The Acoustic Group
CONSULTING ACOUSTICAL AND VIBRATION ENGINEERS

# ACOUSTICAL ASSESSMENT
# TEST FLIGHTS OF EUROCOPTER EC135P2+ HELICOPTER
# MAITLAND AIRPORT – 31 MAY 2021
# 51.3698.R13:MSC

Prepared for: *Chief Operating Officer*
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Date: *30 September 2021*

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## APPENDICES

# 1.0 INTRODUCTION

Port Authority of NSW ("Port Authority") has several functions in relation to Newcastle Harbour, including as the statutory provider under section 74 of the Marine Safety Act 1998 (NSW) of marine pilotage services for certain declared ports within New South Wales, including for the Port of Newcastle.

In the Port of Newcastle, these services generally involve specialist marine pilots either boarding an incoming commercial vessel approximately 3 to 8 nautical miles off the Newcastle coast and navigating that vessel to its berth in the Port, or conversely navigating a vessel from its berth to a release point approximately 1 to 2 nautical miles offshore. At this point, the Marine Pilot is either returned to the Base, or transferred to another incoming vessel.

Marine Pilot transfers by helicopter via an operational helipad facility at Dyke Point, Carrington are the primary method of transport utilised by Port Authority for the Port of Newcastle. As the commercial operations for the Port of Newcastle operate 24 hours a day for 7 days a week, Helicopter Marine Pilot Transfer(HMPT) operations are conducted during both day and night".

The service has utilised a single-engine Hughes 500E helicopter that utilises two flight paths from the helipad with the main flight path to the north of the helipad identified as Flight Path B and a secondary flight path being south-east of the helipad and then east along the main channel of the Newcastle Harbour being identified as Flight Path A (see Appendix A).

Aviation regulations for helicopters in Australia (CASA CASR 138) have been amended and will require in the future the Helicopter Marine Pilot Service to be upgraded to use a twin-engine helicopter. Following a selection process the helicopter type proposed for the pilot transfer is to be a twin-engine Eurocopter Type 135.

As a result of replacing the single-engine helicopter with a twin engine helicopter there is a requirement by way of the existing development consent for the helicopter operations to undertake acoustic testing and evaluate the noise levels of the twin-engine helicopter.

The operational procedures for a twin-engine helicopter utilising the existing helipad at Dyke Point are different to the flight profiles and procedures utilised by the existing single engine helicopter.

Because helicopters do not operate in a manner similar to fixed wing aircraft, the use of computer modelling for helicopter operations (by certification data) has not been accepted by environmental authorities in Australia with the EPAs in NSW and Victoria, and Australian Standard AS2363 requiring the measurement of helicopter operations to assess the noise impact. With respect to the acoustic impact of the proposed helicopter type it was necessary to undertake testing of actual flight operations for the purpose of identifying the extent and magnitude of noise generated by the twin-engine helicopter.

The acoustic testing (following the basis of the original assessment) required multiple flights of the twin-engine helicopter to evaluate the different flight paths. That level of testing would exceed the permitted number of flights per day on the current consent if one was following the previous helicopter noise protocol adopted for the assessment as outlined in Australian Standard AS 2363 ("**AS2363**").

To provide the necessary acoustic data to assess the introduction of a twin engine helicopter for the marine pilot transfer, a Eurocopter 135 twin-engine helicopter was ferried from interstate to Maitland Airport to undertake testing on Monday 31 May 2021.

As the testing was to determine the impact for the use of the existing flight paths from Dyke Point, the test program identified locations on and to the south of Maitland Airport that represented noise monitoring assessment locations that have historically been used for compliance testing of the existing marine pilot helicopter service in Newcastle

## 2.0 THE TESTING SITE

The existing helicopter helipad at Dyke Point is shown in Appendix A1 and indicates the two flight paths utilised by the Marine Pilot Transfer Service. The main flight path used by the service is shown as Flight Path B and on take off utilises a track to the north of the helipad and then a turn to the east, to head out to sea.

Appendix A1 identifies the secondary flight path as generally taking off to the east of the helipad and then proceeding along the main channel out to sea. The secondary flight path (identified as Flight Path A) is used infrequently with the primary reason for using the secondary flight path being weather conditions or restrictions on air traffic as a result of operations at Newcastle Airport/RAAF Base Williamtown.

Appendix A2 provides real-time tracking data from the operation of the existing helicopter operations off Dyke Point to confirm the general use of flight paths to the north and identifies locations used by the helicopter out to sea.

Appendix A3 identifies by one track the occasional use of the eastern flight track.

For the purpose of undertaking the acoustic testing a number of sites were evaluated in Queensland and New South Wales that could permit multiple test flights in one day and incorporate test flights that would be representative of the operations conducted at Newcastle and at which the resident reference locations that have been used for noise monitoring of the existing facility could be located.

With the use of Maitland Airport being identified as suitable for the conduct of the acoustic testing, the existing helipad flight paths (used in The Port of Newcastle) were oriented around the nominated landing site to position the monitoring locations in open areas that would represent the reference compliance check sites that have been previously used in Newcastle.

Appendix B identifies the equivalent Port of Newcastle locations relative to the flight tracks that were used at Maitland Airport and the measurement locations.

The testing involved two measurement locations on the Maitland Airport site and four measurement locations on the southern side of the New England Highway which are representative of the noise monitoring assessment locations that have historically been used for compliance testing of the existing marine pilot helicopter in Newcastle.

The two measurement locations on the airport (to the north-east of the helicopter landing/take-off position) represent the residential premises in Stockton, on Queen Street and at the intersection of Hunter Street and Punt Road.

The four measurement locations on the southern side of the New England Highway represent the Lee Wharf Apartments, Crown Plaza Apartments and Nautilos Apartments which are in close proximity to the southern bank of the Hunter River, and "The Boltons" terraced houses on Menkens Lane, The Hill which are further inland.

With respect to the measurement location to the south-west of the Maitland Airport, the location representative of the Lee Wharf apartment building is in a paddock at 643 New England Highway. This paddock was occupied by horses during the helicopter testing and therefore, the noise monitoring was conducted at the boundary of the paddock (approximately 100 metres to the north of the location identified as being representative of the Lee Wharf Apartments).

As the distance between the Lee Wharf apartment building and the Dyke Point helipad is greater than the distance between measurement location and the landing site at Maitland Airport, it is expected that the noise emission of the helicopter pilot transfer operations at the Lee Wharf apartment building will be slightly less than the measured results as a result of further distance attenuation.

## 3.0 TEST FLIGHTS

For aviation purposes, and Regulations pertaining to the operation of helicopters around the world, the majority of the acoustic or measurements are conducted in terms of certification procedures where the helicopter type of concern is tested at near maximum weight and near maximum speed under specific flight profiles for landing, take-off, and overflight scenarios.

The problem arises with the use of certification data is that normal helicopter operations do not operate at maximum weight but use different loadings/speeds and profiles, such that there can be significant differences in noise levels for measurements using certification procedures versus normal operations. Under AS 2363 the rates of climb and essential be according to usual commercial practice for the type of site under consideration. Similarly, the landing and take off operations shall be along the centre line of the flight path according to usual commercial practice.

The current helicopter landing and take off procedures by the single engine aircraft at Dyke Point requires the helicopter to hover above the helipad and then climb out on the normal flight track to cruise altitude. On the landing phase for the current operations the helicopter leaves cruise altitude and adopts a straight in track to the helipad where the helicopter comes into a hover above the helipad and then lands onto the helipad.

The twin-engine operations involve a different procedure where on take off the helicopter ascends above the pad, incorporating a slight rearward movement so as to be hovering at a position in the order of 100 to 120 feet above the helipad ground level whilst maintaining the take off area insight and then commences the take off procedure on the nominated flight track up to cruise altitude.

For landing the twin-engine helicopter procedure involves the aircraft upon leaving cruise altitude to ascend to a hover at a point before the helipad and at an altitude of 100 to 120 ft above the helipad ground level, and then descend onto the helipad.

This operation results in a different noise emission signature at the reference residential receiver locations for the twin-engine helicopter versus the current single-engine operations.

The following figures identify the above procedures for the twin-engine helicopter landing and take off procedures tested at Maitland Airport.

Fig. C12 Heliport Sight Picture at 120 ft AHE (Surface Level Heliport) – Helicopter equipped with **extended instrument panel**

**VTOL (1) – SURFACE LEVEL OR ELEVATED HELIPORTS: Normal (AEO) Procedures**

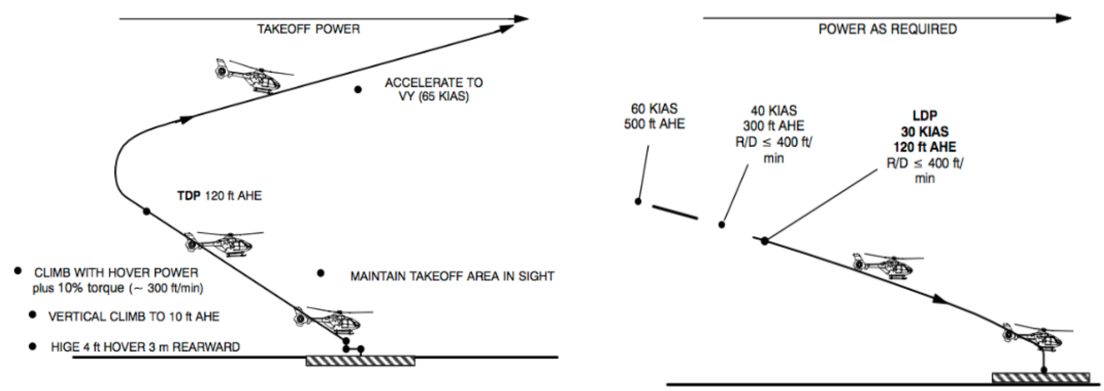



Fig. C7 Vertical Takeoff Profile (Surface Level or Elevated Heliport)

Fig. C16 Vertical Landing Profile (Surface Level or Elevated Heliport)

For the purpose of environmental assessments of helicopters in Australia the environmental regulatory authorities and AS 2363 have in the required the acoustic assessment utilising FAST response on a sound level meter when compared to the international standard for aircraft noise testing of using SLOW response. Whilst the NSW EPA no longer specify noise criteria for helicopter operations, the Victorian EPA in their current helicopter noise guideline have maintained the use of FAST response.

The original acoustic assessment for the marine pilot operations in Newcastle utilised FAST response and adopted the measurement protocol set out in Australian Standard AS 2363.

Under AS 2363 the test helicopter shall be of the type likely to be used and shall be loaded as for the upper limit of the proposed operations.

The helicopter used for the testing is an EC 135P2+ helicopter (serial number 197) having a registration identification of VH-ZGZ. The subject helicopter shown in the following photos taken at Maitland Airport on the day of the test is used for pilot transfers in Queensland.

The existing helicopter operations for the Port of Newcastle utilised either only the helicopter pilot on board the aircraft, or the helicopter pilot and the marine pilot on board the aircraft.

For the purpose of the acoustic testing at Maitland all operations of the helicopter had the helicopter pilot and an observer on board the aircraft with the aircraft at or near full fuel capacity that is such could represent the upper limit of the proposed operations but with respect to general operations via load that would normally occur.

Advice from the helicopter pilot was that at the start of the flight testing the helicopter had an all up take off weight of approximately 2777kg (maximum take off weight being 2910 kg).

At the completion of the first testing (movement 33) the fuel burn was approximately 400kg resulting in an estimate of weight of approximately 2377kg when the helicopter departed the area for refuelling.

When the aircraft returned (after refuelling) to begin the second round of test flights the weight was estimated to be at 2777kg.

Under AS2363 the test shall be done in calm air or in no more than light when conditions (5 km/h). For all of the noise monitoring locations (1.5m above ground) that requirement was satisfied for the entire test. With respect to the situation of the helicopter (in the air) the majority of test flights occurred under such conditions, although there were periods when the helicopter was subject to wind gusts that exceeded that limit (movements 1 – 5 on the basis of maximum gusts).

Due to the two designated flight paths and the different cruise altitudes of the daytime and night-time operations, the test program involved a total of 40 different take-off/landing movements which were followed by 12 overflight movements.

Appendix C provides a listing of the test flights that occurred on the day. The most efficient method for the testing is to undertake the testing in the form of circuits using the two flight paths, rather than conducting a take off on one flight path, conducting a 180° and landing on the same flight path.

The helicopter was initially flown in a clockwise direction to determine the noise emission levels of a take-off to the north on Flight Path B and landing from the east on Flight Path A. As Australian Standard AS 2363 requires testing of at least 4 flights per movement type, the testing involved 10 circuits in the clockwise direction (6 circuits using a daytime cruise altitude and 4 circuits using a night-time cruise altitude).

This exercise was then repeated in an anti-clockwise direction (from movement 21) to determine the noise emission levels of a take-off to the east on Flight Path A and a landing from the north on Flight Path B.

The testing of overflights (commencing at movement 41) involved 6 overflight movements at a daytime altitude and 6 overflights at a night-time altitude above the measurement locations located on the airport (representative of the residential receivers in Stockton).

## 4.0 MEASUREMENT TECHNIQUES

The assessment of helicopter operations for the Port of Newcastle involves the evaluation of the maximum level recorded is on A-weighted value using FAST response.

For the purpose of determining the resultant $L_{Aeq,t}$ helicopter level on a daily basis one needs to obtain the sound exposure level $L_{AE}$ for each individual helicopter movement.

Under both versions of Australian Standard 2363 all instrumentation systems used for measuring the subject noise are to have equivalent performances in frequency-weighting, time-weighting, and tolerances to those specified for a Type 1 sound level meter.

The helicopter testing utilised a mixture of Type 1 sound level meters, with two sound level meters at each measurement location.

