STATE SIGNIFICANT INFRASTRUCTURE – STAGE 2:
AVIATION REPORT – ROOF MOUNTED HELICOPTER LANDING SITE

NEW MAITLAND HOSPITAL (NMH)

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This Report is prepared for Multiplex for the New Maitland Hospital development by Resolution Response Pty. Ltd. ABN: 94 154 052 883, trading as ‘AviPro’.

The Report relates to the aviation aspects associated with the establishment and site design of the proposed hospital rooftop helicopter landing site to inform Design and the other Submissions.

Contents

1. BACKGROUND

1.1. Establishment

Multiplex has been engaged by NSW Health for the design and construction of the new Maitland Hospital (NMH) project.

NMH is expected to provide services including emergency services, medical, surgical, paediatric and maternity services, critical care services for adults and children, including a special care nursery, operating theatres, delivery suites and assessment rooms, palliative care and rehabilitation services, mental health services, satellite renal dialysis, a new chemotherapy service, expanded oral health service, and a range of ambulatory care and outpatient clinics.

The NMH will incorporate a rooftop emergency services helicopter landing site (HLS). The HLS will be used by the NSW Ambulance Helicopter Retrieval Service and, when established, will be in regular use. Helicopter Emergency Medical Services (HEMS) under contract to NSW Ambulance will utilise the HLS. The helicopters can originate from across the network, however are most likely to be dispatched from NSW Ambulance HEMS bases in Newcastle, Tamworth, Bankstown or Orange.

AviPro has been engaged to provide advice regarding aviation specific requirements relative to the construction of a suitable rooftop HLS to meet the development outcomes. Considerations will include size, shape, structural design standards, markings, lighting, flight paths, protected airspace requirements, obstructions and approvals etc.

This report will also provide advice on protected airspace and any constraints this may have on the final hospital or the construction phase of the development.

1.2. HLS Terms of Reference and Applicability

Currently within Australia, there are no set rules or regulations applicable to the design, construction or placement of HLS. There may, however, be local council planning, location and movement approvals required. The appropriate legislation at present for the use of HLS is Civil Aviation Regulation (CAR) 92 which places the onus on the helicopter pilot to determine the suitability of a landing site. The Civil Aviation Safety Authority as the regulator of aviation in Australia divested itself of direct responsibility in the early 1990s and currently provides only basic operating guidelines, via Civil Aviation Advisory Publication (CAAP) 92-2 (2) Guidelines for the Establishment and Operation of Onshore Helicopter Landing Sites. CASA does not provide design, structural information, or advice beyond that provided in the CAAP.

CASA, as a component of a Regulatory Reform Program, does propose to prepare rules for helicopter landing sites and currently has a panel established for this purpose. The new rules will form CASR Part 139R, however it is not expected that they will be completed any time soon. If and when they are introduced, there will be an implementation phase and “grandfather” clauses. Standards set by NSW Ambulance were established to meet or exceed those requirements.

Considerable work internationally has been undertaken over many years in this area, particularly through the International Civil Aviation Organisation (ICAO) and the US Federal Aviation Administration (FAA). The resulting documents on the subject provide excellent advisory material, guidelines and best practice standards.

ICAO sets out international Standards and Recommended Practices (SARPS) for the safe conduct of civil aviation activities in the Annexes to the Convention on International Civil Aviation (Chicago, 1944), with the following Annexes applicable to helicopter operations:

- Annex 6: Operation of Aircraft - Part III: International
- Operations - Helicopters 6th Edition July 2004
- Annex 14: Aerodromes - Volume II: Heliports 4th Edition 2013

Even though the current edition of Annex 14 is dated 2013, recent amendments are largely superficial and the basic document goes back to 1995. Additional guidance on the design of heliports and Helicopter Landing Sites is provided in ICAO's Heliport Manual (Doc. No. 9261-AN/903), although this document is also somewhat dated as it was last amended as the 3rd Edition in 1995.

ICAO Annex 14 Volume II provides SARPS for the planning, design, operation and maintenance of HLS facilities for use by the providers of these facilities, CAAP 92-2(2) provides only limited guidance material on the minimum physical parameters required to assist helicopter pilots and operators in meeting their obligations under CAR 92.

As a signatory to the Convention on International Civil Aviation, Australia has undertaken to apply the ICAO SARPS, except where specific differences have been notified to ICAO.

The Supplement (Second Edition, Amendment No.1, 18 February 1999) to Annex 14 Volume II, lists seven CASA Australia recommended differences to the ICAO SARPS relating to heliports. This document is now out-of-date and the differences remain. Subject to differences, CASA supported the adoption of Annex 14, SARPS for heliports.

These differences recommended by CASA were notified over 25 years ago and are generally no longer considered by NSW Ambulance, HEMS contractors or the industry as best practice or appropriate.

CASA has for some years been undertaking a Regulatory Reform Program in the rotary wing area and it is assumed that the ICAO SARPS with some of the differences removed, will form the basis of the proposed Civil Aviation Safety Regulations.

Proposed new CASRs include:

- Part 133 pertaining to Commercial Air Transport Operations;
- Part 138 pertaining to Aerial Work operations; and
- Part 139R pertaining to helicopter landing sites.

Currently within Australia HEMS comes under Aerial Work, however it is proposed by CASA that helicopter aeromedical functions come under the proposed Air Transport operations category as Medical Transport within Part 133. Should this eventuate, the highest standards required of Air Transport (the carriage of passengers for hire and reward) will apply to Medical Transport.

Although CASA has not historically been active in the HLS field, many countries have, and in particular the US. Many years of experience operating large numbers of helicopters in a range of roles, have resulted in the production of comprehensive helicopter landing site and heliport design and operating procedures. The US Federal Aviation Administration (FAA) has produced an Advisory Circular, the content of which is actually required in the US, detailing the necessary standards. Within the AC is a comprehensive section devoted to hospital based "helicopter landing sites", and where more than one HLS is co-located, "heliports".

The resulting documents on the subject provide excellent advisory material, guidelines and best practice standards. Key current documents are as follows:

- ICAO Annex 14, Vol II, Heliports.
- ICAO Heliport Manual Doc 9261-AN/903.
- US FAA Advisory Circular AC 150/5390-2C, Heliport Design, (covers both operational and design criteria, particularly for hospital-based HLS in Chapter 4, Hospital Heliports).
- Australian Civil Aviation Safety Authority (CASA) Civil Aviation Advisory Publication (CAAP) 92-2 (2) Guidelines for the Establishment and Operation of Onshore Helicopter Landing Sites. (covers essentially operational specifications only and is produced around European commercial helicopter airport-based operations).

NSW Health GL2018_010 Guidelines for Hospital Helicopter Landing Sites in NSW (Guidelines) issued 26 April 2018, were prepared primarily around the ICAO and FAA guidelines and standards utilising the most appropriate recommendations and practical HEMS operating procedures.

The Guidelines are the standards used in this report and will be the document against the commissioning compliance is measured.

Other guidelines/requirements of relevance include:

- Adherence to the performance requirements specified in the Rotorcraft Flight Manual (RFM) of the primary helicopter types used by NSW AMBULANCE, and those likely to be used in the future;
- Acknowledgement of the proposed requirements of CASA CASRs Parts 133, 138 and NPRM 1304OS – July 2013; and
- The noise effect as a result of approaching and departing helicopters over particular flight paths, and thus the use of “Fly Neighbourly” techniques.

