | | |
| NSR 41 | Yue Yan Mansion, Block D | 234.2 | 218.9 | 481.5 | 481.5 | 480.7 | 481.5 | 481.5 | 218.9 | 234.2 | 74.1 | 76.9 | 73.4 | 68.8 | 65.3 | 72.3 | 73.4 | 73.5 | 74.1 | | |
| NSR 42 | Pokfulam Court | 227.2 | 223.5 | 521.7 | 521.7 | 521.0 | 521.7 | 521.7 | 223.5 | 227.2 | 74.4 | 76.7 | 72.7 | 68.1 | 64.6 | 71.6 | 72.7 | 73.3 | 74.4 | | |
| NSR 43 | Pokfulam Mansion | 228.8 | 225.7 | 525.5 | 525.5 | 524.8 | 525.5 | 525.5 | 225.7 | 228.8 | 74.3 | 76.6 | 72.6 | 68.0 | 64.5 | 71.5 | 72.6 | 73.2 | 74.3 | | |
| NSR 44 | 92E Pok Fu Lam Road | 268.6 | 268.7 | 564.0 | 564.0 | 563.2 | 564.0 | 564.0 | 268.7 | 268.6 | 72.9 | 75.1 | 72.0 | 67.4 | 63.9 | 70.9 | 72.0 | 71.7 | 72.9 | | |
| NSR 45 | La Clare Mansion, Block A | 233.5 | 246.5 | 611.1 | 611.1 | 610.6 | 611.1 | 611.1 | 246.5 | 233.5 | 74.2 | 75.8 | 71.3 | 66.7 | 63.2 | 70.2 | 71.3 | 72.5 | 74.2 | | |
| NSR 46 | La Clare Mansion, Block B | 235.0 | 249.6 | 616.4 | 616.4 | 615.9 | 616.4 | 616.4 | 249.6 | 235.0 | 74.1 | 75.7 | 71.2 | 66.6 | 63.1 | 70.1 | 71.2 | 72.4 | 74.1 | | |
| NSR 47 | La Clare Mansion, Block C | 234.3 | 253.6 | 628.7 | 628.7 | 628.2 | 628.7 | 628.7 | 253.6 | 234.3 | 74.1 | 75.6 | 71.1 | 66.5 | 63.0 | 70.0 | 71.1 | 72.2 | 74.1 | | |
| NSR 48 | La Clare Mansion, Block D | 235.7 | 257.0 | 634.4 | 634.4 | 633.9 | 634.4 | 634.4 | 257.0 | 235.7 | 74.1 | 75.5 | 71.0 | 66.4 | 62.9 | 69.9 | 71.0 | 72.1 | 74.1 | | |

Notes:

- (1) This is the shortest distance from noise source to NSR for the corresponding operation mode. Helipad setback has been considered in the mitigated scenario.
- (2) Distance Corrected Maximum Sound Pressure Level: $L_{max}(C_D) = L_{max}(ref)_j + C_D$, where $L_{max}(ref)_j$ is the reference sound pressure level for operation mode j (in dB(A)), and C_D is the distance correction (in dB(A)).
- (3) For NSR 38, since the proposed helipad layout has been changed from the approved EIA report, the noise reduction of 1 dB(A) for the partially screening effect by parapet wall of the helipad access ramp adopted in the approved EIA is not considered in this OHNMMP for conservative approach
- (4) Section drawings of NSRs showing the barrier effect are provided in Appendix C.
- (5) Noise Criterion : 85 dB(A) L_{max}

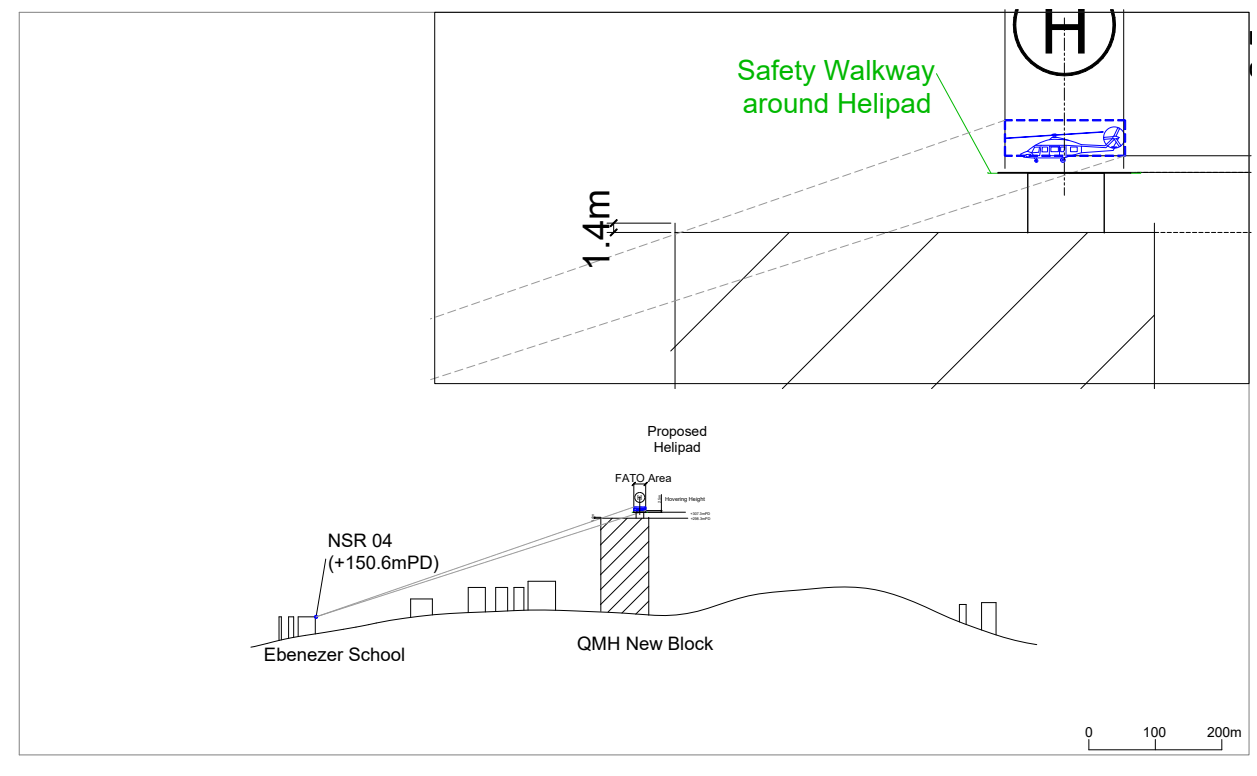
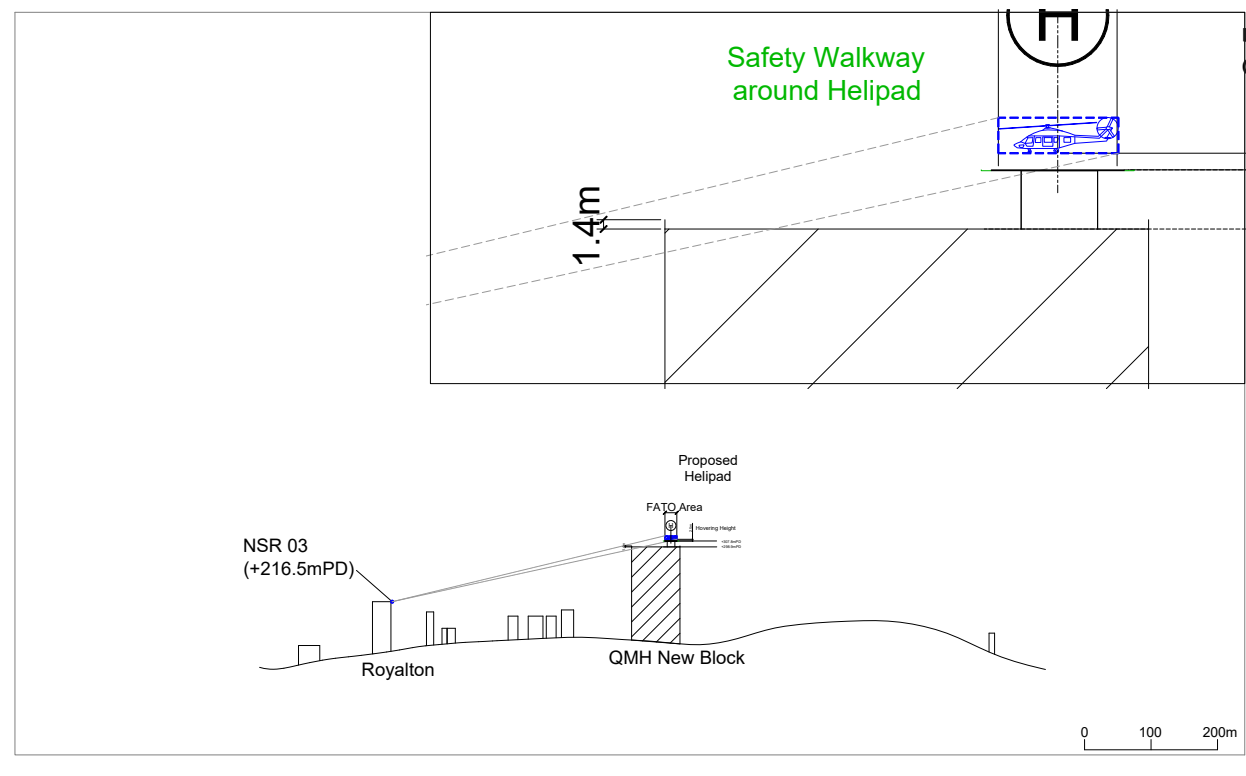
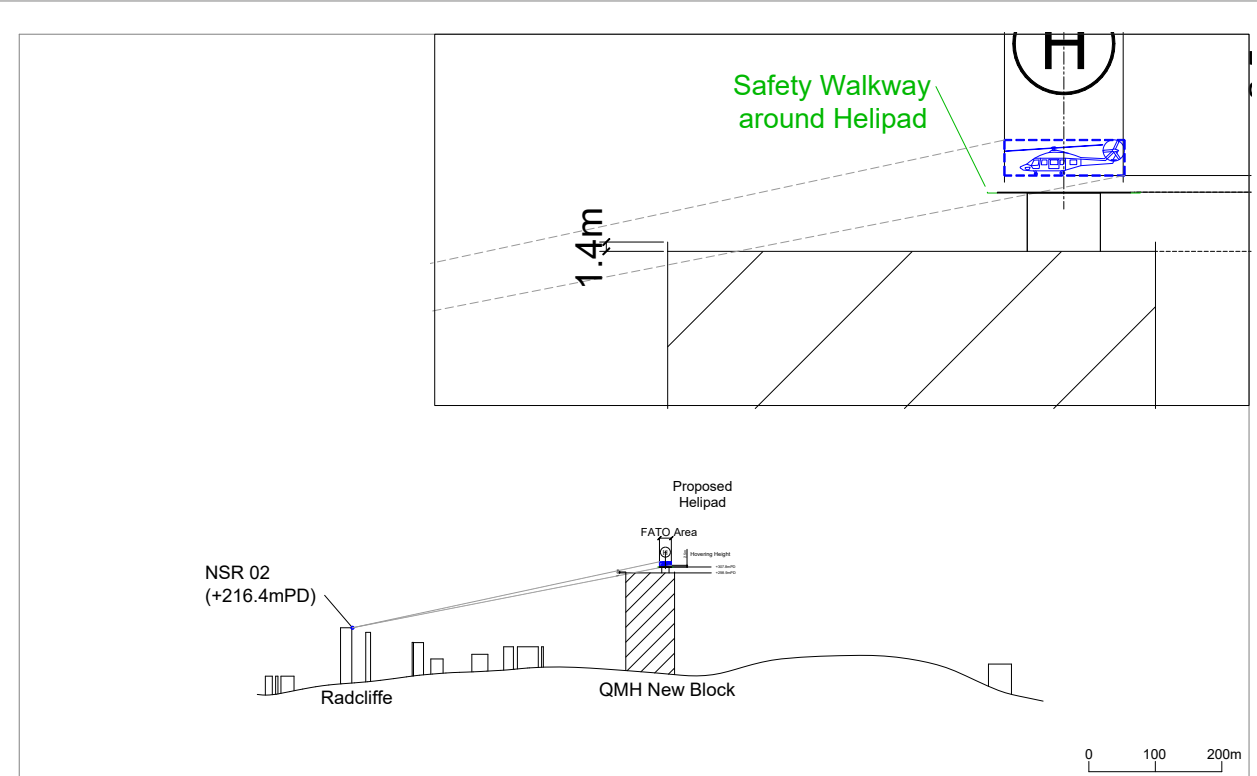
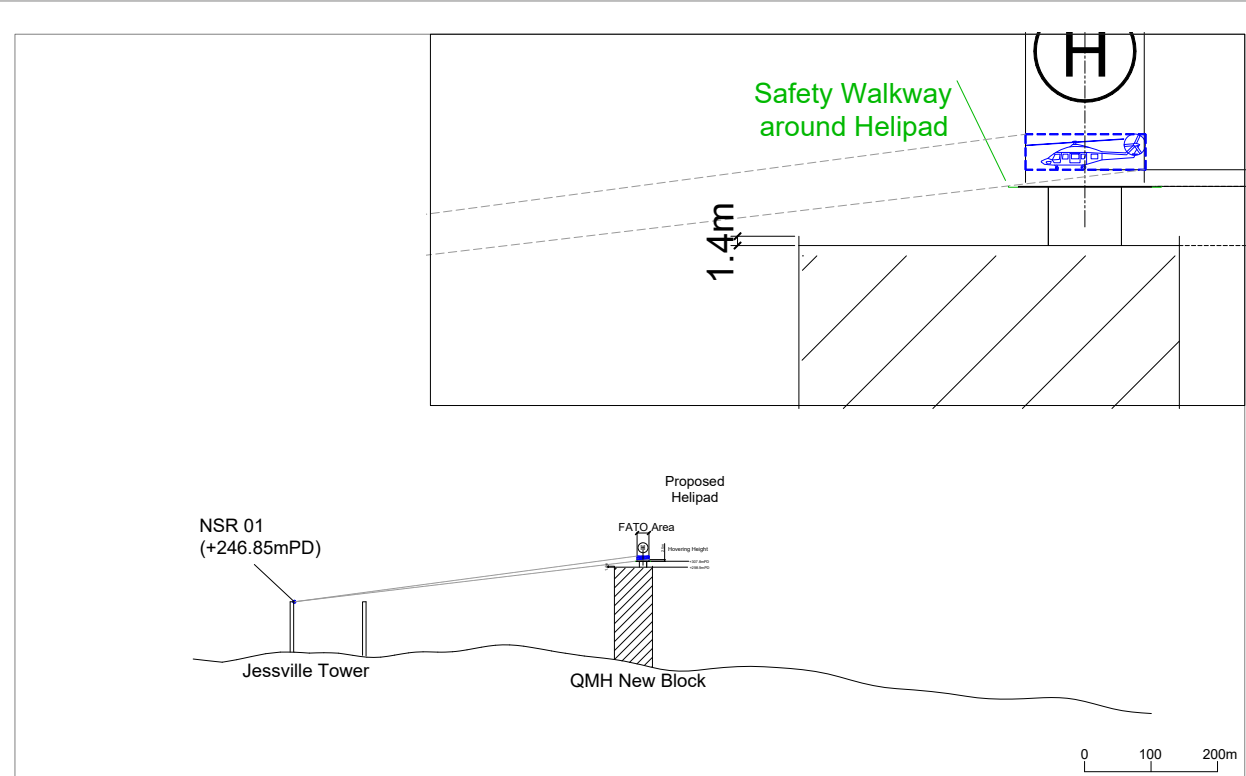
M M **Appendix B**
Helicopter Noise Impact Assessment (Mitigated Scenario)
Maximum Sound Pressure Level (L_{max})

| NSR ID i | Description | Barrier Correction C _B ^{3,4} dB(A) | | | | | | | | | Façade Correction C _F dB(A) | Maximum Sound Pressure Level L _{max} ⁵ dB(A) | | | | | | | | |
|----------|--|--|-------------|----------|-----------|--------|----------|----------|----------|---------|--|--|-------------|----------|-----------|--------|----------|----------|----------|---------|
| | | Operation Mode j | | | | | | | | | | Operation Mode j | | | | | | | | |
| | | Flyover | Approaching | Hovering | Touchdown | Idling | Lift-off | Hovering | Take-off | Flyover | | Flyover | Approaching | Hovering | Touchdown | Idling | Lift-off | Hovering | Take-off | Flyover |
| NSR 1 | Jessville Tower | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 81 | 83 | 76 | 71 | 68 | 75 | 76 | 79 | 81 |
| NSR 2 | Radcliffe | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 79 | 82 | 77 | 72 | 68 | 75 | 77 | 79 | 79 |
| NSR 3 | Royalton | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 78 | 82 | 78 | 73 | 69 | 76 | 78 | 79 | 78 |
| NSR 4 | Ebenezer School | 0.0 | 0.0 | -5.0 | -5.0 | -5.0 | -5.0 | -5.0 | 0.0 | 0.0 | 3.0 | 77 | 79 | 71 | 66 | 63 | 70 | 71 | 76 | 77 |
| NSR 5 | Royalton II | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 83 | 78 | 74 | 70 | 77 | 78 | 79 | 77 |
| NSR 6 | 13 - 15 Northcote Close | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 75 | 78 | 67 | 62 | 59 | 66 | 67 | 75 | 75 |
| NSR 7 | 9 - 11 Northcote Close | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 75 | 78 | 67 | 62 | 59 | 66 | 67 | 75 | 75 |
| NSR 8 | Partrick Manson Building | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 74 | 78 | 67 | 62 | 59 | 66 | 67 | 74 | 74 |
| NSR 9 | R.C. Lee Hall | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 74 | 80 | 69 | 65 | 61 | 68 | 69 | 76 | 74 |
| NSR 10 | Wei Lun Hall | 0.0 | 0.0 | -5.0 | -5.0 | -5.0 | -5.0 | -5.0 | 0.0 | 0.0 | 3.0 | 73 | 81 | 76 | 71 | 68 | 75 | 76 | 77 | 73 |
| NSR 11 | Lee Hysan Hall | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 73 | 79 | 69 | 65 | 61 | 68 | 69 | 76 | 73 |
| NSR 12 | Madam S.H. HO Residence for Medical Students | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 73 | 79 | 70 | 65 | 62 | 69 | 70 | 75 | 73 |
| NSR 13 | 23 Bisney Road | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 72 | 76 | 68 | 63 | 60 | 67 | 68 | 73 | 72 |
| NSR 14 | 21 Bisney Road | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 72 | 76 | 68 | 63 | 60 | 67 | 68 | 73 | 72 |
| NSR 15 | 18 - 24 Bisney Road | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 73 | 77 | 68 | 64 | 60 | 67 | 68 | 74 | 73 |
| NSR 16 | Glamour Court Blocks A-B | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 73 | 77 | 68 | 64 | 60 | 67 | 68 | 74 | 73 |
| NSR 17 | Glamour Court Blocks C-E | 0.0 | 0.0 | -10.0 | -10.0 | -10.0 | -10.0 | -10.0 | 0.0 | 0.0 | 3.0 | 73 | 78 | 68 | 64 | 60 | 67 | 68 | 75 | 73 |
| NSR 18 | Victoria Garden, Block 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 78 | 75 | 71 | 67 | 74 | 75 | 74 | 75 |
| NSR 19 | Victoria Garden, Block 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 78 | 76 | 71 | 68 | 75 | 76 | 75 | 76 |
| NSR 20 | Cherry Court | 0.0 | 0.0 | -5.0 | -5.0 | -5.0 | -5.0 | -5.0 | 0.0 | 0.0 | 3.0 | 74 | 76 | 70 | 66 | 62 | 69 | 70 | 73 | 74 |
| NSR 21 | 3 Consort Rise, Blocks 7 - 8 | 0.0 | 0.0 | -5.0 | -5.0 | -5.0 | -5.0 | -5.0 | 0.0 | 0.0 | 3.0 | 74 | 77 | 71 | 66 | 63 | 70 | 71 | 73 | 74 |
| NSR 22 | TWGHs Jockey Club Care & Attention Home for Elderly, Nurses Quarters | 0.0 | 0.0 | -5.0 | -5.0 | -5.0 | -5.0 | -5.0 | 0.0 | 0.0 | 3.0 | 73 | 75 | 69 | 64 | 61 | 68 | 69 | 72 | 73 |
| NSR 23 | TWGHs Jockey Club Care & Attention Home for Elderly | 0.0 | 0.0 | -5.0 | -5.0 | -5.0 | -5.0 | -5.0 | 0.0 | 0.0 | 3.0 | 73 | 75 | 69 | 64 | 61 | 68 | 69 | 72 | 73 |
| NSR 24 | English School Foundation - West Island School | 0.0 | 0.0 | -5.0 | -5.0 | -5.0 | -5.0 | -5.0 | 0.0 | 0.0 | 3.0 | 74 | 76 | 70 | 65 | 62 | 69 | 70 | 73 | 74 |
| NSR 25 | Greenvale, Block 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 77 | 75 | 70 | 67 | 74 | 75 | 74 | 75 |
| NSR 26 | Greenvale, Block 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 77 | 75 | 71 | 67 | 74 | 75 | 74 | 75 |
| NSR 27 | Greenvale, Block 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 77 | 76 | 71 | 68 | 75 | 76 | 74 | 75 |
| NSR 28 | Greenvale, Block 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 77 | 76 | 71 | 68 | 75 | 76 | 74 | 75 |
| NSR 29 | Greenvale, Block 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 78 | 76 | 72 | 68 | 75 | 76 | 74 | 75 |
| NSR 30 | Mount Davis Village, House A7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 78 | 76 | 71 | 68 | 75 | 76 | 75 | 75 |
| NSR 31 | The High House | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 78 | 75 | 70 | 67 | 74 | 75 | 75 | 76 |
| NSR 32 | 7 Mount Davis Road | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 78 | 77 | 72 | 69 | 76 | 77 | 75 | 75 |
| NSR 33 | Four Winds Apartments | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 79 | 76 | 72 | 68 | 75 | 76 | 76 | 76 |
| NSR 34 | Mount Davis Garden | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 75 | 78 | 77 | 73 | 69 | 76 | 77 | 75 | 75 |
| NSR 35 | Greenery Garden | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 79 | 77 | 72 | 69 | 76 | 77 | 76 | 76 |
| NSR 36 | On Lee, Blocks A-B | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 79 | 76 | 71 | 68 | 75 | 76 | 75 | 76 |
| NSR 37 | On Lee, Blocks C-E | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 79 | 76 | 72 | 68 | 75 | 76 | 75 | 76 |
| NSR 38 | Kai Ming Temple | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 74 | 79 | 78 | 74 | 70 | 77 | 78 | 76 | 74 |
| NSR 39 | Fook Wai Mansion | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 78 | 76 | 71 | 68 | 75 | 76 | 75 | 76 |
| NSR 40 | Yue Yan Mansion, Block C | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 80 | 76 | 72 | 68 | 75 | 76 | 76 | 77 |
| NSR 41 | Yue Yan Mansion, Block D | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 80 | 76 | 72 | 68 | 75 | 76 | 77 | 77 |
| NSR 42 | Pokfulam Court | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 80 | 76 | 71 | 68 | 75 | 76 | 76 | 77 |
| NSR 43 | Pokfulam Mansion | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 80 | 76 | 71 | 68 | 75 | 76 | 76 | 77 |
| NSR 44 | 92E Pok Fu Lam Road | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 76 | 78 | 75 | 70 | 67 | 74 | 75 | 75 | 76 |
| NSR 45 | La Clare Mansion, Block A | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 79 | 74 | 70 | 66 | 73 | 74 | 75 | 77 |
| NSR 46 | La Clare Mansion, Block B | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 79 | 74 | 70 | 66 | 73 | 74 | 75 | 77 |
| NSR 47 | La Clare Mansion, Block C | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 79 | 74 | 69 | 66 | 73 | 74 | 75 | 77 |
| NSR 48 | La Clare Mansion, Block D | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 77 | 78 | 74 | 69 | 66 | 73 | 74 | 75 | 77 |

Notes:

- (1) This is the shortest distance from noise source to NSR for the corresponding operation mode. Helipad setback has been considered in the mitigated scenario.
- (2) Distance Corrected Maximum Sound Pressure Level: $L_{max}(C_D) = L_{max}(ref)_j + C_D$, where $L_{max}(ref)_j$ is the reference sound pressure level for operation mode j (in dB(A)), and C_D is the distance correction (in dB(A)).
- (3) For NSR 38, since the proposed helipad layout has been changed from the approved EIA report, the noise reduction of 1 dB(A) for the partially screening effect by parapet wall of the helipad access ramp adopted in the approved EIA is not considered in this OHNMMP for conservative approach
- (4) Section drawings of NSRs showing the barrier effect are provided in Appendix C.
- (5) Noise Criterion : 85 dB(A) L_{max}

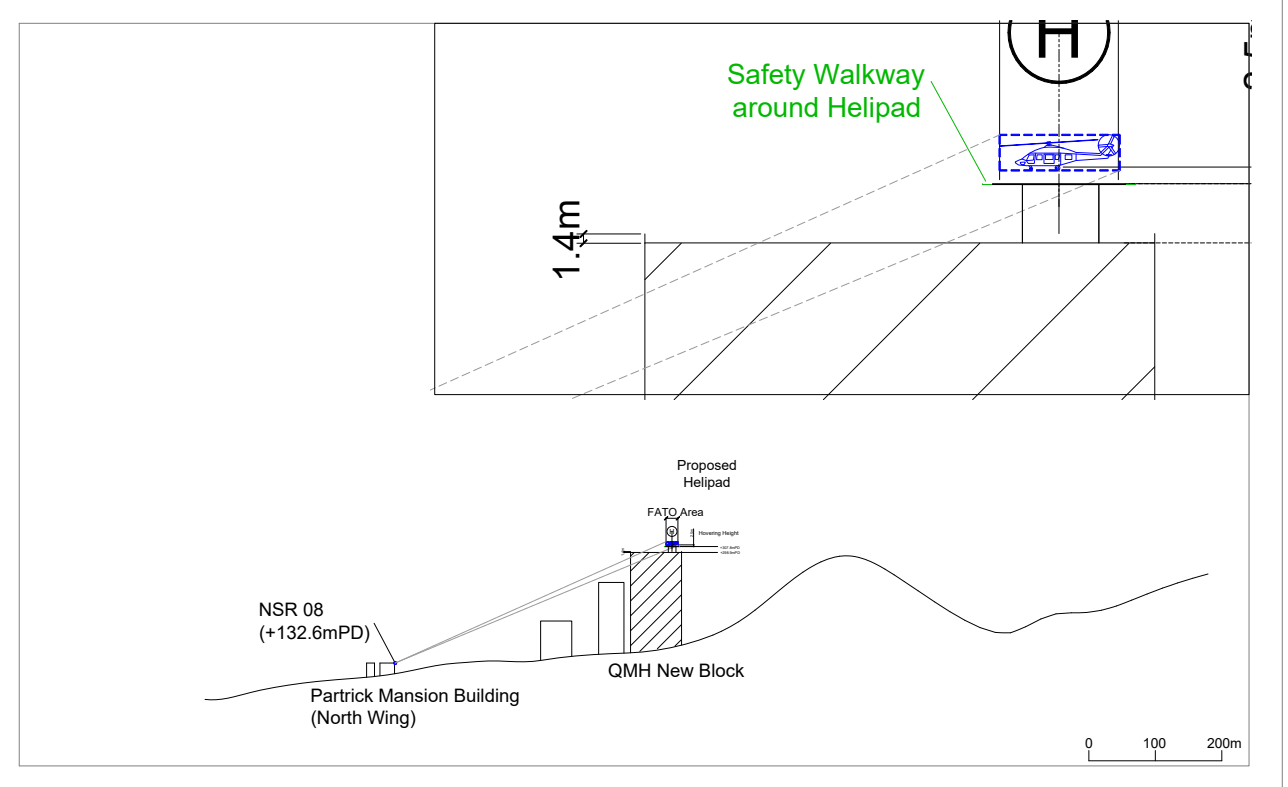
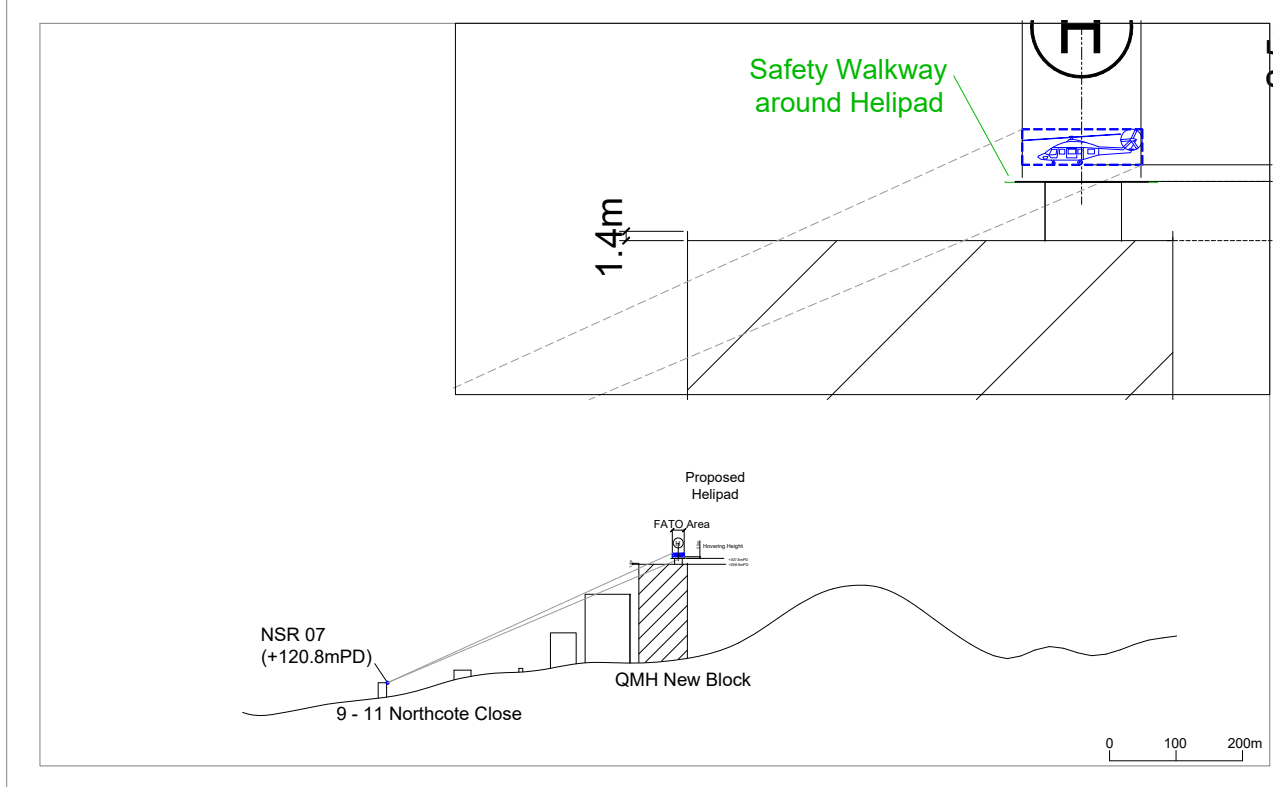
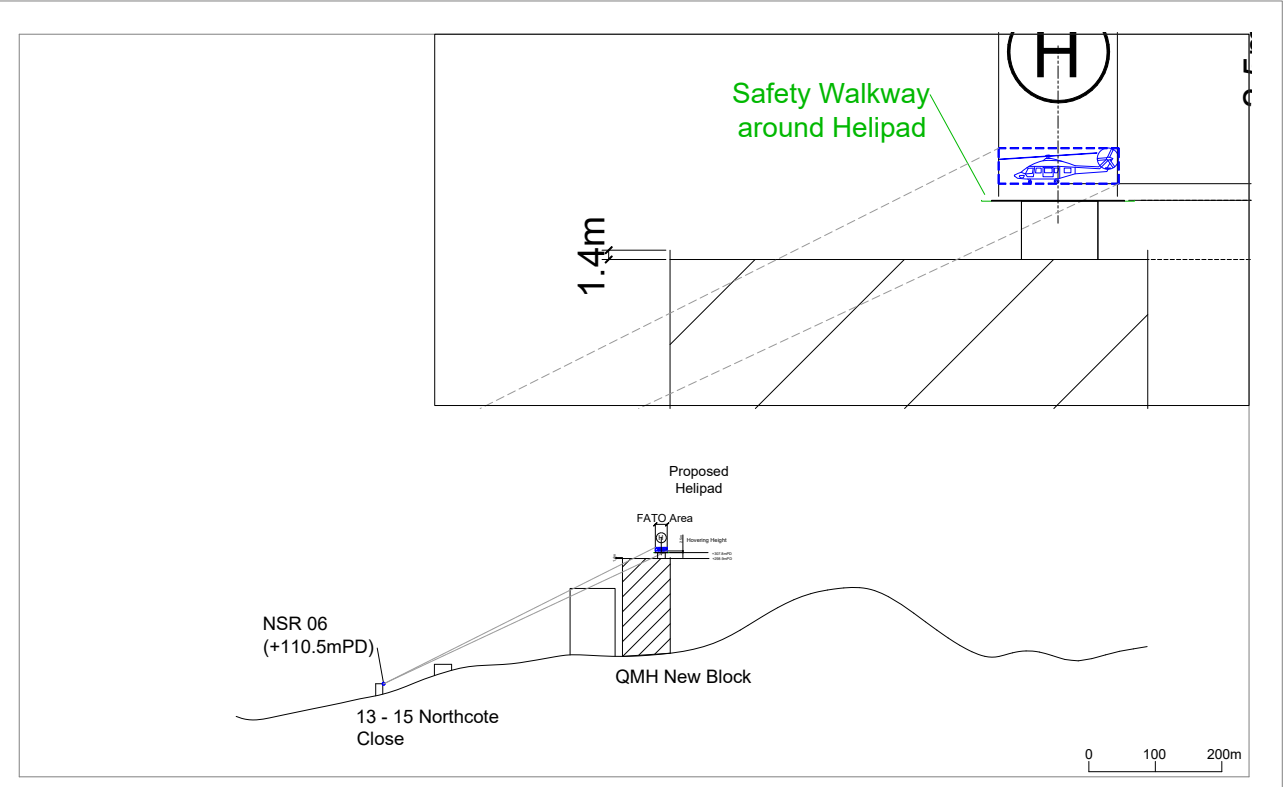
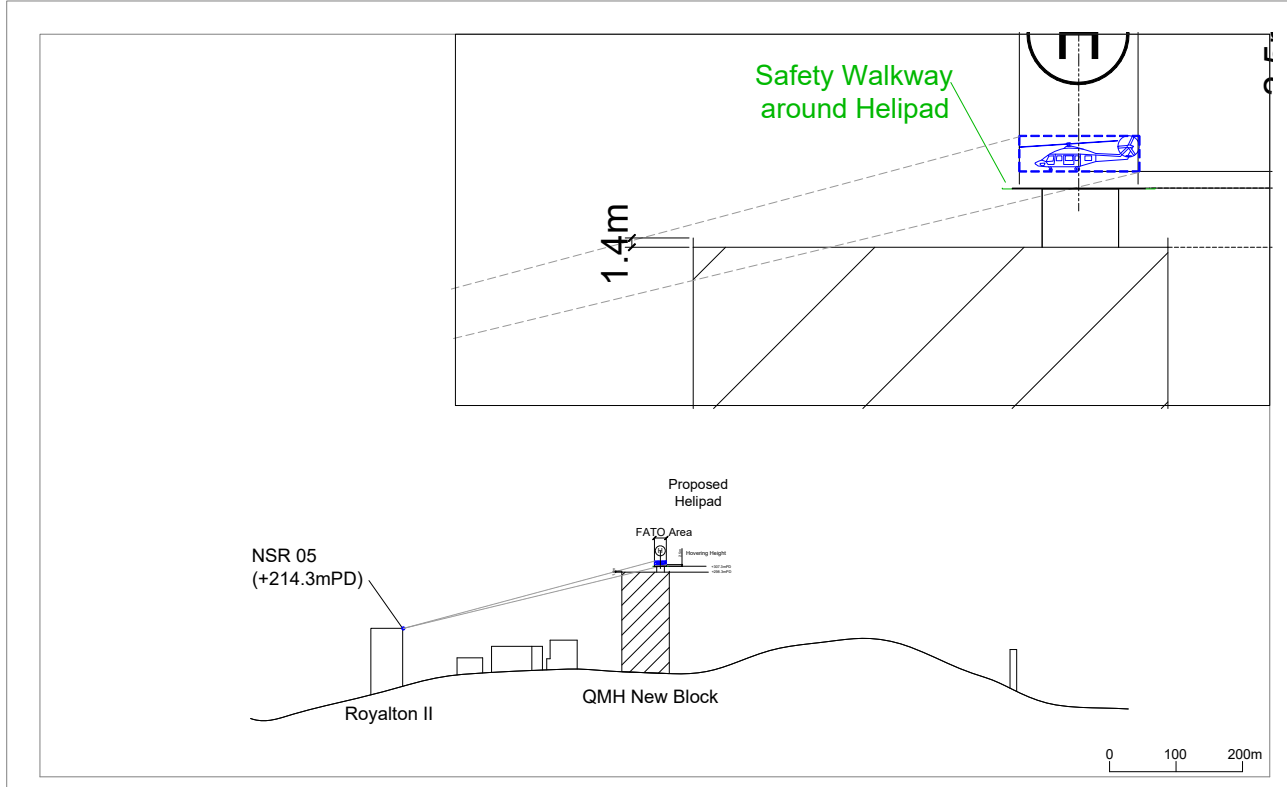
Appendix C. The Illustration of Noise Screening (NSR1 to NSR48)