For the measurement locations on the airport, the measurement location representative of Hunter Street, Stockton utilised a NATA Calibrated SVAN 979 Sound Level Meter whilst the measurement location representative of Queen Street, Stockton utilised a NATA Calibrated SVAN 977C Sound Level Meter. The meters were set to record on a continuous basis and to obtain wav file recordings at the same time. At both locations, there was also a NATA Calibrated SVAN 957 Sound Level meter as back-up.

The Lee Wharf Apartments measurement location had two Bruel & Kjaer Type 2250 Sound Level Meters (one carrying NATA Calibration certification and the other being calibrated the manufacturer's requirements) which provided traces of the A-weighted noise level and wav file recordings of the measurements.

The measurement at the location representative of the Crown Plaza Apartments utilised a Bruel & Kjaer Type 2260 Sound Level Meter with a NATA Calibrated SVAN 979 Sound Level Meter as back-up.

The measurement at the location representative of the Nautilos Apartments utilised a NATA Calibrated Bruel & Kjaer Type 2270 Sound Level Meter with a NATA Calibrated SVAN 979 Sound Level Meter as back-up.

At the location representative of "The Boltons" terraced houses, RCA Australia conducted the measurements utilising a SVAN 979 Sound Level Meter and SVAN 971 Sound Level Meter.

The reference calibration level of all TAG meters was checked prior to and after measurements using Bruel & Kjaer Type 4230 or 4321 Sound Level Calibrators and exhibited no system drift.

# 5.0 ACOUSTIC ANALYSIS

The acoustic analysis of the helicopter test flights when conducted in accordance with Australian Standard 2363 requires an analysis of each of the movements attributed to a take-off, or a landing, or an overflight.

As the aviation regulatory requirements for the operation of a twin-engine helicopter include the ascent from the helipad to the elevated hover position, and the descent from the elevated hover position to the helipad, the acoustic analysis of the landing or take off movement includes the lift off or descent component to/from the elevated hover position.

The assessment procedure requires the determination of the maximum level and the $L_{AE}$ level for each test flight movement, where the entire take off from the helipad to cruise altitude is identified as a movement, and the entire landing procedure to the helipad is identified as a movement, i.e. for one circuit there are two movements.

Appendix D1 presents a three-dimensional view of the individual circuits undertaken for movements 1 to 33 inclusive (prior to the helicopter departing the area for refuelling). The three-dimensional view is obtained from spider tracking in the helicopter which incorporates data points at 15 second intervals elevated out of ground effect hover required for the subject helicopter.

Examination of Appendix D1 identifies different circuit heights which is clarified by the elevation profile of the helicopter along the flight track which is also shown in the figure in Appendix D1. For example, the first six bumps in the section profile relate to the first six circuits occurring in a clockwise direction and utilising a daytime altitude, whilst the next four bumps identify the 4 night-time circuits undertaken in a clockwise direction. The next six bumps relate to 6 circuits undertaken in an anticlockwise direction and one take-off in an anti-clockwise direction to the night-time cruise altitude from which the aircraft left the area for refuelling.

The flight profile set out in Appendix D2 relate to movements 34-52 and include the first landing from a night-time altitude and then the remaining three night fight circuits operating in an anticlockwise direction. From the material in the elevation profile the overflight operations at a daytime cruise altitude and the overflights at the night-time cruise altitude (being above the airport) are shown.

Appendix D3 provides a plan view of the tracks claimed by the helicopter for movements 1 to 12 inclusive, representing the operations conducted in a clockwise direction to a nominal daytime cruise altitude. The figure separates the individual circuits into colours to identify variations in the circuit position removed from the airport but the consistency in terms of the initial take off path and the landing path which relates to the reference noise monitoring positions.

Appendix D4 provides the flight tracks for movements 13 to 20 inclusive that relate to clockwise circuits utilising a night-time cruise altitude whilst appendix D5 provides a combination of all the clockwise circuits.

Appendix D6 provides the daytime altitude circuits for movements 21 to 32 inclusive that relate to operations in an anticlockwise direction. Examination of all the landing for movement 22 (the red line) can be seen as a reciprocal of the take off on flight path B but was observed to be occurring with a downwind component which is not an operation in which the helicopter would utilise the subject site.

The remaining landings on flight path B (movements 24, 26, 28, 30 and 32 in Appendix D6) involve a visual approach to the hover point in front of the helipad (helicopter facing in a southerly direction) to which the then the helicopter proceeded to descend to helipad with a portion of a headwind component as required by the aviation regulations.

Appendix D7 provides the flight track anticlockwise circuit for the night-time altitude. The take off movement 33 was continuing on for the aircraft going to the refuelling point therefore by crossing the highway on that track should be deleted from the analysis as it is not representative of the normal circuit. The track for movement 34 that was returning from refuelling required a diversion due other aircraft operating out of the airport but the landing phase of that movement can be used for assessment purposes.

Appendix D8 presents a summary of the anticlockwise circuits whilst Appendix D9 presents the results of the overflights for the two different altitudes.

During the course of the testing, it was observed at times the helicopter was subject to hovering above the helipad in a downwind configuration, which would not occur for normal operations but was undertaken to conform with the flight program that have been developed for the testing.

Appendix D 10 identifies the turning points for the combined circuits for which the elevation of the helicopter at the turning points are set out in Appendices D11 to D13 to indicate the range of altitudes that were observed on the day to indicate variations which are due primarily as a result all the wind conditions at the time of the testing even though they complied with the requirements of AS 2363 (except recorded wind gusts during movements 1 – 5).

The purpose of providing the elevation net turning points is that the helicopter was operated under visual flight rules with the pilot operating the helicopter at a consistent Indicated Air Speed (IAS) and power setting of the helicopter. The presence of a headwind can result in a slower track across the ground but a quicker attainment of a nominated altitude in the presence of that wind.

Examination of Appendix G, being the Bureau of Meteorology data from Maitland Airport for the day of testing indicates majority is a test complied with the AS 2363 wind requirements but noting that on the day there were variations in the wind strength and wind direction.

Since the development of helicopter guidelines in Australia, there has been a change of instrumentation to which by reference to clause 4.3.1 of AS 2363 where any storage device e.g. a magnetic tape recorder or digital event recorder is used the accuracy of measurement shall be taken into account.

Section 4.3 of AS 2363 – 1999 suggests use of sound level meter with Max hold option or the use of a sound level meter with a graphic level recorder writing speed selected be representative of ‘F’ response to determine the maximum level.

For the original assessment of the operations for the helicopter service the analysis of the utilised either direct readout of the sound level meter with a graphic level recorder wave file recordings, or magnetic recordings that had been verified with respect to accuracy.

All of the instrumentation used for the measurement of the helicopter involved digital event recorders and/or meter that record wave files. The purpose of the dual instrumentation was to permit a validation exercise in terms of the accuracy of such digital measurements where the recordings obtained by digital analysis were cross checked with the provision of analysis by use of a graphic level recorder having a discrete designated writing speed identified as ‘F’ response ( Bruel & Kjaer 2317 Level Recorder).

The results of the individual movements analyse using the multiple systems are set out in Appendix E. To permit a comparison with respect to SLOW response measurements (being maximum levels identified on certification documentation) the maximum slow response levels also included in the results.

For the purpose of calculating the $L_{Aeq}$ helicopter noise contribution AS 2363 and maximum noise levels requires the results of the individual helicopter movements to be logarithmically averaged for the relevant flight path landing or take off operations and overflights.

Appendix F summarises the logarithmic averaging of the measurement data with the exclusion of the results for movement 33 and movement 21 as discussed above.

## 6.0 CONCLUSION

For the purpose of assessing the acoustic impact of transitioning from a single-engine helicopter to a twin-engine helicopter used for the marine pilot transfer operation from Dyke Point, Newcastle, it is necessary to have measurement data that reflects the normal operation of the helicopter service and to provide data to identify the maximum noise level and LAeq level from the helicopter operations.

The use of helicopter certification noise data represent helicopter operations that do not occur in practice does not reflect the normal operation of the existing helicopter service or the operating procedure required for twin-engine helicopters operating in Australia.

To be consistent with the original acoustic assessment and compliance testing for the existing service, AS2363 and EPA procedures, and all helicopter applications before the Land & Environment Court of NSW, the assessment requires the conduct of noise testing of the proposed twin-engine helicopter.

To provide the necessary data examination of possible sites at which testing could be undertaken and incorporate noise monitoring locations representative of the reference residential locations previously used for assessment of the Dyke Point helipad was undertaken with Maitland Airport being identified as a suitable site.

The twin-engine helicopter type that has been nominated for the upgrading of the marine pilot transfer service is a Eurocopter EC 135. A helicopter fitted out for the conduct of marine pilot transfers was sourced from Queensland and was the helicopter used for testing at Maitland Airport on 31 May 2021.

The test flights utilised flight tracks that replicate the Dyke Point helipad operations upon which monitoring was undertaken at the equivalent locations to the reference residential locations used in Newcastle for the monitoring of the existing helicopter service operating from Dyke Point.

The operation of twin engine helicopters are required to undertake a different take off and landing procedure to that utilised by the existing single engine helicopter operating from Dyke Point.

The different landing and take off requirements for the twin-engine helicopter result in the helicopter having a higher altitude on both the landing and take off profiles to that for the existing single-engine profile results in a lower noise level than that that would occur if the twin-engine helicopter followed the existing profiles used at Dyke Point.

The testing undertaken at Maitland Airport utilised operations for both landing and take off on the existing Dyke Point flight paths for both daytime cruise altitude of 1000 feet above ground level and a night time cruise altitude of 1500 feet above ground level.

The analysis of the helicopter testing to determine the applicable $L_{AE}$ and Maximum level for each flight profile/flight track was determined in accordance with Australian Standard 2363, that whilst having been removed from use, was the Standard used for testing for the original Dyke Point Environmental Impact Statement. Therefore, for comparison and consistency with the EIS the same analysis procedure has been used for the subject testing.

The use of modern digital event recorders or the software packages associated with the Type I sound level meters used in the testing have been validated against the instrumentation specified in AS 2363 and has been found to satisfy the requirements of that Standard.

The results of all the individual test flights for the 6 residential reference locations are set out in Appendix E.

Two flight movements in the testing program were not undertaken in accordance with normal operations of the proposed helicopter facility and that data has been removed from the logarithmic average of the $L_{AE}$/SEL and the $L_{A\ Max}$ result set out in Appendix F.

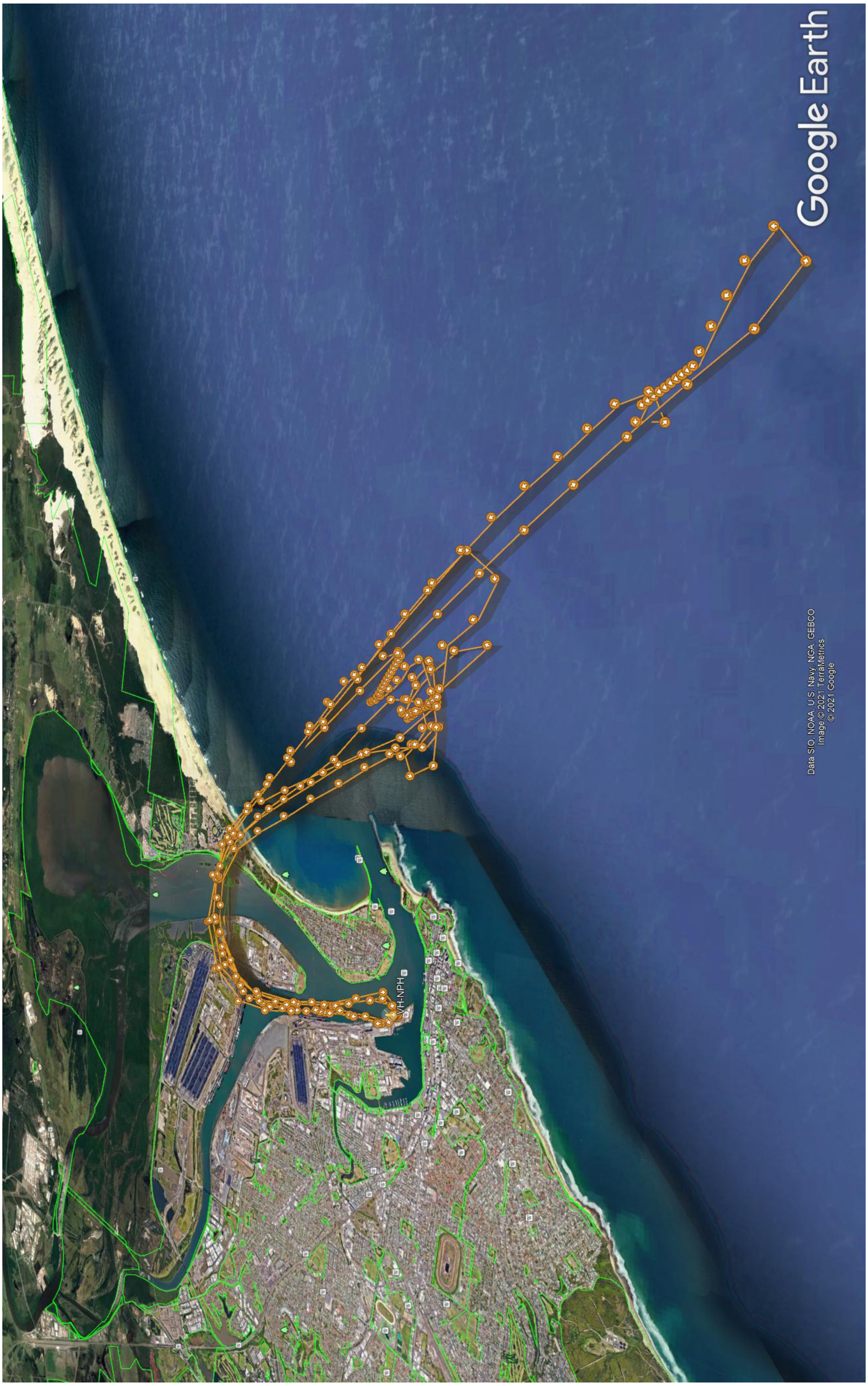
The results in Appendix F form the basis of the acoustical assessment of the twin-engine helicopter for the marine pilot transfer service operating from Dyke Point, Newcastle.