There is an additional very important consideration which is not aviation related, but clinical. That is, that the HLS should be within easy reach and travel of the ED, ICU or NICU as the case may be. This is generally considered to be not more than approximately 100 m.

1.3. Background Material

Reference material provided by Multiplex in support of the report include early planning designs and concept drawings.

1.4. Methodology

Criteria from all relevant references were assessed, with the Guidelines used as the primary tool.

1.5. Explanation of Terms

Aircraft. Refers to both aeroplanes (fixed wing) and helicopters (rotorcraft).

Approach/Departure Path (VFR). The flight track helicopters follow when landing at or departing from the FATO of an HLS. Updated standards to align with ICAO recommendations now has the VFR Approach/Departure path extending outwards from the edge of the FATO with an obstacle free gradient of 2.5º or 4.5% or 1:22 vertical to horizontal, measured from the forward edge of the FATO, to a height initially of 500 feet above the FATO at a distance of ~3,500 m. The flight path commences at the forward edge of the FATO at a width of 25 m, and increases in width uniformly to 150 m at a distance of 3,500 m. The path may be curved left or right to avoid obstacles or to take advantage of a better approach or departure path. Changes in direction by day below 300 feet should be avoided and there should be no changes in direction below 500 ft at night.

Design Helicopter. The Agusta AW139 contracted to the NSW Ambulance. The type reflects the new generation Performance Class 1 capable helicopters used in HEMS and reflects the maximum weight and maximum contact load/minimum contact area.

Elevated Helicopter Landing Site. An HLS located on a roof top or some other elevated structure where the Ground Effect Area/Touchdown and Lift-off Area (TLOF) is at least 2.5 m above ground level.

Final Approach. The reduction of height and airspeed to arrive over a predetermined point above the FATO of an HLS.

Final Approach and Takeoff Area (FATO). A defined area over which the final phase of the approach to a hover, or a landing is completed and from which the takeoff is initiated. For the purposes of these guidelines, the specification of 1.5 x Length Overall of the Design Helicopter is used and equates to 25 m diameter. Area to be load bearing.

Ground Taxi. The surface movement of a wheeled helicopter under its own power with wheels touching the ground.

Hazard to Air Navigation. Any object having a substantial adverse effect upon the safe and efficient use of the navigable airspace by aircraft, upon the operation of air navigation facilities, or upon existing or planned airport/heliport capacity.

Helicopter Landing Site (HLS). One or more may also be known as a Heliport. The area of land, water or a structure used or intended to be used for the landing and takeoff of helicopters, together with appurtenant buildings and facilities.

Helicopter Landing Site Elevation. At a HLS without a precision approach, the HLS elevation is the highest point of the FATO expressed as the distance above mean sea level.

Helicopter Landing Site PC1 Survey Reference Point. A position at eye height (1.5 m) above the forward edge of the FATO in the centre of the flight path, from which the PC1 survey at 2.5º (4.5%) is initiated.

Helicopter Landing Site Reference Point (HRP). The geographic position of the HLS expressed as the latitude and longitude at the centre of the FATO.

> **Hospital Helicopter Landing Site.** HLS limited to serving helicopters engaged in air ambulance, or other hospital related functions.
>
> ***<u>Note</u>:***
>
> *A designated HLS located at a hospital or medical facility is an emergency services HLS and **not** a medical emergency site.*

Heliport. Two or more co-existing helicopter landing sites (HLS).

Hover Taxi. The movement of a wheeled or skid-equipped helicopter above the surface, generally at a wheel/skid height of approximately one metre. For facility design purposes, a skid-equipped helicopter is assumed to hover-taxi.

Length (Overall) (L). The distance from the tip of the main rotor tip plane path to the tip of the tail rotor tip plane path or the fin if further aft, of the Design Helicopter.

Landing and Lift Off Area (LLA). A load-bearing, nominally paved area, normally located in the centre of the TLOF, on which helicopters land and lift off. Minimum dimensions are based upon a 1 x metre clearance around the undercarriage contact points of the Design Helicopter.

Lift Off. To raise the helicopter into the air.

Movement. A landing or a lift off of a helicopter.

Object Identification Surface. The OIS are a set of imaginary surfaces associated with an aerodrome. They define the volume of airspace that should ideally be kept free from obstacles in order to minimise the danger to aircraft during an entirely visual approach.

Obstruction to Air Navigation. Any fixed or mobile object, including a parked helicopter, which impinges the approach/departure surface or the transitional surfaces.

Parking Pad. The paved centre portion of a parking position, normally adjacent to a HLS.

Performance Class 1 (PC1). Similar to Category A requirements. For a rotorcraft, means the class of rotorcraft operations where, in the event of failure of the critical power unit, performance is available to enable the rotorcraft to land within the rejected take-off distance available, or safely continue the flight to an appropriate landing area, depending on when the failure occurs. PC1 also requires CASA approved flight path surveys to/from the HLS.

Performance Class 2 (PC2). For a rotorcraft, means the class of rotorcraft operations where, in the event of failure of the critical power unit, performance is available to enable the rotorcraft to safety continue the flight, except when the failure occurs early during the take-off manoeuvres, in which case a forced landing may be required. PC2 also requires CASA approved flight path surveys to/from the HLS.

Performance Class 3 (PC3). For a rotorcraft, means the class of rotorcraft operations where, in the event of failure of the critical power unit at any time during the flight, a forced landing:

- in the case of multi-engine rotorcraft – may be required; or
- in the case of single-engine rotorcraft – will be required.

Pilot Activated Lighting (PAL). A PAL system utilises a hospital-based VHF radio and timed switching device, activated by the pilot via a VHF radio transmission on a pre-set frequency, to turn on the HLS and associated lighting.

Prior Permission Required (PPR) HLS. A HLS developed for exclusive use of the owner and persons authorized by the owner, i.e. a hospital based emergency services HLS.

Note:

The HLS owner and the HEMS operator are to ensure that all pilots are thoroughly knowledgeable with the *HLS (including such features as approach/departure path characteristics, preferred heading, facility limitations, lighting, obstacles in the area, size of the facility, etc.).*

Rotor Downwash. The volume of air moved downward by the action of the rotating main rotor blades. When this air strikes the ground or some other surface, it causes a turbulent outflow of air from beneath the helicopter.

Safety Area. A defined area on a HLS surrounding the FATO intended to reduce the risk of damage to helicopters accidentally diverging from the FATO (0.3 x RD of the Design Helicopter). This area should be free of objects, other than those frangible mounted objects required for air navigation purposes. The Safety Area for the Design Helicopter extends 4 m beyond the FATO circumference forming a 33 m diameter.

Safety Net. Surrounds the outer edge of a rooftop HLS. Is to be a minimum of 1.5 m wide and have a load carrying capacity of not less than 122 kg/m^2. The outer edge is not to project above the HLS deck, and slope back and down to the deck edge at approximately 10^o. Both inside and outside edges of the safety net are to be secured to a solid structure.

Shielded Obstruction. A proposed or existing obstruction that does **not** need to be marked or lit due to its close proximity to another obstruction whose highest point is at the same or higher elevation.

Standard HLS. A place used as an aerodrome for helicopter operations by day and night.

Take off. To accelerate and commence climb at the relevant climb speed.