LEGEND:

- NOISE SENSITIVE RECEIVER
- LINE OF SIGHT

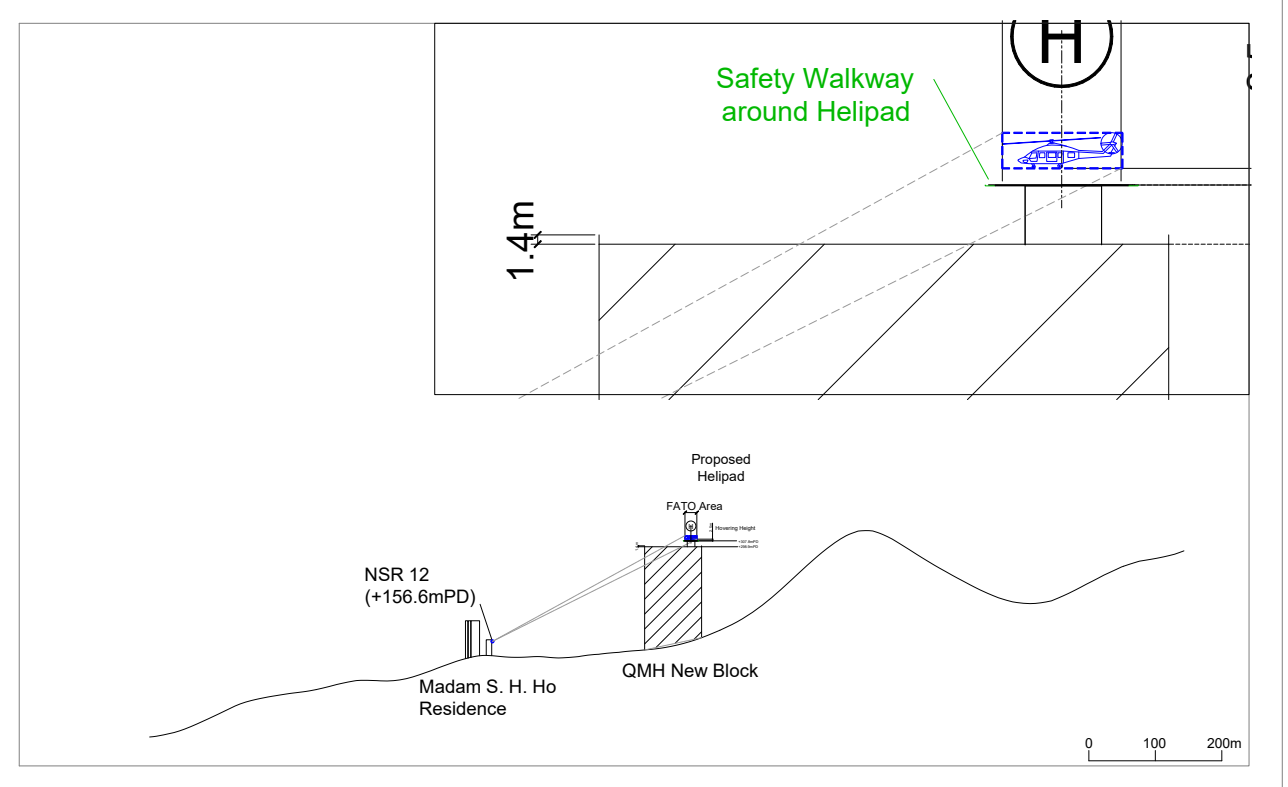
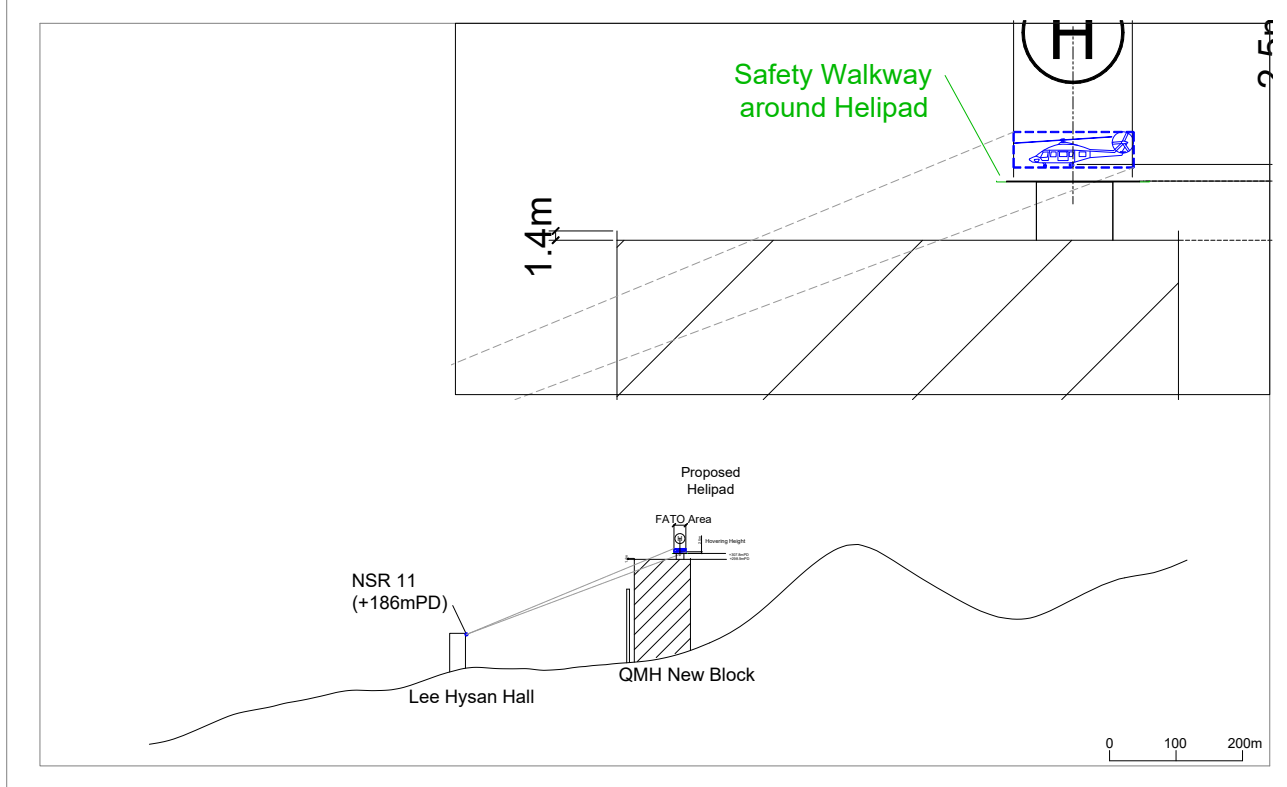
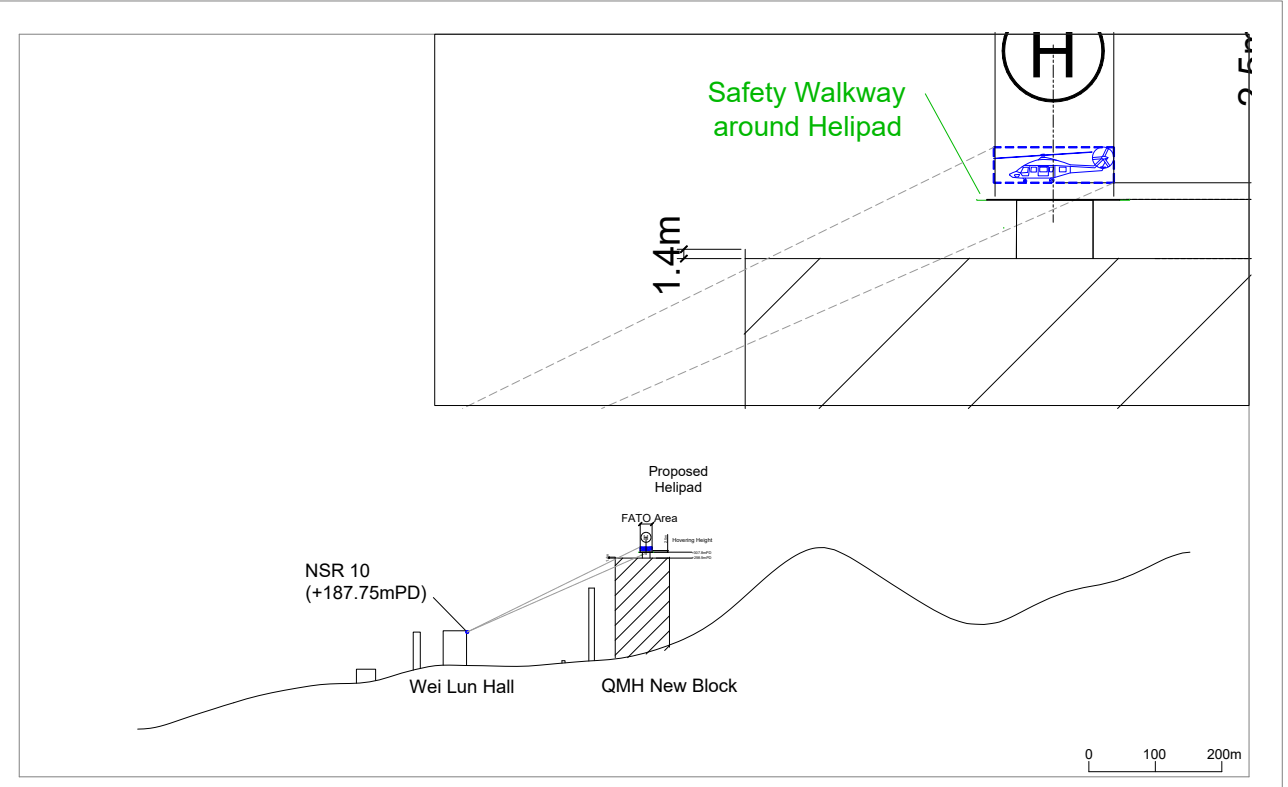
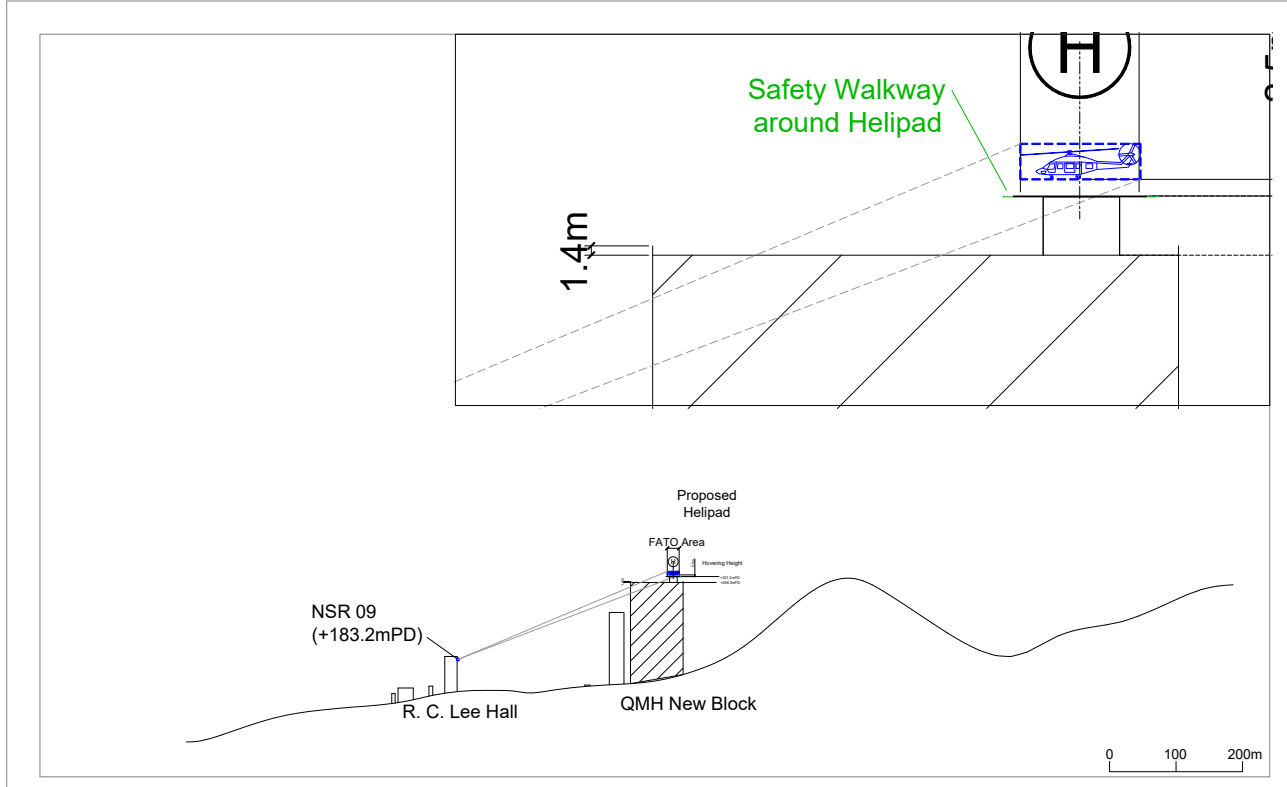
SECTION DRAWING FOR NSR 01-NSR 04



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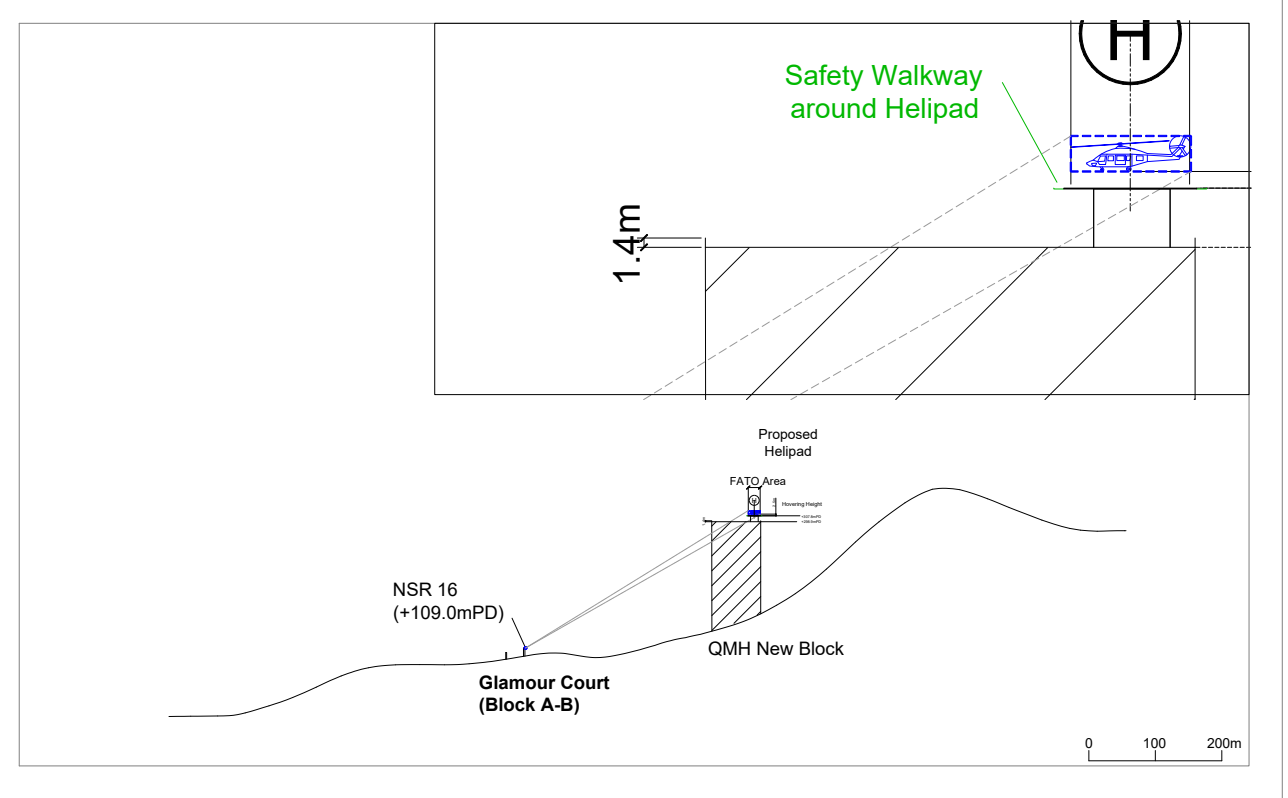
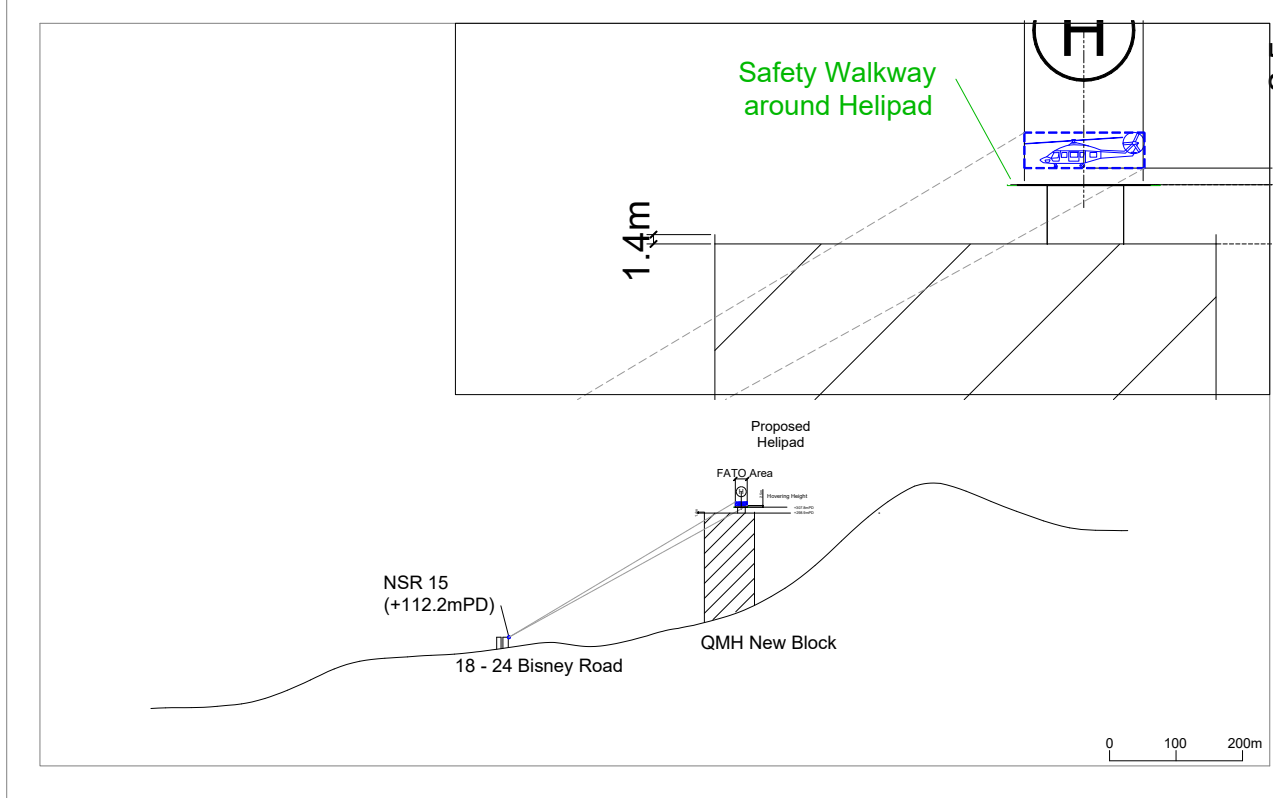
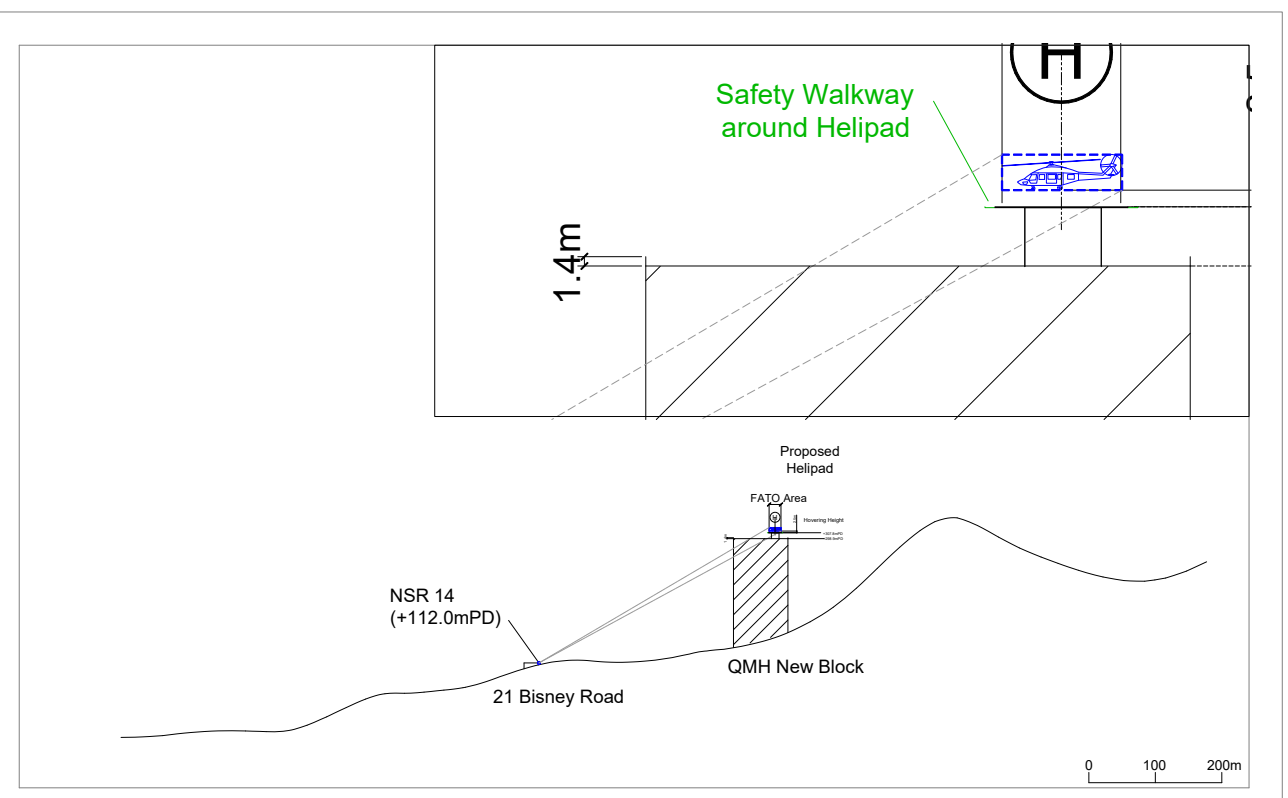
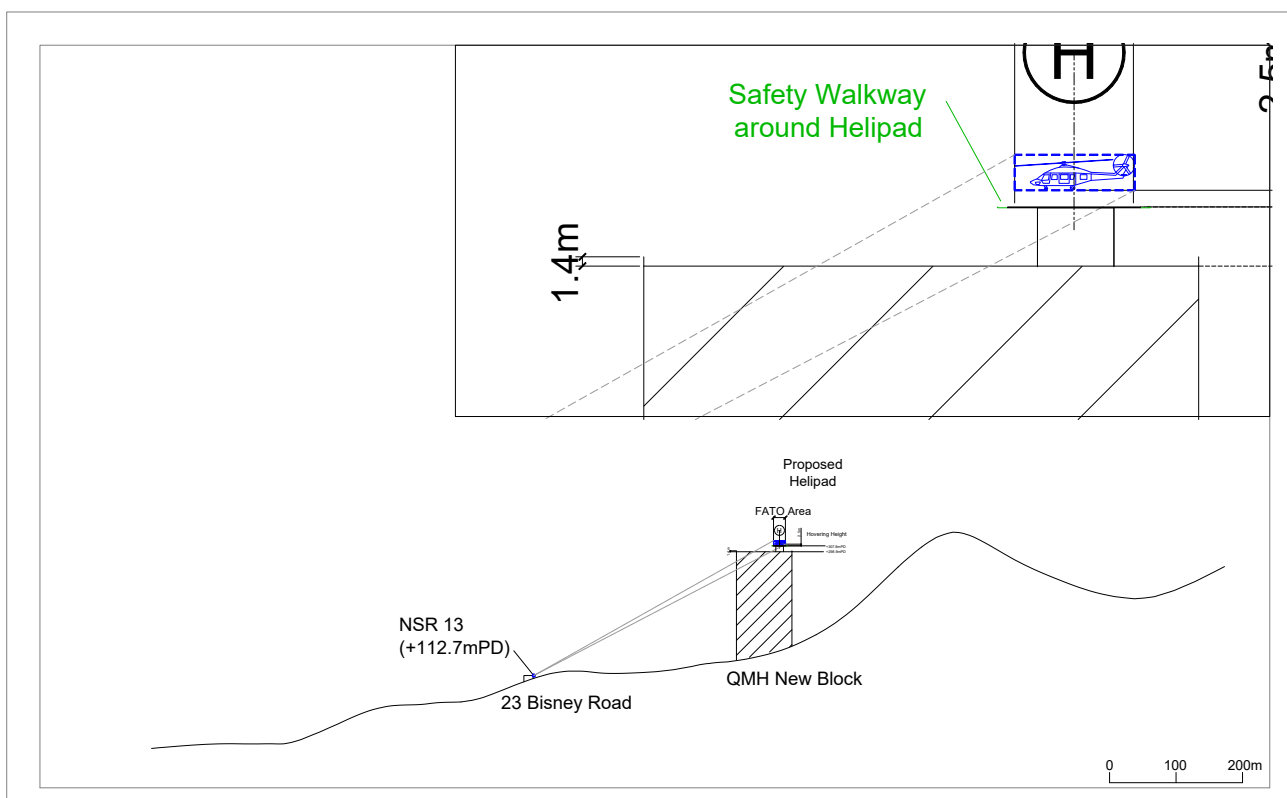
- NOISE SENSITIVE RECEIVER
- LINE OF SIGHT