Yours faithfully,

**THE ACOUSTIC GROUP PTY LTD**

**STEVEN E COOPER**

# **APPENDIX A:** Flight Tracks - Newcastle Ports Helipad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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2021 TerraMetrics
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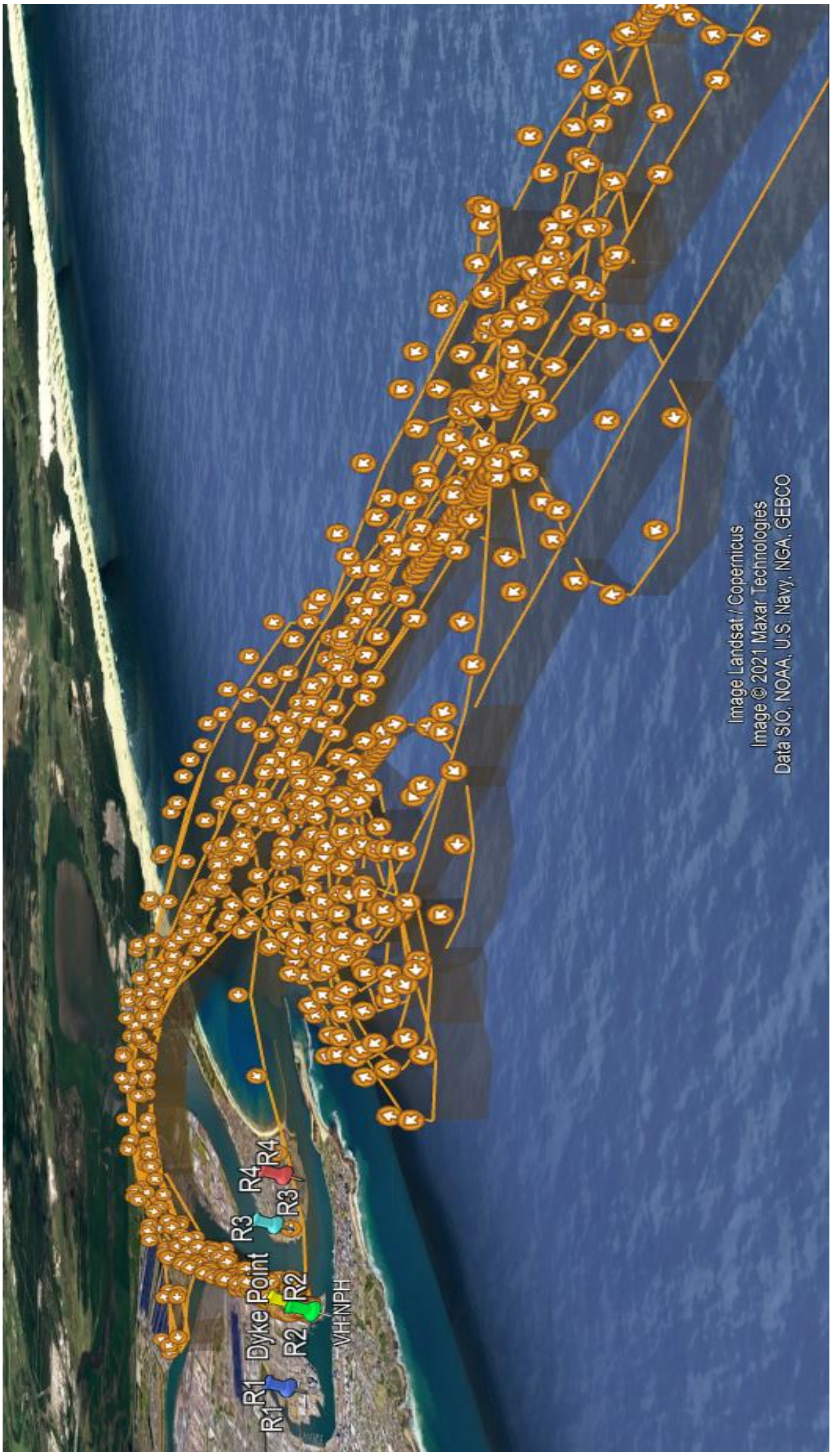
R1
R1
Dyke Point
R2
R2
VHNPH
R3
R3
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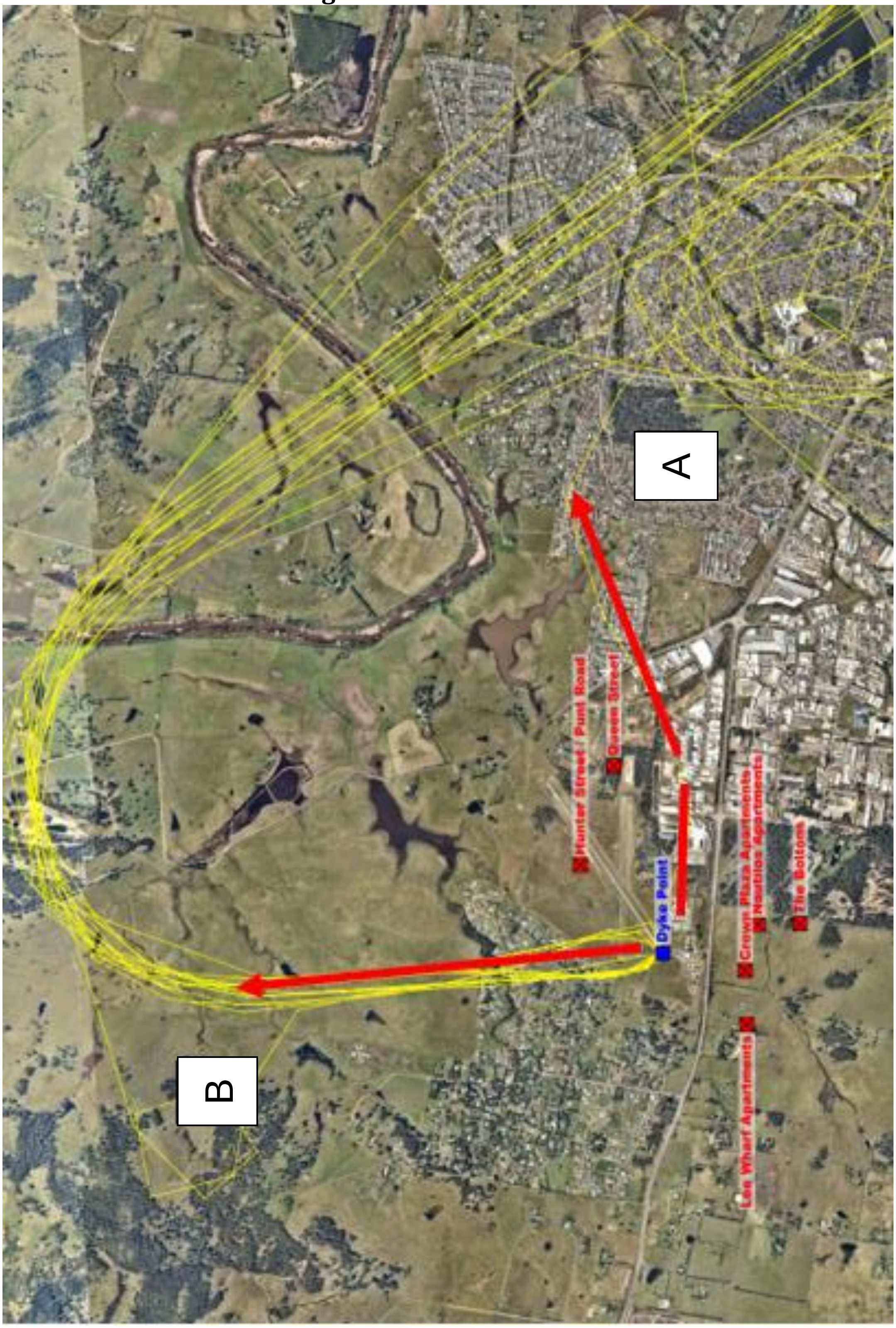
R4
Image Landsat / Copernicus
Image © 2021 Maxar Technologies
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

## APPENDIX B: Newcastle Flight Path and Measurement Locations overlayed on Maitland Flight Tracks



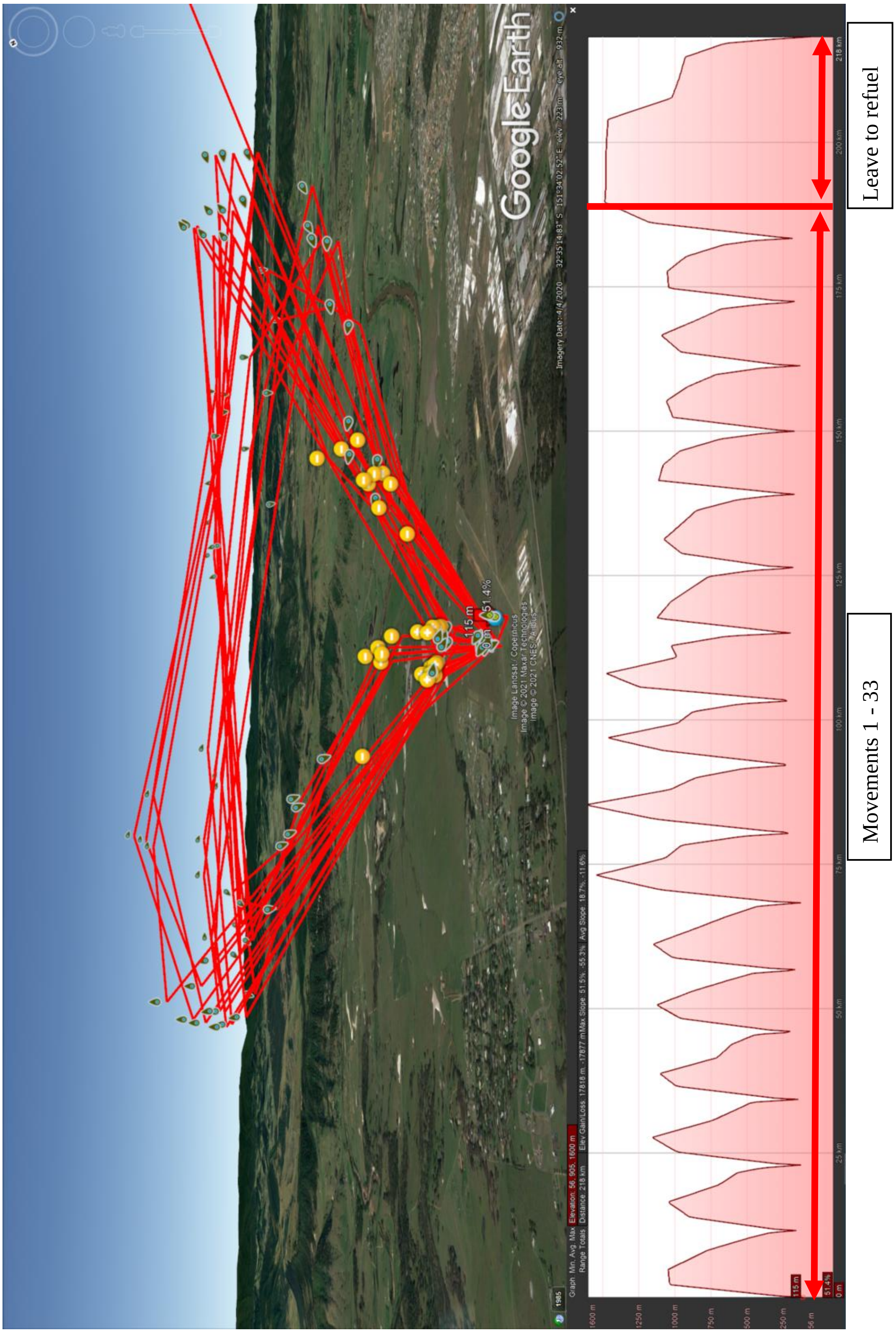
# APPENDIX C: Movements Flown (31/05/2021)

| Movement Number | Circuit Height | Flight Path | Movement Type |
|---|---|---|---|
| 1 | DAY | B | Take off |
| 2 | DAY | A | Landing |
| 3 | DAY | B | Take off |
| 4 | DAY | A | Landing |
| 5 | DAY | B | Take off |
| 6 | DAY | A | Landing |
| 7 | DAY | B | Take off |
| 8 | DAY | A | Landing |
| 9 | DAY | B | Take off |
| 10 | DAY | A | Landing |
| 11 | DAY | B | Take off |
| 12 | DAY | A | Landing |
| 13 | NIGHT | B | Take off |
| 14 | NIGHT | A | Landing |
| 15 | NIGHT | B | Take off |
| 16 | NIGHT | A | Landing |
| 17 | NIGHT | B | Take off |
| 18 | NIGHT | A | Landing |
| 19 | NIGHT | B | Take off |
| 20 | NIGHT | A | Landing |
| 21 | DAY | A | Take off |
| 22 | DAY | B | Landing |
| 23 | DAY | A | Take off |
| 24 | DAY | B | Landing |
| 25 | DAY | A | Take off |
| 26 | DAY | B | Landing |
| 27 | DAY | A | Take off |
| 28 | DAY | B | Landing |
| 29 | DAY | A | Take off |
| 30 | DAY | B | Landing |
| 31 | DAY | A | Take off |
| 32 | DAY | B | Landing |
| 33 | NIGHT | A | Take off |
| 34 | NIGHT | B | Landing |
| 35 | NIGHT | A | Take off |
| 36 | NIGHT | B | Landing |
| 37 | NIGHT | A | Take off |
| 38 | NIGHT | B | Landing |