Take off Position. A load bearing, generally paved area, normally located on the centreline and at the edge of the TLOF, from which the helicopter takes off. Typically, there are two such positions at the edge of the TLOF, one for each of two takeoff or arrival directions.

Touchdown and Lift-off Area (TLOF). A load bearing, generally paved area, normally centred in the FATO, on which the helicopter lands or takes off, and that provides ground effect for a helicopter rotor system. Size is based on 1 x main rotor diameter of Design Helicopter and is 14 m diameter.

Transitional Surfaces. Starts from the edges of the FATO parallel to the flight path centre line and extends outwards (to the sides) at a slope of 2:1 (two-units horizontal in one-unit vertical or 26.6°) from the outer edges of approach/departure surface. The outer sides are 75 m from the centreline, i.e. the outer edges are 150 m wide. The transitional surfaces start at the forward edge of the FATO, overlaid over the approach/departure path (surfaces) and extend to the end of the approach/departure surface at 3,500 m.

Unshielded Obstruction. A proposed or existing obstruction that may need to be marked or lit since it is **not** in close proximity to another marked and lit obstruction whose highest point is at the same or higher elevation.

1.6. Applicable Abbreviations

Acronym	Meaning
AC	US FAA Advisory Circular
ACC	Aeromedical Control Centre (HQ Eveleigh). Responsible for control and tasking of HEMS
ACMA	Australian Communication and Media Authority
CAAP	Civil Aviation Advisory Publication (Australia)
CASA	Civil Aviation Safety Authority (Australia)
CAOs	Civil Aviation Orders (Australia)
CARs	Civil Aviation Regulations (1988) Australia
CASRs	Civil Aviation Safety Regulations (1998) Australia
CSB	Clinical Services Building
CTAF	Common Traffic Advisory Frequency (5 nm Radius, ground level to 3,000 ft)
DIFFS	Deck Integrated Fire Fighting System
FAA	Federal Aviation Administration, USA
FATO	Final approach and Take-Off Area (1.5 x helicopter length)
FARA	Final Approach Reference Area
FMS	Fixed Monitor System (foam fire fighting system)
GPS	Global Positioning System
HEMS	Helicopter Emergency Medical Service
HLS	Helicopter Landing Site
HLSRO	HLS Reporting Officer (Airservices requirement)
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions - requiring flight under IFR
L	Length (also referred to as Overall Length), in relation to a helicopter, the total distance between the main rotor and tail rotor tip plane paths when rotating
LDP	Landing Decision Point (Category A/Performance Class 1 operations)
LLA	Landing and Lift Off Area. Solid surface meeting dynamic loading requirements, with undercarriage contact points + I metre in all directions
MoH	Ministry of Health NSW
MRI	Magnetic Resonance Imagers
MTOW	Maximum Take Off Weight
NMH	New Maitland Hospital
NOTAM	Notice to Airmen. Issued by Airservices in relation to airspace and navigation warnings
NVG	Night Vision Goggles
OIS	Object Identification Surface

Acronym	Meaning
PC1	Performance Class 1
PC2	Performance Class 2
PC3	Performance Class 3
RD	Main Rotor Diameter
SARPS	Standards and Recommended Practices developed by ICAO and promulgated in the Annexes to the Convention of International Civil Aviation
TDP	Takeoff Decision Point (Category A/Performance Class 1 operations)
TLOF	Touch Down and Lift Off Area. Load bearing min. 1 x main rotor diameter.
VFR	Visual Flight Rules
VHF	Very High Frequency radio
VMC	Visual Meteorological Conditions - allowing flight under VFR
V_{TOSS}	Take off Safety Speed

1.1. List of Figures

2. EXECUTIVE SUMMARY AND RECOMMENDATIONS

The scope of this report provided by AviPro includes detailed advice on the selected rooftop HLS option, any issues relating to the site pertaining to aviation matters, considerations relative to HEMS operations during the planning and following the completion the development, and advice on future developments as they may affect HEMS if applicable.

The positioning of the rooftop HLS option is the result of a number of meetings, workshops and analysis undertaken as part of the design program. The design for the HLS is based upon the current Guidelines.

The Guidelines relate to the structural requirements for the static loads to meet the Design Helicopter limitations drawn from the ICAO Heliport Manual Doc 9261-AN/903 recommendations. For the dimensions, marking and lighting for the LLA, TLOF, FATO and the Safety Area for the Design Helicopter, plus the VFR approach/departure and transitional surfaces, the Guidelines draw upon the FAA document AC 150/5390-2C, Heliport Design.

Design and Concept Drawings have been provided. As advised by the Project Team, the HLS is to cater for the operation of a single emergency services helicopter. The HLS location has been planned to allow for two obstacle free VFR approach and departure paths positioned up to 180º apart. The HLS will be well positioned for patient access to the new emergency and critical care facilities.

A review of the OIS associated with the Maitland Airport and the Newcastle Airport (RAAF Williamtown airspace) indicate there is no risk of penetration of protected airspace by the cranes (construction) or the final structure.

A formal VFR approach and departure path and transitional surface survey will need to be completed to meet Performance Class 1 requirements prior to operations from the new HLS. This needs to be included in the construction company Scope of Work. This survey is conducted from the surface of the HLS out to 3,500 m and provides surety that the approach/departure surface is free of penetrations. Any penetration of the transitional surface is to be considered a hazard.

The survey should also incorporate a Design Development Overlay (DDO) for the purposes of protecting the airspace from future development below the VFR approach and departure paths and transitional surfaces.

3. GENERAL HLS REQUIREMENTS AND CONSIDERATIONS

3.1. Design Helicopter

The predominant helicopter type to use the proposed HLS is the Agusta Westland (Leonardo) AW139. The AW139 is the largest/heaviest of the types employed by NSW Ambulance and is the “Design Helicopter” for planning purposes. The Design Helicopter is almost the same dimensions as the Bell 412 series formerly in common use, but has a normal Maximum Take Off Weight (MTOW) of 6,800 kg. See Figures 1 and 2.

Figure 1: NSW Ambulance AW139 “Design Helicopter”

The external dimensions of the AW139 are seen at Figure 2.