SECTION DRAWING FOR NSR 05-NSR 08



LEGEND:
 ● NOISE SENSITIVE RECEIVER
 - - - LINE OF SIGHT

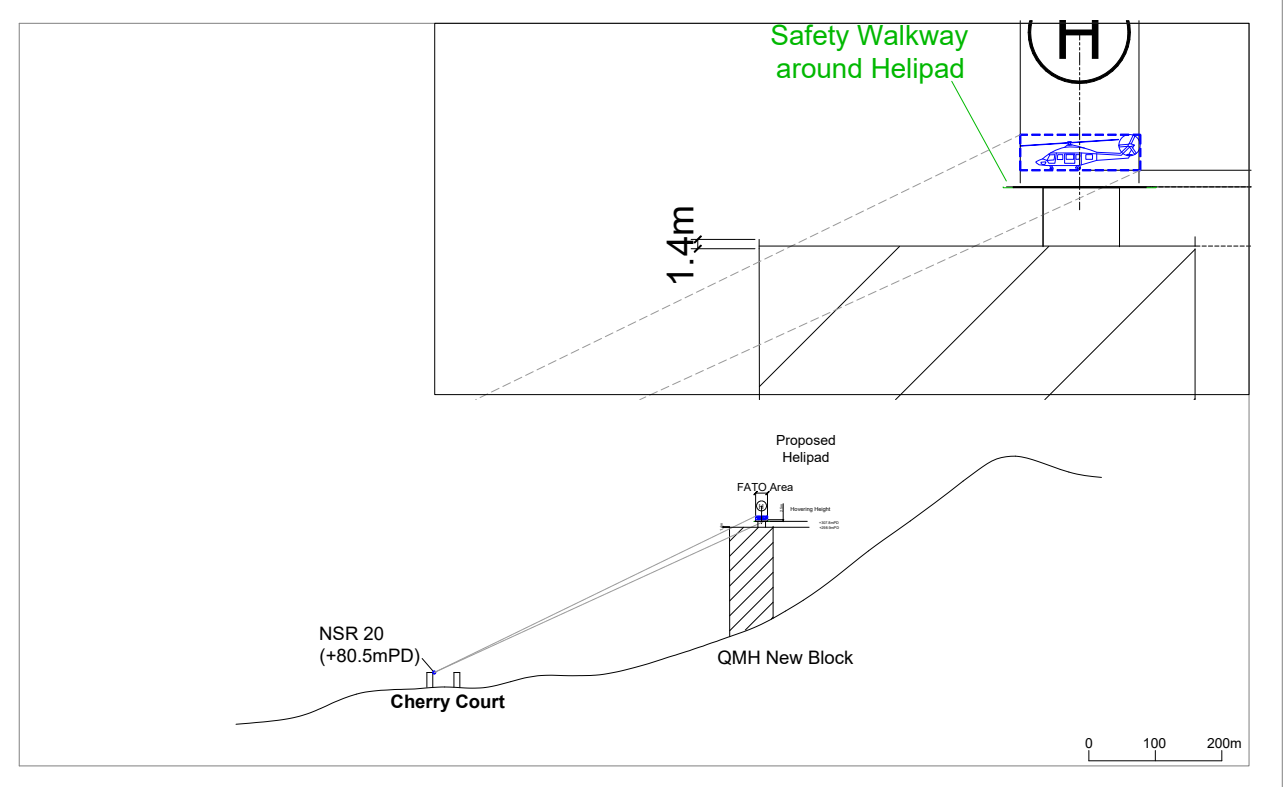
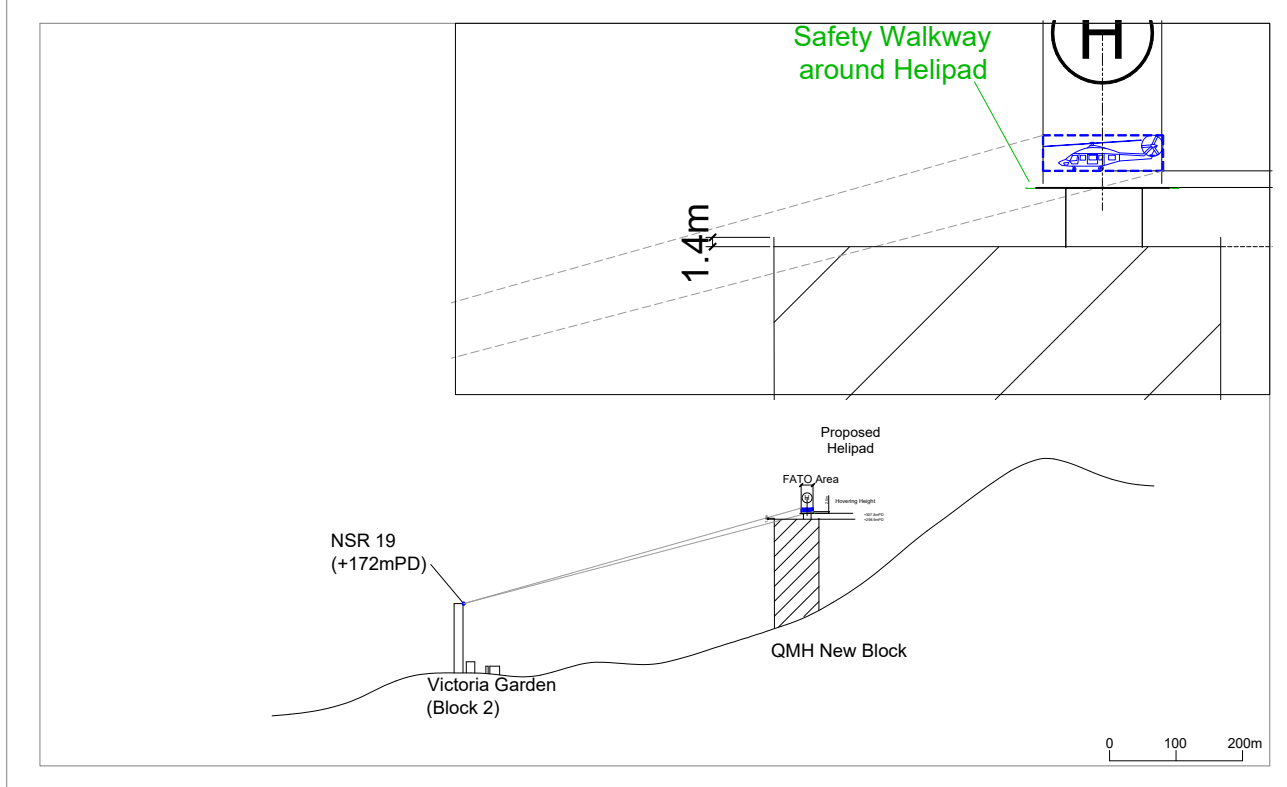
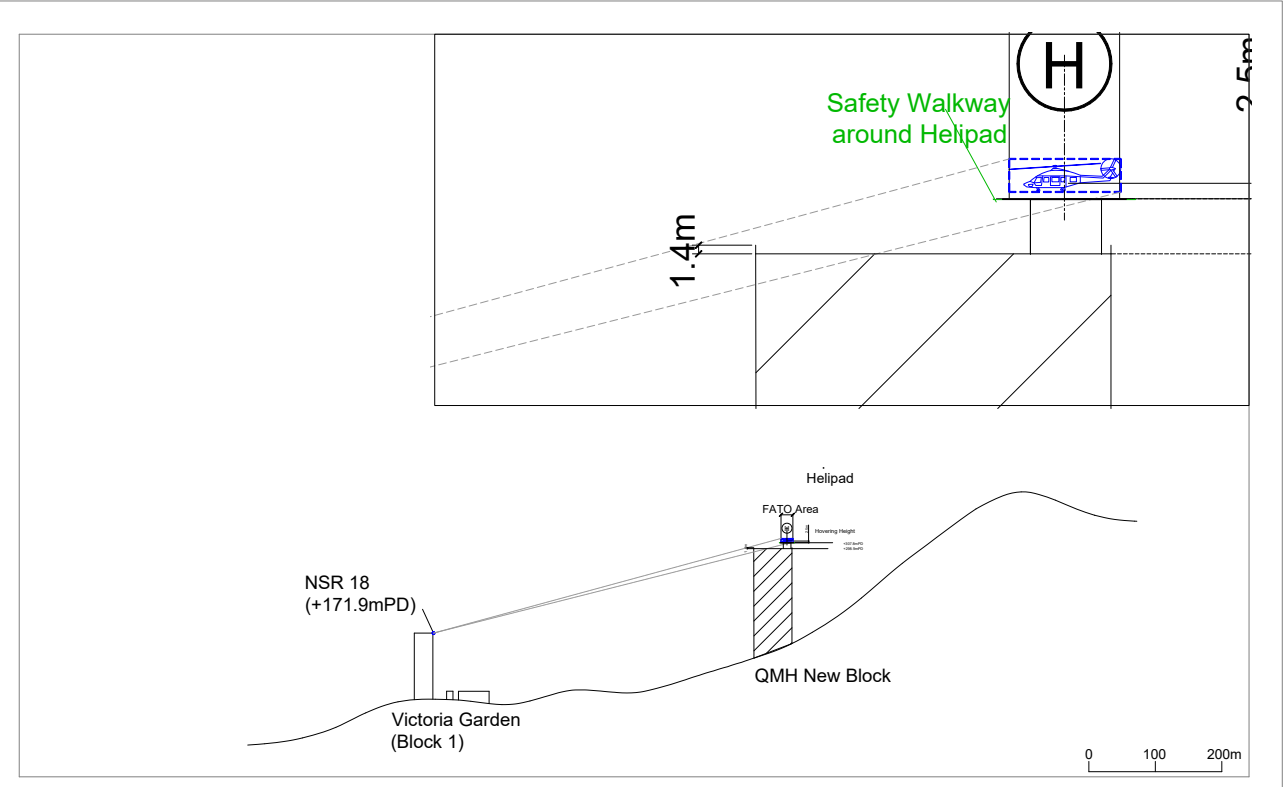
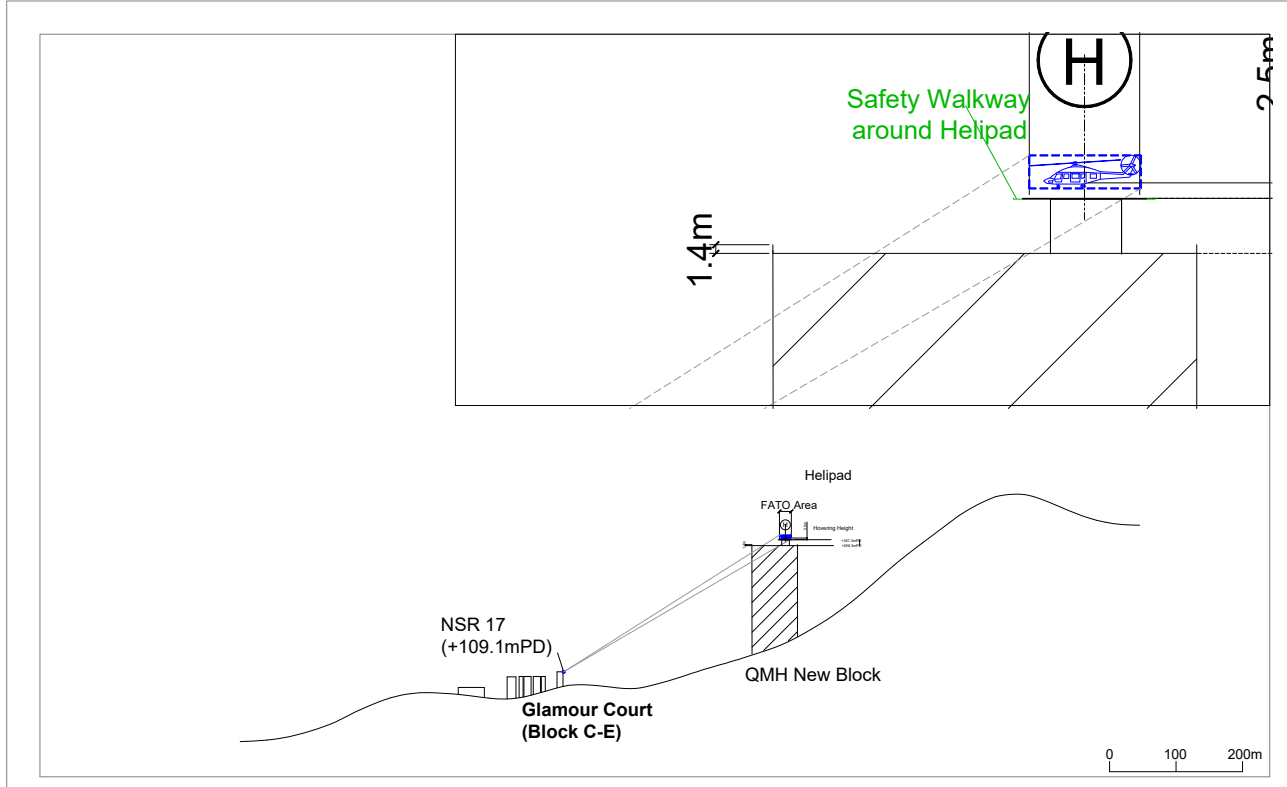
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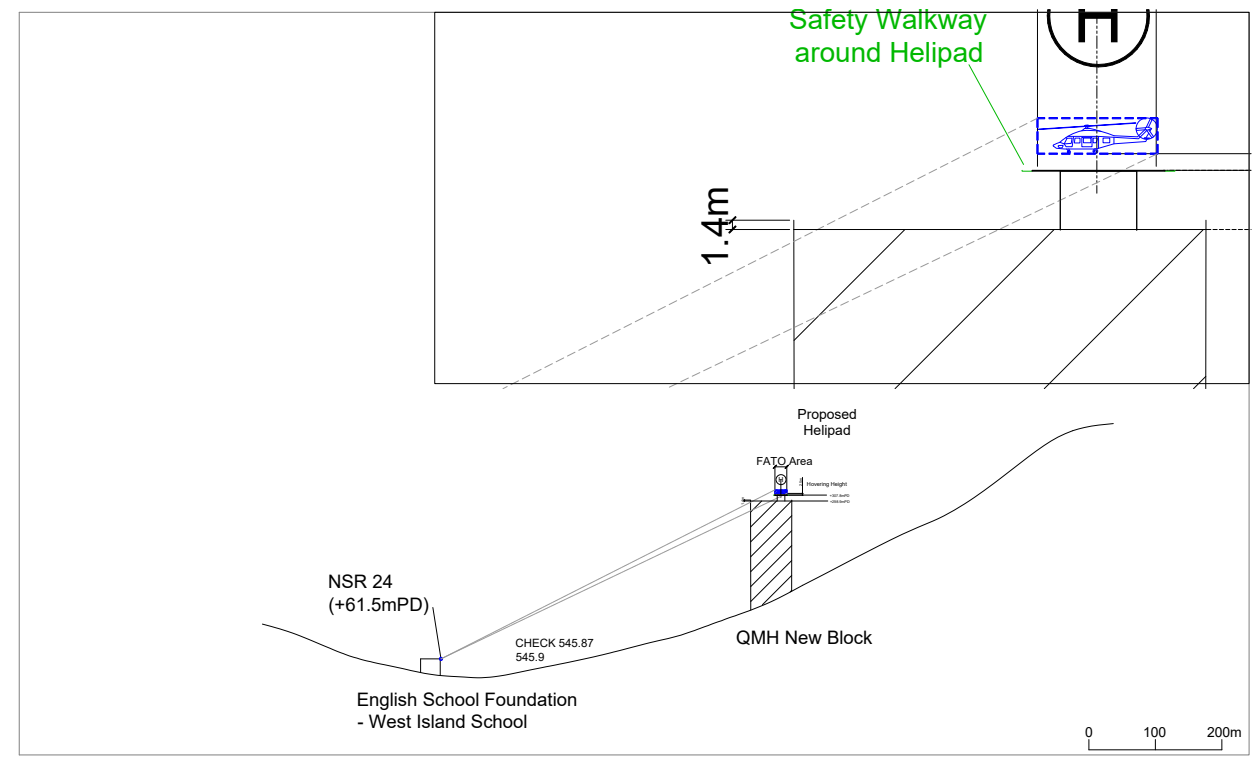
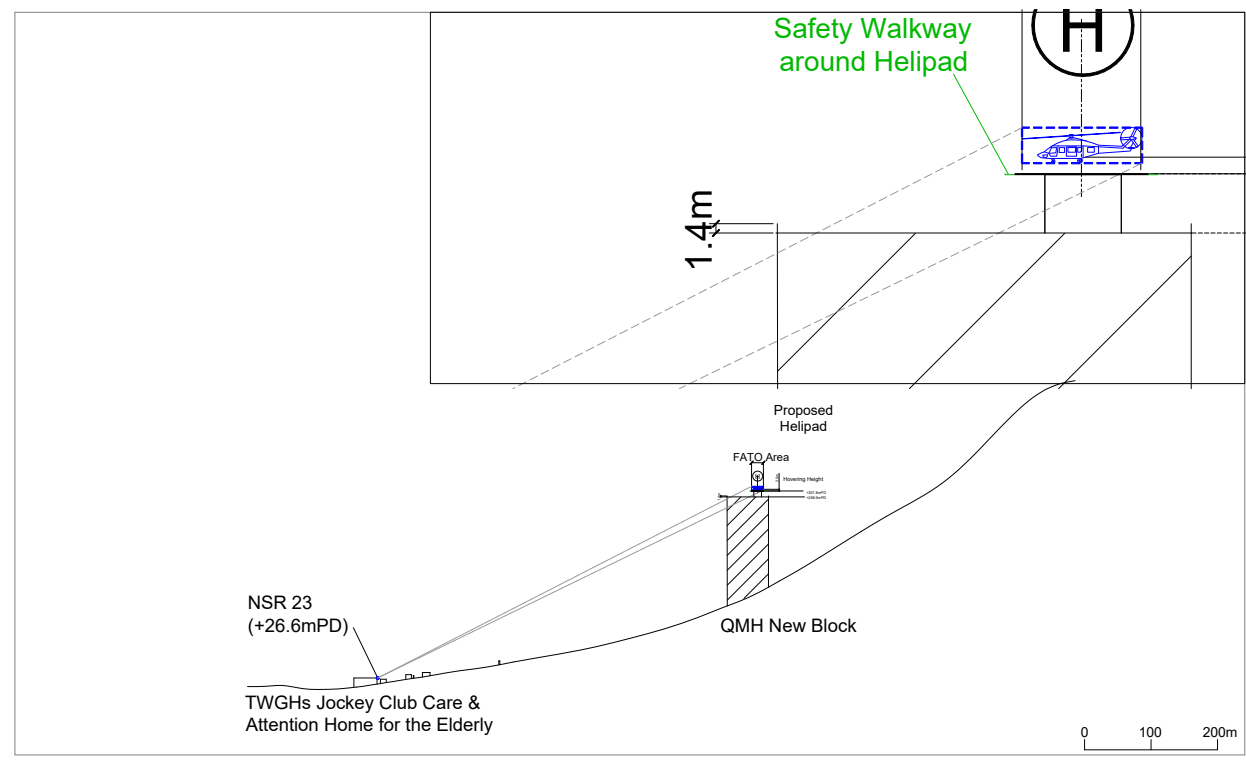
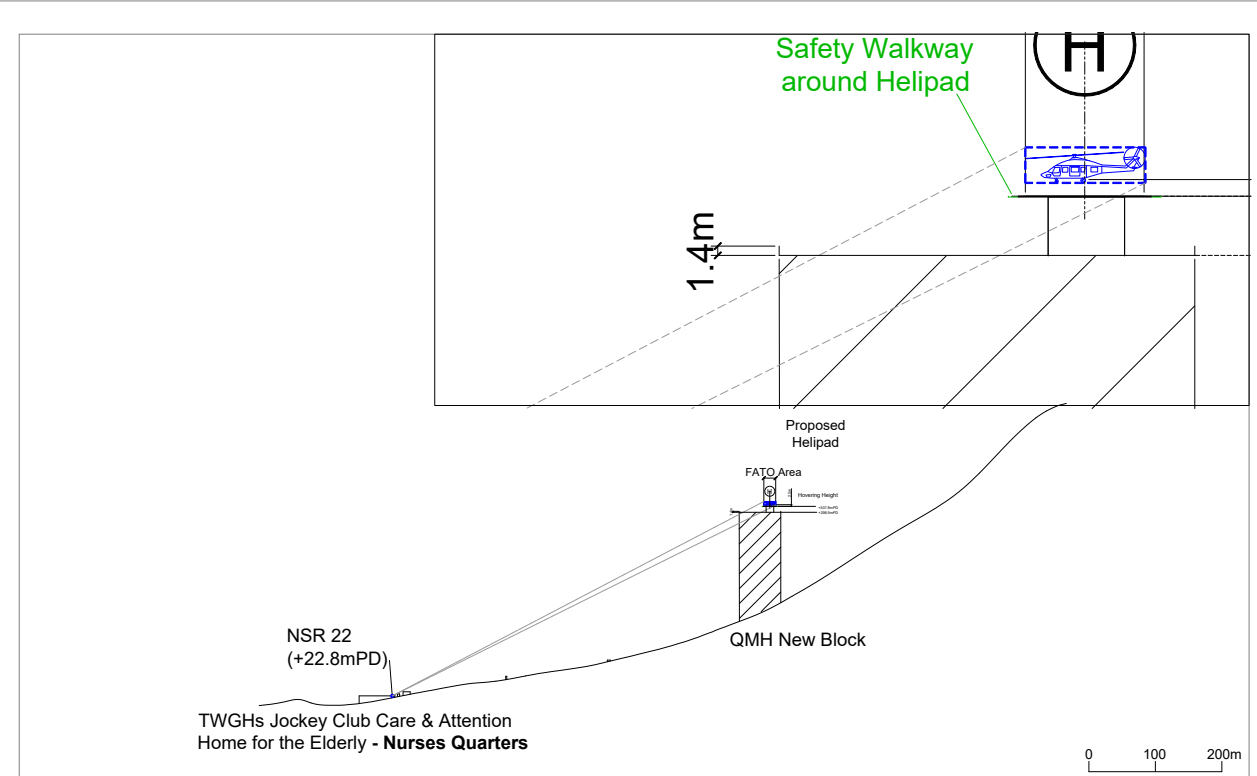
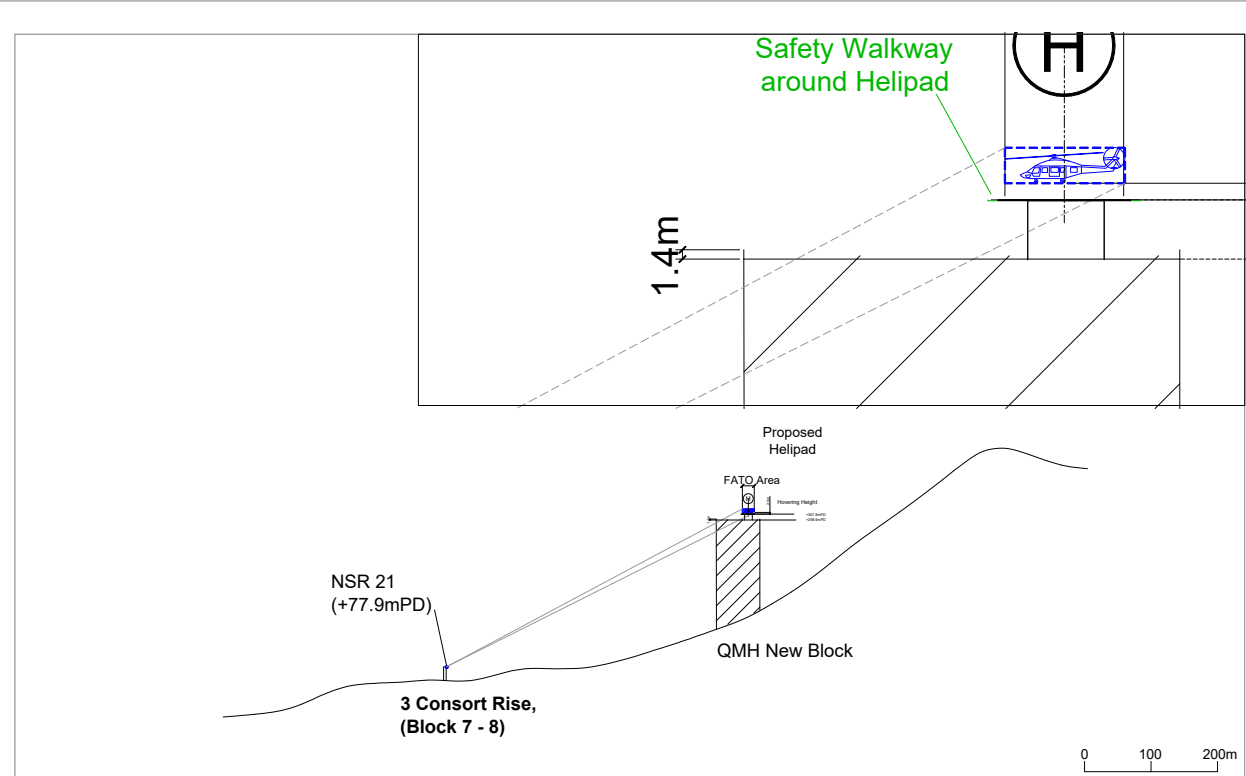
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- LINE OF SIGHT