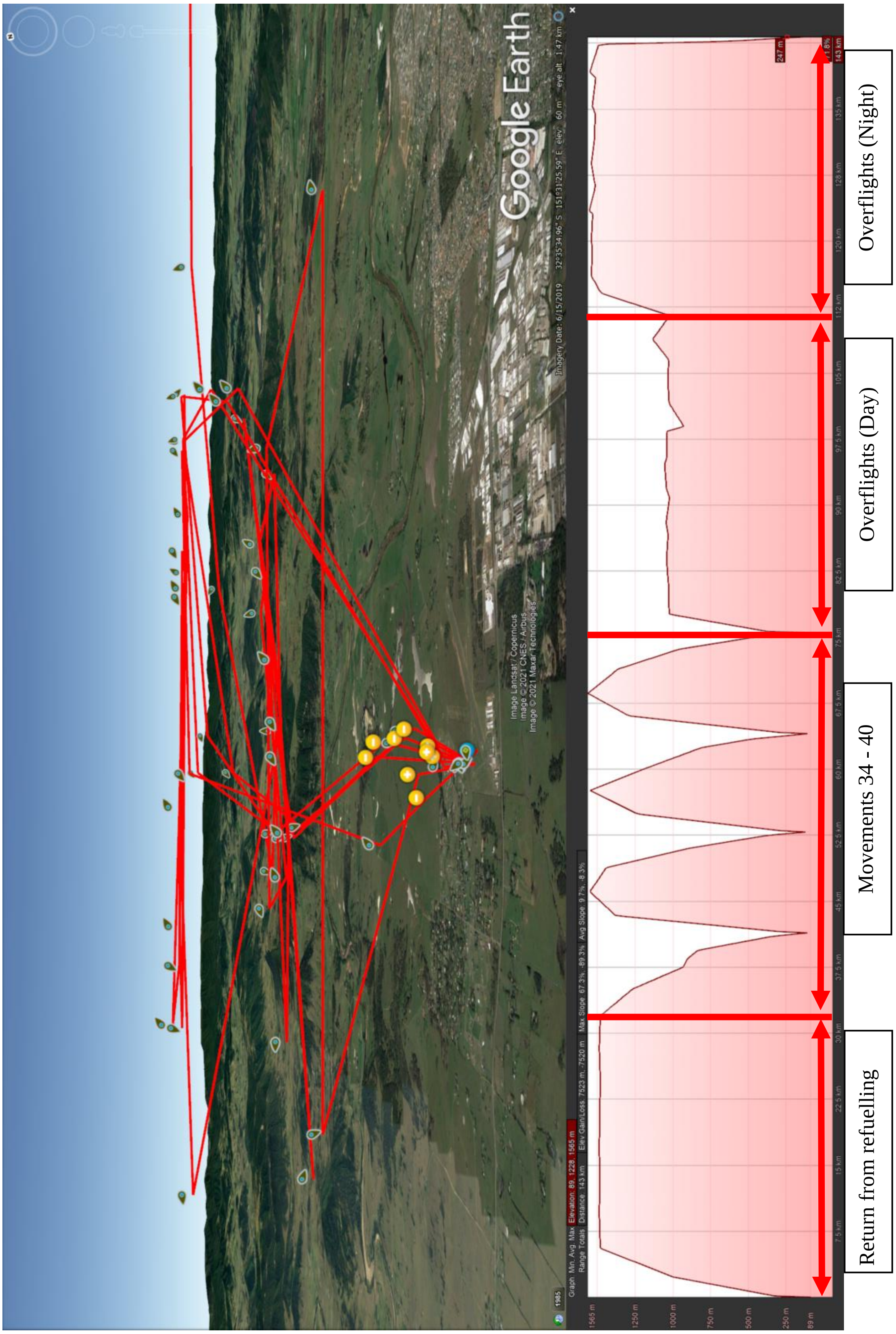
| Movement Number | Circuit Height | Flight Path | Movement Type |
|---|---|---|---|
| 39 | NIGHT | A | Take off |
| 40 | NIGHT | B | Landing |
| 41 | DAY | - | Overflight |
| 42 | DAY | - | Overflight |
| 43 | DAY | - | Overflight |
| 44 | DAY | - | Overflight |
| 45 | DAY | - | Overflight |
| 46 | DAY | - | Overflight |
| 47 | NIGHT | - | Overflight |
| 48 | NIGHT | - | Overflight |
| 49 | NIGHT | - | Overflight |
| 50 | NIGHT | - | Overflight |
| 51 | NIGHT | - | Overflight |
| 52 | NIGHT | - | Overflight |

# APPENDIX D: Flight Tracks Flown (31/05/2021)

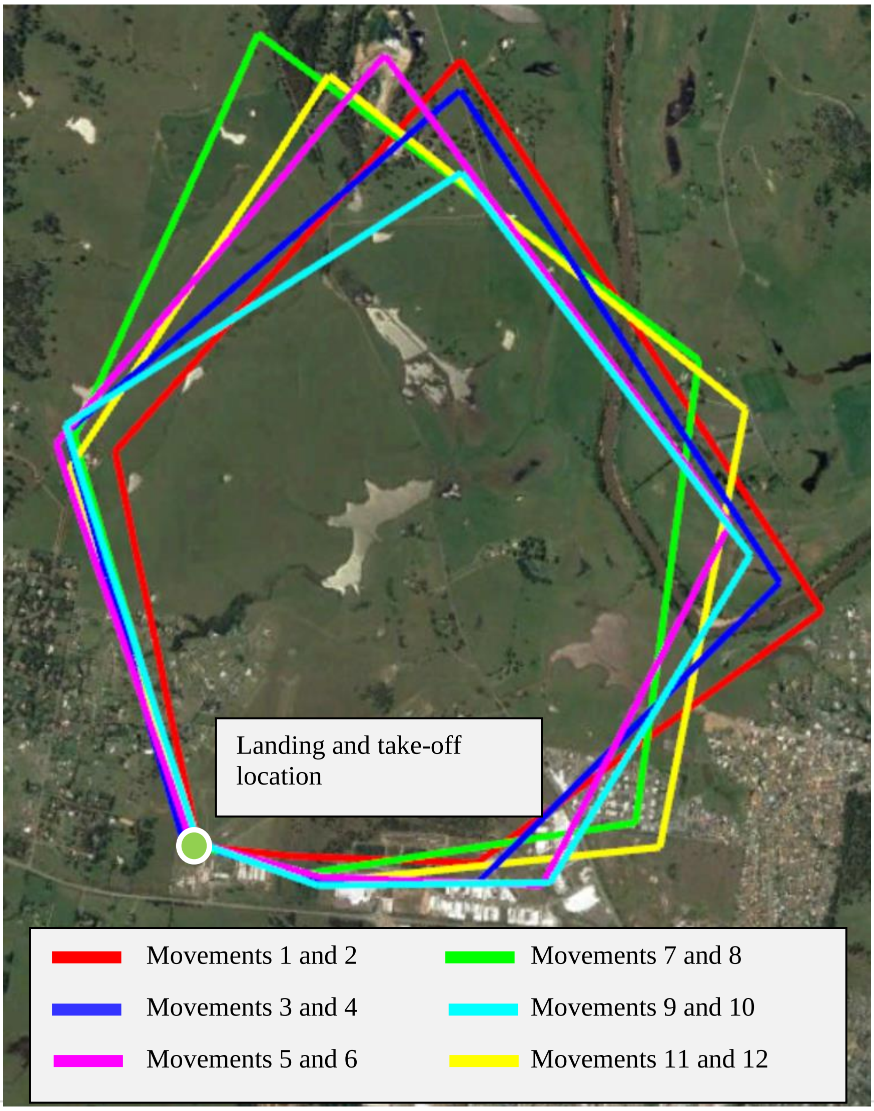
## Profile of flight paths (Movements 1 – 33)

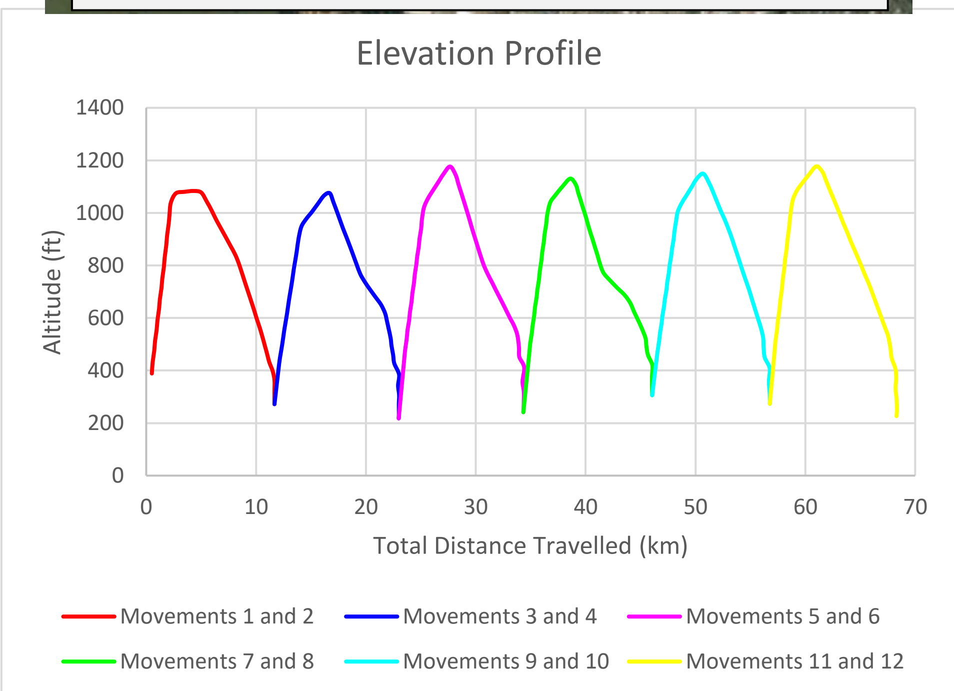


**Profile of flight paths (Movements 34 – 52)**

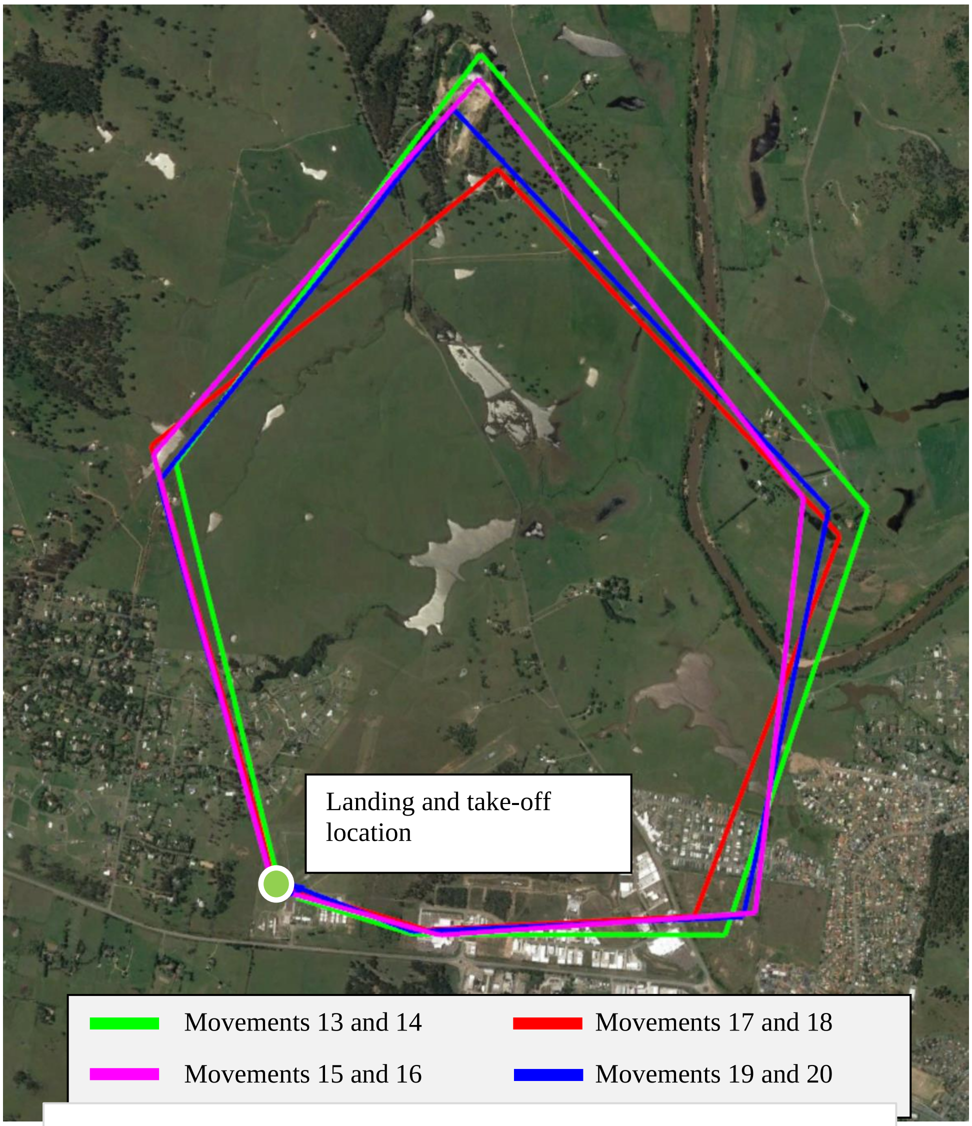


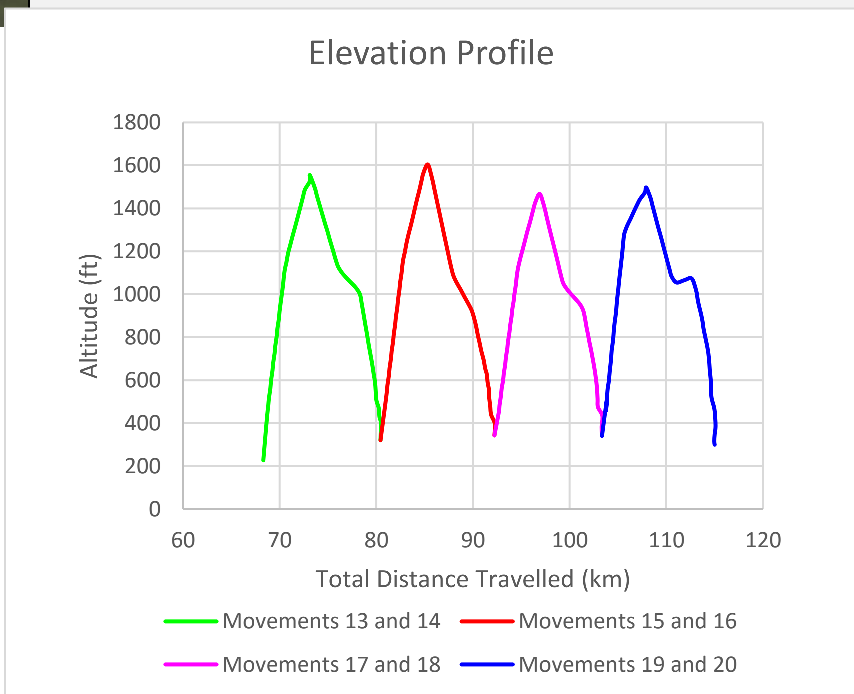
**Take off on Flight Path B and Landing on Flight Path A (Day)**