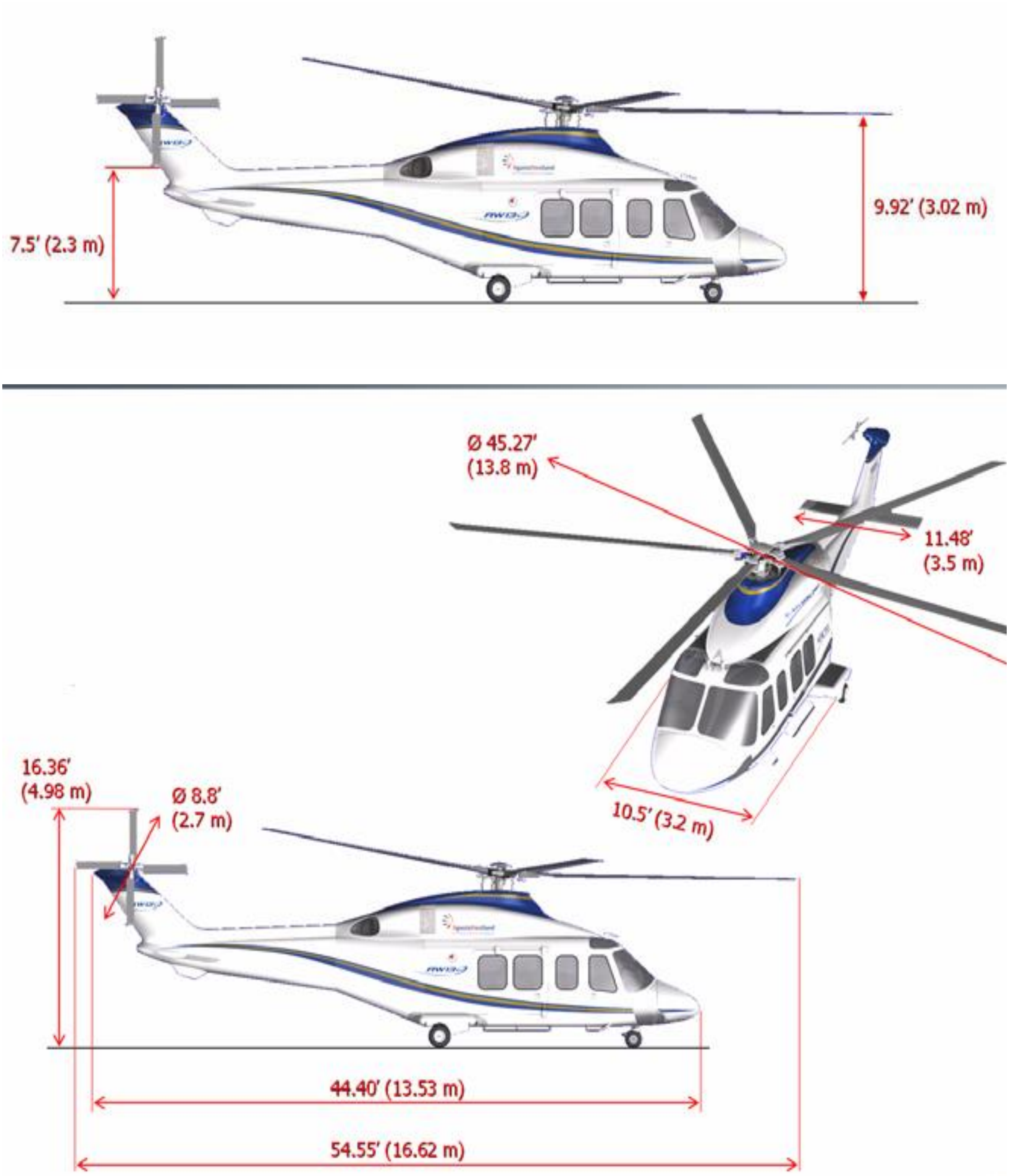

Figure 2: AW139 Dimensions

3.2. Helicopter Landing Site Loading and Dimensions

The primary reference for the following information is the Guidelines. All loadings and dimensions are based upon the Design Helicopter at Maximum Take Off Weight (MTOW) of 6.8 tonnes.

Therefore, the minimum acceptable static loading for the HLS is 6.8 tonnes.

3.2.1. FATO

Diameter minimum 1.5 x Length = 1.5 x 16.62 m = 24.93 m, and a maximum slope in any direction not exceeding 3%. Rounded up, the FATO is required to be a diameter **of 25 m**. The FATO is to be load bearing (See Figure 3).

3.2.2. TLOF

Diameter minimum 1 x main rotor dia. of 13.8 m. Rounded to a diameter **of 14 m**. The TLOF is load bearing (See Figure 4).

3.2.3. Safety Area

The FATO shall be surrounded by a Safety Area which is to be free of all obstacles.

The purpose of a Safety Area is to:

- reduce the risk of damage to a helicopter caused to move off the FATO by the effect of turbulence or cross-wind, mislanding if on- grade, or mishandling; and
- protect helicopters flying over the area during landing, missed approach or take-off by providing an area which is cleared of all personnel and obstacles except small, frangible objects which, because of their function, must be located on the area.

A Safety Area surrounding a FATO intended to be used in visual meteorological conditions (VMC) shall extend outwards from the periphery of the FATO for a distance of 0.3 times the rotor diameter (RD) of the Design Helicopter. This size assumes that all markings and lighting will be in place.

Therefore, 0.3 x L (13.8 m) = 4.14 m. The Safety Area width surrounding the FATO is thus rounded to 4m. The total diameter of a round HLS including the Safety Area will therefore be **(25 + 8 m) = 33m** (See Figure 4).

No fixed object shall be permitted on a Safety Area, except for frangibly mounted objects which, because of their function, must be located on the area. No mobile object shall be permitted on a Safety Area during helicopter operations. Objects whose functions require them to be located on the safety area shall not exceed a height of 20- 25 cm when located along the edge of the FATO, nor penetrate a plane originating at a height of 20-25 cm above the edge of the FATO and sloping upwards and outwards from the edge of the FATO at a gradient of 5%.

The surface of the Safety Area shall not exceed an upward slope of 3º or 5% outwards from the edge of the FATO.

The surface of the Safety Area abutting the FATO shall be continuous with the FATO. For rooftop HLS the Safety area may in in space. The minimum recommended Safety Area surrounding the FATO is dependent upon whether there are suitable markings for the FATO, the TLOF and the central “H”.

Figures 3 and 4 following are examples of round HLS showing the dimensions[1].