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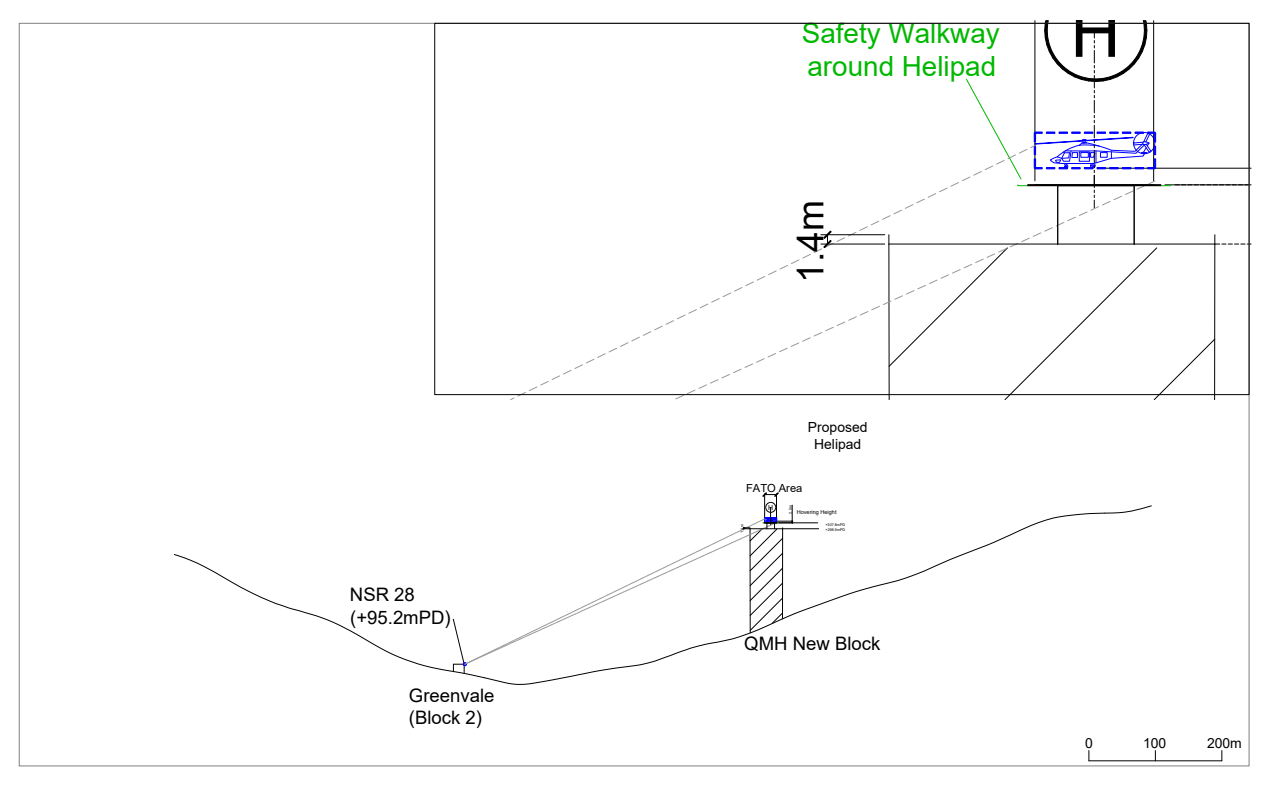
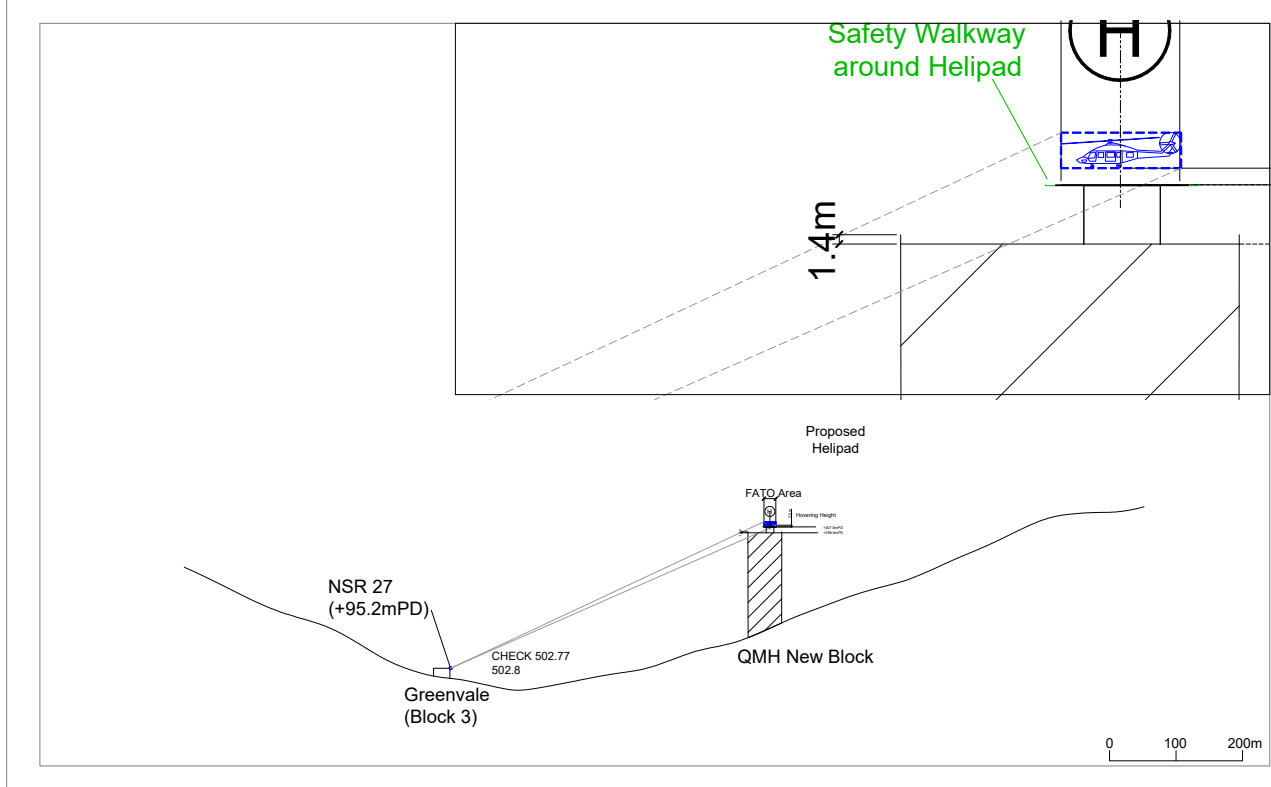
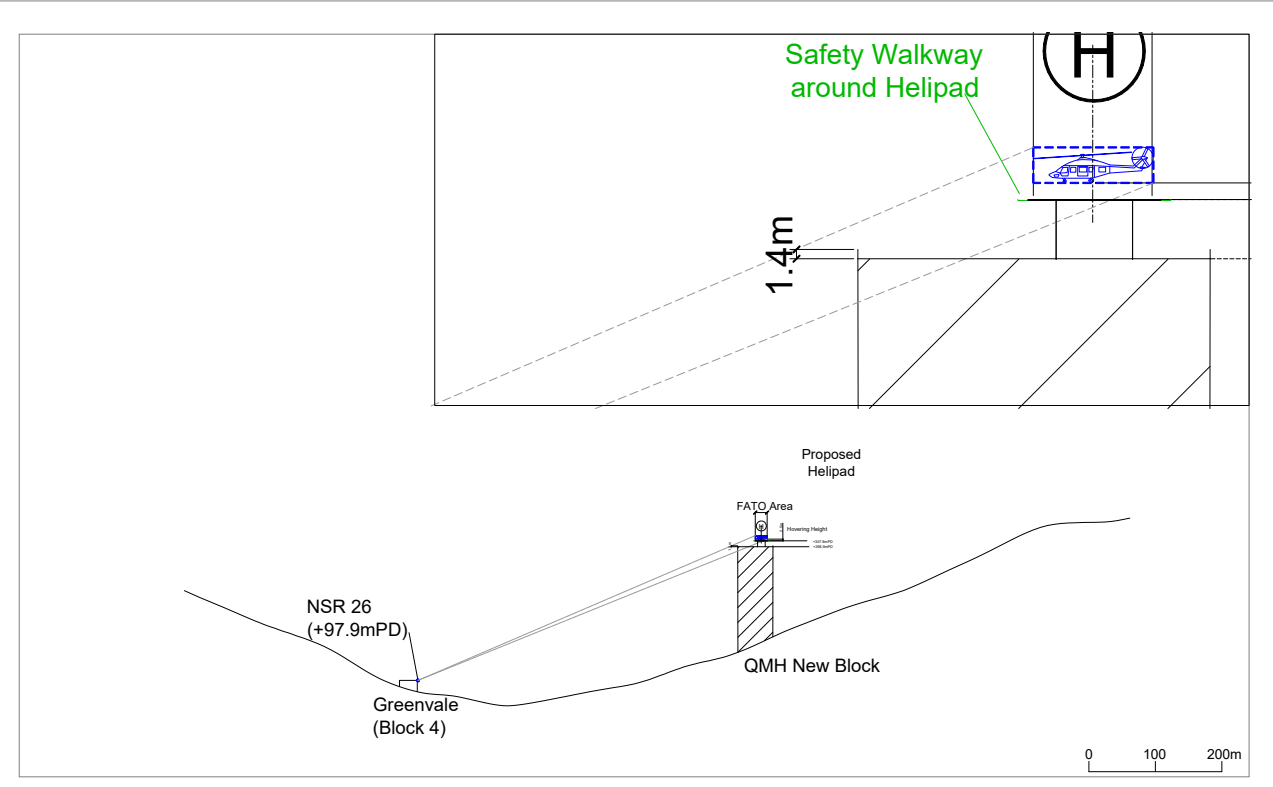
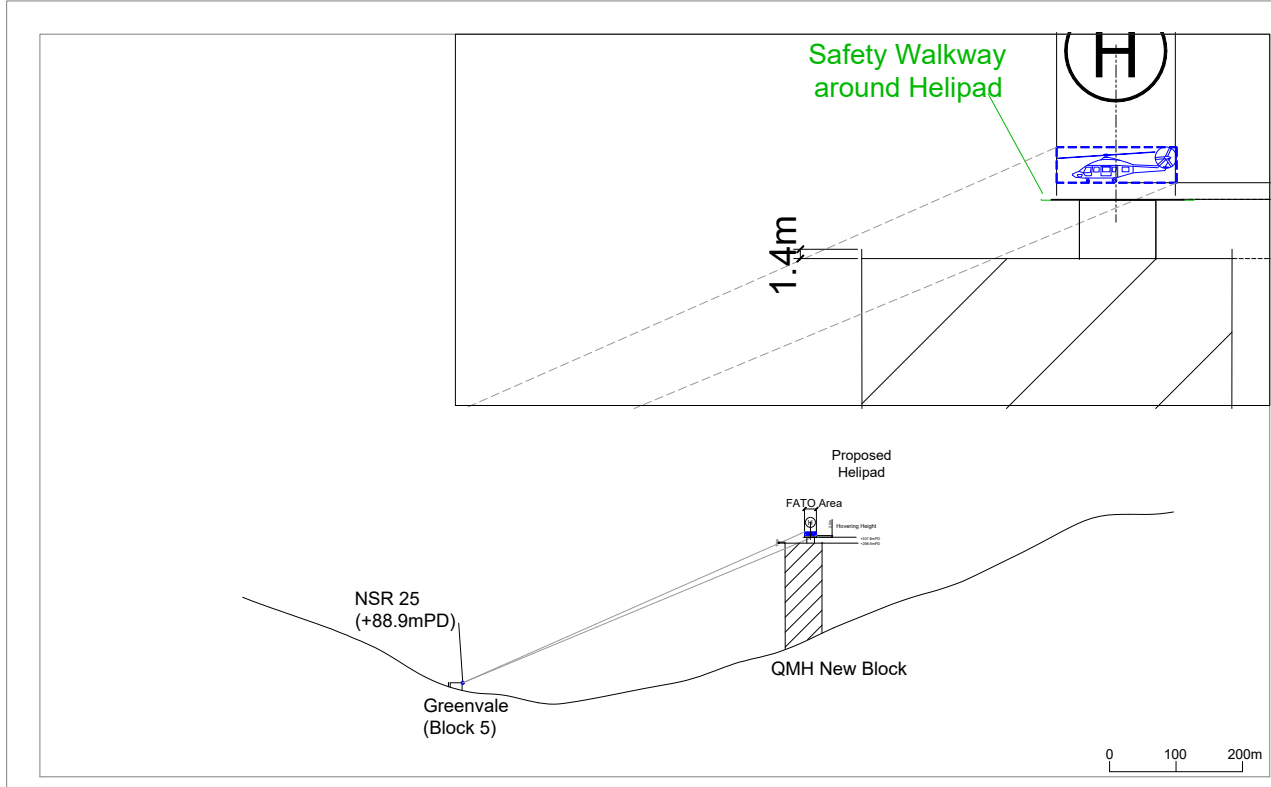
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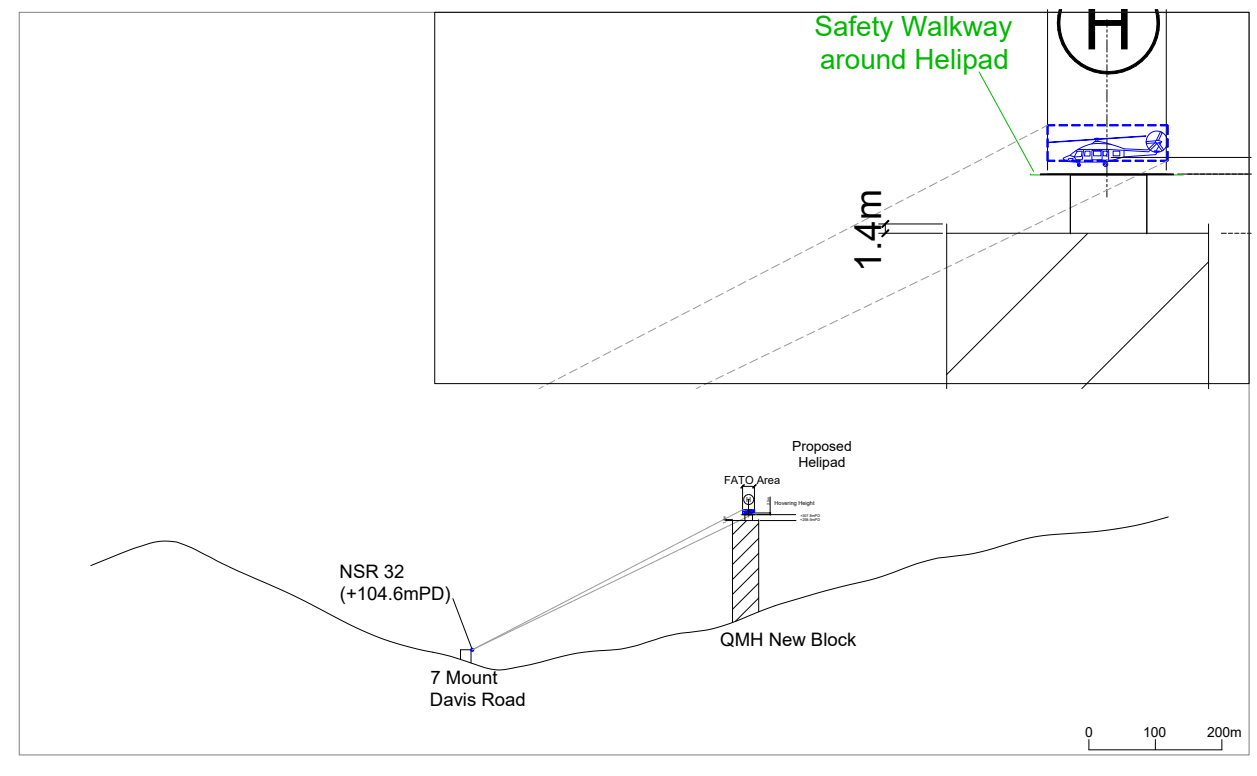
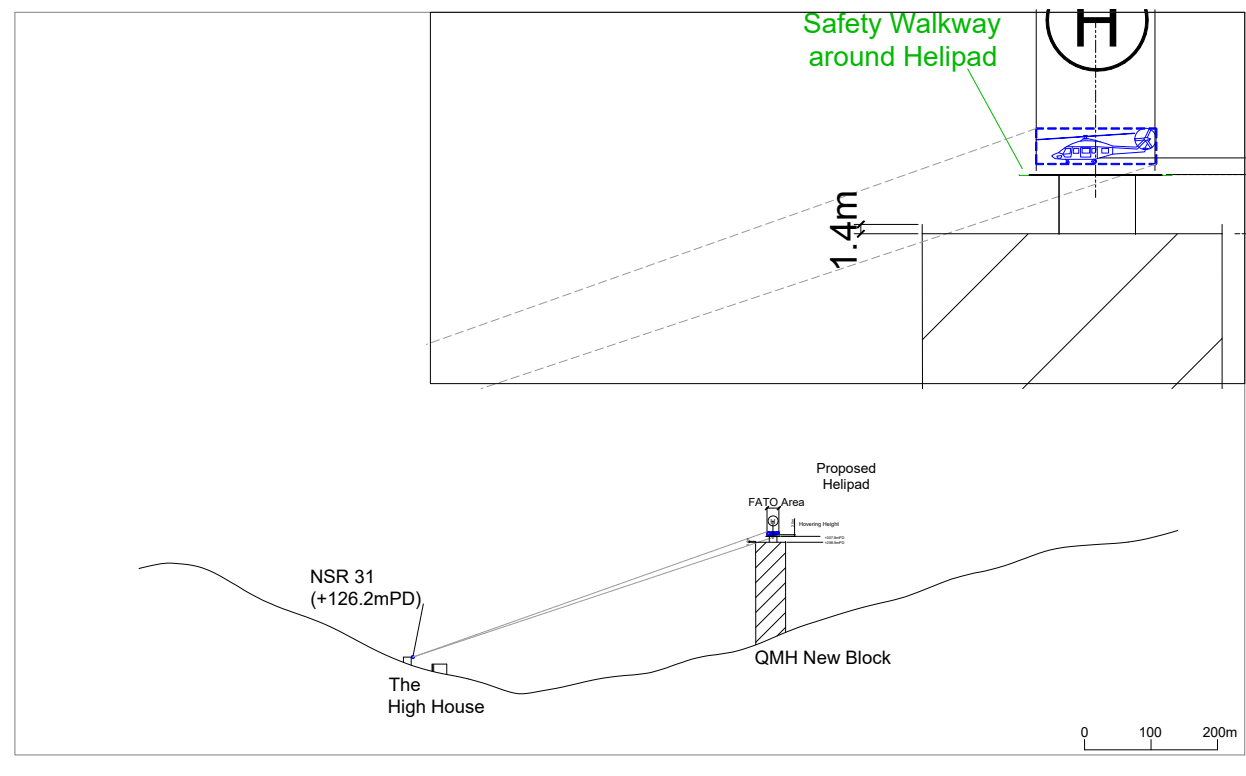
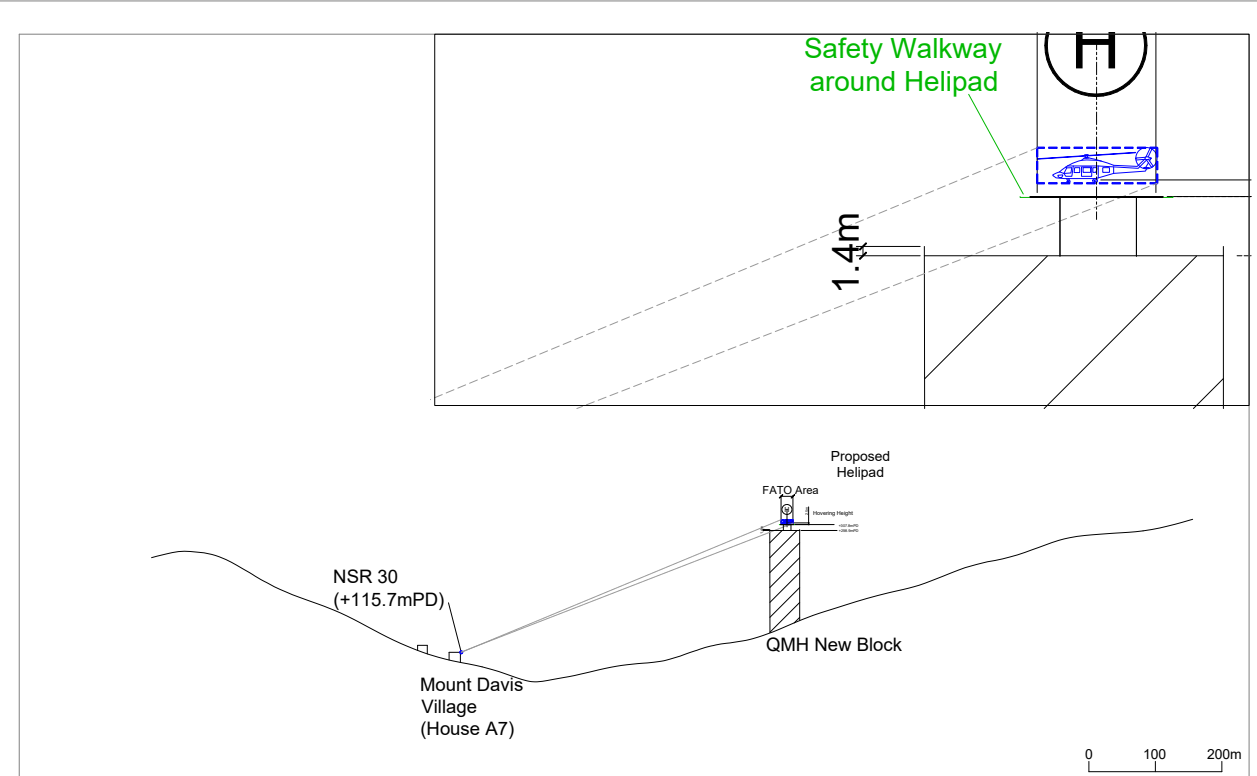
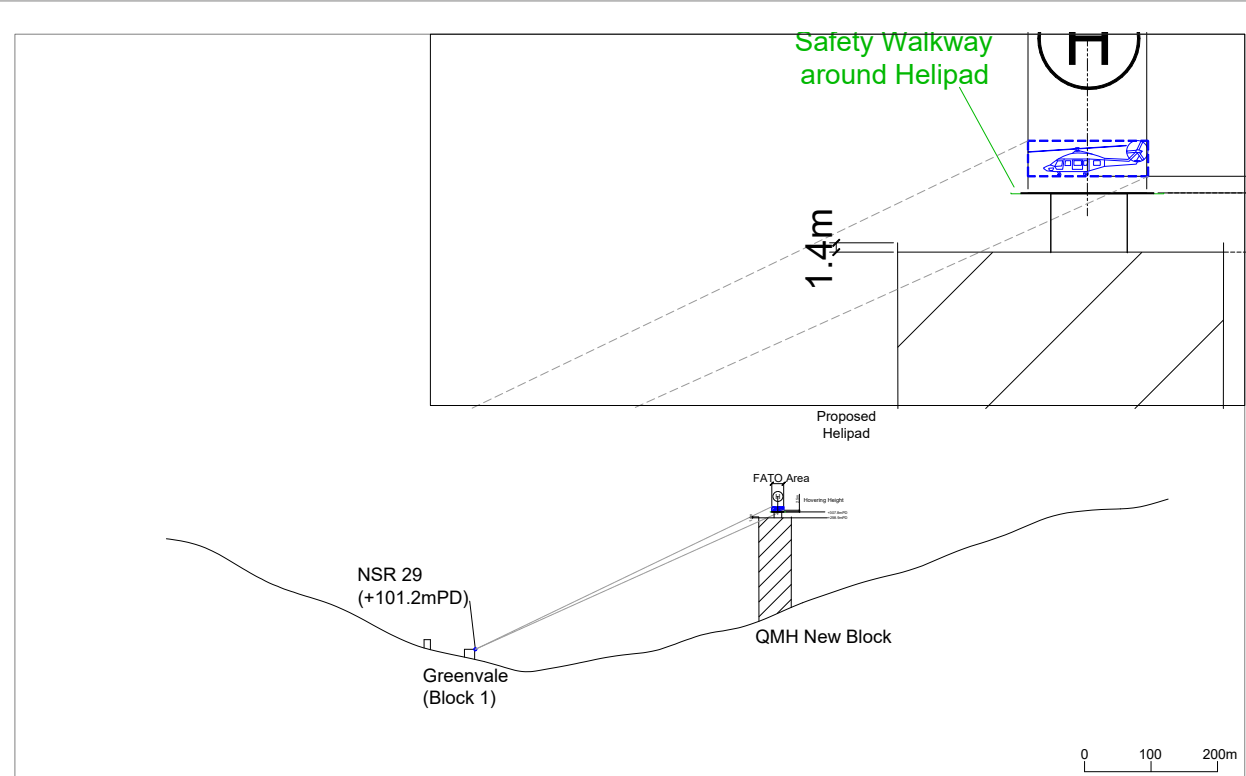
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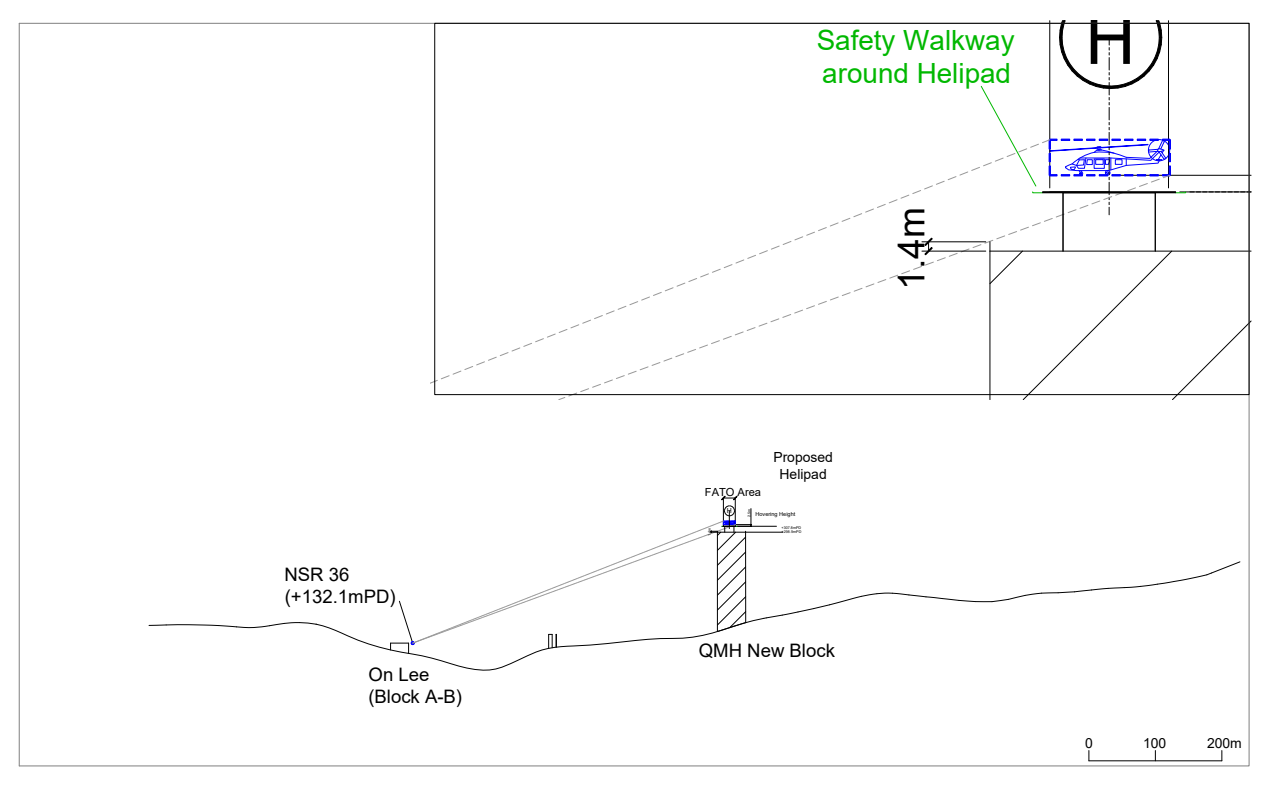
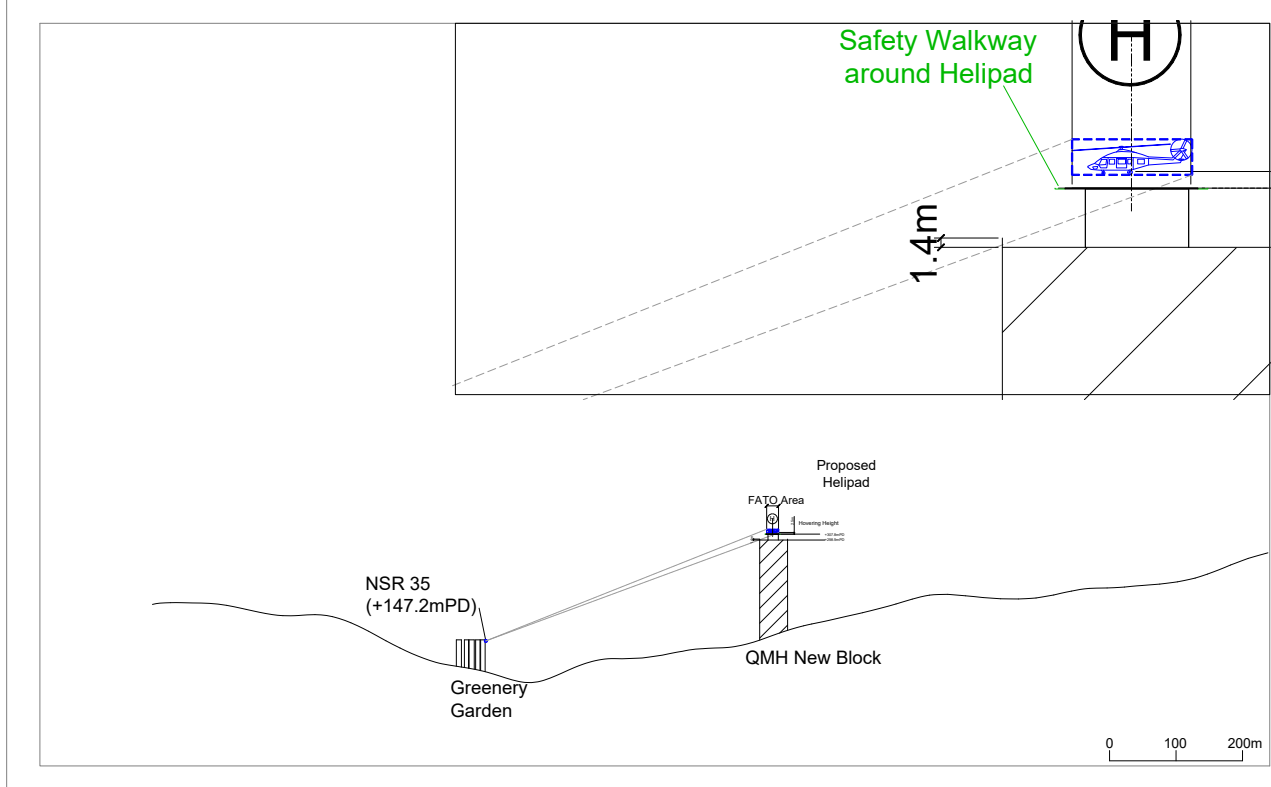
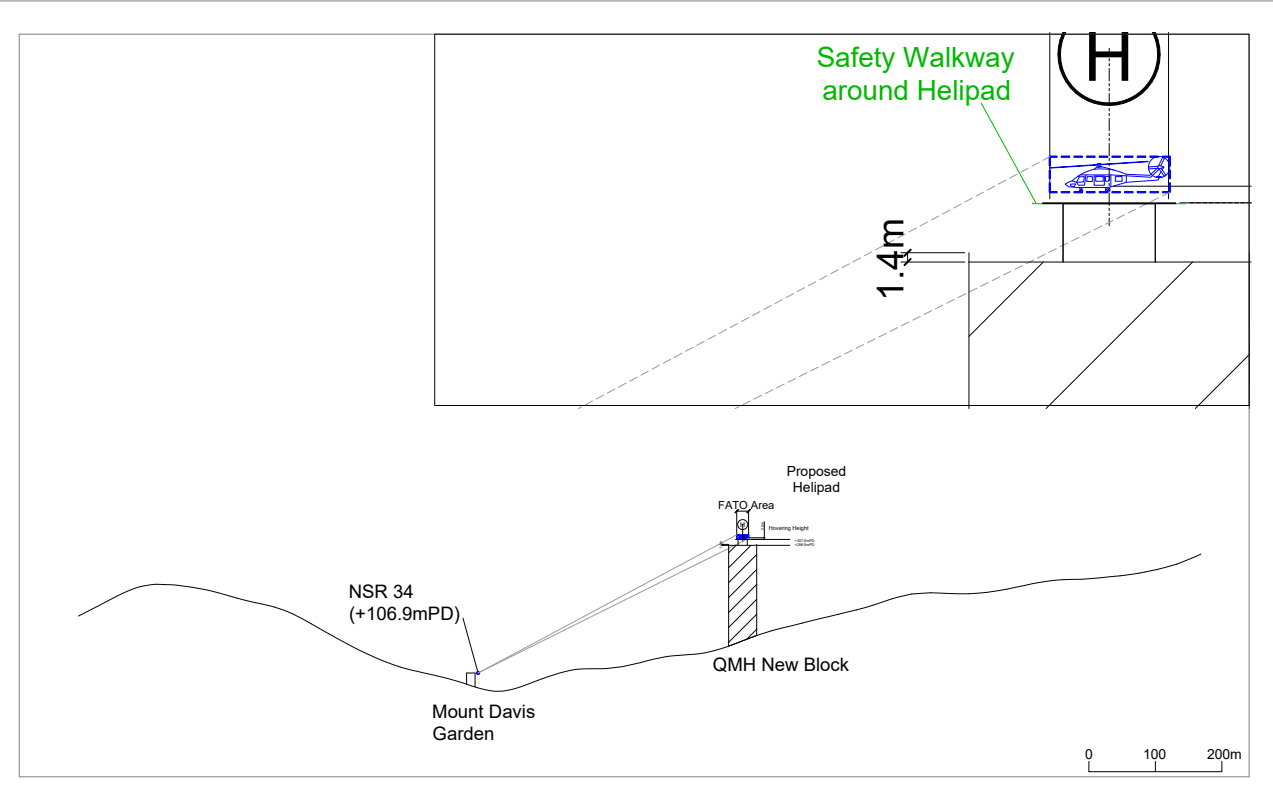
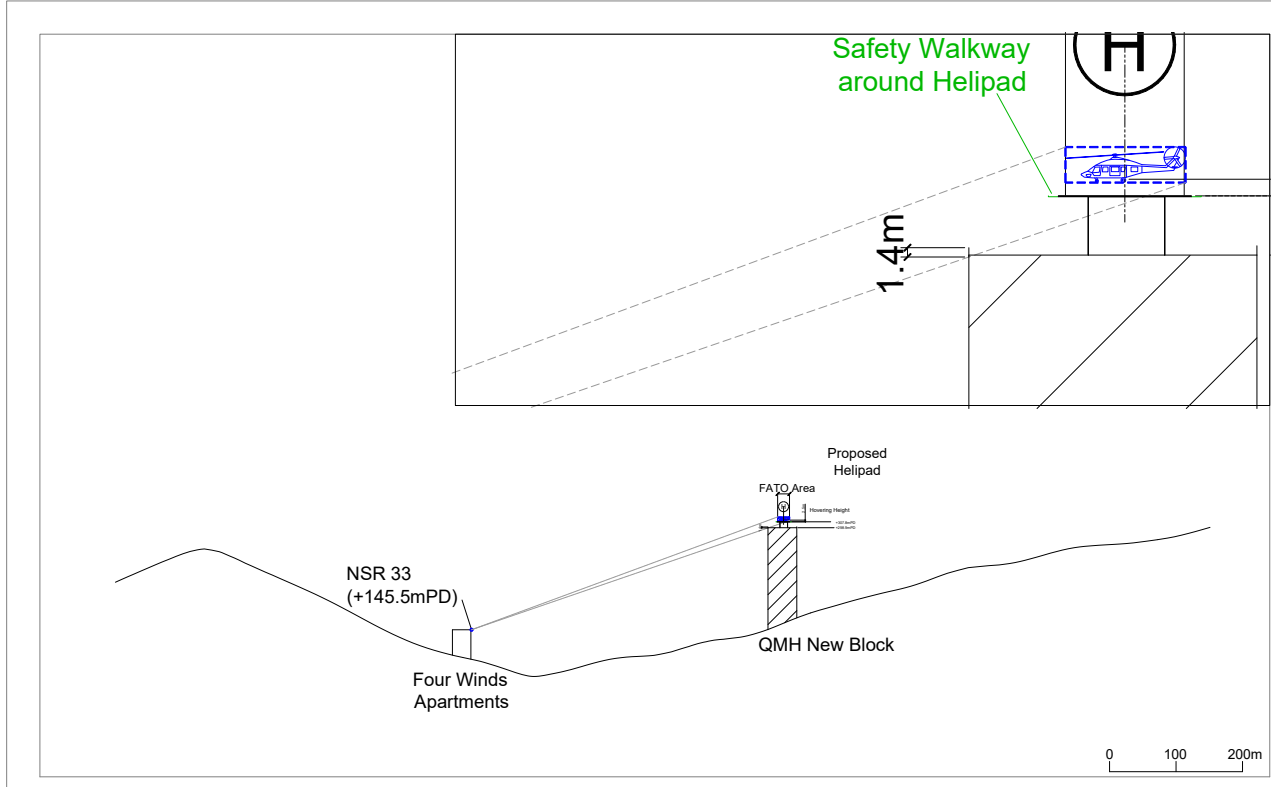
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- LINE OF SIGHT