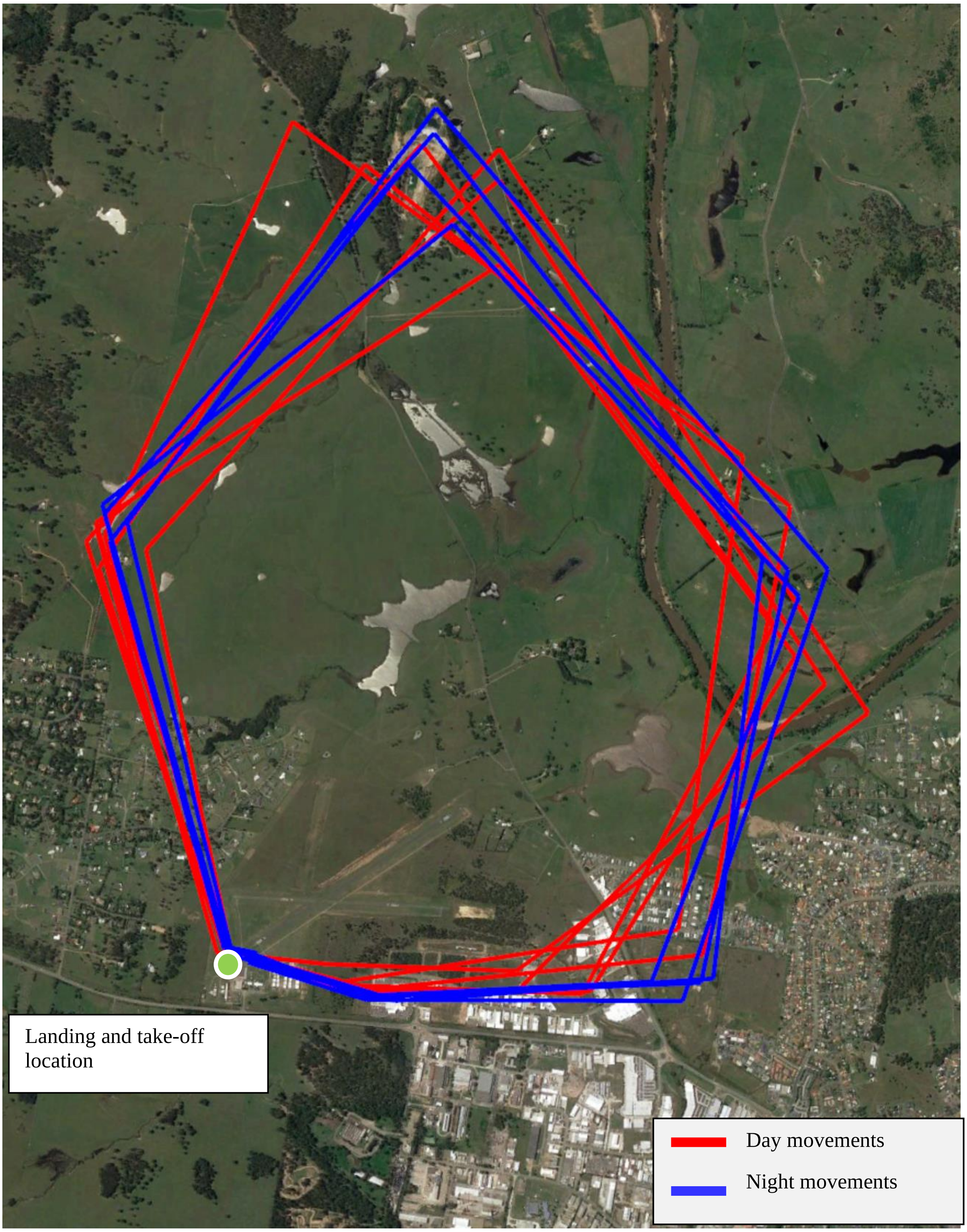



**Take off on Flight Path B and Landing on Flight Path A (Night)**

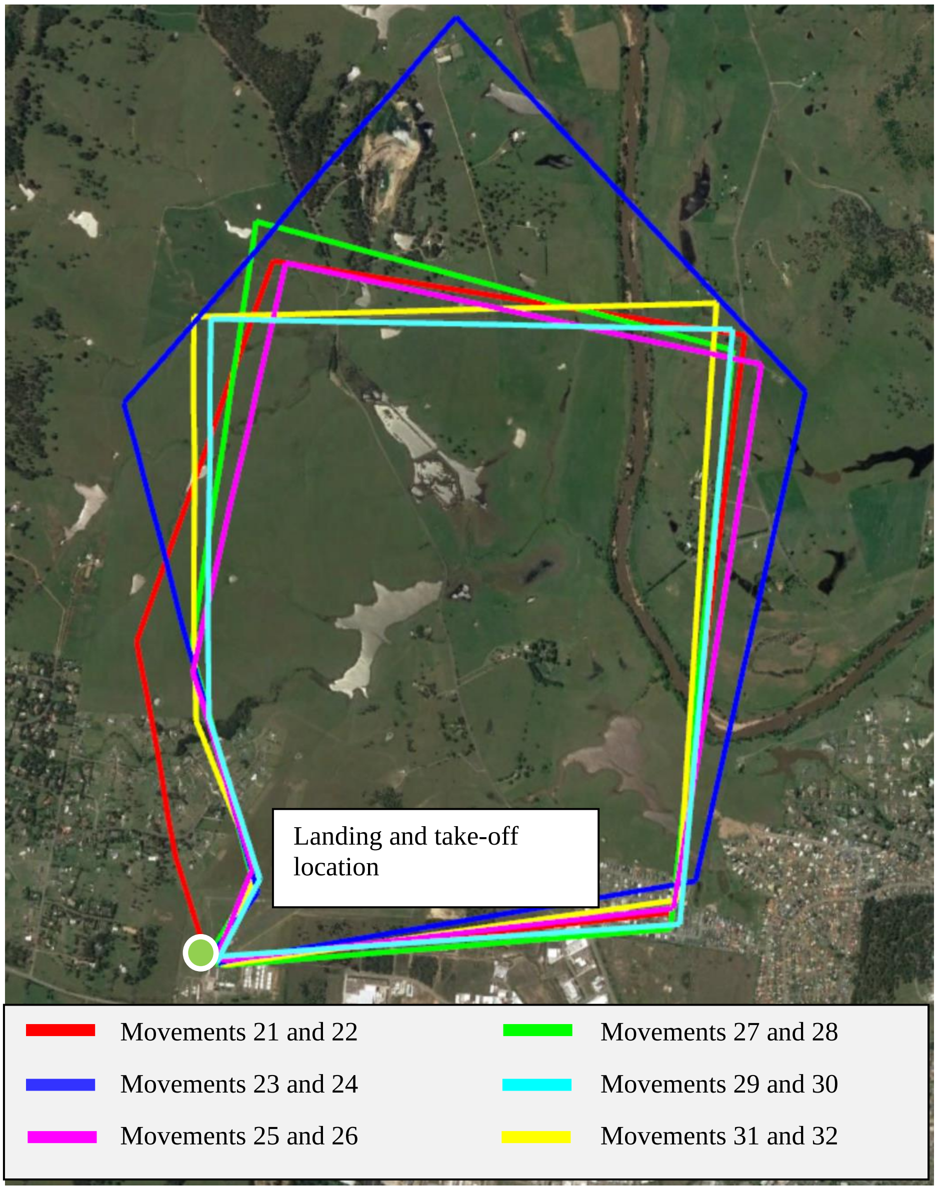


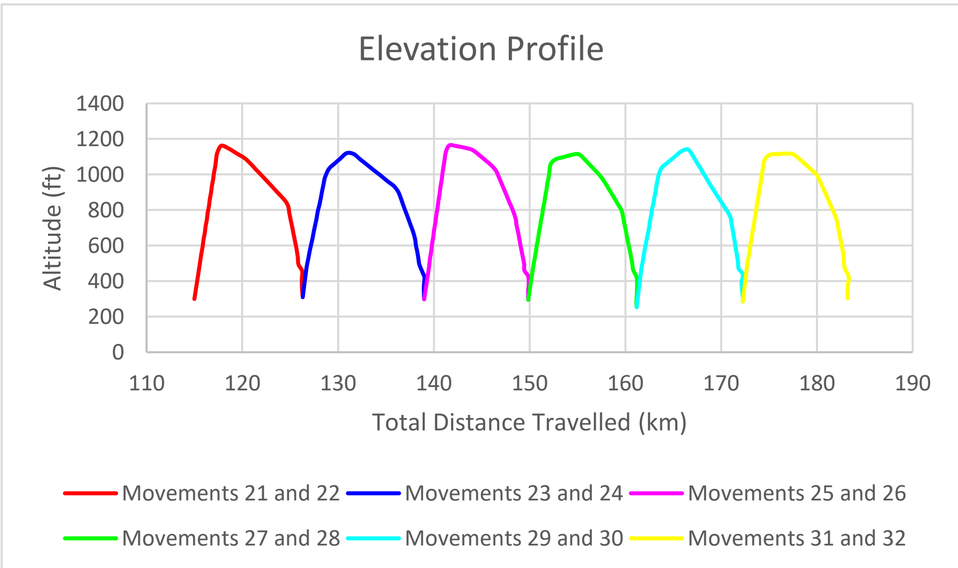



**Take off on Flight Path B and Landing on Flight Path A (Day and Night)**

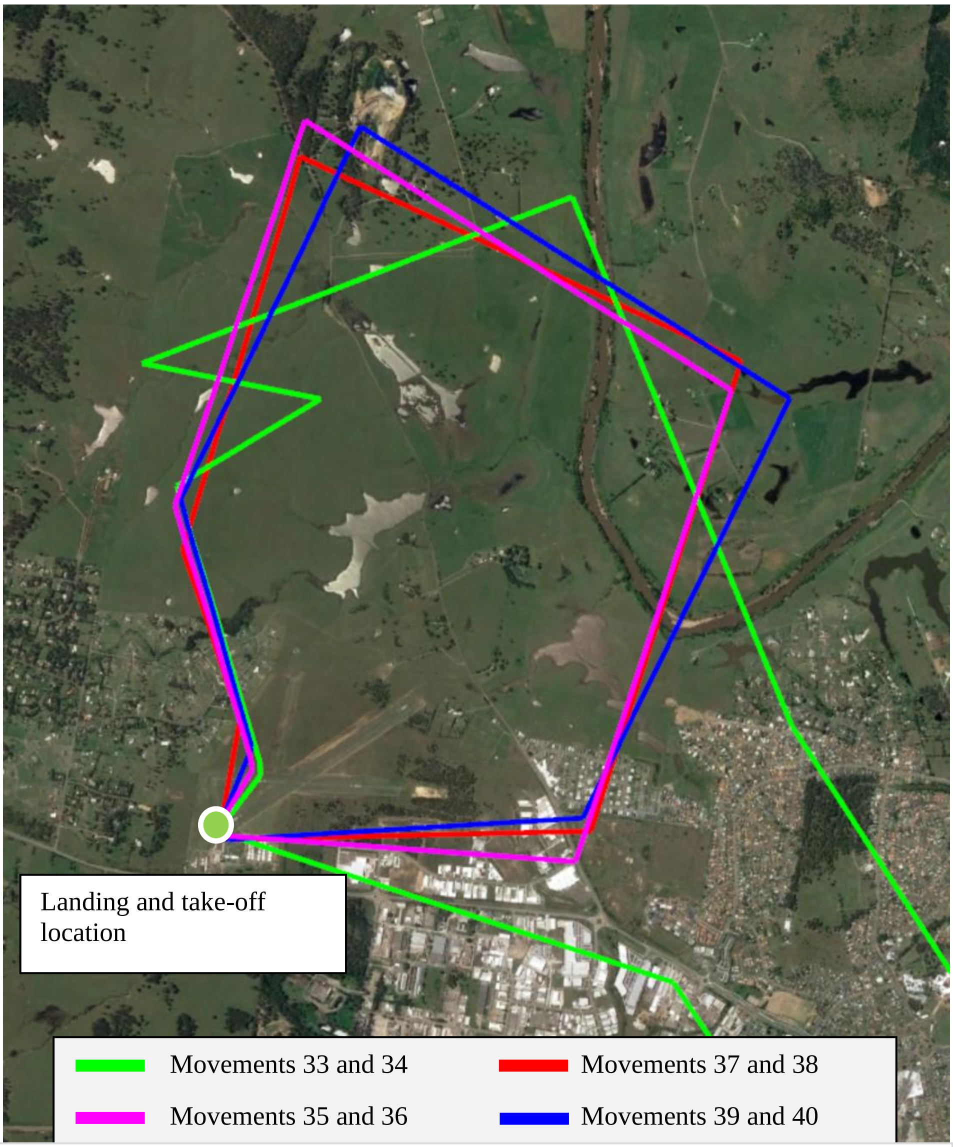


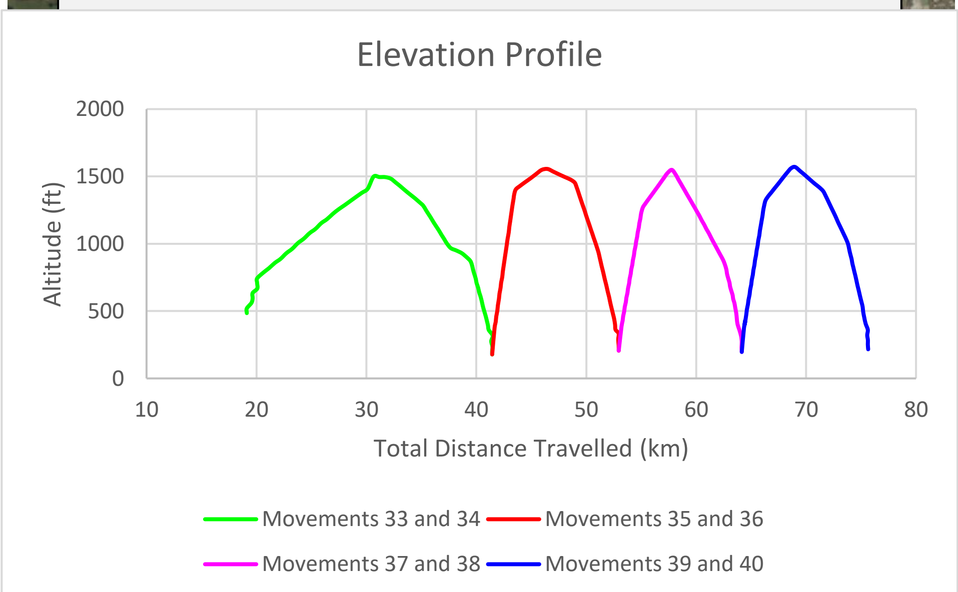