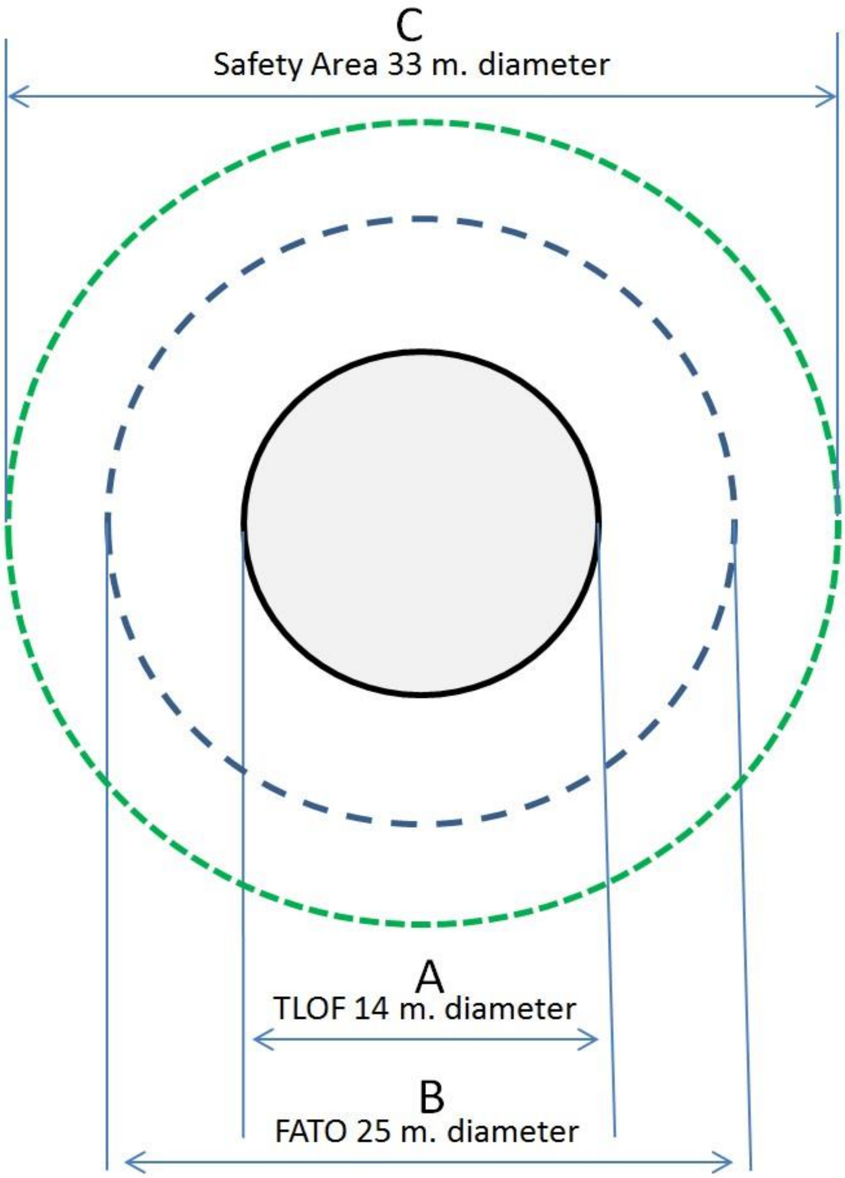

Figure 3: TLOF and FATO/Safety Area Relationships and Dimensions

Note: Preference is for a round HLS.

Design Helicopter:	**Agusta AW139**
RD:	Rotor diameter of the design helicopter
L:	Overall length of the design helicopter
A –TLOF diameter:	1.0 x RD (14 m)
B –FATO diameter:	1.5 x L (25 m). All load bearing.
C –Safety Area width:	0.3 x RD (4 m)

Min separation between perimeters of the TLOF and FATO: 0.5 (1.5 x OL – 1.0 x RD) (5.5 m)

[1] AC 150/5390-2C

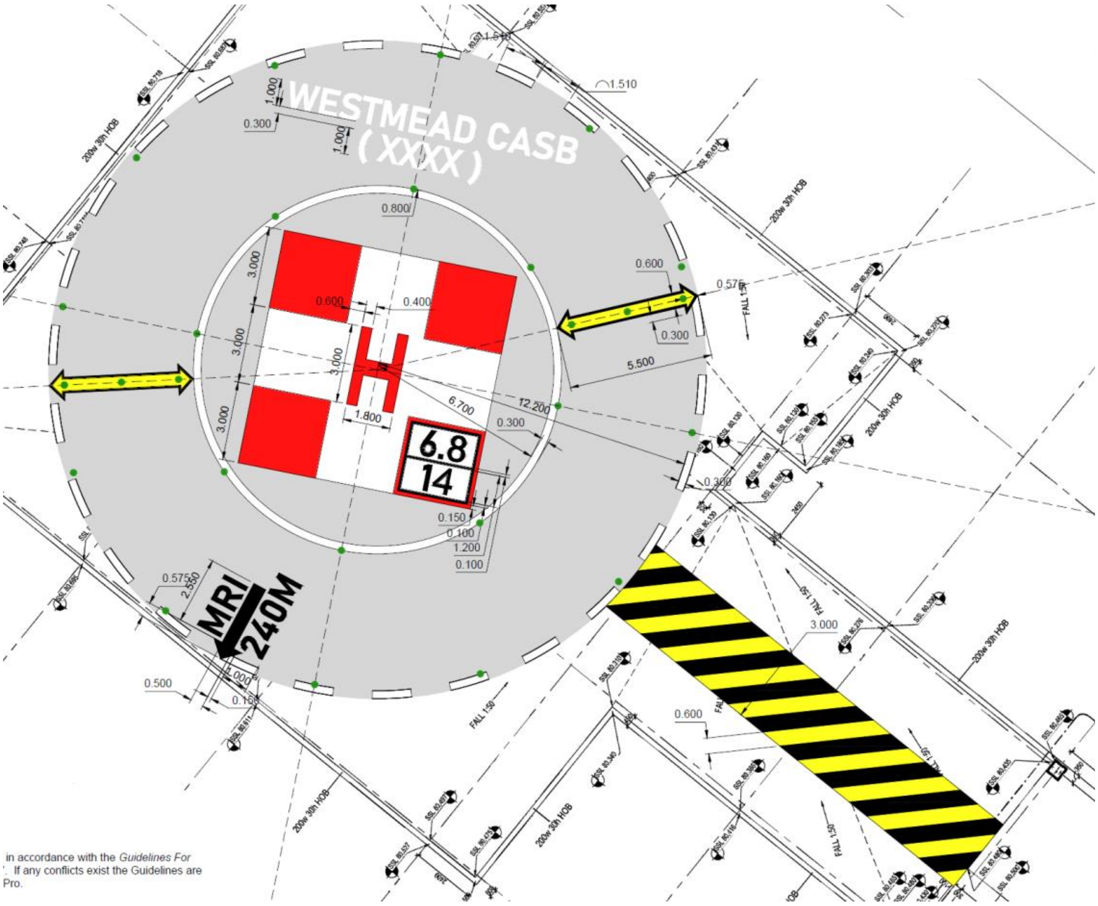

Figure 4: An example HLS illustrating TLOF, FATO, "H" and Weight/Rotor Diameter Markings

Note:

1. The "H" is orientated to Magnetic North.
2. The perimeter of the TLOF is defined with a continuous, 30 cm wide white line.
3. The perimeter of the FATO is defined with a 30 cm dashed white line approximately 1.5m. in length, and with end-to-end spacing of approximately 1.5 m.
4. VFR approach/departure path direction are examples only.
5. HLS deck static weight limit for the AW139 is minimum 6.8 tons.

3.3. Object Identification Surfaces (OIS)

Where possible, the OIS as specified in the Guidelines are to be met. However, at most hospital HLS, existing obstructions do not allow for this standard to be met. It can normally only be accommodated at a "new" rural hospital "green field" location or on a roof top HLS which is high above the surroundings

The OIS can be described as:

- In all directions from the Safety Area, except under the approach /departure paths, the OIS starts at the Safety Area perimeter and extends out horizontally for a distance of ~30 m.
- Under the approach/departure surface, the OIS starts from the outside edge of the FATO and extends horizontally out for a distance of ~700 m. From this point, the OIS extends out for an additional distance ~2,800 m while rising on a 2.5º or 22:1 slope (22 units horizontal in 1 unit vertical). From the point ~700 m from the FATO perimeter, the OIS is ~30 m beneath the approach/departure surface.

- Safety surface width increases as a function of distance from the Safety Area. From the Safety Area perimeter, the OIS extends laterally to a point ~30 m outside the Safety Area perimeter. At the upper end of the surface, the OIS extends laterally ~60 m on either side of the approach/departure path. See Figure 5.