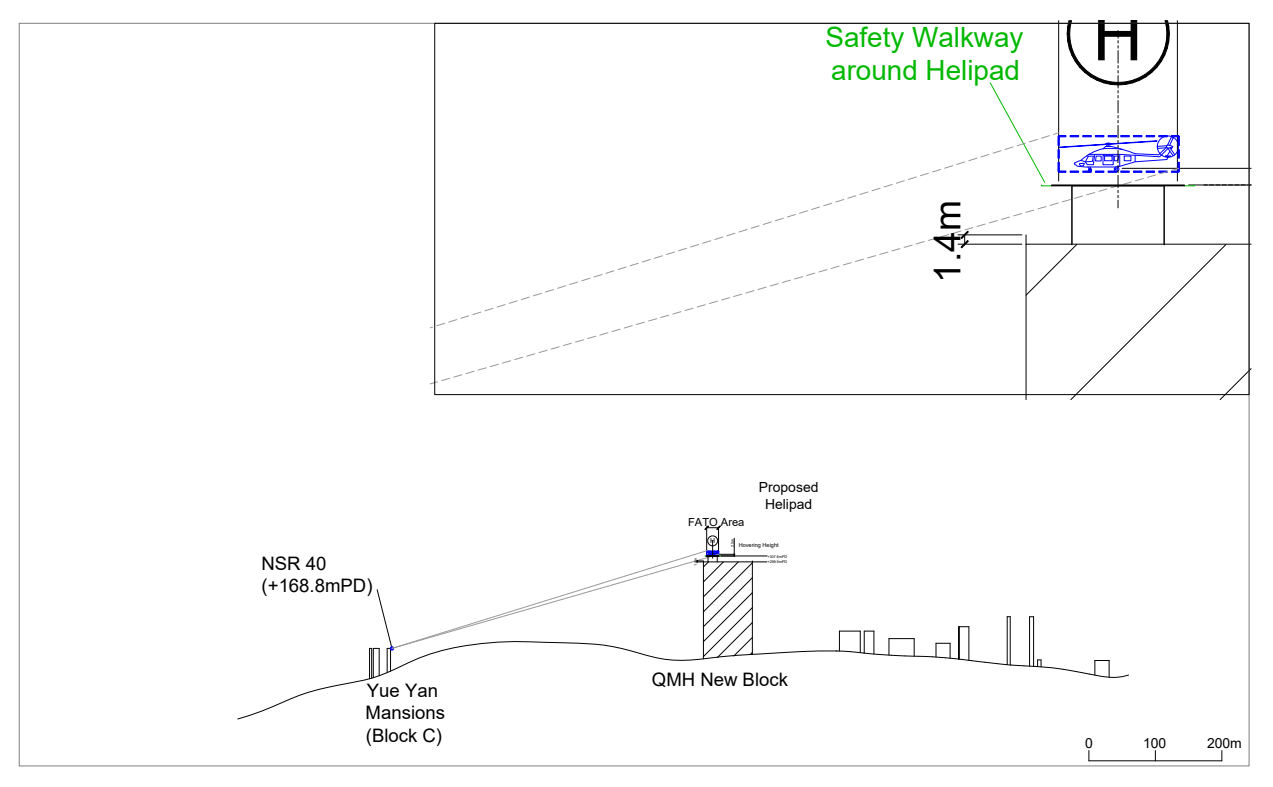
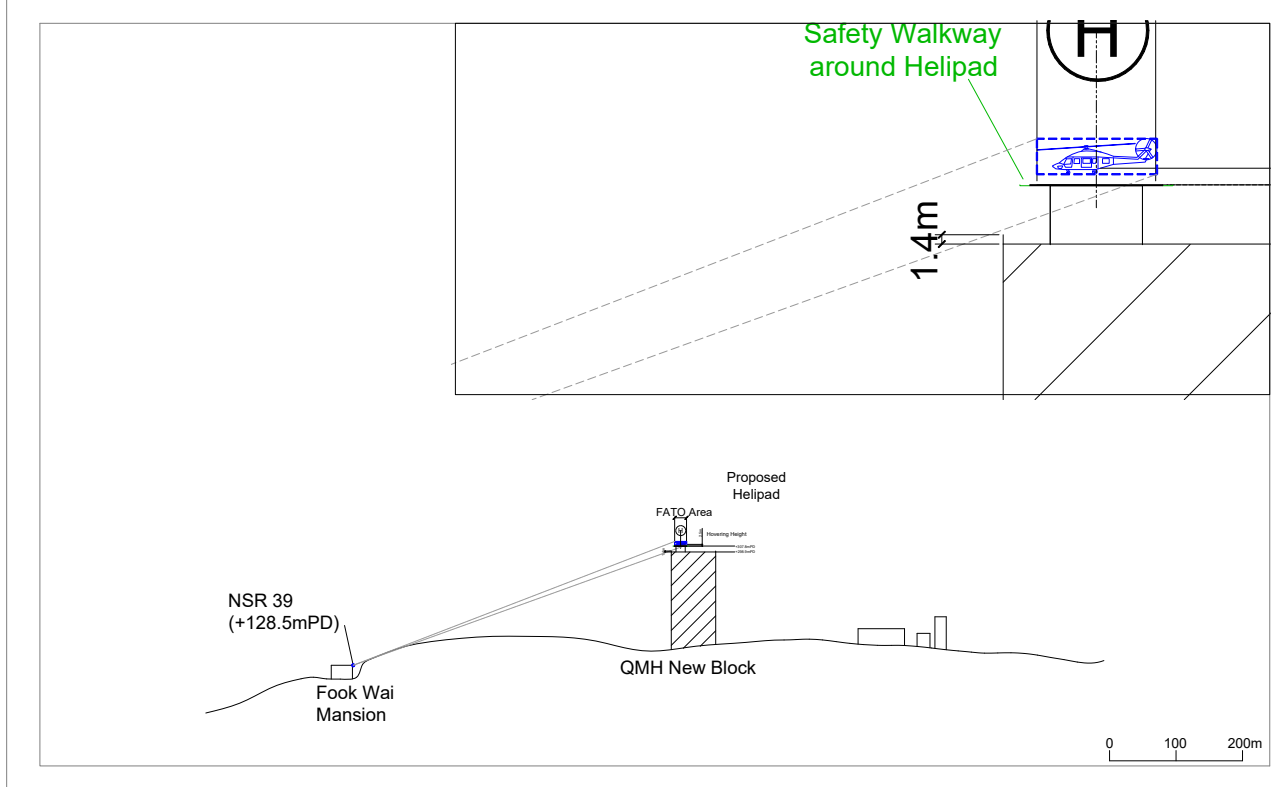
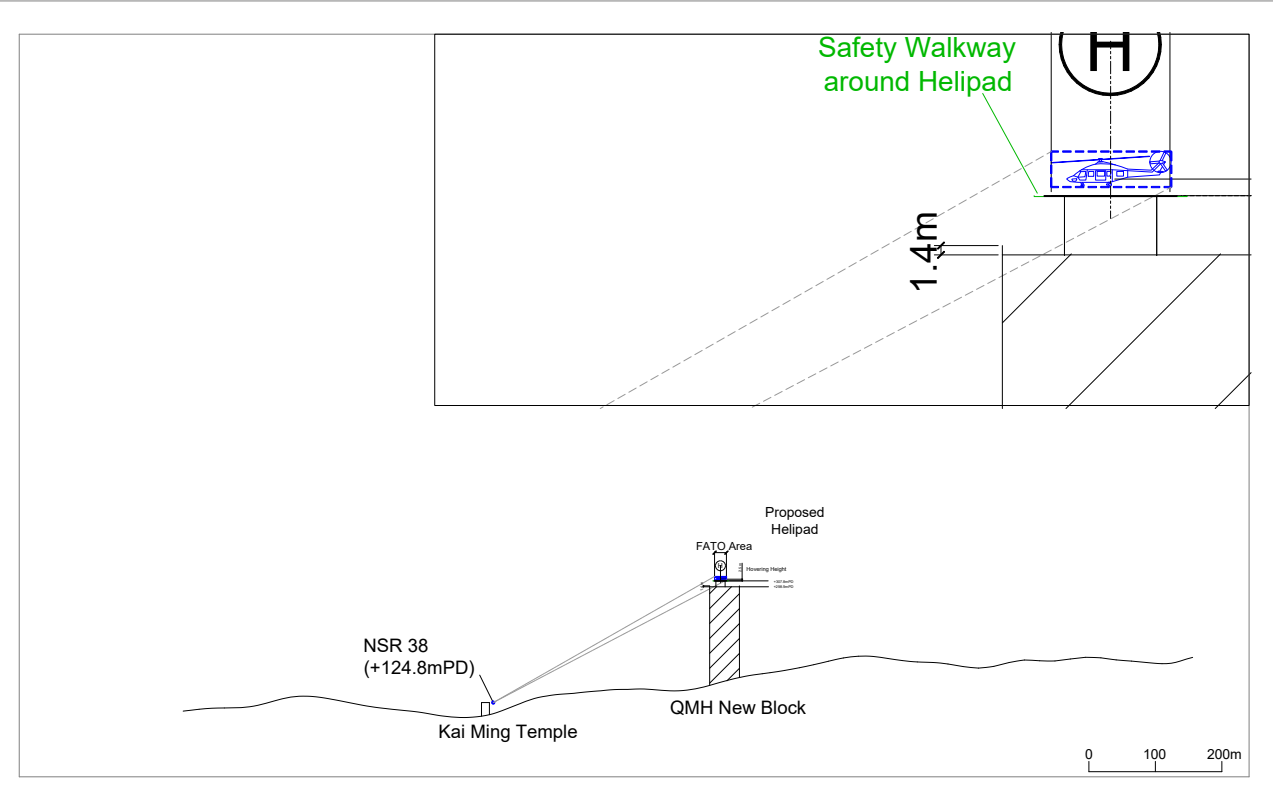
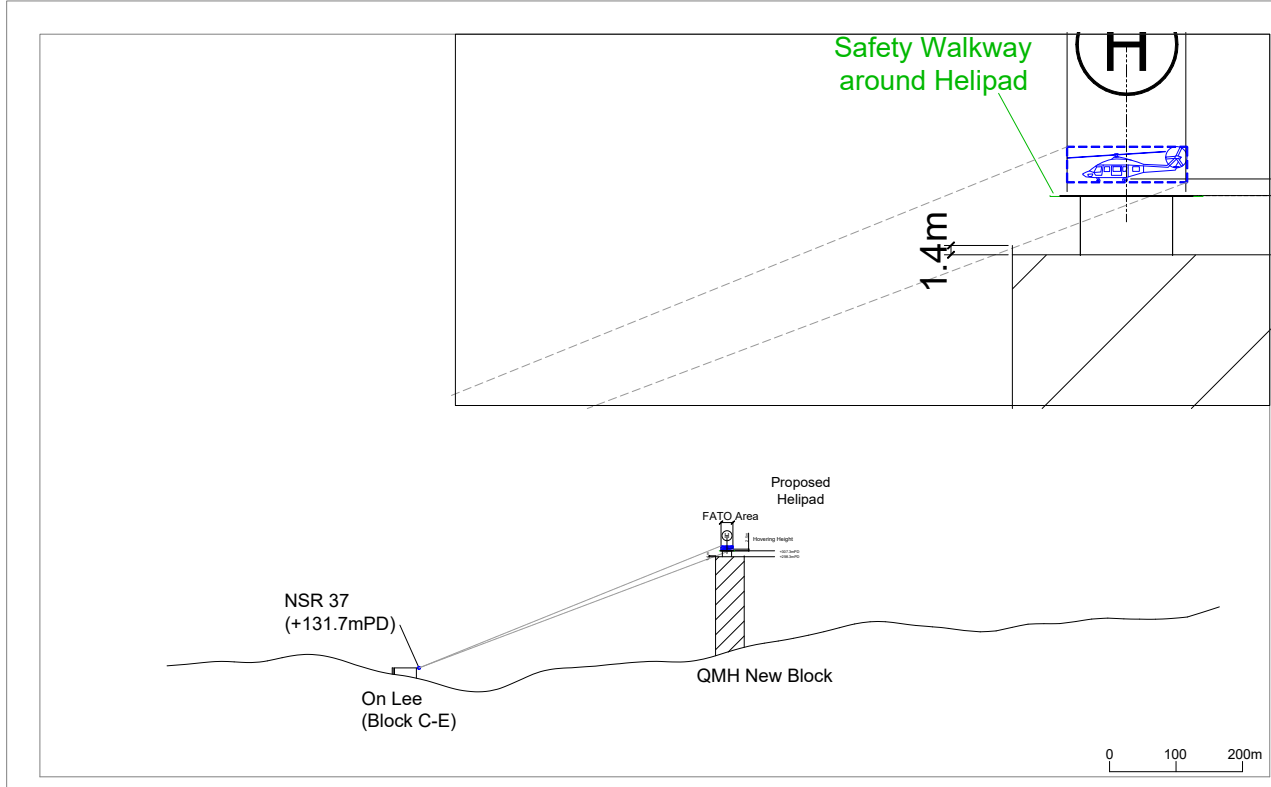
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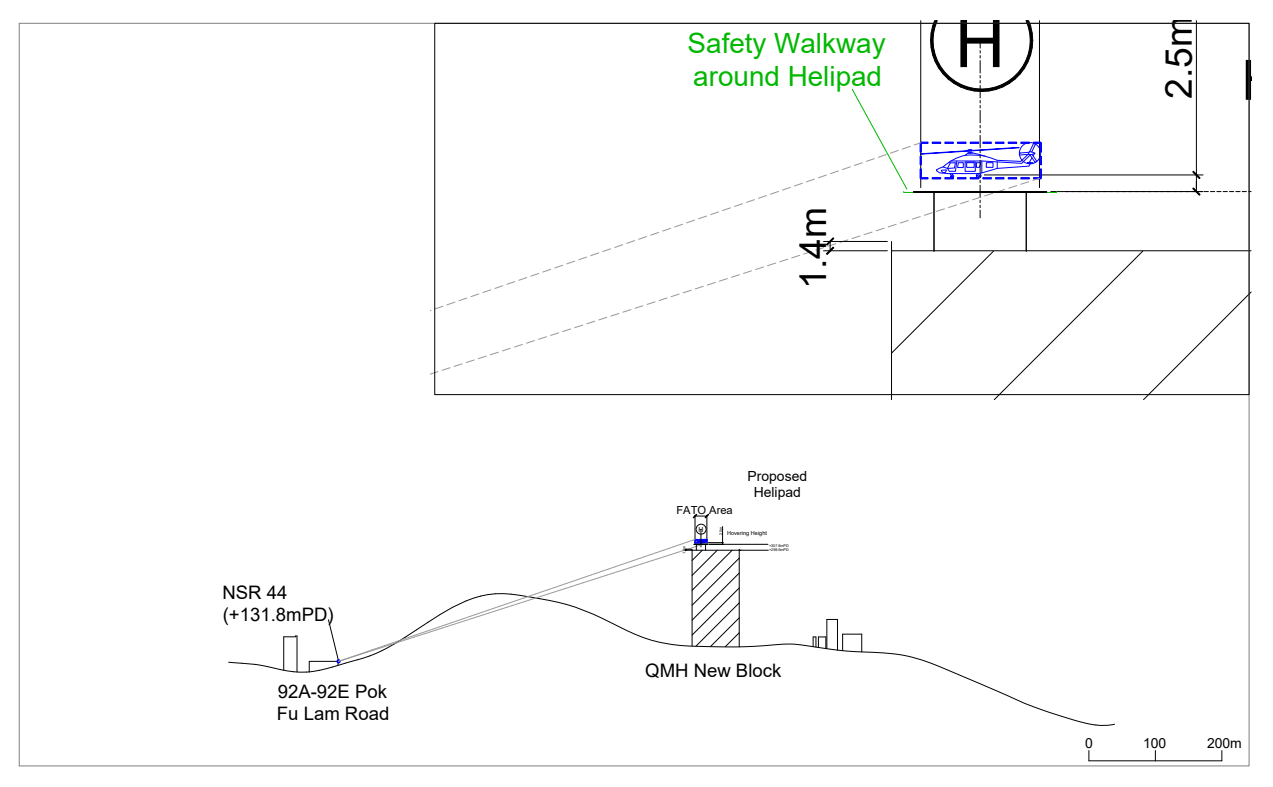
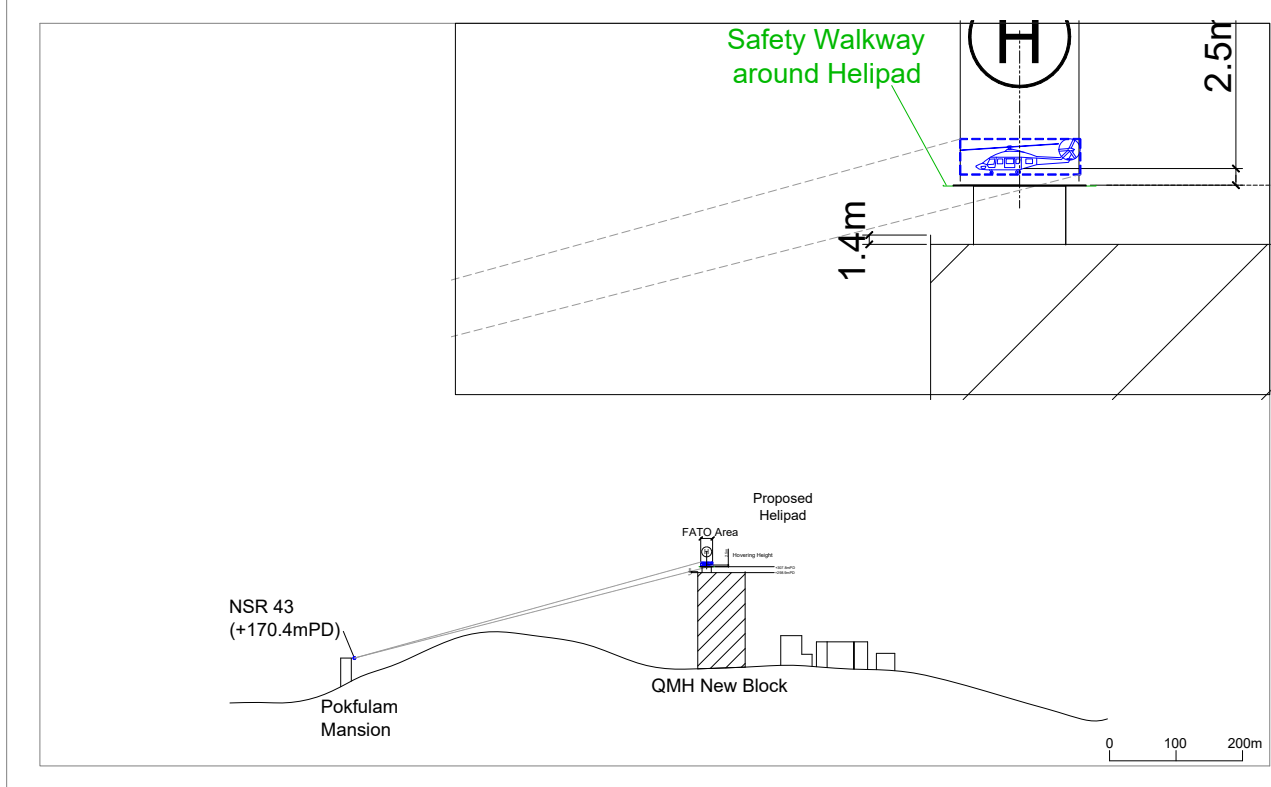
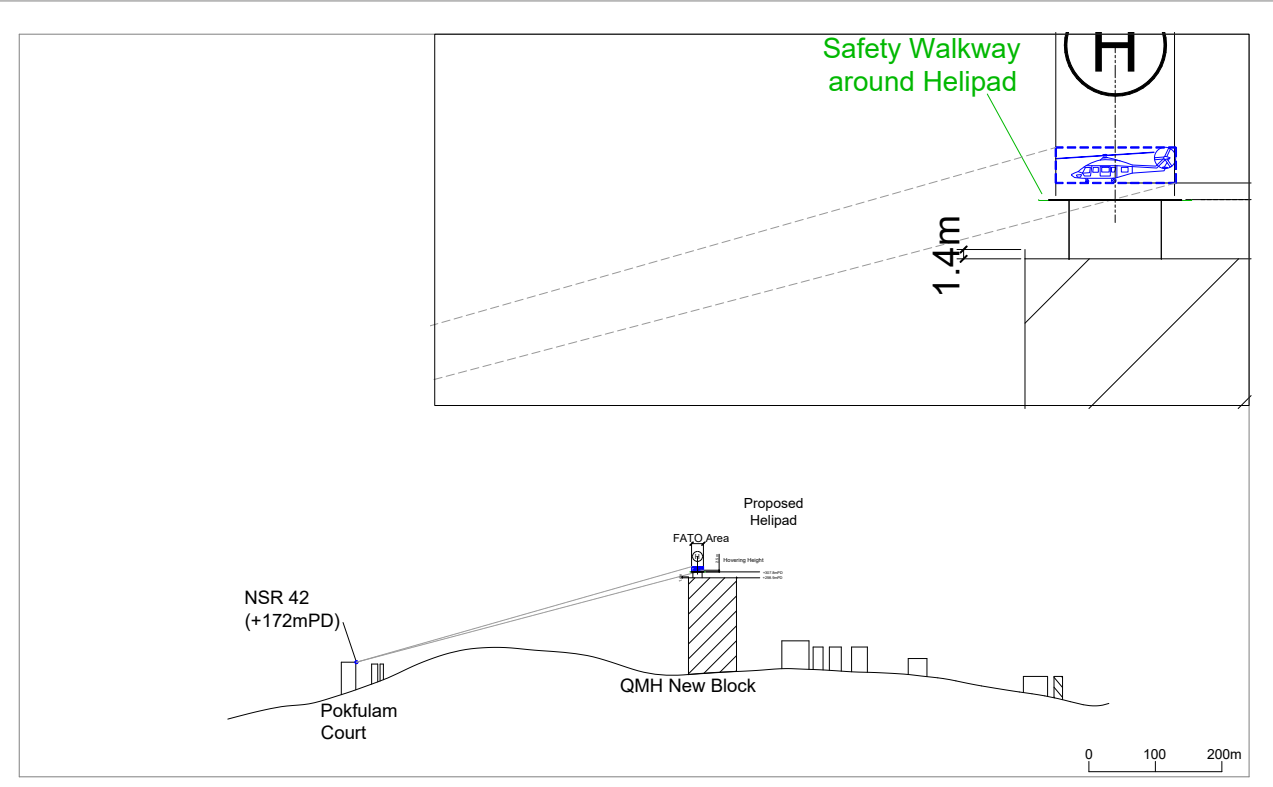
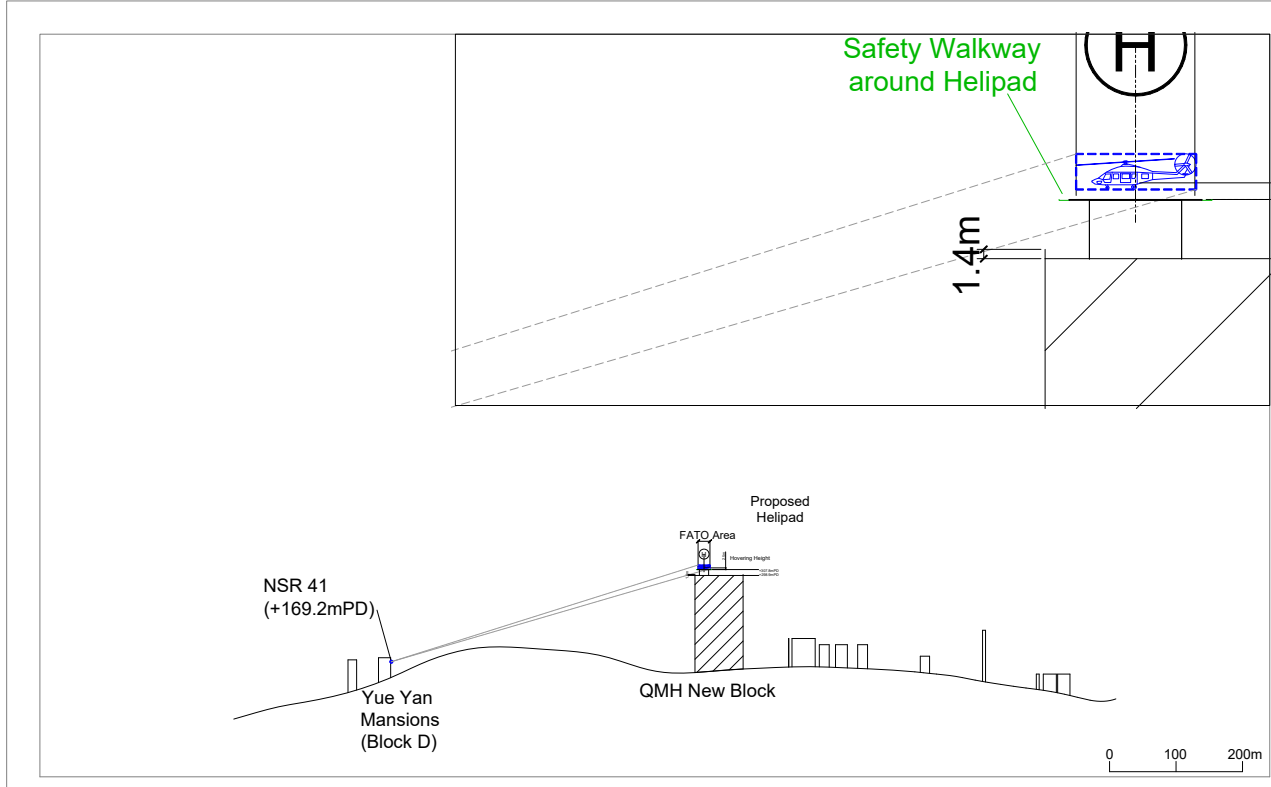
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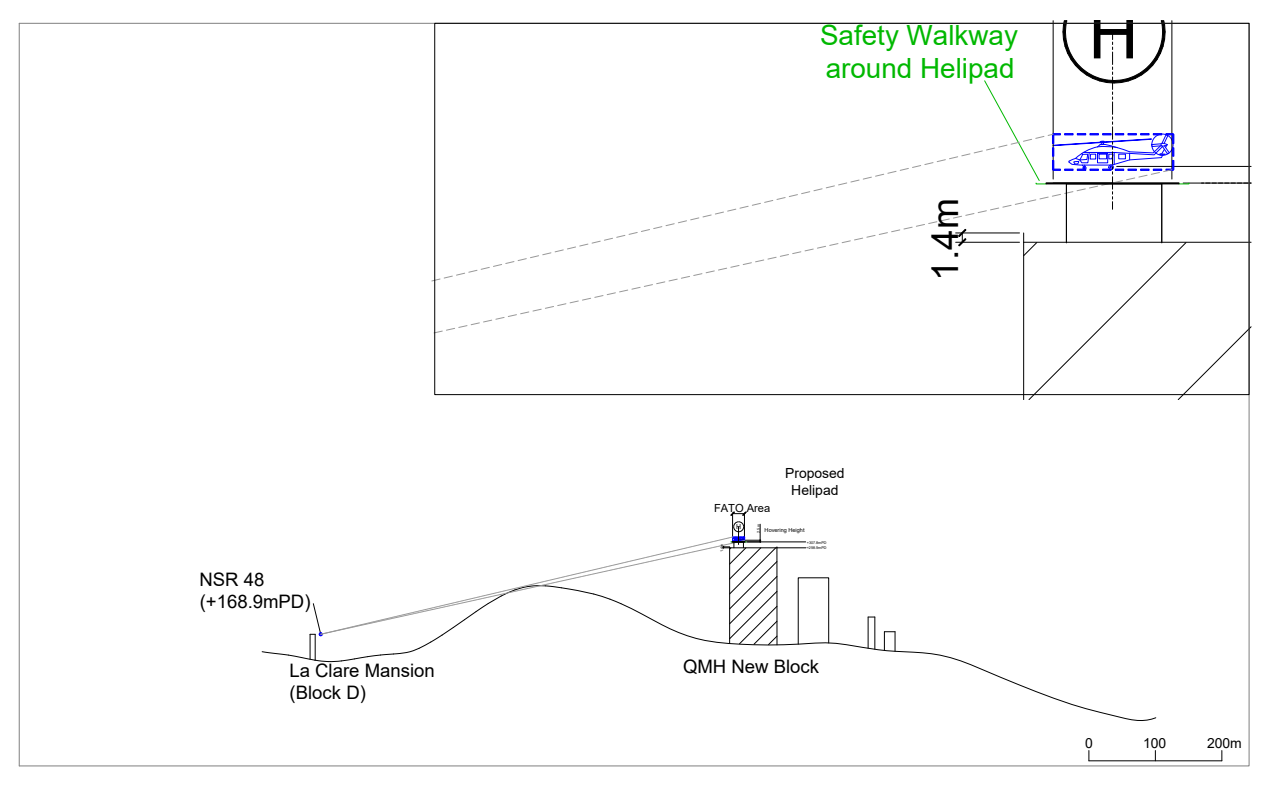
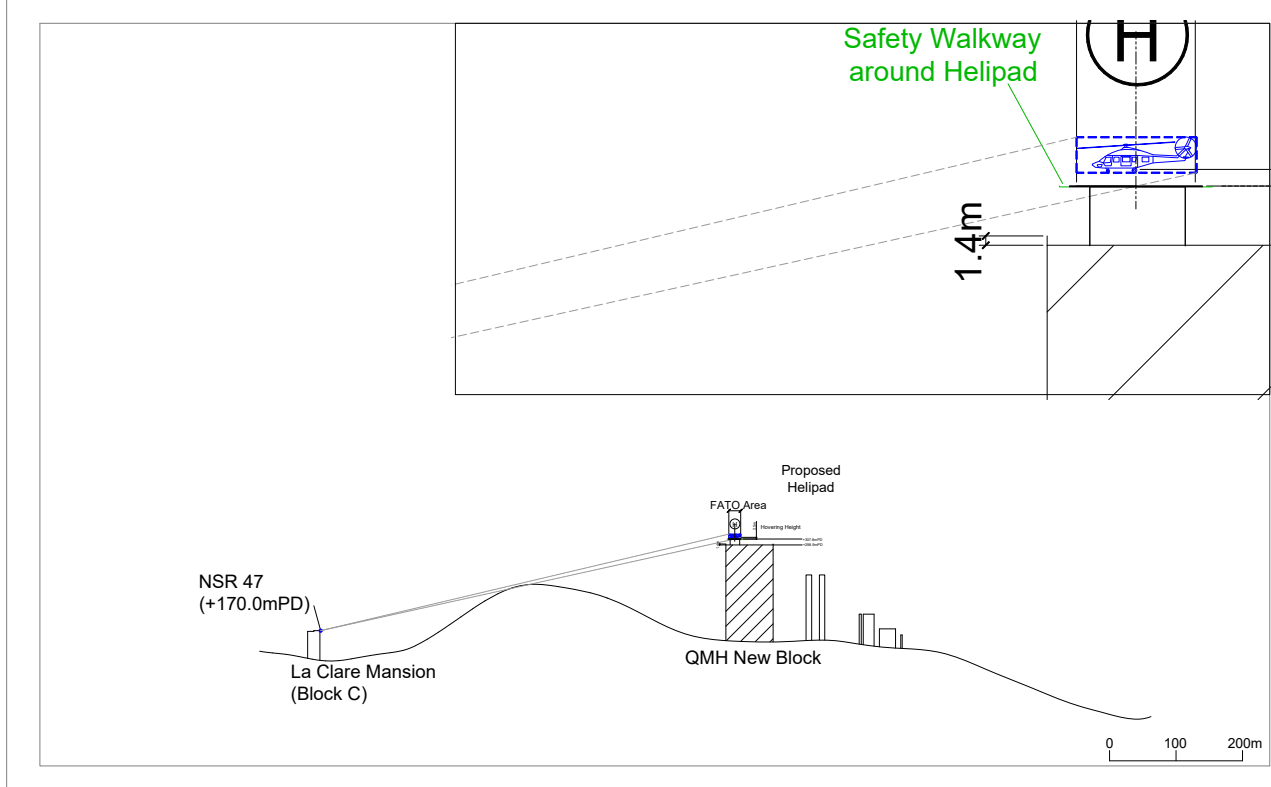
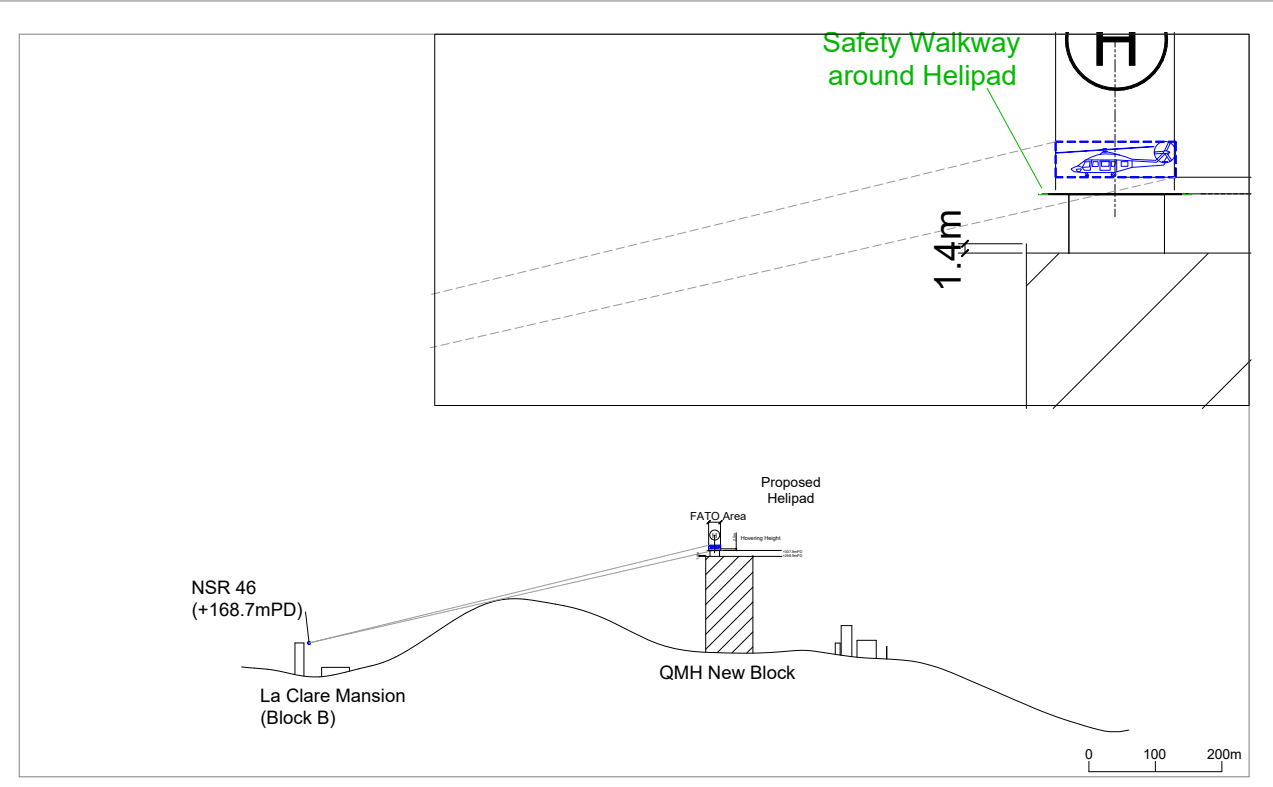
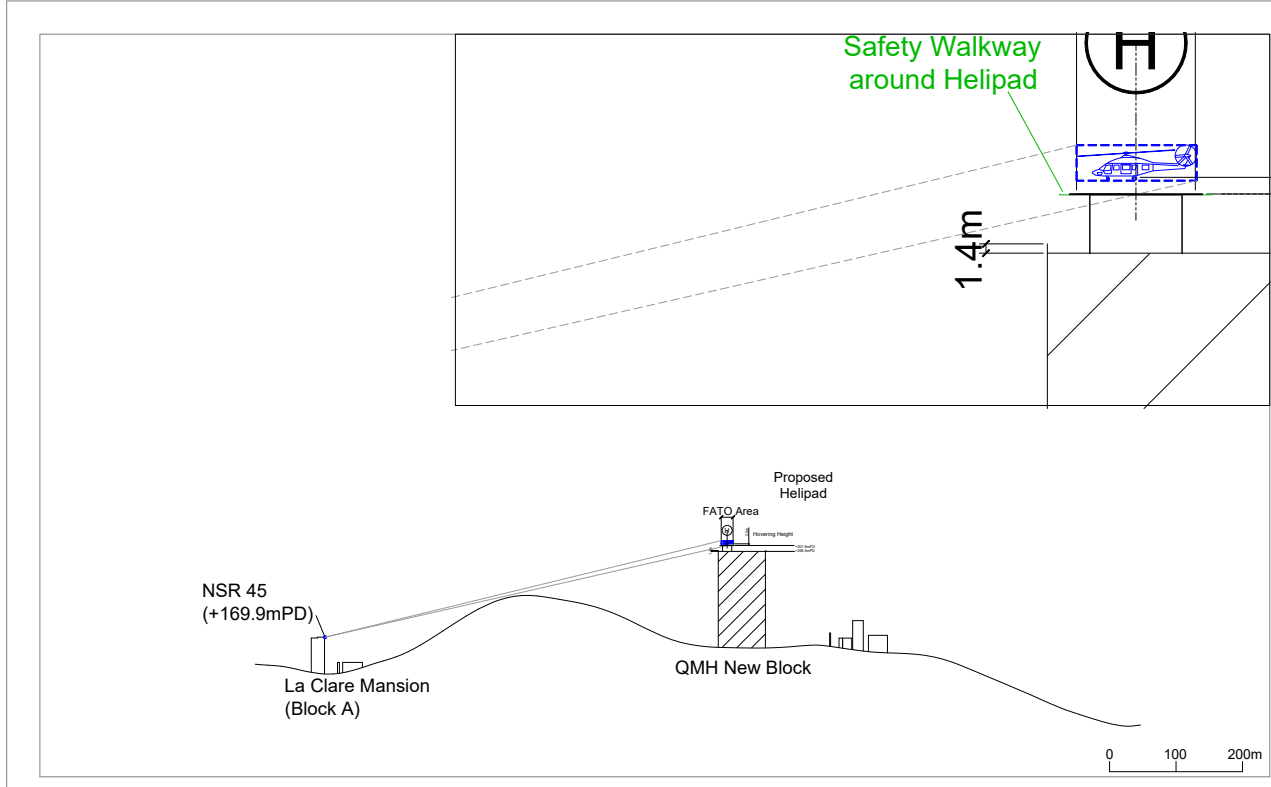
- NOISE SENSITIVE RECEIVER
- LINE OF SIGHT

SECTION DRAWING FOR NSR 37-NSR 40



LEGEND:
 ● NOISE SENSITIVE RECEIVER
 --- LINE OF SIGHT

SECTION DRAWING FOR NSR 41-NSR 44



LEGEND:
 ● NOISE SENSITIVE RECEIVER
 --- LINE OF SIGHT

SECTION DRAWING FOR NSR 45-NSR 48

Appendix D. Helicopter Noise Survey Report

A Rooftop Helipad at New Acute Hospital at Kai Tak Development Area

Technical Note – Helicopter Noise Survey Report

December 2019

Submitted to

Wong Tung & Partners Limited

Hospital Authority

Prepared By

Meinhardt Infrastructure and Environment Ltd

| Date | Revision | Prepared By | Checked By | Approved By |
|------------------|----------|--------------|------------|----------------|
| 04 December 2019 | 3 | Fredric TSIM | WK CHIU | Helen COCHRANE |

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1.0 INTRODUCTION

1.1 Purpose of This Technical Note

1.1.1 A helicopter noise survey has been carried out on 22 May 2019, from 15:30 to 16:30, at Lo Wu Shooting Range to obtain reliable and latest helicopter noise data. Data obtained will be adopted for the purpose of design and assessment of the future New Acute Hospital at Kai Tak Development Area (NAH) and the proposed helipad on rooftop of NAH, including helicopter noise assessment of Environmental Impact Assessment (EIA) (Study Brief No.ESB-311/2019 “A Rooftop Helipad at New Acute Hospital at Kai Tak Development Area” issued by Environmental Protection Department (EPD) under EIA Ordinance (EIAO)).