**Take off on Flight Path A and Landing on Flight Path B (Day)**



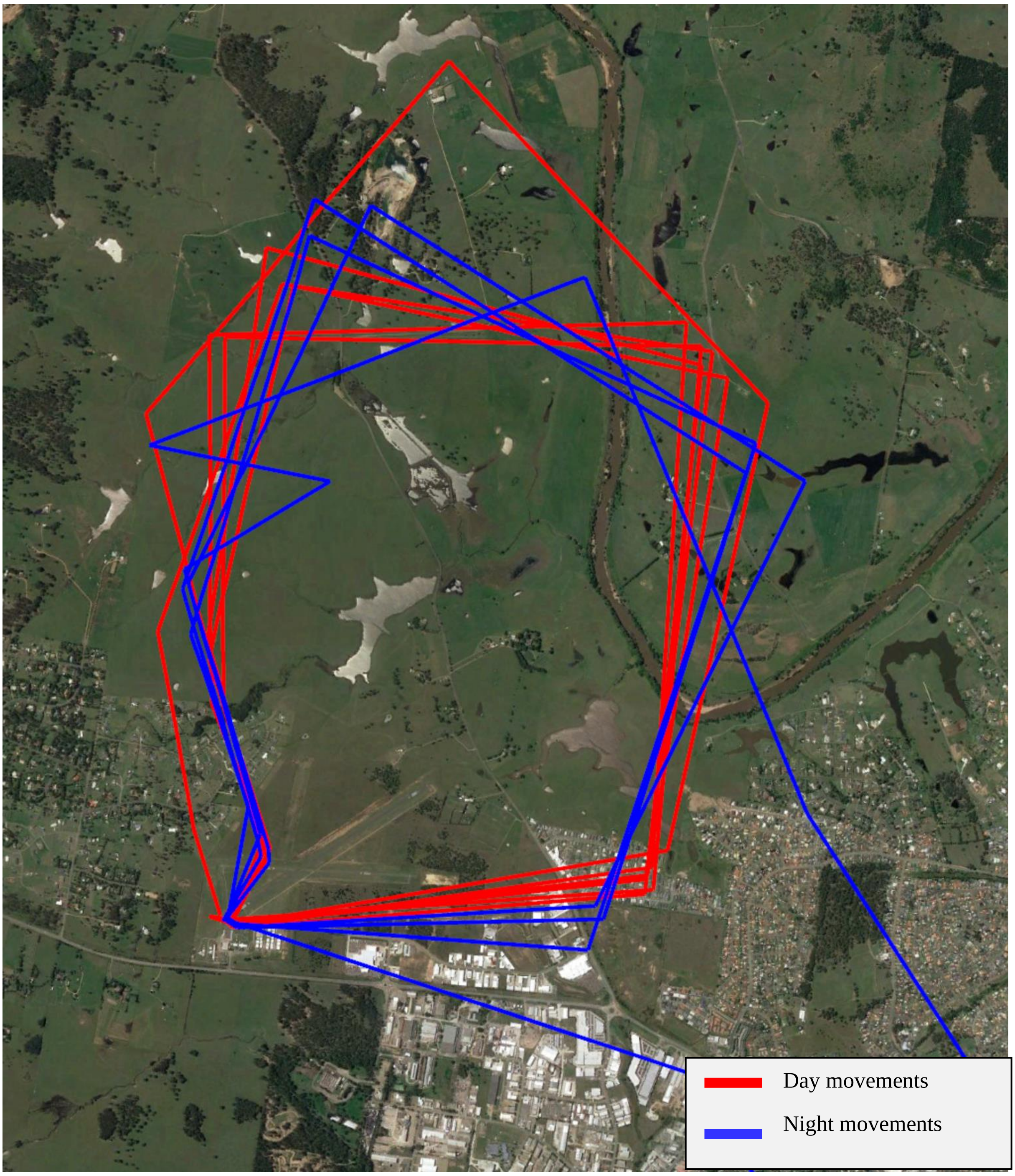



**Take off on Flight Path A and Landing on Flight Path B (Night)**

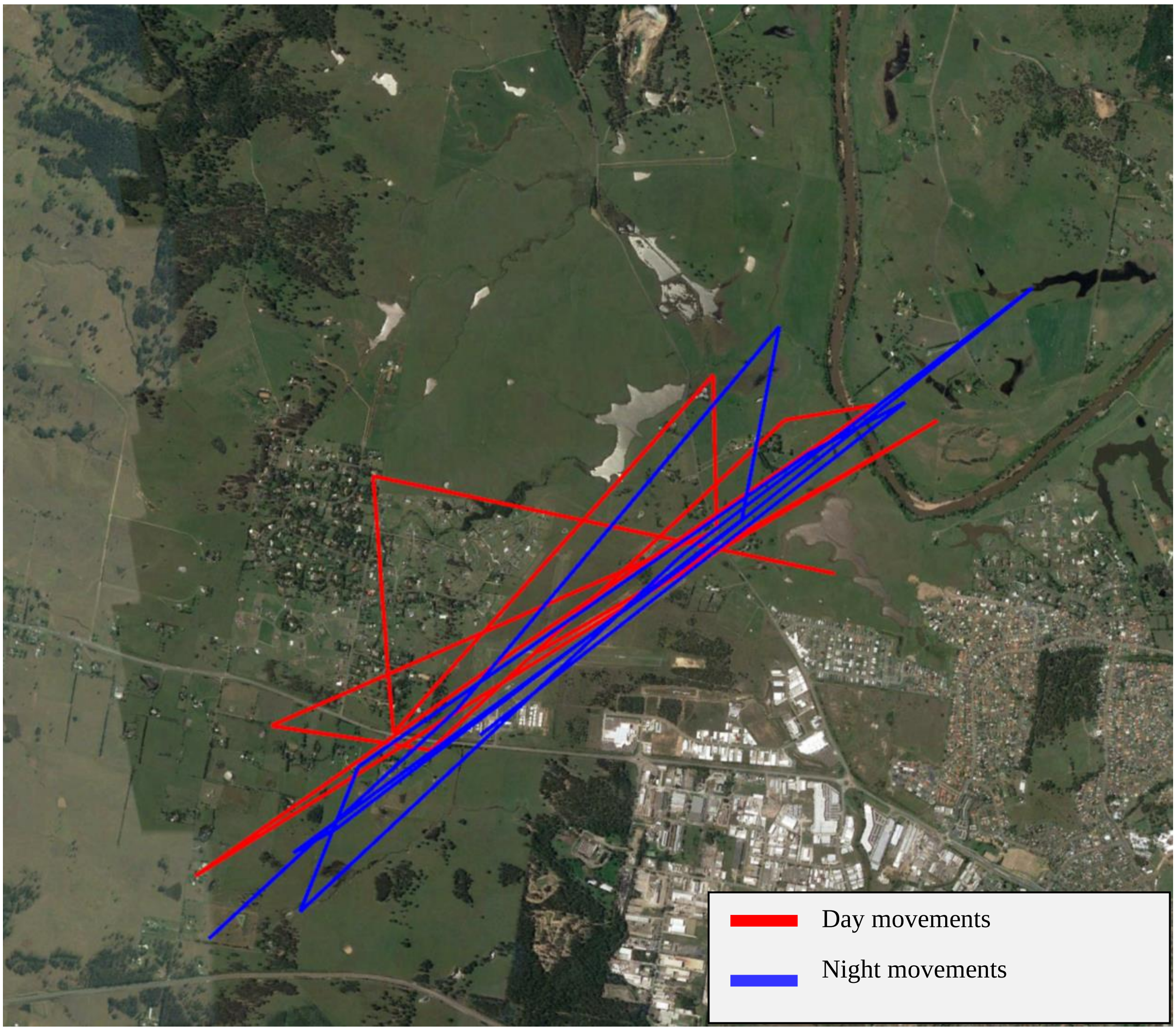


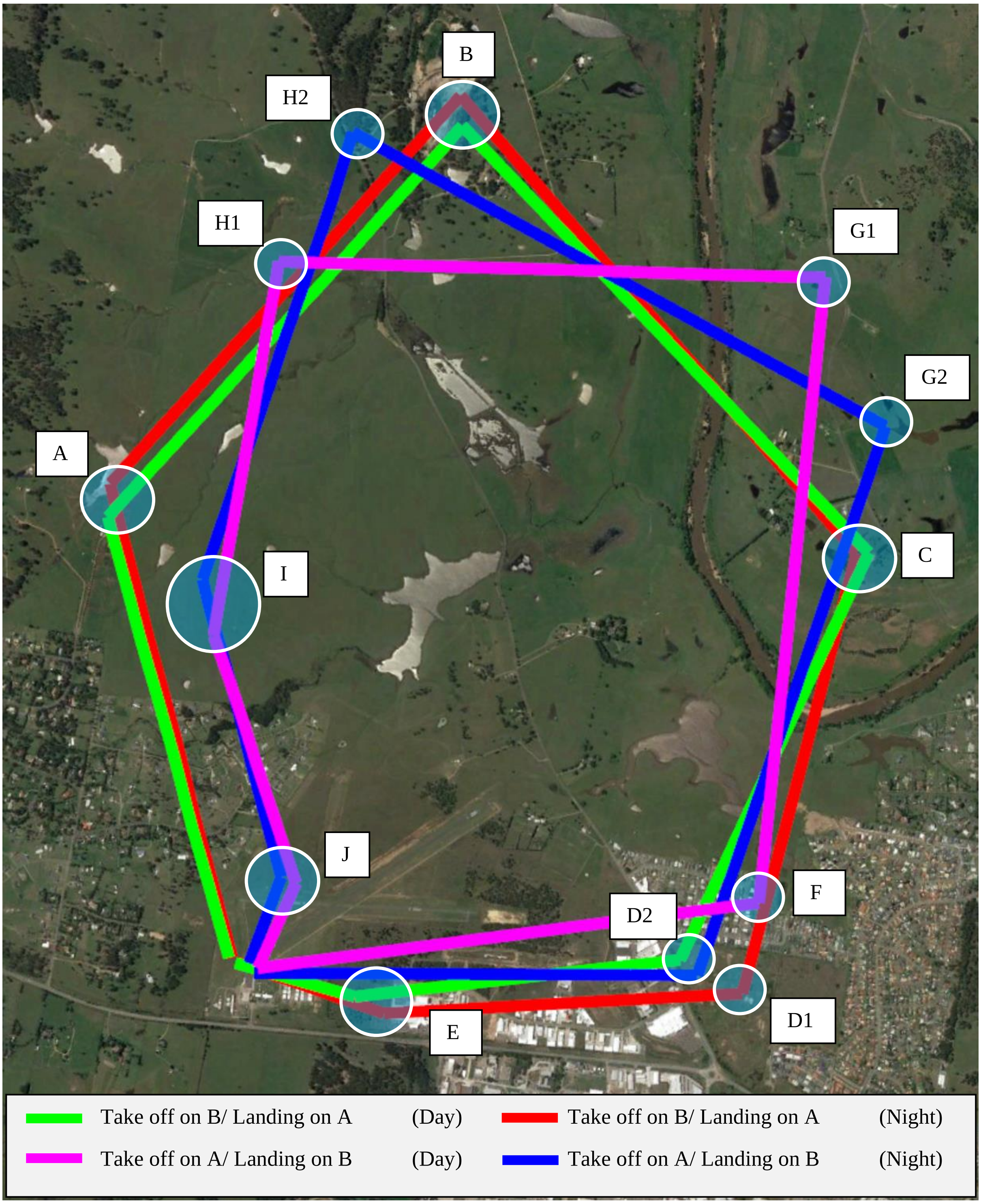
**Take off on Flight Path A and Landing on Flight Path B (Day and Night)**