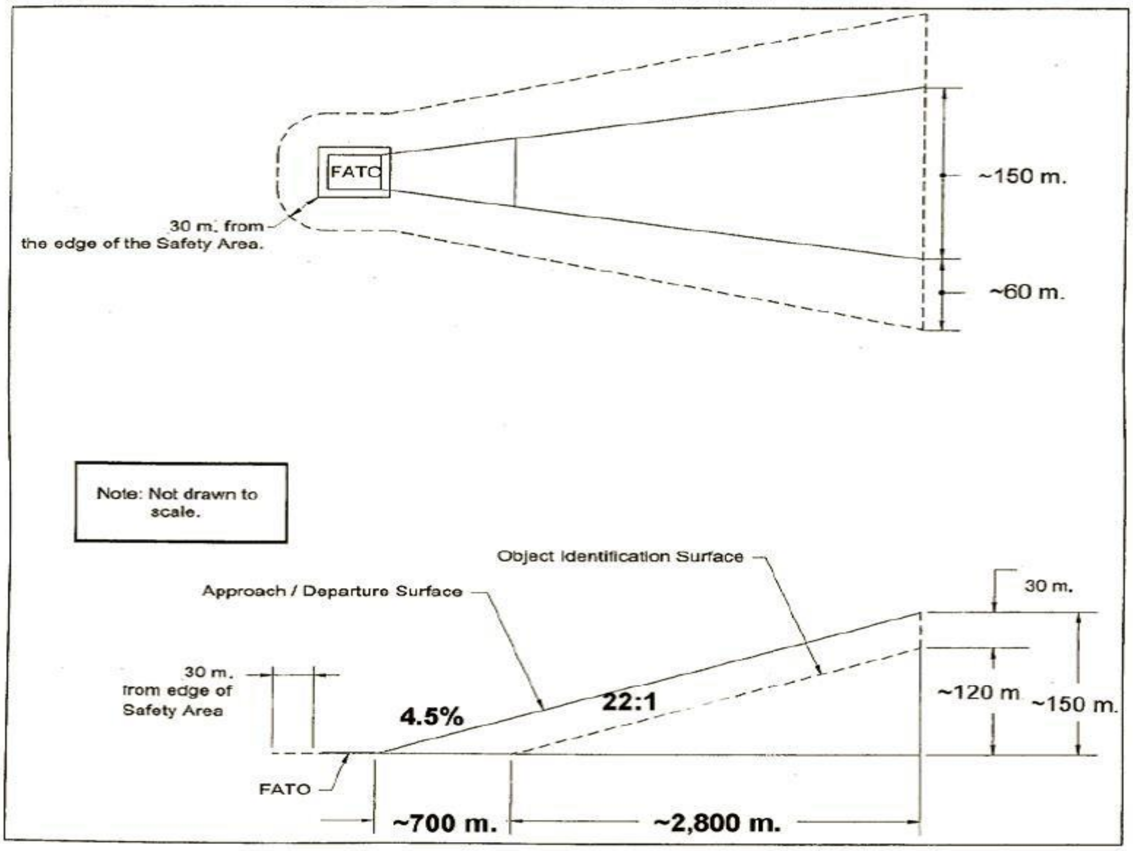

Figure 5: Object Identification Surface

The OIS is used for the purpose of the Design Development Overlay (DDO) and sits below each VFR approach and departure path to provide flight path protection. The OIS below a VFR approach and departure path is the limit for the penetration of obstructions below the flight path. That is, there should be no future development penetrating the OIS. The OIS extends out to 3.5 km from the forward edge of the FATO.

3.4. VFR Approach/Departure Paths

The purpose of approach/departure flight path airspace is to provide sufficient airspace clear of hazards to allow safe approaches to and departures from landing sites.

VFR approach/departure paths should be such that there are no downwind operations and crosswind operations are kept to a minimum. To accomplish this, an HLS must have more than one approach/departure path which provides an additional safety margin and operational flexibility.

The preferred flight approach/departure path should where possible, be aligned with the predominate wind when taking account of potential obstacles. Other approach/ departure paths should also be based on an assessment of the prevailing winds and potential obstacles. The separation between such flight paths should not be less than 150 degrees, and preferably180 degrees.

3.5. VFR Approach/Departure and Transitional Surfaces

An approach/departure surface is centred on each approach/ departure path. Under the Guidelines, the approach/departure path starts at the forward edge of the FATO and slopes upward at 2.5°/4.5%/22:1 (22 units horizontal in 1 unit vertical) for a distance of ~3,500 m. The approach /departure path commences at the FATO width of 25 m and expands uniformly to a width of 150 m at a distance of 3,500 m, where the height is 500 feet above the elevation of FATO surface. For PC1 survey purposes, the survey commences from the forward edge of the FATO in the flight path direction, from a datum point 1.5 m above the FATO edge. The VFR approach /departure paths are to be obstacle free. It is important to achieve 2.5° obstacle free to account for the performance requirements of one engine inoperative (OEI) flight following an emergency.

The transitional surface starts from the edges of the FATO parallel to the flight path centre line and extends outwards (to the sides) at a slope of 2:1 (2 units horizontal in 1 unit vertical or 26.6°) from the outer edges of approach/departure surface. The outer sides are 75 m from the centreline, i.e. the outer edges are 150 m wide. The transitional surfaces start at the forward edge of the FATO, overlaid over the approach/departure path (surfaces) and extend to the end of the approach/departure surface at 3,500 m. See Figure 6.

> ***Note**: The transitional surface is not applied on the FATO edge opposite the approach departure surface.*

The approach/departure surface is to be free of penetrations. Any penetration of the transitional surface is to be considered a hazard.

Figure 6 illustrates the VFR approach/departure and transitional surfaces.