1.1.2 As advised by Hospital Authority (HA), the Applicant of the Study Brief, it is agreed that the results of this noise survey can be used or referenced for EIA or environmental review for other helicopter landing sites (HLS) in the HA’s facilities and proposal of HLS to be used by Government Flying Service (GFS), before the survey results are made available to the public under the EIAO mechanism.

1.1.3 This Technical Note presents the survey site location, measurement points, instrumentation, survey methodology for the helicopter noise survey and the noise measurement result. The identification of helicopter noise source is also included.

1.2 Structure of This Technical Note

1.2.1 This Technical Note comprises the following sections:

- Section 1 presents the background information
- Section 2 presents the survey site and measurement points
- Section 3 presents the instrumentation
- Section 4 presents the identification of helicopter noise source
- Section 5 presents the survey methodology
- Section 6 presents the helicopter noise measurement results

2.0 SURVEY SITE AND MEASUREMENT POINTS

2.1 Proposed Survey Site

2.1.1 In order to ensure the noise data obtained are reliable, with the least potential to be affected by the survey site itself or site environment, the following principles for site for site selection are identified:

- The site should be a large, flat and leveled ground with at least 150m* clear distance between the proposed location of the helicopter and each measurement point, and no reflective surface and obstacle such as building façade should be behind or in between them as far as possible.
- The background noise level anticipated should be at least 10dB(A) lower than expected measured noise level.
- The more measurement points that could be accommodated on the site to represent different directions simultaneously, the more preferable.

*Note: refer to **Section 2.2.1**.

2.1.2 Based on the above principles, various sites including Government or public helipads or other potentially suitable areas including shooting ranges in Hong Kong have been explored to review their suitability for the helicopter noise survey. Details of the review for these helicopter landing sites are provided in **Appendix A**. All relevant factors including existing noise sources, practicality for measurement, etc. have been taken into account when reviewing the list of helicopter landing sites. This exercise has been undertaken in close consultation with the Government Flying Service (GFS) in March 2019.

2.1.3 The helipads located in urban areas are deemed not preferred since, due to the presence of buildings, the 150m clear distance could not be provided and there is no room to accommodate accessible measurement points. For example, the GFS Hong Kong Convention & Exhibition Centre Heliport at Wan Chai would not be suitable as there is only around 60m clear distance to the south available, and nothing in other directions. Besides, the background noise will be anticipated to be high due to its urban setting and the reflective structures in close proximity are not favorable for noise measurement.

2.1.4 Sites located in remote areas, such as those in the Country Parks, have also been reviewed. However, these sites located on hillsides, such as the Robin's Nest Heliport, are small in size, typically the helipad size with some small buffer, and could not maintain the same horizontal level for measurement points with clear distances and safe access due to topography. As such, these are not deemed suitable. Sites located in coastal areas, such as Yung Shue Wan Helipad or at Peng Chau, are also considered unsuitable as these facilities are surrounded by water on at least 2-3 sides and it is not practical for noise measurements to take place on the sea surface at 150m from the site due to constraint on fixing the measurement equipment and distance, unstable platform easily affected by marine vessel movements, waves and wind.

2.1.5 Another possibility is the Shek Kong airfield operated by the People's Liberation Army (PLA) which is open to civilian traffic at weekends and could have sufficient space for the noise measurements, unobstructed by buildings. However, it is understood from the GFS that at the weekend, the airfield is frequently utilized by aviation clubs, with

- large volumes of landings and take-offs. As such, besides the need to get permission from the PLA, any noise reading would be affected by the background noise and the data could actually be even worse than those obtained at GFS Headquarters at Lantau (refer to **Section 2.1.7**). Therefore, this location is not recommended.
- 2.1.6 The Government Flying Service Headquarters, No.18 South Perimeter Road, Chek Lap Kok (GFS Headquarter at Lantau) has been used in the past for helicopter noise measurements (EIA for Peng Chau Helipad, Register No. AEIAR-087/2005 approved on 25 Aug 2005). The benefits of this location are that there are existing helipads with the designated FATO area, the ground surface is flat and hard and the results could be directly comparable with the previous EIA measurement.
- 2.1.7 However, although up to 3 measurement points could be accommodated, all of them could only be on the same side (to the east) of helicopter. While this could be addressed by the reorientation of the helicopter, the main issue of this location would be background aircraft noise from the adjacent runway due to the operation of HKIA. Given the concern of potential background noise, this location may not be the most preferred option.
- 2.1.8 With the above considerations, one site has been identified as feasible, the Hong Kong Police Lo Wu Shooting Range, Ho Sheung Heung Village, Ku Tung (Lo Wu Shooting Range).
- 2.1.9 This large site is located in a remote area, with limited background noise, as the measurement will be undertaken when no shooting practices are on-going. While the shape of the site is rectangular, it will allow for 2 measurement points on opposite sides of helicopter (1 point on each sides) to be accommodated and allow measurements to represent 2 directions simultaneously. The helicopter can then be re-orientated to allow the opposite sides to be measured, again at 150m. The proposed re-orientation of the helicopter and measurement procedure are detailed in **Section 5.2**.
- 2.1.10 This site is paved with grass which may not be directly comparable with hard structure of a helipad. However, it is anticipated that ground types would not contribute a significant difference in terms of noise level when compared to other factors such as intrusive noise.
- 2.1.11 It is noted that the GFS do use this area for helicopter manoeuvres in joint operations with the Hong Kong Police Force (HKPF) and have confirmed it is a suitable location.
- 2.1.12 The indicative measurement points for this site are shown in **Figure 1**.
- 2.1.13 Based on the above, it is considered that Lo Wu Shooting Range is the preferred option (the Proposed Site) since the noise survey could be done practically, with minimal background noise from the site environment where the constraints are limited. It is considered that the proposal of measurement survey at this Proposed Site is the best compromise among the factors as mentioned in **Sections 2.1.1 to 2.1.2** and **Appendix A**. Approval from HKPF for carry out helicopter noise survey on this site was sought.
- 2.1.14 Apart from noise issues, other factors such as flight safety, site availability should also be considered. No objection on the site proposal was received from EPD and GFS.

2.2 Measurement Points

- 2.2.1 Distance between the proposed location of the helicopter and each measurement point should be 150m to demonstrate far-field measurements, such that helicopter noise can be considered as a point source. Also, distance of 150m is adopted to consistent with International Civil Aviation Organization (ICAO) standard.
- 2.2.2 As mentioned in **Section 2.1.9**, two measurement points (i.e. M1 and M2) were proposed on opposite sides of helicopter (1 point on each side). Indicative measurement points adopted at the Lu Wu Shooting Range are shown in **Figure 1**.
- 2.2.3 GPS information of the two measurement points, the center point of helicopter and the GPS readout of helicopter provided by GFS were recorded on site and checked in order to ensure there were approximate 150m distance separations during the noise survey. The GPS information recorded are presented in **Table 2.1**.

Table 2.1 GPS Information Recorded

| Record Point | GPS Information (WGS84) | |
|--------------------------------|-------------------------|---------------|
| | Latitude | Longitude |
| Readout from Helicopter by GFS | 22° 31.08' | 114° 6.05' |
| Center Point of Helicopter | 22° 31' 4.9" | 114° 6' 3.3" |
| Measurement Point M1 | 22° 31' 7" | 114° 6' 8" |
| Measurement Point M2 | 22° 31' 2" | 114° 5' 59.1" |

- 2.2.4 As advised by GFS, the GPS sensor which provided the readout is installed at the tail part of the helicopter. It is noted that the separation between the readout and the centre point is about 9m, which is about half of the total length of the helicopter (i.e. approx. 18m), and the readout was recorded while the helicopter head was facing toward northeast. Hence, it is reasonably concluded that the GPS recorded is representative for the center point of helicopter and thus, the two measurement points were approximate 150m from the helicopter according to GPS records.

3.0 INSTRUMENTATION

3.1 Adopted Instrument

3.1.1 The instruments adopted for the helicopter noise survey is presented in **Table 3.1**:

Table 3.1 Instrument Adopted for Helicopter Noise Survey

| Item | Manufacturer and Model | Class / Standard |
|-----------------------|----------------------------------|-------------------|
| Sound Level Meter | NOR 139 (1 nos.) | IEC 61672 Class 1 |
| | NTi-XL2 (1 nos.) | IEC 61672 Class 1 |
| Acoustical Calibrator | Casella CEL CEL-120/1 (1 nos.) | IEC 60942 Class 1 |
| | Castle GA607 (1 nos.) | IEC 60942 Class 1 |
| GPS Device | Garmin eTrex 12 channel (1 nos.) | - |
| | Garmin GPSmap 62s (1 nos.) | - |

3.1.2 Immediately prior to the noise measurement, the accuracy of the sound level meter was checked using an acoustic calibrator, which generated a known SPL at a known frequency. Measurements were accepted as valid only if the calibration level before and after the noise measurement agrees to be within 1.0 dB. Calibration certificates of the sound level meter are presented in **Appendix B**.

3.2 Measurement Parameter

3.2.1 Maximum A-weighted Sound Pressure Level (SPL) L_{Max} dB(A) is adopted to present the noise measurement results. “Fast” time-weighting was used for measurement of maximum SPL. SPL in 1/3 octave band are also obtained.

3.3 Competent Professionals

3.3.1 The noise measurements, data checking and calculation are carried out by the competent professionals, who are members of Hong Kong Institute of Acoustics (HKIOA) or equivalent institute, as listed in **Table 3.2**.

Table 3.2 Competent Professionals for Helicopter Noise Survey

| Responsibility | Competent Professional |
|-------------------------------|------------------------|
| Data Checking and Calculation | Mr. W K Chiu |
| Noise Measurement at M1 | Mr. Alvin Chan |
| Noise Measurement at M2 | Mr. Henry Leung |

4.0 IDENTIFICATION OF HELICOPTER NOISE SOURCE

4.1 Helicopter Model

4.1.1 The helicopter model Airbus H175 was operated by GFS.

4.1.2 Since the load carrying condition (e.g. % of fuel storage, no. of persons and equipment on board etc.) may affect the noise emission of the helicopter, equivalent weights were included to demonstrate a conservative measured helicopter noise for “casevac” (casualty evacuation), SAR (Search and Rescue) operations and urgent transportation of organs for transplantation by GFS. As advised by GFS, this weights is approximately 6,500 kg. However, it should be noted that the exact landing weight will differ from aircraft to aircraft depending on the mission equipment onboard.

4.1.3 The GPS data of the helicopter during the noise survey was obtained as presented in **Table 2.1**.

4.2 Operation Modes

4.2.1 Helicopter operations include lateral movements and non-lateral movements. For lateral movement (i.e. Take-Off, Overflight and Approach), noise data are available from the noise certificate for Airbus H175, which are determined under conditions prescribed in Chapter 8 and Appendix 4 of Annex 16 of ICAO. Therefore, the noise level due to the non-lateral movements of helicopter Airbus H175 as presented in **Table 4.1** are needed and hence were measured:

Table 4.1 Operation Modes of Helicopter

| Operation Modes | | Description |
|-----------------|-----------|--|
| a | Idling | Helicopter remains on the ground surface with its rotary blades kept running |
| b | Lift-off | Helicopter ascends vertically from the ground surface to achieve a hover |
| c | Hovering | Helicopter turns on the spot over the ground to achieve the desirable orientation for touchdown / lift-off |
| d | Touchdown | Helicopter descends on the ground surface |

5.0 SURVEY METHODOLOGY

5.1 Measurement Period

5.1.1 The helicopter noise measurement was carried out on 22 May 2019 at Lo Wo Classification Firing Range. The measurements were conducted between 3:30pm and 4:30pm.

5.1.2 The weather during the noise measurement period was fine and sunny. The wind speed measured before and after at both measurement locations was 1-3m/s.

5.2 Measurement Procedure

5.2.1 The following measurement procedure was followed:

- 1) 4 orientations of helicopter nose were specified on site (i.e. due northeast, due southeast, due southwest and due northwest).
- 2) 5-minute background noise was measured before the helicopter noise measurement.
- 3) Measurement started with the 1st orientation (i.e. due northeast).
- 4) The helicopter performed the 4 operation modes (i.e. Idling, Lift-off, Hovering and Touchdown) one by one. For each operation mode, the noise levels at all measurement points were recorded simultaneously.
- 5) Procedure no.3 and no.4 were repeated for the other 3 orientations (i.e. due southeast, southwest and northwest).
- 6) 5-minute background noise was measured after the helicopter noise measurement.

5.2.2 The operation sequence of helicopter based on above procedure is shown in **Table 5.1** as below:

Table 5.1 Operation Sequence of Helicopter

| Sequence | Orientation | Event ID ^[1] | Operation Mode ^{[2], [3]} |
|----------|---------------------------------|-------------------------|------------------------------------|
| 1a | 1 st (due Northeast) | A01a | Idling (a) |
| 1b | | A01b | Idling (b) |
| 2 | | A02 | Lift-off |
| 3 | | A03 | Hovering (e) |
| 4 | | A04 | Hovering (a) |
| 5 | | A05 | Hovering (b) |
| 6 | | A06 | Hovering (c) |
| 7 | | A07 | Hovering (d) |
| 8 | | A08 | Touchdown |
| 9 | | A09 | Hovering (c) |
| 10 | | A10 | Hovering (d) |
| 11 | | A11 | Touchdown |
| 12 | | A12 | Hovering (c) |
| 13 | | A13 | Hovering (d) |
| 14 | A14 | Touchdown | |
| 15a | 2 nd (due Southeast) | B01a | Idling (a) |
| 15b | | B01b | Idling (b) |
| 16 | | B02 | Lift-off |

| Sequence | Orientation | Event ID ^[1] | Operation Mode ^{[2], [3]} |
|----------|---------------------------------|-------------------------|------------------------------------|
| 17 | | B03 | Hovering (a) |
| 18 | | B04 | Hovering (b) |
| 19 | | B05 | Hovering (e) |
| 20 | | B06 | Touchdown |
| 21a | 3 rd (due Southwest) | C01a | Idling (a) |
| 21b | | C01b | Idling (b) |
| 22 | | C02 | Lift-off |
| 23 | | C03 | Hovering (e) |
| 24 | | C04 | Hovering (a) |
| 25 | | C05 | Hovering (b) |
| 26 | 4 th (due Northwest) | C06 | Touchdown |
| 27a | | D01a | Idling (a) |
| 27b | | D01b | Idling (b) |
| 28 | | D02 | Lift-off |
| 29 | | D03 | Hovering (e) |
| 30 | | D04 | Hovering (a) |
| 31 | D05 | Hovering (b) | |
| 32 | | D06 | Touchdown |

Note:

[1] Orientation of Event: A – Due Northeast; B – Southeast; C – Southwest; D – Northwest.

[2] The transition operation from idling steadily to lift off was included for conservative measurement. Idling mode specified with “a” and “b” represent the idling steadily and transition to lift off respectively.

[3] Hovering mode for both directions of turning were carried out. Hovering mode specified with “a” and “b” represent the turning direction as clockwise and anti-clockwise respectively. Also, the transition operation in the near vicinity of the helicopter landing site were included for conservative measurement. Hovering mode specified with “c” and “d” represent “transition from hovering mode to take-off mode” and “transition from approach mode to hovering mode” respectively, while “e” represent the hovering at the same elevation level.

5.2.3 As advised by GFS, the helicopter take-off and approach could only be conducted toward northeast (i.e. 1st orientation) due to flight safety reason at Lo Wu Classification Firing Range. Therefore, Hovering (c) and (d) were omitted in the 2nd, 3rd and 4th orientations (i.e. due southeast (B), southwest (C) and northwest (D)) and hence, they were repeated two times in the 1st orientation (i.e. due northeast (A)) for repeat measurement.

5.2.4 In addition, the helicopter controlled by GFS had been returned to the same landing location as close as possible after each approach to ensure the separation distance between center point of helicopter and measurement points remain approx. 150m as described in **Section 2.2**. However, it was noted that the helicopter did not appear to stay in exact one single position throughout the measurement, and the distance separation between helicopter and one of the measurement points was less than 150m at some instant. As advised by GFS, this distance deviation from the recorded center point was controlled to within 2-3m, which is considered small when compared to 150m. Nonetheless, the highest measurement results of the two measurement points are adopted for conservative approach.

6.0 MEASUREMENT RESULTS

6.1 Background Noise Measurement

6.1.1 The results of background noise measurement are presented in **Table 6.1**.

Table 6.1 Background Noise Measurement Results

| Period | Measured Noise Level $L_{eq, 5min}$ in dB(A) | |
|-------------------------------------|--|------|
| | M1 | M2 |
| Before Helicopter Noise Measurement | 46.4 | 48.8 |
| After Helicopter Noise Measurement | 50.1 | 52.9 |

6.2 Helicopter Noise Measurement

6.2.1 The results of helicopter noise measurement are presented in **Table 6.2**. Detailed graphical time history of the measured noise levels are shown in **Appendix C**.

Table 6.2 Helicopter Noise Measurement Results

| Operation Mode | | Event ID ^[1] | Highest Measured Noise Level L_{Max} in dB(A) | | |
|----------------|--|-------------------------|---|---------------------|---------|
| | | | M1 | M2 | Adopted |
| Idling | (a) – Idling Steadily | A01a | 65.0 | N/A | 75.4 |
| | | B01a | 64.7 | 64.6 | |
| | | C01a | 61.1 | 78.8 ^[1] | |
| | | D01a | 63.4 | 73.6 ^[2] | |
| | (b) – Transition to Lift Off | A01b | 75.4 | N/A | |
| | | B01b | 64.5 | 71.0 | |
| | | C01b | 75.2 | 82.0 ^[1] | |
| | | D01b | 76.8 ^[2] | 80.3 ^[2] | |
| Lift Off | A02 | 73.6 | 82.0 | 82.4 | |
| | B02 | 77.0 | 77.8 | | |
| | C02 | 75.2 | 82.4 | | |
| | D02 | 86.0 ^[2] | 82.7 ^[2] | | |
| Hovering | (a) - Rotate-Clockwise | A04 | 79.8 | 78.0 | 83.5 |
| | | B03 | 76.1 | 76.4 | |
| | | C04 | 82.3 | 80.9 | |
| | | D04 | 76.4 | 78.5 | |
| | (b) - Rotate-Anti Clockwise | A05 | 81.4 | 79.1 | |
| | | B04 | 75.3 | 79.8 | |
| | | C05 | 78.4 | 78.2 | |
| | | D05 | 83.0 | 80.5 | |
| | (c) - Transition to Take-Off | A06 | 81.8 | 80.8 | |
| | | A09 | 81.2 | 79.9 | |
| | | A12 | 80.6 | 78.5 | |
| | (d) - Transition from Approach | A07 | 80.7 | 78.1 | |
| | | A10 | 83.2 | 83.5 | |
| | | A13 | 81.7 | 82.8 | |
| | (e) - Hovering at the same elevation level | A03 | 79.6 | 75.1 | |
| | | B05 | 75.6 | 80.0 | |
| C03 | | 74.5 | 79.3 | | |
| D03 | | 80.1 | 79.0 | | |
| Touchdown | A08 | 75.3 | 78.9 | 78.9 | |
| | A11 | 78.7 | 73.7 | | |
| | A14 | 76.8 | 75.2 | | |
| | B06 | 72.7 | 66.1 | | |
| | C06 | 72.5 | 73.3 | | |
| | D06 | 75.9 | 71.5 | | |

Note:

[1] Noise measurement result was discarded due to intermittent traffic noise at Ma Tsoi Lung Road. According to the GPS data and site layout, M2 is only approx. 40m from the nearby Ma Tso Lung Road. Based on the site observation, high intrusive road traffic noise was induced by heavy vehicle (e.g. container truck) crossing the Ma Tso Lung Road to nearby open storage area during the C01 event. The sound record was checked. The duration of the high extraneous noise matches with the noise character from heavy vehicle.

[2] Noise measurement result was discarded due to other helicopter flyover.

6.2.2 The SPL in one third octave bands of the adopted noise levels for each operation mode are presented in **Table 6.3**. Graphical presentations of the SPL in one third octave bands are shown in **Appendix D**.

Table 6.3 SPL in One Third Octave Bands of the Adopted Noise Levels

| SPL at Approx. 150m | | Operation Mode of Helicopter | | | | | | | |
|---|---------|------------------------------|------|----------|------|----------|------|-----------|------|
| | | Idling | | Lift-off | | Hovering | | Touchdown | |
| Adopted L_{max} dB(A) | | 75.4 | | 82.4 | | 83.5 | | 78.9 | |
| SPL (dB/dB(A)) in One Third Octave Band | 50 Hz | 57.8 | 27.6 | 78.2 | 48.0 | 84.0 | 53.8 | 80.1 | 49.9 |
| | 63 Hz | 56.0 | 29.8 | 85.7 | 59.5 | 84.9 | 58.7 | 87.0 | 60.8 |
| | 80 Hz | 56.9 | 34.4 | 74.7 | 52.2 | 77.5 | 55.0 | 71.4 | 48.9 |
| | 100 Hz | 57.0 | 37.9 | 77.9 | 58.8 | 75.9 | 56.8 | 72.1 | 53.0 |
| | 125 Hz | 61.1 | 45.0 | 77.6 | 61.5 | 77.2 | 61.1 | 81.8 | 65.7 |
| | 160 Hz | 58.9 | 45.5 | 74.6 | 61.2 | 76.6 | 63.2 | 74.9 | 61.5 |
| | 200 Hz | 57.2 | 46.3 | 73.7 | 62.8 | 75.9 | 65.0 | 69.8 | 58.9 |
| | 250 Hz | 53.2 | 44.6 | 65.2 | 56.6 | 63.5 | 54.9 | 67.8 | 59.2 |
| | 315 Hz | 49.1 | 42.5 | 64.0 | 57.4 | 71.6 | 65.0 | 59.3 | 52.7 |
| | 400 Hz | 42.5 | 37.7 | 69.3 | 64.5 | 74.0 | 69.2 | 65.9 | 61.1 |
| | 500 Hz | 40.8 | 37.6 | 74.3 | 71.1 | 78.9 | 75.7 | 66.1 | 62.9 |
| | 630 Hz | 42.8 | 40.9 | 72.4 | 70.5 | 77.4 | 75.5 | 69.1 | 67.2 |
| | 800 Hz | 46.5 | 45.7 | 72.3 | 71.5 | 75.0 | 74.2 | 73.5 | 72.7 |
| | 1000 Hz | 48.9 | 48.9 | 72.2 | 72.2 | 71.5 | 71.5 | 74.4 | 74.4 |
| | 1250 Hz | 49.6 | 50.2 | 71.4 | 72.0 | 74.9 | 75.5 | 65.0 | 65.6 |
| | 1600 Hz | 54.3 | 55.3 | 72.8 | 73.8 | 72.7 | 73.7 | 65.6 | 66.6 |
| | 2000 Hz | 59.2 | 60.4 | 69.6 | 70.8 | 68.9 | 70.1 | 63.5 | 64.7 |
| | 2500 Hz | 63.0 | 64.3 | 66.0 | 67.3 | 67.8 | 69.1 | 61.1 | 62.4 |
| | 3150 Hz | 65.7 | 66.9 | 64.5 | 65.7 | 66.6 | 67.8 | 59.0 | 60.2 |
| 4000 Hz | 69.1 | 70.1 | 61.8 | 62.8 | 64.4 | 65.4 | 55.8 | 56.8 | |
| 5000 Hz | 68.2 | 68.7 | 58.2 | 58.7 | 61.0 | 61.5 | 53.6 | 54.1 | |
| 6300 Hz | 66.9 | 66.8 | 56.1 | 56.0 | 58.5 | 58.4 | 51.1 | 51.0 | |
| 8000 Hz | 64.9 | 63.8 | 75.1 | 74.0 | 59.1 | 58.0 | 47.7 | 46.6 | |
| 10000 Hz | 60.1 | 57.6 | 75.0 | 72.5 | 58.7 | 56.2 | 41.7 | 39.2 | |

Figure 1

Figure 1 – Location of the Survey Site and Measurement Points

Survey Site: Lo Wu Shooting Range

● **Locations of Noise Measurement Point**



Appendix A

A Rooftop Helipad at New Acute Hospital at Kai Tak Development Area

Technical Note – Helicopter Noise Survey Report

Appendix A – List of Helicopter Landing Sites Under Review (Source: GEOINFO MAP - <https://www.map.gov.hk/gm/>)

| Site | Location | Remarks ^[1] |
|------|---|--|
| 1 | Helicopter Landing Site - LT36 - GFS DISPERSAL - CLK | Government Flying Service, Hong Kong International Airport, 18 South Perimeter Road, Chek Lap Kok, NT |
| 2 | Helicopter Landing Site - HK07 - HONG KONG CONVENTION AND EXHIBITION CENTRE | Expo Drive East, Wan Chai, HK |
| 3 | Helicopter Landing Site - LT34 - SHA CHAU HELIPAD | Sha Chau, Tuen Mun, NT |
| 4 | Helicopter Landing Site - CP17 - DEEP BAY LINK HELIPAD | Kong Sham Western Highway, Ha Tsuen, Yuen Long, NT |
| 5 | Helicopter Landing Site - HK01 - PENG CHAU NORTH HELIPAD | Peng Chau, NT (Near Sea Crest Villa) |
| 6 | Helicopter Landing Pad | Sha Chau, Tuen Mun, NT |
| 7 | Helicopter Landing Pad | Cove Hill, Sha Tin, NT (Tai Po Kau Forest Track - Chueng Lek Mei Section) |
| 8 | Helicopter Landing Pad | Lung Kwu Tan, Tuen Mun, NT (Near Black Point Power Station) |
| 9 | Helicopter Landing Pad | Tsing Shan Firing Range, Siu Lang Shui, Tuen Mun, NT |
| 10 | Helicopter Landing Pad | Tai Lam Country Park Tai Tong Management Centre, Tai Tong Shan Road, Shap Pat Heung, Yuen Long, NT (Tai Tong Forest Nursery) |
| 11 | Helicopter Landing Pad | Kadoorie Farm and Botanic Garden, Lam Kam Road, Lam Tsuen Valley, Tai Po, NT |
| 12 | Helicopter Landing Pad | Dai Kwai Street, Tai Po Industrial Estate, NT |
| 13 | Helicopter Landing Pad | Tuen Mun, NT |
| 14 | Helicopter Landing Pad | Lantau Island, NT (Near Kap Shui Mun Bridge) |
| 15 | Helicopter Landing Pad | Chuen Lung, Route Twisk, Tsuen Wan, NT (Near Tai Mo Shan Country Park Chuen Lung Management Office) |
| 16 | Helicopter Landing Pad | The Jockey Club Kau Sai Chau Public Golf Course, Kau Sai Chau, Sai Kung, NT |
| 17 | Helicopter Landing Pad | North Lantau Highway, Lantau Island, NT (Near Toll Plaza) |
| 18 | Helicopter Landing Pad | Lamma Island, NT (Near Lamma Fire Station) |
| 19 | Helicopter Landing Pad | The Jockey Club Kau Sai Chau Public Golf Course, Kau Sai Chau, Sai Kung, NT |

| Site | | Location | Remarks ^[*] |
|------|---|---|--|
| 20 | Helicopter Landing Pad | Hong Kong International Airport, Chek Lap Kok, NT | d |
| 21 | Helicopter Landing Site - CC04 - CHEUNG CHAU | Hak Pai Road, Cheung Chau, NT | a, b |
| 22 | Helicopter Landing Site - EB07 - LUK KENG | Luk Keng, Sha Tau Kok, NT (Near Shek Pan Tam) | c |
| 23 | Helicopter Landing Site - LT08 - SOKO ISLANDS | Ha Tsuen, Tai A Chau, NT | c |
| 24 | Helicopter Landing Site - PT02 - WAGLAN ISLAND | Waglan Radar Station, Waglan Island, NT | c |
| 25 | Helicopter Landing Site - CC03 - HEI LING CHAU | Hei Ling Chau, NT (Near Nei Kwu Correctional Institution) | c |
| 26 | Helicopter Landing Site - CP02 - BLACK POINT VTMS | Black Point, Tuen Mun, NT | c |
| 27 | Helicopter Landing Site - CP03 - CASTLE PEAK TRANSMITTERS | Castle Peak, Tuen Mun, NT | c |
| 28 | Helicopter Landing Site - CP09 - TSING SHAN RANGE | Castle Peak, Tuen Mun, NT | c |
| 29 | Helicopter Landing Site - EB06 - FAN SHUI AU | Fan Shui Au, Kuk Po, Sha Tau Kok, NT | c |
| 30 | Helicopter Landing Site - HK24 - PAMELA YOUDE HOSPITAL | Pamela Youde Nethersole Eastern Hospital, 3 Lok Man Road, Chai Wan, HK | a |
| 31 | Helicopter Landing Site - JB08 - LEAD MINE PASS | Lead Mine Pass, Tsuen Wan, NT | c |
| 32 | Helicopter Landing Site - LT08A - SOKO FOOTBALL PITCH | Tai A Chau, NT (Near Tung Wan) | a |
| 33 | Helicopter Landing Site - LT35 - LUNG KWU CHAU | Lung Kwu Chau, Tuen Mun, NT | c |
| 34 | Helicopter Landing Site - P01 - PAK HOK CHAU | Tam Kon Chau, Tam Kon Chau Road, Mai Po, Yuen Long, NT (Near Hong Kong Police Force Pak Hok Chau Operational Base) | d |
| 35 | Helicopter Landing Site - P03 - CREST HILL OP | Crest Hill, Sheung Shui, NT | c |
| 36 | Helicopter Landing Site - P05 - LO WU RANGE | Lo Wu Classification Range, Ma Tso Lung Road, Sheung Shui, NT | Proposed Site, refer to Sections 2.1.9 to 2.1.13 |
| 37 | Helicopter Landing Site - P10 - MAN KAM TO | Man Kam To, Man Kam To Road, Sheung Shui, NT (Near Man Kam To Operation Base, Ta Kwu Ling Division, Hong Kong Police Force) | a |
| 38 | Helicopter Landing Site - P23 - KAT O SOUTH | Mun Tsai Wan, Crooked Island, NT | c |

| Site | | Location | Remarks ^[*] |
|------|---|---|------------------------|
| 39 | Helicopter Landing Site - P24 - SHA TAU KOK | Sha Tau Kok Sewage Treatment Works, Sha Tau Kok Road-Shek Chung Au, Sha Tau Kok, NT | a |
| 40 | Helicopter Landing Site - P25 - KAT O ISLAND | Tung O Wan, Crooked Island, NT | b |
| 41 | Helicopter Landing Site - P27 - ROBINS NEST ALTERNATE | Robin's Nest, Ta Kwu Ling, NT | Refer to Section 2.1.4 |
| 42 | Helicopter Landing Site - WB12 - LUT CHAU NORTH | Lut Chau, Mai Po, Yuen Long, NT | d |
| 43 | Helicopter Landing Site - WB13 - TSIM BEI TSUI | Tsim Bei Tsui, Deep Bay Road, Lau Fau Shan, Yuen Long, NT | a |
| 44 | Helicopter Landing Site - WB15 - PTU HQ FANLING | Hong Kong Police Force Police Tactical Unit Headquarters, 1 Wu Tip Shan Road, Fanling, NT | a |
| 45 | Helicopter Landing Site - WB16 - FANLING LODGE (LAWN) | Kam Tsin Road, Fanling, NT | a |
| 46 | Helicopter Landing Site - WB17 - FANLING LODGE (GOLFCOURSE) | The Hong Kong Golf Club Fanling Golf Course, Kam Tsin Road, Fanling, NT | a |
| 47 | Helicopter Landing Site - HK21 - BRICK HILL | Brick Hill, Wong Chuk Hang, HK | c |
| 48 | Helicopter Landing Site - JB05 - ISLAND HOUSE | Yuen Chau Tsai, 1 Island House Lane, Tai Po, NT | b |
| 49 | Helicopter Landing Site - LT04 - SHEK PIK | Wang Pui Road, Shek Pik, Lantau Island, NT | b |
| 50 | Helicopter Landing Site - LT06 - SHUI HAU | Shui Hau, South Lantau Road, Lantau Island, NT | c |
| 51 | Helicopter Landing Site - LT12 - LUK TEI | Nam Shan, Lantau Trail, Lantau Island, NT | c |
| 52 | Helicopter Landing Site - LT23 - HILL 275 | Lantau Island, NT (Near Pak Fu Tin) | c |
| 53 | Helicopter Landing Site - P26 - PING CHAU | Au Kung Shan, Ping Chau, NT | c |
| 54 | Helicopter Landing Site - HK02 - LAMMA YUNG SHUE WAN | Yung Shue Wan, Lamma Island, NT | Refer to Section 2.1.4 |
| 55 | SHEK KONG BARRACKS | 250 KAM TIN ROAD | Refer to Section 2.1.5 |
| 56 | Helipad at Tuen Mun Hospital | 23 Tsing Chung Koon Road, Tuen Mun, NT | a |