## Overflights (Day and Night)



**Average Flight Paths and Turning Points**



## Elevation at the turning points

| Movement Number | Circuit Height | Movement Type | Turning Point | Elevation (ft) | Average Elevation (ft) |
|---|---|---|---|---|---|
| 1 | DAY | Take off on B | A | 1037 | 981 |
| 3 | DAY | Take off on B | A | 899 | |
| 5 | DAY | Take off on B | A | 985 | |
| 7 | DAY | Take off on B | A | 991 | |
| 9 | DAY | Take off on B | A | 962 | |
| 11 | DAY | Take off on B | A | 1014 | |
| 1 | DAY | Take off on B | B | 1047 | 1107 |
| 3 | DAY | Take off on B | B | 1050 | |
| 5 | DAY | Take off on B | B | 1159 | |
| 7 | DAY | Take off on B | B | 1106 | |
| 9 | DAY | Take off on B | B | 1126 | |
| 11 | DAY | Take off on B | B | 1152 | |
| 2 | DAY | Landing on A | C | 775 | 777 |
| 4 | DAY | Landing on A | C | 699 | |
| 6 | DAY | Landing on A | C | 742 | |
| 8 | DAY | Landing on A | C | 709 | |
| 10 | DAY | Landing on A | C | 873 | |
| 12 | DAY | Landing on A | C | 863 | |
| 2 | DAY | Landing on A | D1 | 486 | 577 |
| 4 | DAY | Landing on A | D1 | 565 | |
| 6 | DAY | Landing on A | D1 | 562 | |
| 8 | DAY | Landing on A | D1 | 604 | |
| 10 | DAY | Landing on A | D1 | 617 | |
| 12 | DAY | Landing on A | D1 | 630 | |
| 2 | DAY | Landing on A | E | 335 | 421 |
| 4 | DAY | Landing on A | E | 397 | |
| 6 | DAY | Landing on A | E | 466 | |
| 8 | DAY | Landing on A | E | 443 | |
| 10 | DAY | Landing on A | E | 453 | |
| 12 | DAY | Landing on A | E | 434 | |
| 13 | NIGHT | Take off on B | A | 1100 | 1141 |
| 15 | NIGHT | Take off on B | A | 1136 | |
| 17 | NIGHT | Take off on B | A | 1080 | |
| 19 | NIGHT | Take off on B | A | 1247 | |
| 13 | NIGHT | Take off on B | B | 1549 | 1528 |
| 15 | NIGHT | Take off on B | B | 1618 | |
| 17 | NIGHT | Take off on B | B | 1467 | |
| 19 | NIGHT | Take off on B | B | 1477 | |

| Movement Number | Circuit Height | Movement Type | Turning Point | Elevation (ft) | Average Elevation (ft) |
|---|---|---|---|---|---|
| 14 | NIGHT | Landing on A | C | 1067 | 1019 |
| 16 | NIGHT | Landing on A | C | 1034 | |
| 18 | NIGHT | Landing on A | C | 985 | |
| 20 | NIGHT | Landing on A | C | 988 | |
| 14 | NIGHT | Landing on A | D2 | 955 | 929 |
| 16 | NIGHT | Landing on A | D2 | 857 | |
| 18 | NIGHT | Landing on A | D2 | 876 | |
| 20 | NIGHT | Landing on A | D2 | 1027 | |
| 14 | NIGHT | Landing on A | E | 532 | 564 |
| 16 | NIGHT | Landing on A | E | 529 | |
| 18 | NIGHT | Landing on A | E | 555 | |
| 20 | NIGHT | Landing on A | E | 640 | |
| 21 | DAY | Take off on A | F | 1126 | 1035 |
| 23 | DAY | Take off on A | F | 955 | |
| 25 | DAY | Take off on A | F | 1113 | |
| 27 | DAY | Take off on A | F | 1014 | |
| 29 | DAY | Take off on A | F | 959 | |
| 31 | DAY | Take off on A | F | 1044 | |
| 21 | DAY | Take off on A | G1 | 1031 | 1067 |
| 23 | DAY | Take off on A | G1 | 1077 | |
| 25 | DAY | Take off on A | G1 | 1083 | |
| 27 | DAY | Take off on A | G1 | 1060 | |
| 29 | DAY | Take off on A | G1 | 1096 | |
| 31 | DAY | Take off on A | G1 | 1054 | |
| 22 | DAY | Landing on B | H1 | 886 | 899 |
| 24 | DAY | Landing on B | H1 | 850 | |
| 26 | DAY | Landing on B | H1 | 965 | |
| 28 | DAY | Landing on B | H1 | 916 | |
| 30 | DAY | Landing on B | H1 | 854 | |
| 32 | DAY | Landing on B | H1 | 922 | |
| 22 | DAY | Landing on B | I | 771 | 681 |
| 24 | DAY | Landing on B | I | 568 | |
| 26 | DAY | Landing on B | I | 686 | |
| 28 | DAY | Landing on B | I | 716 | |
| 30 | DAY | Landing on B | I | 680 | |
| 32 | DAY | Landing on B | I | 663 | |
| 22 | DAY | Landing on B | J | 466 | 405 |
| 24 | DAY | Landing on B | J | 355 | |
| 26 | DAY | Landing on B | J | 384 | |
| 28 | DAY | Landing on B | J | 388 | |

| Movement Number | Circuit Height | Movement Type | Turning Point | Elevation (ft) | Average Elevation (ft) |
|---|---|---|---|---|---|
| 30 | DAY | Landing on B | J | 397 | |
| 32 | DAY | Landing on B | J | 440 | |
| 33 | NIGHT | Take off on A | D2 | 1175 | 1272 |
| 35 | NIGHT | Take off on A | D2 | 1382 | |
| 37 | NIGHT | Take off on A | D2 | 1237 | |
| 39 | NIGHT | Take off on A | D2 | 1293 | |
| 33 | NIGHT | Take off on A | G2 | 1483 | 1538 |
| 35 | NIGHT | Take off on A | G2 | 1552 | |
| 37 | NIGHT | Take off on A | G2 | 1552 | |
| 39 | NIGHT | Take off on A | G2 | 1565 | |
| 34 | NIGHT | Landing on B | H2 | 1270 | 1310 |
| 36 | NIGHT | Landing on B | H2 | 1444 | |
| 38 | NIGHT | Landing on B | H2 | 1162 | |
| 40 | NIGHT | Landing on B | H2 | 1365 | |
| 34 | NIGHT | Landing on B | I | 837 | 877 |
| 36 | NIGHT | Landing on B | I | 896 | |
| 38 | NIGHT | Landing on B | I | 814 | |
| 40 | NIGHT | Landing on B | I | 962 | |
| 34 | NIGHT | Landing on B | J | 352 | 421 |
| 36 | NIGHT | Landing on B | J | 394 | |
| 38 | NIGHT | Landing on B | J | 480 | |
| 40 | NIGHT | Landing on B | J | 457 | |

### Turning Point Elevation Summary

| Movement Type | Turning Point | | Average Elevation (ft) | |
|---|---|---|---|---|
| | Day | Night | Day | Night |
| Take off on B | A | A | 981 | 1141 |
| | B | B | 1107 | 1528 |
| Landing on A | C | C | 777 | 1019 |
| | D1 | D2 | 577 | 929 |
| | E | E | 421 | 564 |
| Take off on A | F | D2 | 1035 | 1272 |
| | G1 | G2 | 1067 | 1538 |
| Landing on B | H1 | H2 | 899 | 1310 |
| | I | I | 681 | 877 |
| | J | J | 405 | 421 |

# APPENDIX E: Digital Analysis Results - dB(A)

| No. | Circuit Height | Path | Movmnt Type | Lee Wharf Apartments | | | Crown Plaza Apartments | | | Nautilos Apartments | | | The Boltons | | | Hunter Street | | | Queen Street | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max |
| 1 | DAY | B | Take off | 74 | 65 | 62 | 81 | 75 | 72 | 77 | 76 | 72 | 71 | 64 | 62 | 77 | 71 | 67 | 66 | 57 | 56 |
| 2 | DAY | A | Landing | 72 | 63 | 61 | 79 | 72 | 68 | 75 | 68 | 64 | 74 | 60 | 57 | 78 | 68 | 66 | 84 | 75 | 73 |
| 3 | DAY | B | Take off | 73 | 66 | 63 | 82 | 75 | 73 | 76 | 71 | 67 | 72 | 70 | 64 | 79 | 69 | 66 | 76 | 64 | 62 |
| 4 | DAY | A | Landing | 78 | 70 | 63 | 82 | 73 | 70 | 79 | 68 | 64 | 75 | 63 | 59 | 79 | 67 | 65 | 81 | 73 | 69 |
| 5 | DAY | B | Take off | 74 | 66 | 63 | 78 | 71 | 71 | 72 | 68 | 65 | 71 | 66 | 62 | 77 | 68 | 66 | 73 | 60 | 59 |
| 6 | DAY | A | Landing | 74 | 66 | 65 | 82 | 77 | 72 | 78 | 69 | 66 | 74 | 65 | 62 | 80 | 69 | 66 | 80 | 69 | 67 |
| 7 | DAY | B | Take off | 74 | 67 | 65 | 80 | 71 | 68 | 78 | 76 | 72 | 71 | 66 | 63 | 78 | 70 | 67 | 73 | 60 | 59 |
| 8 | DAY | A | Landing | 73 | 64 | 61 | 82 | 71 | 68 | 80 | 73 | 68 | 73 | 65 | 59 | 79 | 67 | 64 | 79 | 68 | 66 |
| 9 | DAY | B | Take off | 73 | 67 | 65 | 81 | 70 | 69 | 76 | 70 | 68 | 72 | 68 | 64 | 77 | 71 | 68 | 72 | 60 | 56 |
| 10 | DAY | A | Landing | 76 | 68 | 65 | 82 | 73 | 69 | 79 | 71 | 67 | 74 | 61 | 58 | 77 | 68 | 65 | 79 | 68 | 65 |
| 11 | DAY | B | Take off | 75 | 69 | 65 | 81 | 76 | 73 | 76 | 72 | 68 | 73 | 69 | 65 | 76 | 66 | 64 | 71 | 59 | 57 |
| 12 | DAY | A | Landing | 75 | 63 | 60 | 81 | 71 | 68 | 79 | 71 | 67 | 74 | 64 | 59 | 76 | 65 | 62 | 80 | 72 | 68 |
| 13 | NIGHT | B | Take off | 75 | 68 | 65 | 81 | 77 | 74 | 73 | 68 | 66 | 72 | 67 | 65 | 79 | 72 | 68 | 71 | 59 | 57 |
| 14 | NIGHT | A | Landing | 77 | 70 | 67 | 81 | 74 | 71 | 79 | 67 | 65 | 75 | 62 | 58 | 79 | 67 | 65 | 80 | 69 | 67 |
| 15 | NIGHT | B | Take off | 75 | 68 | 64 | 82 | 77 | 74 | 73 | 69 | 63 | 71 | 65 | 61 | 78 | 68 | 66 | 74 | 63 | 60 |
| 16 | NIGHT | A | Landing | 76 | 71 | 67 | 83 | 72 | 71 | 81 | 70 | 66 | 76 | 61 | 59 | 78 | 69 | 65 | 80 | 70 | 68 |
| 17 | NIGHT | B | Take off | 76 | 72 | 68 | 82 | 76 | 73 | 75 | 71 | 67 | 69 | 62 | 60 | 78 | 70 | 68 | 69 | 60 | 58 |
| 18 | NIGHT | A | Landing | 77 | 71 | 67 | 81 | 73 | 70 | 80 | 69 | 67 | 75 | 63 | 59 | 79 | 67 | 64 | 79 | 67 | 65 |
| 19 | NIGHT | B | Take off | 75 | 66 | 63 | 79 | 71 | 68 | 74 | 71 | 65 | 72 | 66 | 63 | 77 | 70 | 67 | 73 | 64 | 61 |
| 20 | NIGHT | A | Landing | 76 | 67 | 63 | 82 | 70 | 68 | 81 | 71 | 67 | 76 | 67 | 63 | 79 | 70 | 67 | 81 | 73 | 70 |
| 21 | DAY | A | Take off | 81 | 75 | 74 | 83 | 75 | 74 | 76 | 69 | 65 | 74 | 67 | 62 | 76 | 66 | 64 | 75 | 67 | 63 |
| 22 | DAY | B | Landing | 75 | 66 | 64 | 83 | 77 | 76 | 74 | 66 | 64 | 71 | 58 | 56 | 76 | 67 | 66 | 67 | 55 | 53 |
| 23 | DAY | A | Take off | 80 | 73 | 71 | 83 | 72 | 71 | 77 | 73 | 68 | 72 | 62 | 59 | 75 | 65 | 62 | 70 | 60 | 57 |
| 24 | DAY | B | Landing | 71 | 61 | 59 | 74 | 63 | 62 | 73 | 63 | 60 | 71 | 57 | 56 | 78 | 68 | 66 | 73 | 65 | 62 |
| 25 | DAY | A | Take off | 78 | 74 | 71 | 83 | 76 | 73 | 76 | 68 | 66 | 73 | 64 | 60 | - | - | - | 75 | 64 | 62 |
| 26 | DAY | B | Landing | 67 | 56 | 56 | 79 | 69 | 68 | 71 | 60 | 59 | 71 | 61 | 58 | - | - | - | 76 | 65 | 63 |
| 27 | DAY | A | Take off | 81 | 77 | 74 | 84 | 75 | 73 | 77 | 71 | 68 | 71 | 62 | 58 | - | - | - | 75 | 67 | 65 |
| 28 | DAY | B | Landing | 72 | 62 | 60 | 77 | 67 | 65 | 73 | 63 | 62 | 67 | 57 | 55 | 79 | 68 | 64 | 74 | 64 | 62 |
| 29 | DAY | A | Take off | 67 | 72 | 70 | 84 | 76 | 74 | 77 | 67 | 64 | 74 | 63 | 60 | 74 | 62 | 60 | 74 | 65 | 64 |
| 30 | DAY | B | Landing | 67 | 57 | 56 | 76 | 66 | 65 | 71 | 62 | 59 | 71 | 56 | 54 | 79 | 68 | 65 | 73 | 63 | 61 |