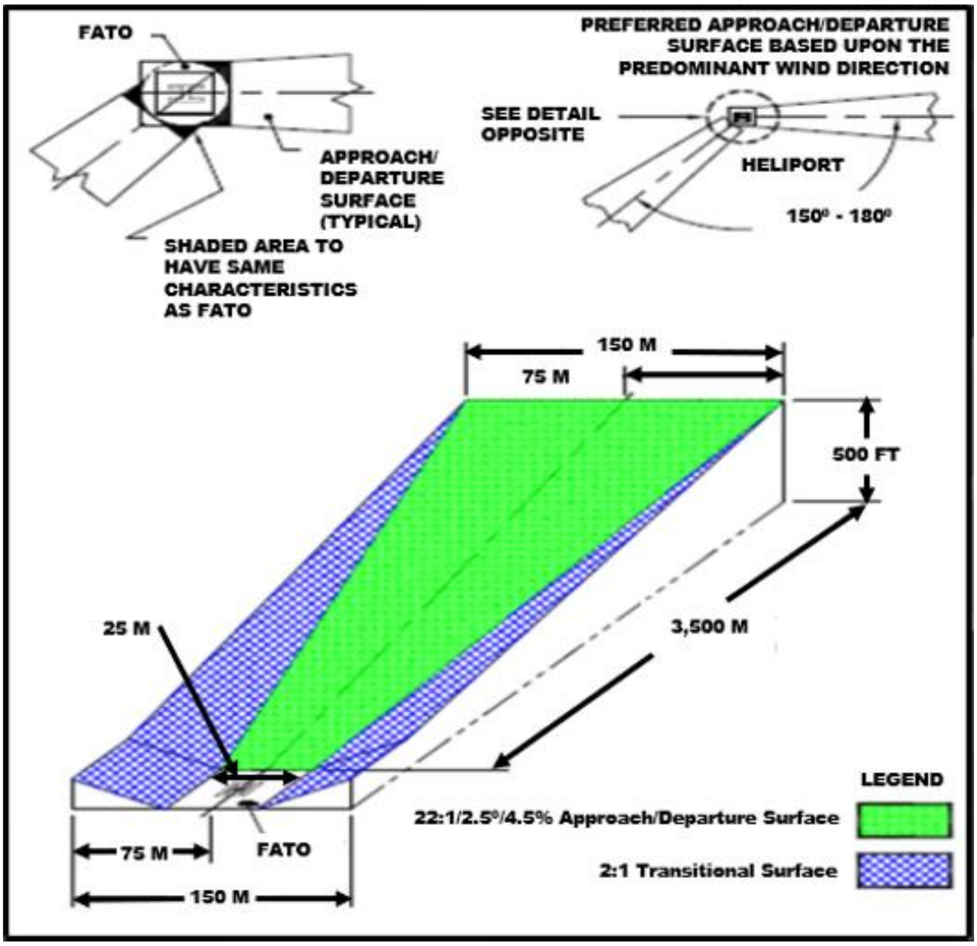

Figure 6: HLS VFR Approach/Departure and Transitional Surfaces

3.6. Obstructions on or in the Vicinity of the HLS

The adverse effect of an object presumed or determined to be a hazard to air navigation may be mitigated by:

- Removing the object.
- Altering the object, e.g. reducing its height.
- Marking and/or lighting the object, provided that the object would not be a hazard to air navigation if it were marked and lit.

An example of an obstruction light required close to the HLS would be that required to be positioned on the top of the windsock. Other obstacles in close proximity to the HLS deck may include radio aerials or exhaust stacks etc. attached to the main building, other buildings in the vicinity such as a lift lobby, or stand alone. All such obstacles are required to have red obstacle lights fitted.

3.7. Obstructions in close Proximity but Outside/Below the Approach/Departure Surface

Unmarked wires, antennae, poles, cell towers, and similar objects are often difficult to see in time for a pilot to successfully take evasive action, even in the best daylight weather. Pilots can avoid such objects during enroute operations by flying well above them. Approaches and departures require operations where obstacles may be in closer proximity.

Where possible obstructions are to be moved, however if this is impractical, markings and/or obstruction lighting is to be affixed.

3.8. Prevailing Winds

Helicopters require and use head wind to advantage during both takeoff and landing. A head wind component will provide its maximum benefit when coming from directly in front of a helicopter. During takeoff it will improve performance by reducing the amount of power required and/or allow for increased payload and/or allow for an increased angle of climb and will allow for a reduction in power required for landing.

A headwind is effectively air flow through the rotor system (disc) which provides its first positive performance benefit (translational lift) during takeoff at approximately 15 knots, depending on the type of helicopter. Performance improves until best rate of climb speed is achieved at approximately 70 knots, depending on the helicopter type. The transition from hover to takeoff safety speed (V^{TOSS}) during takeoff is the most critical phase of flight. V^{TOSS} is dependent on the helicopter type and is generally between 40-50 knots.

It is therefore important to review the prevailing wind direction and speed when considering approach and departure paths to and from an HLS. It is however even more important to achieve two approach and departure paths which are at least 150º apart and preferably 180º apart. Achieving two approach/departure paths 180º apart is far more important than aligning a path or paths with the estimated prevailing wind. As long as there is a head wind component there is advantage. Except for periods of extreme weather with excessively strong winds and turbulence, there is almost no time that an HLS would be unusable due to wind direction if two paths 180º apart are available.

The most common methods of securing local wind information is via the Bureau of Meteorology automated weather stations. A less effective and less popular method is the use of the CSIRO's TAPM (The Air Pollution Model). TAPM is designed to estimate the spread of air pollution and is a simulation and purely a prognostic model which provides only a very rough idea. It does not take account of the local topographical situation. TAPM is invariably of little assistance due to its unreliability.

If a BoM weather station is within a reasonable distance of the location of interest, it is the most accurate and reliable source of information.

3.9. Turbulence

Air flowing around and over buildings, stands of trees, terrain irregularities, etc. can create turbulence that may affect helicopter operations. Rotor downwash coming up against a close wall can also produce considerable turbulence and recirculation.

A wind and air quality study of the area should be considered.

3.10. Exhaust Gas Ingestion

Hospital air conditioning air intake systems should not be positioned in the vicinity of an HLS. Under particular wind conditions the exhaust gases emitted from the helicopter engines exhausts can travel for some distance. It may be necessary to install a venting system that is closed during helicopter movements. Reference to a Qualitative Turbulence and Air Quality Study of the area may be relevant.

Some HLS designs incorporate a vent shut-off valve that is linked to the activation of the HLS lights. Therefore, when a helicopter pilot or hospital staff member activates the lights (radio/switch respectively), the air shut-off valve activates before the helicopter (and fumes) arrives at the HLS for the landing.

3.11. HLS Covering and Marking

In accordance with Section 3.9.1 of the Guidelines, the HLS deck is to be painted in a light grey, hydrocarbon, water and UV resistant non-slip paint. All marking materials are to meet the same resistance requirements.

The FATO and TLOF dimensions are to be defined by markings which also include the hospital cross, the “H”, the static weight limit and main rotor diameter of the Design Helicopter. Additionally, the name of the HLS and its Airservices identification code are to be marked on the surface.

When the hospital has an MRI, its direction and distance are to be marked on the deck. Figure 4 provides an example of markings for a ground level HLS.

Complete marking details are found in the Guidelines.

3.12. HLS Lighting

For night operations, the TLOF, the FATO, and the windsock must be illuminated. All lights other than flood lights must be Night Vision Goggles (NVG) compliant and must be visible from a distance of at least 3 km at the prevailing Lowest Safe Altitude (LSALT) in clear conditions. That is, all lighting must be visible both with and without the use of NVGs under these conditions.

To meet NVG requirements, all lights must operate within the wavelength range of 600 and 900 nanometer (nm). Current generation LED lights have been found noncompliant unless they are equipped with additional IR LEDs providing a wavelength of Approximately 850 nm.

This wavelength requirement applies to all obstruction lights used on the hospital infrastructure and on all cranes used in the vicinity of the HLS.

A statement relating to NVG compliance is required from the lighting contractor. The approach/departure paths are to have the appropriate NVG compliant yellow lights over yellow arrows.

3.12.1. TLOF Perimeter Lights

Eight uniformly spaced NVG compliant flush mounted green lights are to define the perimeter of the TLOF. Flush mounted lights are to be used, and they are to be located preferably within the white TLOF defining circle, but in no case more than 30 cm from the outside edge of the TLOF perimeter.

3.12.2. FATO Perimeter Lights

Twelve uniformly spaced NVG compliant flush mounted green lights are to define the perimeter of the FATO. Flush mounted lights are to be used, and they are to be located preferably within the white FATO defining (broken) circle, but in no case more than 30 cm from the outside edge of the FATO perimeter.

3.12.3. Landing and Take-Off Direction Lights

Landing and Take-Off direction lights are a feature of the HLS. The lighting is positioned equally spaced within yellow direction path arrows located between the TLOF and FATO markings.

Landing direction lights are a configuration of three NVG compliant yellow, flush mounted omni-directional lights on the centreline of a yellow two-headed arrow with black borders painted on the HLS deck. The arrows and lights also signify the PC1 surveyed approach/ departure path directions. See Figure 7.