***Note:**

Remark a – Site with less than 150m clear distance or with reflective structure in vicinity

Remark b – Site located in coastal areas surrounded by water on at least 2-3 sides

Remark c – Site located on hillsides with topographically challenge

Remark d – Site where anticipated measurement location is inaccessible

Appendix B

Certificate of Calibration

Certificate No.: 474271593

Object: Sound Analyser Nor139

Supplier: Norsonic AS

Type: Nor139

Serial number: 1392834

Client: Ramboll, Hong Kong

This instrument is tested and calibrated in accordance to the Norsonic production standard set for Nor139, ensuring that the instrument conforms to the following standards;

IEC 61672-1:2002 class 1
IEC 61260-1 class 1 Ed 1.0 2014-02
ANSI S1.4-1983 (R2001) with amd. S1.4A-1985 class 1
ANSI S1.43-1997 (R2002) class 1
ANSI S1.11-2004 class 1
DIN 45 657, Applicable parts
IEC 61094 part 4

Instrumentation used for calibration traceable to:

Electrical Parameters: MT, Norway
Acoustical Parameters: PTB, Germany
Environmental Parameters: Justervesenet, Norway

Adjustments: None

Comments: None

Date of calibration: 2018-02-14
Calibration interval recommended 2 years

The environmental parameters applicable to this calibration are kept well within limits ensuring negligible deviation on obtained measurement results.

Calibrated by:

Sign.



PO.BOX 24, N-3420 LIERSKOGEN, NORWAY
TEL: +47 32 85 89 00

Warranty

Norsonic products are thoroughly inspected before they leave the factory. Carefully check the shipment for any physical damage in transit. Notify the factory or the distributor and file the claim with the carrier if there is any such damage.

Product type: Sound Analyser Nor139

Serial no.: 1392834

Power: 11-15 Volt DC

Option included: 1,3,4,5,6,7,8,16,58,68

Option description:

00: Tmax 5 and LeqI according to German standards
01: 1/1 octave real time frequency filters 0,5 - 16.000Hz
03: 1/3 octave real time filters 0,4 - 20.000Hz, require opt 2
04: Statistical Calculations for weighting network and 1/n octave filters
05: Parallel calculation of F, S, I time constants
06: Profile. L/t measuring mode w / multi spectrum if opt 2 or 3 are installed
07: Enhanced profile including 4 markers and time resolution from 50ms
08 Sound recording
16: Enhanced global trigger

Application version:

3.1.984 2015-03-27 09:58r

Id no.: 4271593

Accessories: Preamplifier 1207 Serial No.: 20873
Microphone 1228 Serial No.: 02739

Related to order: SO1807003

Checked and approved by:

Date: 2018-02-14



P.O. BOX 24, N-3420 LIERSKOGEN, NORWAY
TEL: +47 32 85 89 00

Warranty statement

Norsonic products are warranted against defects in material and workmanship. This warranty applies to 36 months from date of delivery.

Norsonic AS will repair or replace equipment, which proves to be defective during the warranty period.

This warranty includes labour and parts. Equipment returned to the factory, for repair must be shipped freight prepaid. Repair due to misuse of the equipment and/or use of hardware, software or interfacing not provided by Norsonic AS are not covered by this warranty.

No other warranty is expressed or implied, included, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

Norsonic AS shall not be liable for consequential damages

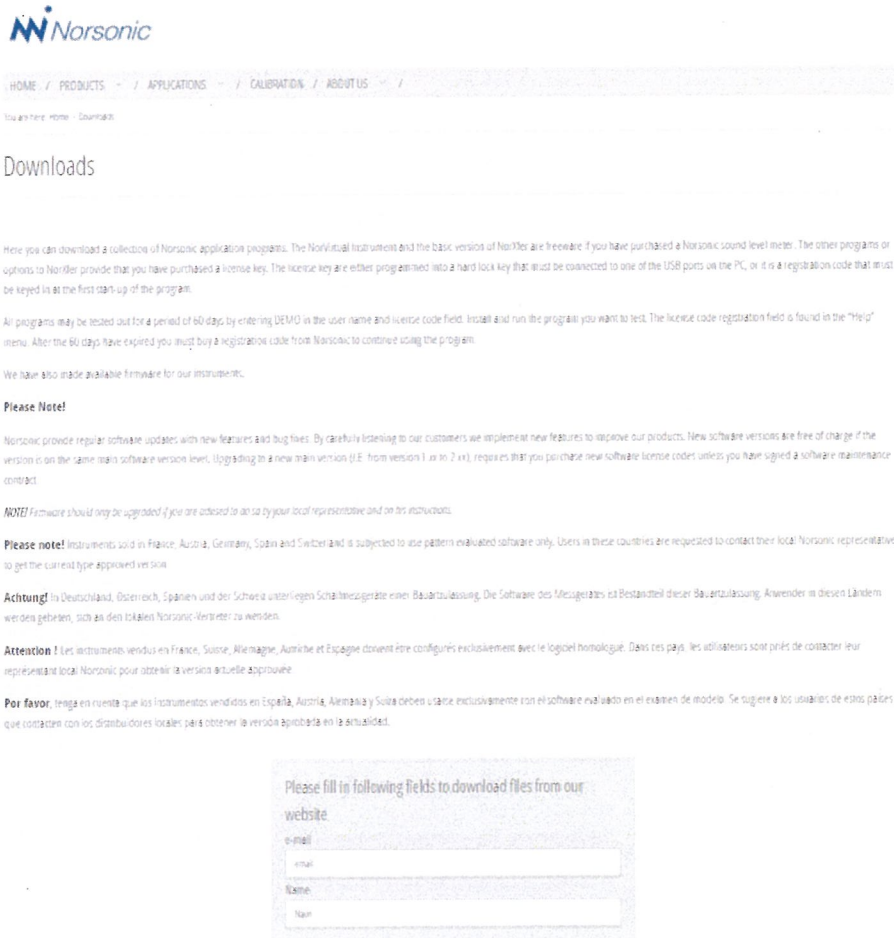
Thank you for purchasing measurement instrumentation from Norsonic.

Before starting to use this, there are a few simple steps you need to do:

- Download and install USB drivers
- Download and install NorXfer file download software

The drivers and program are available from www.norsonic.com/download

Fill in the required fields



Download USB drivers and follow the instruction included in the .zip file

Download and install the latest NorXfer software.

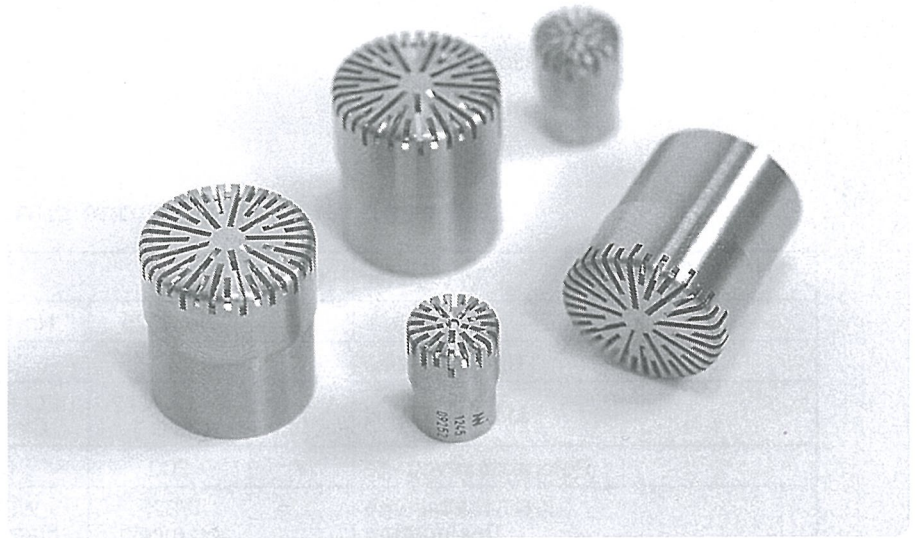
We also recommend you to take a trial measurement, transfer this to the PC and get the results in Excel.

A brief example is given in Instruction Manual for NorXfer, included in the program. Chapter "Quick Reference Guide – transfer and convert a measurement to Excel".

Please contact your local representative if you have problems downloading/installing the drivers/software.



Microphone Cartridges



The key components that determines the accuracy of a sound level meter is the measurement microphone and its associated preamplifier. The effectiveness of these components in converting the acoustic signal into an electrical analogue set the maximum accuracy that can be achieved by the ensuing signal processing. Norsonic have a carefully balanced range of measurement microphones to suite a range of applications that complement modern instrumentation yet maintain traditional values.

Norsonic's range of microphones covers most application and can be used as direct replacement with other brands.

Full use has been made of modern materials which when coupled with traditional engineering skills produces microphones that meet all the requirements of the precision measurement standards yet are robust and resistant to corrosion. These microphones are used in conjunction with the Norsonic range of preamplifiers that closely couple to them and ensure perfect matching to the associated instrument with minimum disturbance to the acoustic field. The preamplifiers have the necessary signal handling capability and low self noise to allow full use to be made of the wide dynamic range of the microphones.

Calibration

Calibration of all Norsonic microphones is directly traceable to National and International Standards with particular attention being paid in the design to ensuring long term stability. Each microphone is delivered with an individual certificate of calibration giving all the key information relating to its performance. This includes the nominal sensitivity and frequency response along with the environmental data that relates to the calibration.

Norsonic Calibration Laboratory is an international accredited laboratory. This ensures that the quality of the measured values are at the highest possible level.

Free-Field Microphones

All Norsonic microphones are free-field types. A free-field microphone is designed to measure the sound pressure in the sound field, compensating for the influence of the presence of the microphone in the sound field. In effect, the microphone measures the sound pressure as it existed before the microphone was introduced in the sound field, i.e. free-field conditions. Applicable standard is IEC 61672 and the former IEC 60651. The free-field microphone should be pointed towards the sound source at a 0° angle of incidence.



Cartridge Overview

Below is a summary of our range of microphone cartridges.

Nor1225 is a ½" free-field high sensitivity microphone. A general purpose microphone covering the frequency range from 3.15Hz to 20 kHz. Correspond to the Class 1 of the sound level meter standard IEC 61672.

Nor1227 is a ½" free-field, high sensitivity self-polarised microphone for use in applications where environmental or safety considerations do not permit the use of 200-volt polarisation supplies, or as a general IEC 61672 Class 1 microphone in sound level meters with no polarisation voltage.

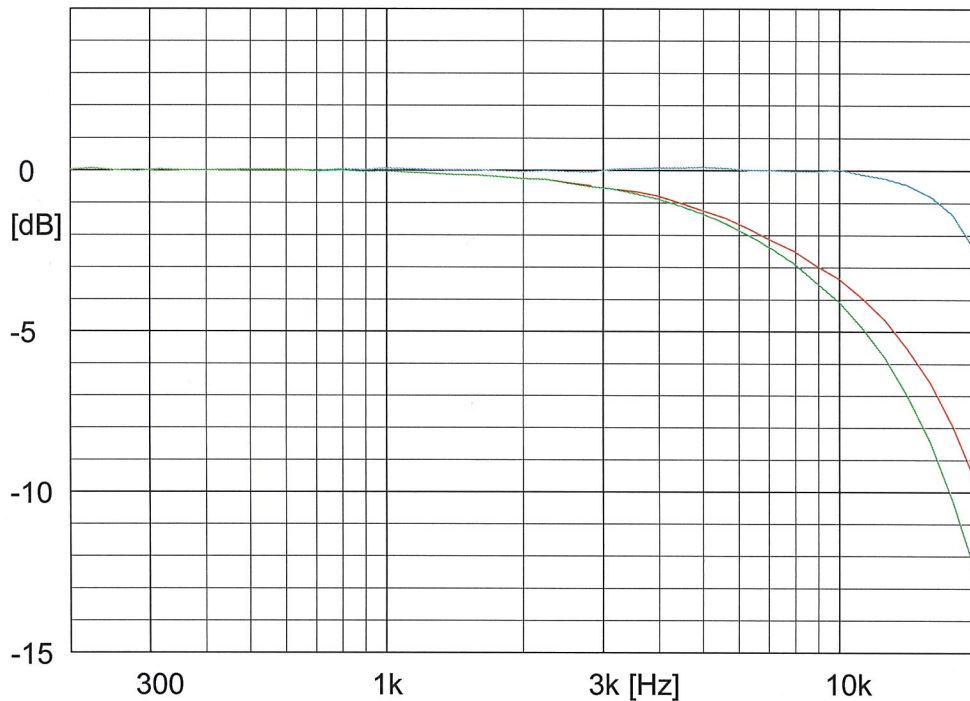
Nor1228 is a ½" free-field, high sensitivity, low cost self-polarised Class 1 microphone. Ideal for use in multi channels systems or other applications that requires a self polarised IEC 61672 Class 1 microphone at low cost.

Nor1229 is a ½" free-field, high sensitivity, low cost self-polarised Class 2 microphone. Ideal for use in multi channels systems or other applications that requires a self polarised microphone at low cost with Class 2 accuracy. Unlike most other low cost Class 2 microphones it features a nickel membrane and a stainless steel housing, ensuring low sensitivity to environmental parameters such as temperature, static pressure and humidity.

Selection chart microphone cartridges

| Parameter | Unit | | | | |
|--|-----------------|-------------------|-------------------|-------------------|-------------------|
| | | Nor1225 | Nor1227 | Nor1228 | Nor1229 |
| Cartridge size | " | ½" | ½" | ½" | ½" |
| Main standard | | IEC 61672 Class 1 | IEC 61672 Class 1 | IEC 61672 Class 1 | IEC 61672 Class 2 |
| Polarisation voltage | V | 200 | 0 | 0 | 0 |
| IEC 61094-4 type Designation | — | WS2F Free-field | WS2F Free-field | WS2F Free-field | WS2F Free-field |
| Nomial sensitivity@ 250Hz | mV/Pa | 50 | 50 | 50 | 40 |
| Frequency Respons ±1dB ±3dB | Hz | 5-10k | 5-10k | 20-10k | — |
| | Hz | 3.15-20k | 3.15-20k | 12.5-16k | 20-10k |
| Maximum SPL 3% | dB | 146 | 146 | 146 | 146 |
| Self noise Based on typical thermal noise | dB(A) | 15 | 15 | 16 | 24 |
| Response | | Free field | Free field | Free field | Free field |
| Capacitance | pF | 18 | 14 | 16 | 13 |
| Effective front volume | mm ³ | 50 | 50 | 50 | 45 |
| Temperature coeff. @250Hz -10 to +50°C -40 to +150°C | dB/°C | <-0.005 | <-0.005 | <-0.005 | <-0.01 |
| | | <-0.01 | <-0.01 | — | — |
| Max. temperature | °C | 300 | 150 | 80 | 80 |
| Static pressure coeff @250Hz | dB/kPa | -0.0008 | -0.0008 | -0.004 | ±0.03 |
| Relative humidity NM = not measureable 0-100% RH no condensation | dB/% | NM | NM | -0.003 | ±0.006 |
| Vibration sensitivity SPL for 0.1g perpendicular do dia- phragm | dB | 62 | 62 | 62 | 65 |
| Magnetic field effect SPL for field strength of 80A/m | dB | 3.5 | 3.5 | 4 | 5 |
| Diameter with protection grid | mm | 13.2 | 13.2 | 13.2 | 13.2 |
| Length with protection grid | mm | 16.2 | 16.2 | 17.3 | 16.6 |
| Weight with protection grid | g | 6 | 6 | 9 | 7 |

Microphone Calibration Certificate



Norsonic
Type: 1228

Serial no: 02739

Sensitivity: 56,0 mV/Pa

-25,0 dB re. 1 V/Pa

Capacitance: 14,4 pF

Date: 2018-02-14

Signature:

Measurement conditions:

Polarisation voltage: 0,0 V

Pressure: 98,50 kPa

Temperature: 23,0 °C

Relative humidity: 31,2 %RH

Results are normalized to the reference conditions.

Free field response

Diffuse field response

Pressure (Actuator) response

Norsonic AS

www.norsonic.com

Microphone Specifications

Calibration of your microphone cartridge has been made with utmost care to meet all your needs for a high quality measurement device. The calibration is traceable to PTB in Germany.

Nominal Specifications

Ambient temperature coefficient: 0.01 dB/°C

Ambient pressure coefficient: -1×10^{-5} dB/Pa

Temperature range: -30 to +70°C

Diameter: 13.2 mm with protection grid on,
12.7 mm without protection grid

Thread for preamp mounting: 11.7 mm 60 UNS

Reference Values

Temperature: 23°C

Relative humidity: 50%

Ambient pressure: 101.325 kPa

Test frequency for sensitivity: 250 Hz

Norsonic Warranty Statement

The warranty period for microphones is 36 months after the time of delivery.

The warranty does not include damage due to improper handling, overload, force majeure, or normal wear and tear. The warranty is not granted if the buyer make modifications or repairs without our written consent.

Norsonic can choose either to repair or replace microphones having defects due to material or workmanship. Defective goods should be returned to our factory or one of our distributors, and shipments are to be paid and insured by the buyer unless otherwise agreed.

Certificate of
Conformance and Calibration for**CEL-120 Acoustic Calibrator**

Applicable Standards :- IEC 60942: 2003 & ANSI S1.40: 2006

CEL-120/1 Class 1 CEL-120/2 Class 2 Serial No: 2383737Firmware: 04Temperature: 19 °C Pressure: 1013 mb %RH 50

| Frequency = 1.00kHz ± 2Hz T.H.D. = < 1% | Calibration Level |
|--|---------------------|
| SPL @ 114.0dB Setting | <u>114.00</u> dB |
| SPL @ 94.0dB Setting (CEL-120/1 only) | <u>93.97</u> dB/N.A |

Engineer :- ATEZ Date :- 17 OCT 2018

Company test equipment and acoustic working standards, used for conformance testing, are subject to periodic calibration, traceable to UK national standards, in accordance with the company's ISO9001 Quality System.

DECLARATION OF CONFORMITY

This certificate confirms that the instrument specified above has been produced and tested to comply with the manufacturer's published specifications and the relevant European Community CE directives.

Casella CEL (U.K.),
Regent House, Wolsley Road, Kempston, Bedford. MK42 7JY
Phone: +44 (0) 1234 844100 Fax: +44 (0) 1234 841490
E-mail: info@casellacel.com
Web: www.casellameasurement.com

198032A-01

Manufacturer Calibration Certificate

The following instrument has been tested and calibrated to the manufacturer specifications.
The calibration is traceable in accordance with ISO/IEC 17025 covering all instrument functions.

- Device Type: **XL2 Audio and Acoustic Analyzer**
- Serial Number: **A2A-14829-E0**

- Certificate Issued: **28 August 2018**
- Certificate Number: **43340-A2A-14829-E0**
- Results: **PASSED**
(for detailed report see next page)

Tested by: **M. Frick**

Signature:

Stamp:



NTi Audio AG
Im alten Riet 102
LI 9494 Schaan
www.nti-audio.com

Calibration of: XL2 Audio and Acoustic Analyzer
 Serial Number: A2A-14829-E0
 Date: 28 August 2018

• Detailed Calibration Test Results:

| | reference | actual | unit | actual error | XL2 tolerance | calibration uncertainty ² |
|----------------------------------|-----------|------------------|------|--------------|---------------|--------------------------------------|
| RMS Level @ 1kHz, XLR Input | 0.1 | 0.100 | V | ≤0.1% | ±0.5% | ±0.10% |
| | 1 | 1.000 | V | ≤0.1% | ±0.5% | ±0.09% |
| | 10 | 9.988 | V | -0.1% | ±0.5% | ±0.09% |
| Flatness, XLR Input ¹ | 20 Hz | 0.996 | V | -0.4% | ±1.1% | ±0.09% |
| | 20 kHz | 1.005 | V | 0.5% | ±1.1% | ±0.09% |
| Frequency | 1000 | 999.99 | Hz | ≤0.003% | ±0.003% | ±0.01% |
| Residual Noise | XLR | < 2 uV | | | <2 uV | ±0.50% |
| THD+N @ 0 dBu, 1 kHz, XLR Input | | -98.5 | dB | | typ. -100 dB | ±0.50% |

- Test Conditions: Temperature: **25.7** °C
 Relative Humidity: **55.2** %

• Calibration Equipment Used:

- Agilent Multimeter, Typ 34401A, Serial No. MY 5300 4607
 Last calibration: 15.08.2018, Next calibration: 15.08.2019
 Calibrated by ELCAL to the national standards maintained at Swiss Federal Office of Metrology. SCS 0002

- FX100 Audio Analyzer, Serial No. 10408
 Last Calibration: 27.04.2018, Next Calibration: 27.04.2019
 Manufacturer calibration based on Agilent 34410, Serial No. MY47014254,
 Last Calibration: 11.05.2018, Next Calibration: 11.05.2019
 which is calibrated by ELCAL to national standards maintained at Swiss Federal Office of Metrology. SCS 002

¹ The specified tolerance +/-0.1 dB @ 1V = +/- 1.1%

² The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the regulations of the GUM.



Calibration Certificate

Certificate No. **807533**

Page 1 of 2 Pages

Customer : Mott MacDonald Hong Kong Limited

Address : 20/F, Two Landmark East, 100 How Ming Street, Kwun Tong, Kowloon, Hong Kong.

Order No. : Q82248

Date of receipt : 25-Jul-18

Item Tested

Description : Acoustic Calibrator

Manufacturer : Castle

I.D. : --

Model : GA607

Serial No. : 040162

Test Conditions

Date of Test : 7-Aug-18

Supply Voltage : --

Ambient Temperature : (23 ± 3)°C

Relative Humidity : (50 ± 25) %

Test Specifications

Calibration check.

Ref. Document/Procedure : F06, F20, Z02.

Test Results

All results were within the IEC 60942 Class 1 specification.


The results are shown in the attached page(s).


Main Test equipment used:

| <u>Equipment No.</u> | <u>Description</u> | <u>Cert. No.</u> | <u>Traceable to</u> |
|----------------------|------------------------|------------------|---------------------|
| S014 | Spectrum Analyzer | 805025 | NIM-PRC & SCL-HKSAR |
| S240 | Sound Level Calibrator | 803357 | NIM-PRC & SCL-HKSAR |
| S041 | Universal Counter | 802061 | SCL-HKSAR |
| S206 | Sound Level Meter | 805027 | SCL-HKSAR |

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI), or by reference to a natural constant.
The test results apply to the above Unit-Under-Test only

Calibrated by : 
Elva Chong

Approved by : 
Kin Wong

Date: 7-Aug-18



Calibration Certificate

Certificate No. 807533

Page 2 of 2 Pages

Results :

1. Generated Sound Pressure Level

| UUT Nominal Value (dB) | Measured Value (dB) | IEC 60942 Class 1 Spec. |
|------------------------|---------------------|-------------------------|
| 94.0 | 94.0 | ± 0.4 dB |

Uncertainty : ± 0.2 dB

2. Short-term Level Fluctuation : 0.0 dB

IEC 60942 Class 1 Spec. : ± 0.1 dB

Uncertainty : ± 0.01 dB

3. Frequency

| UUT Nominal Value (kHz) | Measured Value (kHz) | IEC 60942 Class 1 Spec. |
|-------------------------|----------------------|-------------------------|
| 1 | 1.000 | ± 1 % |

Uncertainty : ± 3.6 x 10⁻⁶

4. Total Distortion : < 0.7%

IEC 60942 Class 1 Spec. : < 4 %

Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test

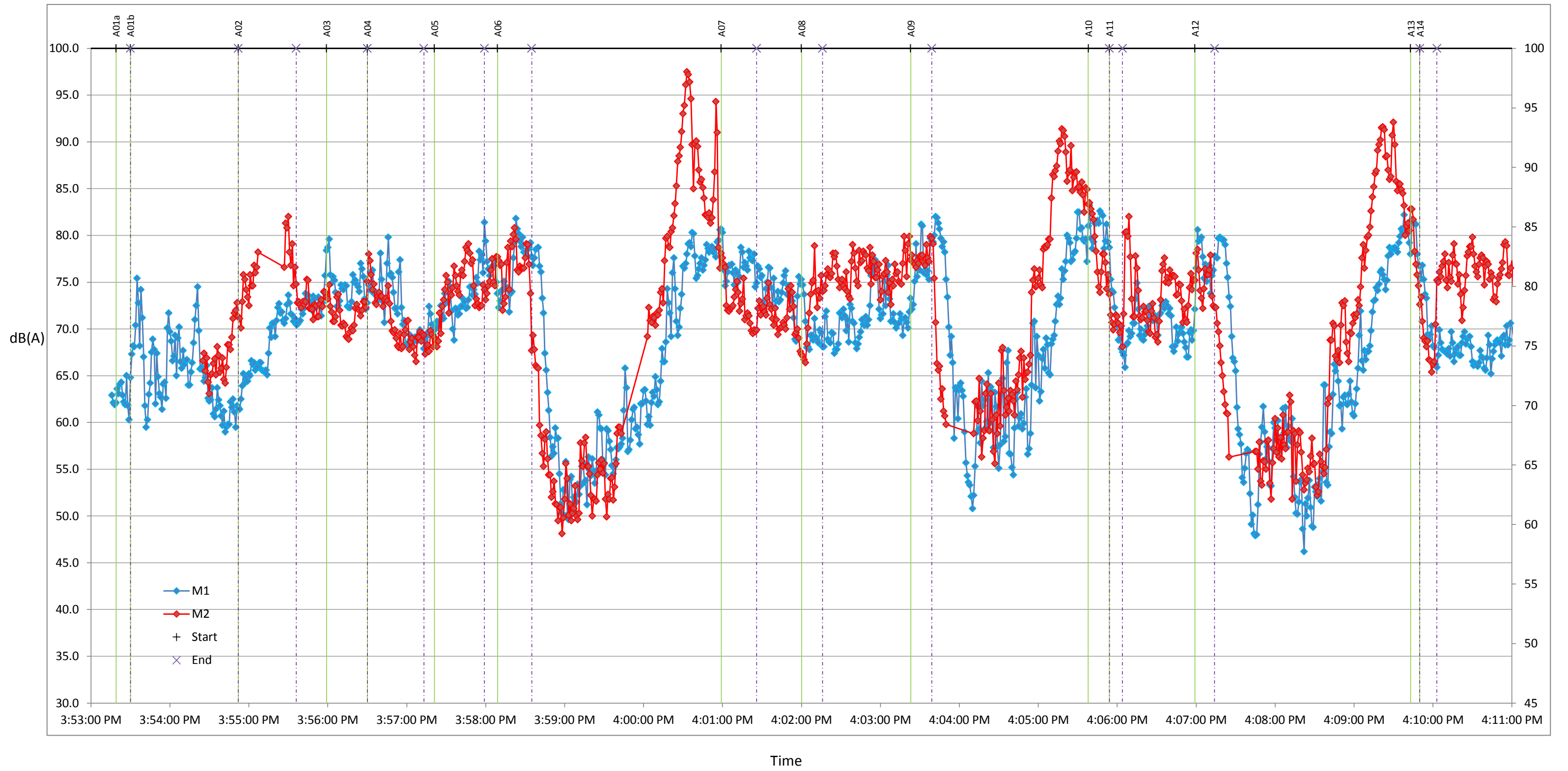
2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 1 004 hPa.