| No. | Circuit Height | Path | Movmnt Type | Lee Wharf Apartments | | | Crown Plaza Apartments | | | Nautilos Apartments | | | The Boltons | | | Hunter Street | | | Queen Street | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SEL | $L_{AFmax}$ | $L_{ASmax}$ | SEL | $L_{AFmax}$ | $L_{ASmax}$ | SEL | $L_{AFmax}$ | $L_{ASmax}$ | SEL | $L_{AFmax}$ | $L_{ASmax}$ | SEL | $L_{AFmax}$ | $L_{ASmax}$ | SEL | $L_{AFmax}$ | $L_{ASmax}$ |
| 31 | DAY | A | Take off | 72 | 70 | 68 | 83 | 75 | 73 | 75 | 67 | 63 | 72 | 64 | 61 | 73 | 65 | 61 | 75 | 66 | 63 |
| 32 | DAY | B | Landing | 73 | 63 | 61 | 79 | 74 | 71 | 73 | 64 | 62 | 70 | 56 | 54 | 80 | 69 | 67 | 73 | 63 | 61 |
| 33 | NIGHT | A | Take off | 79 | 74 | 71 | 81 | 80 | 76 | 77 | 70 | 67 | 73 | 67 | 62 | 76 | 69 | 66 | 75 | 65 | 63 |
| 34 | NIGHT | B | Landing | 76 | 69 | 67 | 78 | 66 | 66 | 70 | 56 | 55 | 72 | 59 | 57 | 79 | 66 | 65 | 75 | 63 | 52 |
| 35 | NIGHT | A | Take off | 82 | 75 | 73 | 86 | 81 | 79 | 78 | 71 | 68 | 75 | 67 | 63 | 74 | 65 | 61 | 75 | 65 | 60 |
| 36 | NIGHT | B | Landing | 73 | 66 | 63 | 78 | 67 | 65 | 69 | 56 | 54 | 71 | 59 | 57 | 79 | 67 | 65 | 74 | 62 | 61 |
| 37 | NIGHT | A | Take off | 81 | 76 | 71 | 83 | 75 | 72 | 78 | 72 | 67 | 74 | 63 | 60 | 76 | 68 | 66 | 75 | 65 | 62 |
| 38 | NIGHT | B | Landing | 74 | 66 | 64 | 79 | 70 | 67 | 70 | 58 | 56 | 70 | 58 | 55 | 80 | 67 | 65 | 75 | 69 | 66 |
| 39 | NIGHT | A | Take off | 80 | 73 | 70 | 83 | 77 | 73 | 77 | 70 | 67 | 74 | 66 | 62 | 73 | 63 | 60 | 75 | 66 | 64 |
| 40 | NIGHT | B | Landing | 76 | 64 | 63 | 82 | 73 | 71 | 76 | 69 | 66 | 72 | 61 | 58 | 80 | 71 | 68 | 74 | 62 | 59 |
| 41 | DAY | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 76 | 67 | 66 | 73 | 67 | 63 |
| 42 | DAY | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 77 | 68 | 66 | 72 | 63 | 60 |
| 43 | DAY | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 78 | 68 | 66 | 73 | 65 | 62 |
| 44 | DAY | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 76 | 67 | 66 | 71 | 62 | 59 |
| 45 | DAY | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 77 | 69 | 63 | 74 | 64 | 61 |
| 46 | DAY | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 78 | 72 | 63 | 73 | 65 | 62 |
| 47 | NIGHT | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 76 | 68 | 62 | 73 | 65 | 61 |
| 48 | NIGHT | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 75 | 66 | 61 | 72 | 65 | 60 |
| 49 | NIGHT | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 75 | 66 | 63 | 73 | 65 | 62 |
| 50 | NIGHT | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 73 | 63 | 62 | 71 | 61 | 59 |
| 51 | NIGHT | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 75 | 65 | 62 | 72 | 65 | 62 |
| 52 | NIGHT | - | Over flight | - | - | - | - | - | - | - | - | - | - | - | - | 75 | 64 | 62 | 72 | 64 | 61 |

## APPENDIX F: Summary of Measurement Results - dB(A)

| Circuit Height | Flight Path | Movement Type | Lee Wharf Apartments | | | Crown Plaza Apartments | | | Nautilos Apartments | | | The Boltons | | | Hunter Street | | | Queen Street | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max | SEL | $L_{AF}$ max | $L_{AS}$ max |
| Day | B | Take off | 74 | 67 | 64 | 81 | 74 | 71 | 76 | 73 | 68 | 72 | 68 | 63 | 77 | 69 | 66 | 73 | 61 | 58 |
| | B | Landing | 72 | 62 | 59 | 79 | 72 | 68 | 72 | 63 | 61 | 70 | 58 | 55 | 79 | 68 | 65 | 73 | 63 | 60 |
| | A | Take off | 78 | 74 | 71 | 83 | 75 | 73 | 76 | 70 | 66 | 73 | 64 | 60 | 75 | 65 | 62 | 74 | 65 | 62 |
| | A | Landing | 75 | 66 | 63 | 81 | 73 | 69 | 79 | 70 | 66 | 74 | 63 | 59 | 78 | 67 | 65 | 81 | 72 | 68 |
| Night | B | Take off | 75 | 69 | 65 | 81 | 75 | 73 | 73 | 72 | 70 | 71 | 65 | 62 | 78 | 70 | 67 | 72 | 62 | 59 |
| | B | Landing | 75 | 66 | 64 | 80 | 70 | 67 | 73 | 64 | 58 | 72 | 59 | 57 | 80 | 68 | 65 | 75 | 65 | 60 |
| | A | Take off | 81 | 74 | 72 | 84 | 76 | 76 | 75 | 71 | 66 | 74 | 66 | 62 | 75 | 67 | 63 | 75 | 65 | 62 |
| | A | Landing | 77 | 70 | 66 | 82 | 72 | 70 | 80 | 70 | 67 | 75 | 64 | 60 | 79 | 68 | 65 | 80 | 70 | 68 |
| Day | - | Overflight | - | - | - | - | - | - | - | - | - | - | - | - | 77 | 69 | 65 | 73 | 65 | 61 |
| Night | - | Overflight | - | - | - | - | - | - | - | - | - | - | - | - | 75 | 66 | 62 | 72 | 64 | 61 |

## APPENDIX G: Weather Data from BOM Maitland Airport (31/05/2021)

| Time (EST) | Wind dir | Wind spd | Wind gust | Tmp | Dew pt | rh | Rain | Pres |
|---|---|---|---|---|---|---|---|---|
| | | km/h | km/h | °C | °C | % | mm | hPa |
| Mon 15:00 | ESE | 6 | 9 | 18.6 | 8.6 | 52 | 0 | 1022.8 |
| Mon 14:50 | SE | 6 | 7 | 18.4 | 8.7 | 53 | 0 | 1022.8 |
| Mon 14:40 | SE | 9 | 11 | 18.3 | 8.3 | 52 | 0 | 1022.8 |
| Mon 14:30 | SSE | 7 | 11 | 19 | 9.2 | 53 | 0 | 1022.8 |
| Mon 14:20 | S | 6 | 7 | 18.2 | 8.5 | 53 | 0 | 1022.9 |
| Mon 14:10 | S | 7 | 9 | 18.3 | 8.6 | 53 | 0 | 1023 |
| Mon 14:00 | SSE | 7 | 13 | 18.2 | 8.7 | 54 | 0 | 1023.1 |
| Mon 13:50 | SSE | 6 | 7 | 18.1 | 8.4 | 53 | 0 | 1023.2 |
| Mon 13:40 | ESE | 9 | 11 | 18.5 | 8.7 | 53 | 0 | 1023.2 |
| Mon 13:30 | E | 6 | 11 | 18.5 | 9 | 54 | 0 | 1023.3 |
| Mon 13:20 | - | 0 | 0 | 18.1 | 8.7 | 54 | 0 | 1023.3 |
| Mon 13:10 | NNW | 6 | 7 | 18 | 8.6 | 54 | 0 | 1023.5 |
| Mon 13:00 | WNW | 6 | 9 | 17.9 | 8.2 | 53 | 0 | 1023.5 |
| Mon 12:50 | NNW | 7 | 7 | 18 | 8.6 | 54 | 0 | 1023.6 |

| Time (EST) | Wind dir | Wind spd | Wind gust | Tmp | Dew pt | rh | Rain | Pres |
|---|---|---|---|---|---|---|---|---|
| | | km/h | km/h | °C | °C | % | mm | hPa |
| Mon 12:40 | N | 9 | 9 | 17.8 | 8.4 | 54 | 0 | 1023.9 |
| Mon 12:30 | NW | 7 | 11 | 17.6 | 8.5 | 55 | 0 | 1024 |
| Mon 12:20 | NW | 9 | 9 | 17.6 | 8.5 | 55 | 0 | 1024.2 |
| Mon 12:10 | WNW | 9 | 11 | 17.4 | 8.3 | 55 | 0 | 1024.3 |
| Mon 12:00 | NW | 9 | 13 | 17.5 | 8.4 | 55 | 0 | 1024.5 |
| Mon 11:50 | WNW | 9 | 9 | 17.5 | 8.6 | 56 | 0 | 1024.5 |
| Mon 11:40 | W | 7 | 9 | 17.2 | 8.1 | 55 | 0 | 1024.7 |
| Mon 11:30 | NW | 9 | 13 | 16.7 | 7.6 | 55 | 0 | 1024.8 |
| Mon 11:20 | WNW | 7 | 9 | 16.8 | 8.5 | 58 | 0 | 1025.1 |
| Mon 11:10 | NW | 9 | 13 | 16.4 | 8.1 | 58 | 0 | 1025.2 |
| Mon 11:00 | WNW | 13 | 17 | 16.3 | 8.3 | 59 | 0 | 1025.4 |
| Mon 10:50 | WNW | 11 | 13 | 16 | 8.2 | 60 | 0 | 1025.5 |
| Mon 10:40 | W | 11 | 13 | 15.6 | 8.4 | 62 | 0 | 1025.6 |
| Mon 10:30 | NW | 17 | 22 | 15 | 8.7 | 66 | 0 | 1025.7 |
| Mon 10:20 | NW | 19 | 20 | 14.6 | 8.1 | 65 | 0 | 1025.7 |

| Time (EST) | Wind dir | Wind spd | Wind gust | Tmp | Dew pt | rh | Rain | Pres |
|---|---|---|---|---|---|---|---|---|
| | | km/h | km/h | °C | °C | % | mm | hPa |
| Mon 10:10 | NW | 19 | 24 | 14.9 | 8.6 | 66 | 0 | 1025.7 |
| Mon 10:00 | NW | 19 | 24 | 14.2 | 8.4 | 68 | 0 | 1025.8 |
| Mon 09:50 | NW | 19 | 20 | 14 | 8.6 | 70 | 0 | 1025.8 |
| Mon 09:40 | WNW | 19 | 22 | 13.7 | 8.7 | 72 | 0 | 1025.8 |
| Mon 09:30 | WNW | 17 | 24 | 13.1 | 8.8 | 75 | 0 | 1025.8 |
| Mon 09:20 | NW | 13 | 17 | 12.7 | 8.8 | 77 | 0 | 1025.8 |
| Mon 09:10 | WNW | 17 | 19 | 12.2 | 8.7 | 79 | 0 | 1025.8 |
| Mon 09:00 | WNW | 13 | 20 | 11.6 | 8.6 | 82 | 0 | 1025.9 |
| Mon 08:50 | W | 15 | 17 | 11.1 | 8.3 | 83 | 0 | 1026 |
| Mon 08:40 | WNW | 11 | 13 | 10.7 | 8.1 | 84 | 0 | 1026 |
| Mon 08:30 | WNW | 13 | 17 | 10.4 | 7.6 | 83 | 0 | 1026 |
| Mon 08:20 | WNW | 15 | 17 | 9.9 | 7.3 | 84 | 0 | 1026.1 |
| Mon 08:10 | W | 11 | 13 | 9.8 | 7.2 | 84 | 0 | 1026.1 |
| Mon 08:00 | W | 9 | 11 | 9.6 | 7 | 84 | 0 | 1026.1 |
| Mon 07:50 | W | 9 | 11 | 9.2 | 6.8 | 85 | 0 | 1026.1 |

| Time (EST) | Wind dir | Wind spd | Wind gust | Tmp | Dew pt | rh | Rain | Pres |
|---|---|---|---|---|---|---|---|---|
| | | km/h | km/h | °C | °C | % | mm | hPa |
| Mon 07:40 | W | 11 | 11 | 9 | 7 | 87 | 0 | 1026.1 |
| Mon 07:30 | W | 9 | 13 | 8.4 | 7 | 91 | 0 | 1026 |
| Mon 07:20 | W | 9 | 11 | 7.7 | 6.6 | 93 | 0 | 1025.9 |
| Mon 07:10 | W | 6 | 7 | 6.4 | 5 | 91 | 0 | 1025.9 |
| Mon 07:00 | W | 4 | 11 | 6.7 | 5.2 | 90 | 0 | 1025.9 |