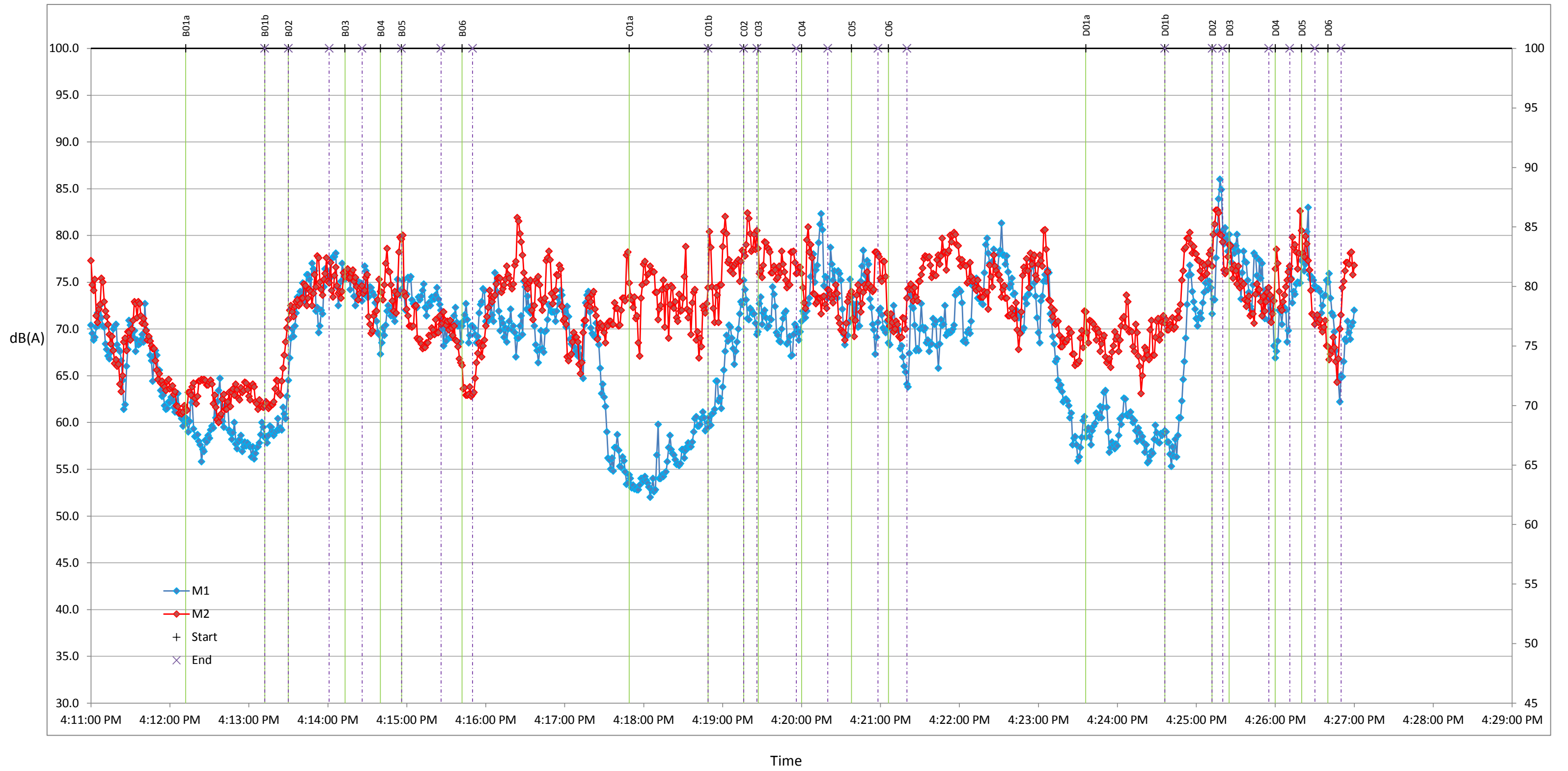
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Appendix C

A Rooftop Helipad at New Acute Hospital at Kai Tak Development Area
Technical Note - Helicopter Noise Survey Report
Appendix C - Graphical Time History of Measured Noise Levels

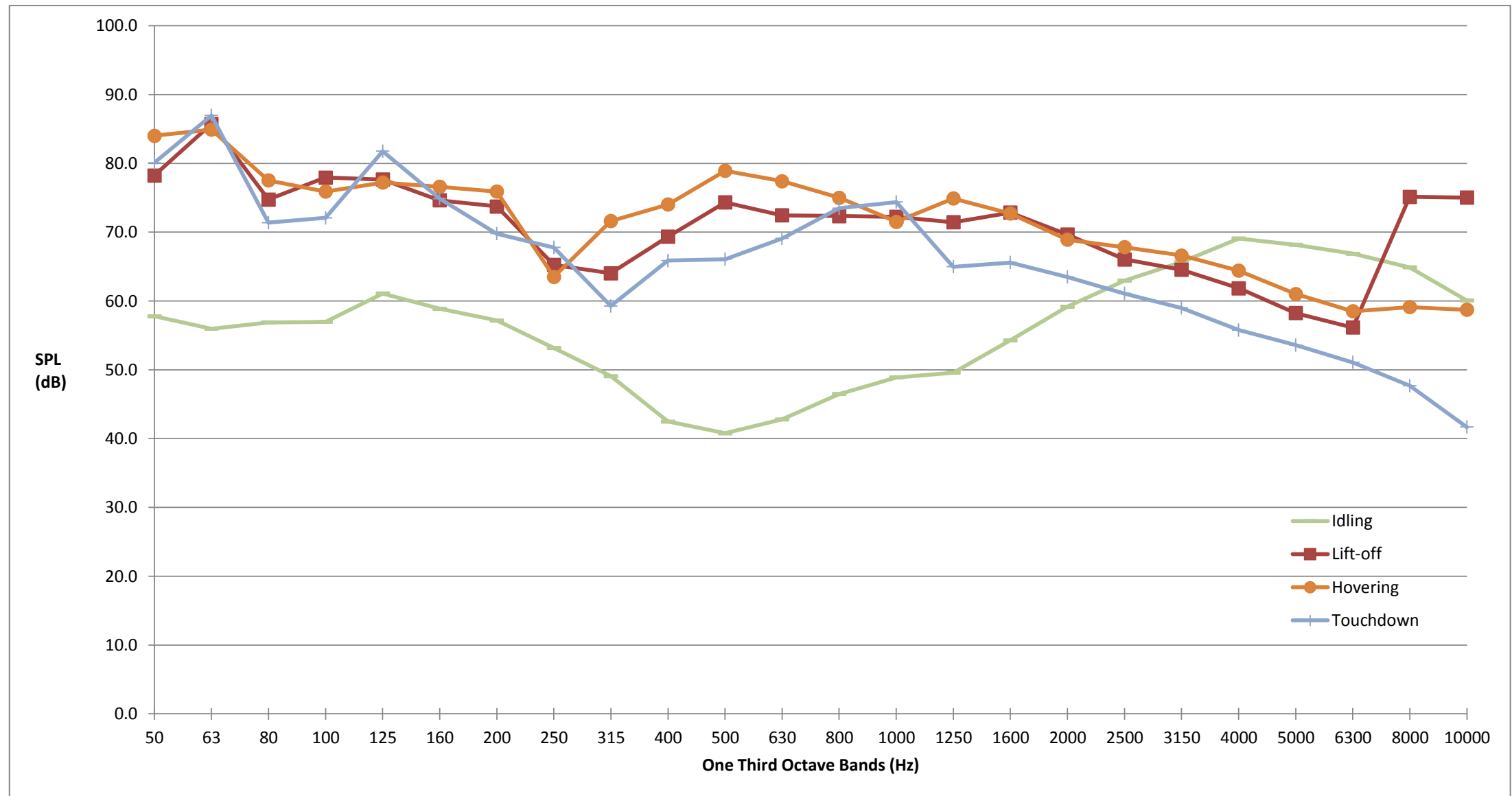


A Rooftop Helipad at New Acute Hospital at Kai Tak Development Area
Technical Note - Helicopter Noise Survey Report
Appendix C - Graphical Time History of Measured Noise Levels



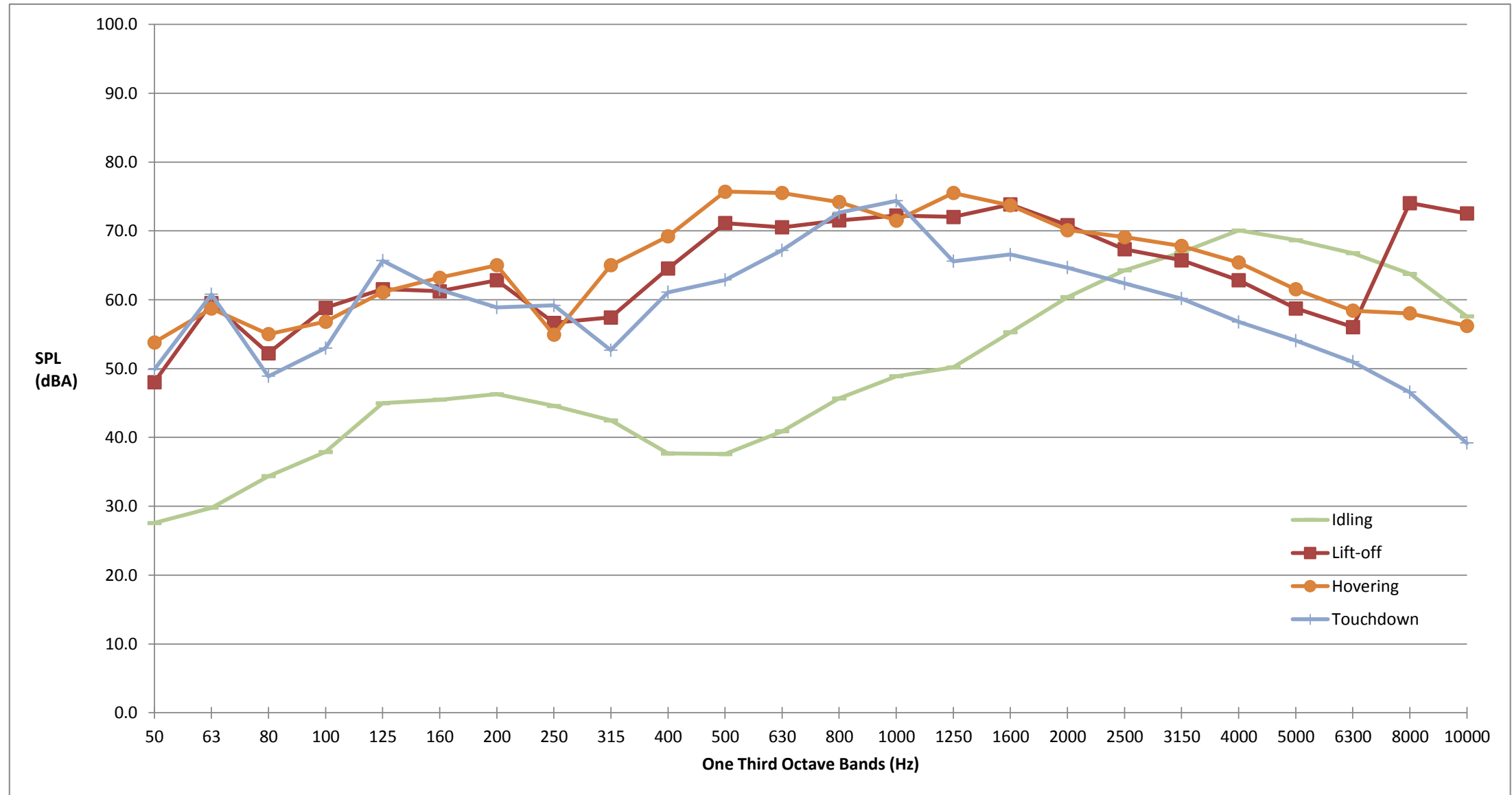
Appendix D

A Rooftop Helipad at New Acute Hospital at Kai Tak Development Area
 Technical Note - Helicopter Noise Survey Report
 Appendix D - Graphical Presentation of SPL in One Third Octave Bands



| Operation Mode | L _{max} (dBA) | SPL (dB) in One Third Octave Bands (Hz) | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|------------------------|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | | 50 | 63 | 80 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | 5000 | 6300 | 8000 | 10000 |
| Idling | 75.4 | 57.8 | 56.0 | 56.9 | 57.0 | 61.1 | 58.9 | 57.2 | 53.2 | 49.1 | 42.5 | 40.8 | 42.8 | 46.5 | 48.9 | 49.6 | 54.3 | 59.2 | 63.0 | 65.7 | 69.1 | 68.2 | 66.9 | 64.9 | 60.1 |
| Lift-off | 82.4 | 78.2 | 85.7 | 74.7 | 77.9 | 77.6 | 74.6 | 73.7 | 65.2 | 64.0 | 69.3 | 74.3 | 72.4 | 72.3 | 72.2 | 71.4 | 72.8 | 69.6 | 66.0 | 64.5 | 61.8 | 58.2 | 56.1 | 75.1 | 75.0 |
| Hovering | 83.5 | 84.0 | 84.9 | 77.5 | 75.9 | 77.2 | 76.6 | 75.9 | 63.5 | 71.6 | 74.0 | 78.9 | 77.4 | 75.0 | 71.5 | 74.9 | 72.7 | 68.9 | 67.8 | 66.6 | 64.4 | 61.0 | 58.5 | 59.1 | 58.7 |
| Touchdown | 78.9 | 80.1 | 87.0 | 71.4 | 72.1 | 81.8 | 74.9 | 69.8 | 67.8 | 59.3 | 65.9 | 66.1 | 69.1 | 73.5 | 74.4 | 65.0 | 65.6 | 63.5 | 61.1 | 59.0 | 55.8 | 53.6 | 51.1 | 47.7 | 41.7 |

A Rooftop Helipad at New Acute Hospital at Kai Tak Development Area
 Technical Note - Helicopter Noise Survey Report
 Appendix D - Graphical Presentation of SPL in One Third Octave Bands



| Operation Mode | L _{max} (dBA) | SPL (dBA) in One Third Octave Bands (Hz) | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|------------------------|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|--|
| | | 50 | 63 | 80 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | 5000 | 6300 | 8000 | 10000 | |
| Idling | 75.4 | 27.6 | 29.8 | 34.4 | 37.9 | 45.0 | 45.5 | 46.3 | 44.6 | 42.5 | 37.7 | 37.6 | 40.9 | 45.7 | 48.9 | 50.2 | 55.3 | 60.4 | 64.3 | 66.9 | 70.1 | 68.7 | 66.8 | 63.8 | 57.6 | |
| Lift-off | 82.4 | 48.0 | 59.5 | 52.2 | 58.8 | 61.5 | 61.2 | 62.8 | 56.6 | 57.4 | 64.5 | 71.1 | 70.5 | 71.5 | 72.2 | 72.0 | 73.8 | 70.8 | 67.3 | 65.7 | 62.8 | 58.7 | 56.0 | 74.0 | 72.5 | |
| Hovering | 83.5 | 53.8 | 58.7 | 55.0 | 56.8 | 61.1 | 63.2 | 65.0 | 54.9 | 65.0 | 69.2 | 75.7 | 75.5 | 74.2 | 71.5 | 75.5 | 73.7 | 70.1 | 69.1 | 67.8 | 65.4 | 61.5 | 58.4 | 58.0 | 56.2 | |
| Touchdown | 78.9 | 49.9 | 60.8 | 48.9 | 53.0 | 65.7 | 61.5 | 58.9 | 59.2 | 52.7 | 61.1 | 62.9 | 67.2 | 72.7 | 74.4 | 65.6 | 66.6 | 64.7 | 62.4 | 60.2 | 56.8 | 54.1 | 51.0 | 46.6 | 39.2 | |

Appendix E. Implementation Schedule

Appendix E - Implementation Schedule

This appendix presents the implementation schedule of mitigation measures for the operational phase of the proposed helipad. Below table summarise the details of the recommended mitigation measures for helicopter noise of the project. For each recommended mitigation measures, both the location and timing for the measure as well as the parties responsible for implementing the measure have clearly been identified.

Noise Impact – Operational Phase (Helicopter Noise)

| OHNMMP Ref. | Recommended Key Mitigation Measures | Implementation Party | Location | Timing | Environmental Performance / Specification of Recommended Mitigation Measures |
|--------------------|--|----------------------|--|--|---|
| S.3.3.8 & S.3.4 | Full fleet replacement with new GFS helicopters (Airbus H175) for the operation of the emergency helicopter services. | GFS | For the proposed helipad | Starting from mid-2020 | Airbus H175 helicopters will be equipped with more advanced engines and provide a quieter flight compared with the existing GFS's helicopter Super Puma AS332 L2. |
| S.3.4 & Figure 3.1 | Operate the helicopter within the proposed flight sectors as shown in Figure 3.1 . | GFS | Flight path | Throughout the operation phase | Minimize any disturbance to the surrounding areas during the course of actions. |
| S.3.4 | Proposed Helipad is intentionally moved to the north-eastern side of the rooftop of the New Block of QMH. | ArchSD / Contractors | North-eastern side of rooftop | During the construction phase | To maximise the separation distance between helipad and NSRs, and also reduce direct line of sight at NSRs. |
| S.3.4 | Installation of noise barriers and noise reducers. | ArchSD / Contractors | Roof edges as shown in Figure 3.2 | Before commencement of the operation phase | Solid concrete parapet walls 1.4m*. Top Level 300.3 mPD. Noise reducers at all top edges to further improve the noise shielding effect at roof top. |
| S.3.4 | Maintenance of noise barriers and noise reducers as in approved EIA study. | Hospital Authority | Roof edges as shown in Figure 3.2 | Throughout the operation phase | Solid concrete parapet walls 1.4m*. Top Level 300.3 mPD. Noise reducers at all top edges to further improve the noise shielding effect at roof top. |
| S.3.4 & Appendix A | Apply steeper glide slope and larger take-off angle during approaching and departure operations (i.e. 10 degrees) as in approved EIA study. | GFS | Flight path | Throughout the operation phase | Minimize any disturbance to the surrounding areas during the course of actions. |
| S.3.4 & Appendix A | Helicopter operations are expected to be in one-way-direction to minimise the overall noise exposure at NSRs as in approved EIA study. Using same flight path for both arrival and departure is not preferred. | GFS | Flight path | Throughout the operation phase | Minimize any disturbance to the surrounding areas during the course of actions. |

Remark (*): Solid concrete parapet walls with 150mm thick (at least 10kg/m²) will be installed at four sides of roof floor to provide noise screening to the proposed helipad (i.e. acting as noise barriers).

Figures

Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction) – Operational Helicopter Noise Mitigation Measures Plan

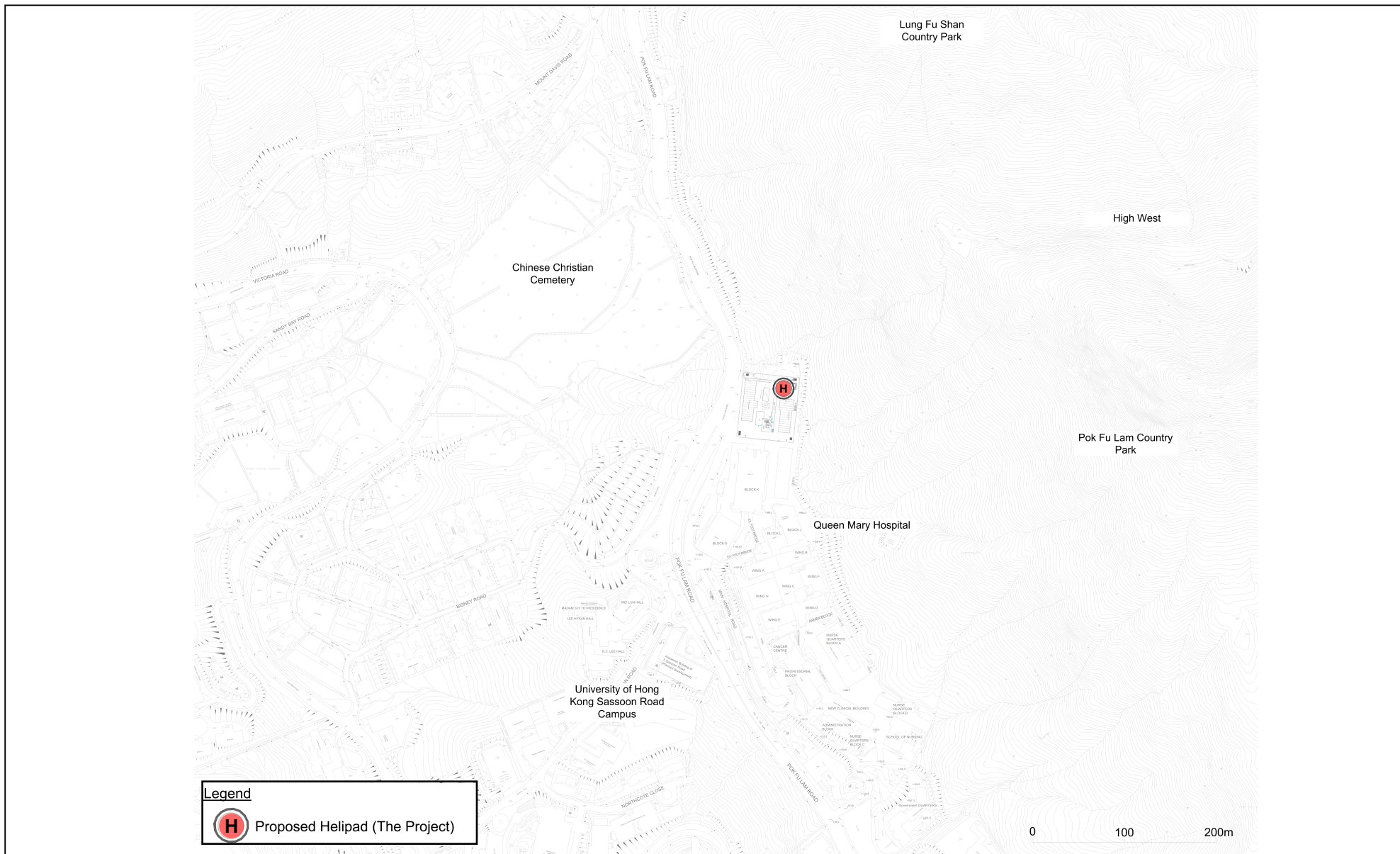


Figure 1.1 - Location of the Project

Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction) – Operational Helicopter Noise Mitigation Measures Plan

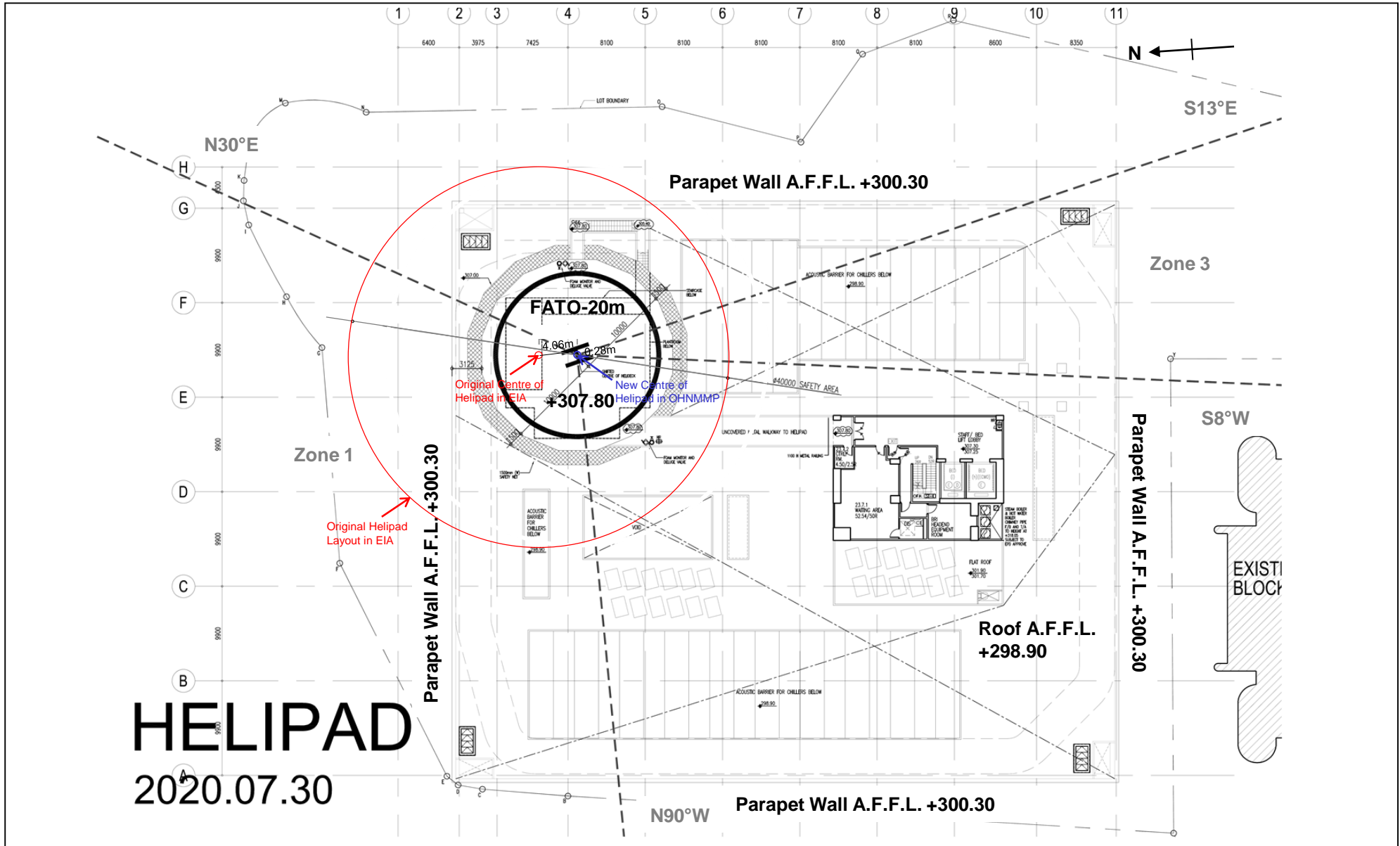


Figure 2.1 – Close View of Proposed Helipad

Queen Mary Hospital (QMH) Redevelopment Phase 1 (Design & Construction) – Operational Helicopter Noise Mitigation Measures Plan

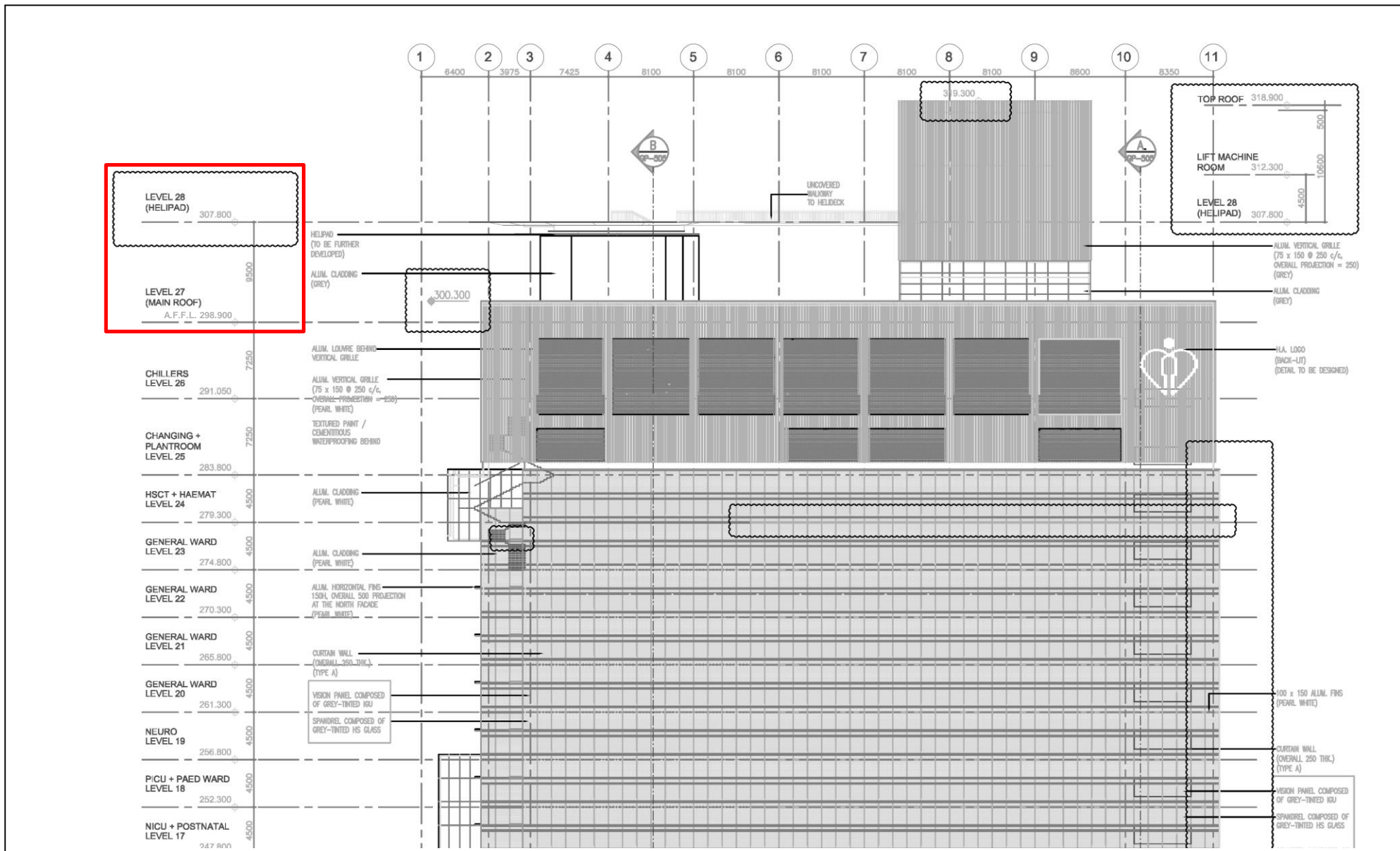


Figure 2.2 – Section View of Proposed Helipad

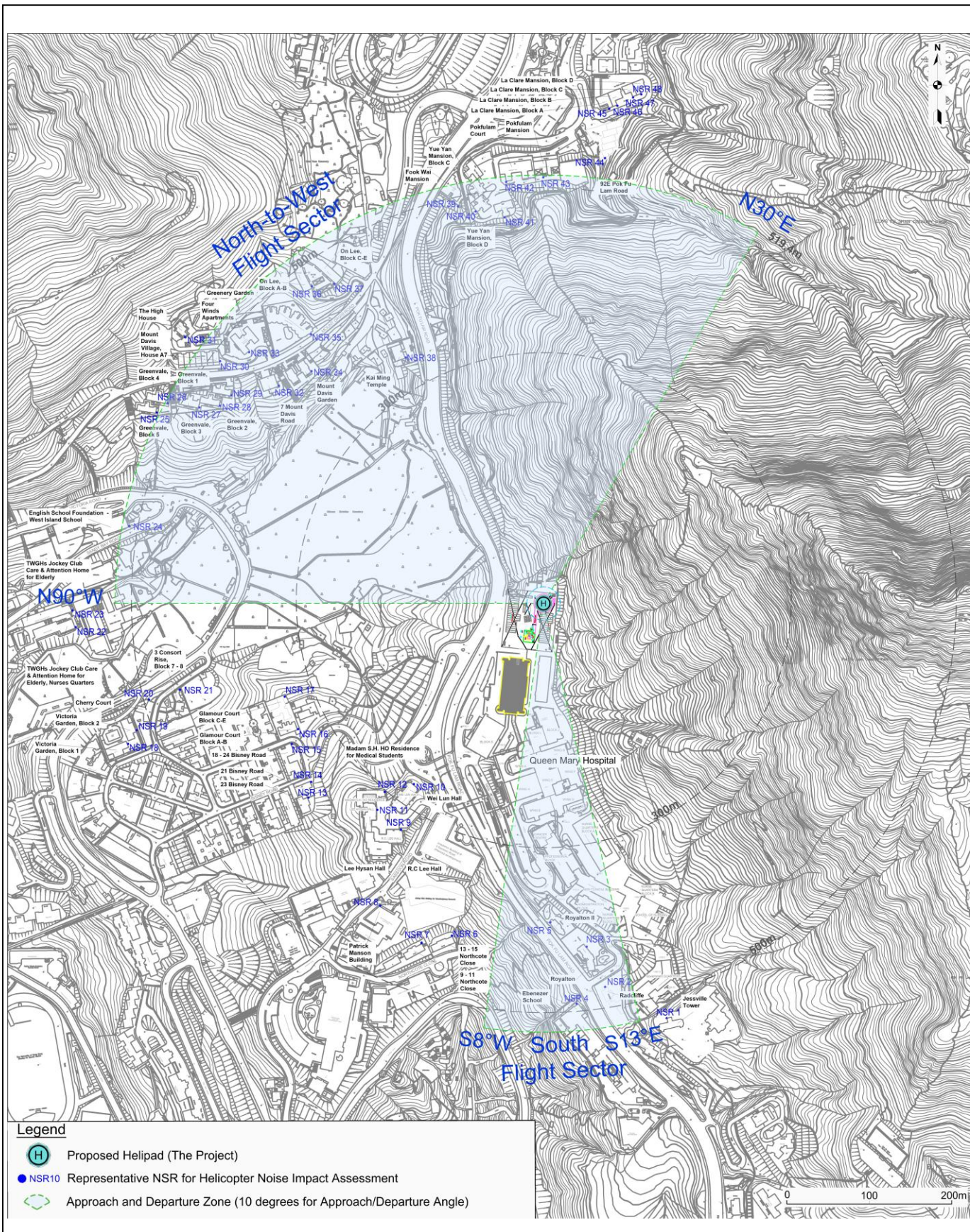


Figure 3.1 Locations of Proposed Flight Sectors and Representative Noise Sensitive Receiver (NSR)