Figure 7: Approach/Departure Directional Arrow and Lights

Note: 1. Lights are flush mounted NVG compliant yellow omni-directional.

2. Arrow is yellow with a black border.

3.12.4. Windsock Lighting

The windsock is to be illuminated from above by four closely mounted white lights to ensure that it may be seen clearly from all directions. A steady red low intensity obstruction light is to be positioned on the top of the mast. See Figure 8.

Figure 8: Example Windsock Lighting

3.12.5. Flood Lights

Appropriately positioned flood lights illuminate the TLOF and the FATO for the purposes of aiding patient loading and unloading. To eliminate the need for tall poles, these flood lights may be mounted on a co-located building wall if it is high enough. The flood lights are to be clear of the TLOF, the FATO, the Safety Area, and the approach/departure surfaces and where possible, any required transitional surfaces.

Care should be taken to ensure that flood lights and their associated hardware do not constitute an obstruction hazard. Flood lights are to be aimed down and provide a minimum of 3-foot candles (32 lux) of illumination on the HLS surface and are to illuminate the area of the deck between the helicopter and the reception room/lift lobby.

Flood lights can interfere with pilot vision during takeoff and landings and must be capable of being independently manually turned off. They are to be on a separate circuit to that of all other lights. Flood lights are normally only illuminated for patient loading and unloading and are **not** to be illuminated during landing and takeoff.

3.12.6. HLS Identification Beacon

A hospital HLS identification beacon is to be located on the highest point of the hospital reasonably available. The beacon is to be visible through 360. The AC recommends a low intensity **10** nm beacon capable of flashing white/green/yellow at the rate of 30 to 45 flashes per minute. With a Pilot Activated Lighting (PAL) system, the beacon will be on the PAL circuit.

3.12.7. Lighting Activation

HLS lighting is to be on two independent circuits. Flood lighting is to be on one independent circuit, and all other lighting including FATO, TLOF, approach/departure directional lighting, windsock, the hospital HLS identification beacon, local obstruction lighting and any visual glideslope indicator installed, is to be on the second circuit.

The second circuit is normally controlled by a PAL system, whereas the flood lights are manually controlled only.

The PAL circuit must also have a manual override switch for testing and for use if there is a problem with the PAL activation. The PAL system utilises a hospital-based VHF radio and timed switching device. The pilot is able when within range (~20 nm), to activate via a VHF radio transmission from the aircraft, on a pre-set frequency. The PAL illumination system is to be set for 45 minutes duration. The PAL system will automatically flash the windsock lights at 35 minutes, i.e. ten minutes prior to automatic turn off.

3.13. Airspace

Civil Aviation Safety Authority/Airservices Australia approvals (through Council) may be required if primary prescribed airspace could be impinged. Primary prescribed airspace includes an airport's OIS involving a set of imaginary surfaces associated with an aerodrome that should be kept free of obstacles.

Additionally, the Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) that takes account of the airspace associated with aircraft instrument procedures, must be considered (again applied for through Council).

Instrument approach procedures should also be assessed for nearby airports (if applicable) to ensure cranes do not obstruct lower segments of the final stage of the instrument approaches.

The normal contacts for this process are local councils in the first instance or the airport operator.

3.14. Noise and Vibration

Helicopters generate both noise and vibration. Where possible flights are conducted on a "Fly Neighbourly" basis with overflight of buildings, particularly those occupied, avoided. In the case of the NMH, the urban area surrounding the hospital makes overflight over occupied housing and industrial buildings along the flight paths inevitable. "Fly Neighbourly" procedures will however be followed at all times.

A combination of helicopter noise and downwash created by the main rotors can cause vibration to existing and new buildings. Local building codes and Australian Standards should be consulted for guidance in this area. There is no guidance information provided within the Guidelines.

Noise effect from the proposed HLS deck height will be dependent on the wind direction and strength and the frequency of movements.

It is relevant to understand the estimated expired time that applies to helicopter movements into and from HLS. This is important when quantifying noise events.

Helicopter arrival:	1 minute	Approach and land
	2 minutes	Engine stabilise before shutdown
Total	3 minutes	
Helicopter departure:	2 minutes	Start-up and hover
	1 minute	Backup and depart
Total:	3 minutes	

3.15. Main Rotor Downwash

The effects of main rotor downwash must be considered, particularly during the take-off and landing phases of flight. Downwash behind the helicopter during Category A take-offs involving a rear moving climb, and landings, both when within 50-70 m of the HLS, can produce strong gusts capable of blowing over people and raising loose objects into the air.

The vertical velocity of the column of air beneath a hovering helicopter depends on several factors including surface wind, main rotor radius and 'disc loading' (the weight of the helicopter divided by the 'swept' area of the rotor disc).

Large helicopters not only have a greater mass, but they generally have a higher 'disc loading' when compared to smaller helicopters. This is because other design influences limit the practical main rotor radius on large helicopters. The AW139 is a larger medium helicopter and this inevitably means greater impact due to rotor downwash in the vicinity of the landing site that needs to be planned for in the design of the building and immediate surrounds.

The following Table provides the final velocity of the down wash for the AW139.

	Disc Loading		Air Density at Sea Level		Final Velocity	
	Metric	Imperial	Metric	Imperial	Metric	Imperial
	kg/m^2	lbs/ft^2	kg/m^3	$slugs/ft^3$	m/sec	ft/sec
AW 139	42.78897861	8.764518314	0.1225	0.002377	26.43095854	85.87454191
S 76C	37.56814994	7.695129654	0.1225	0.002377	24.76605641	80.46525238
B412 EP	34.95960439	7.16081811	0.1225	0.002377	23.89077335	77.62144588
EC 155	38.89652174	7.96722166	0.1225	0.002377	25.20010423	81.8754796

3.16. Slope and Drainage

The maximum slope in any direction across the FATO should not exceed a maximum of 3% and is recommended at 2%. Adequate water/spill drainage is required to account for prolonged heavy rain.

3.17. Fuel/Water Separator

A gravity operated fuel/water separator of sufficient size (total capacity of minimum 2,700 litres [static holding capacity of ~1,500 litres and integral storage of 1,200 litres]) is to be installed below a rooftop (elevated) HLS deck, to ensure that any fuel, oils and greases are appropriately collected in the event of spillage. The separator should have an adjustable oil draw-off, a contents indicator and integral baffle system. Common construction materials are concrete or stainless steel.

3.18. Fire Fighting Equipment

Firefighting equipment is to be available at all hospital HLS.

The Guidelines detail the minimum level of firefighting appliance coverage for a relatively low use HLS to be:

- a fire waterpoint with fire hose attached;
- 1 x CO2 3.5 kg;
- 1 x Dry Powder 9.0 kg;
- 1 x Foam 90 litres; and
- 1 x Fire Blanket.

On elevated HLS, such equipment is to be located close to the lift lobby/reception room, and it is also recommended that a second set be located below the deck in the emergency egress stair well. This allows a fire to be fought when the emergency situation limits access to the primary egress and associated firefighting equipment.

Consultation with the local fire authority and hospital administration may be required to assess the level of firefighting protection desired.

Although not currently a regulatory requirement, some hospital administrations have required a Fixed Monitor System (FMS) (foam installation) on elevated HLS. The CASA consultative group preparing the new HLS rules are considering adopting the standards of the US National Fire Protection Association, which are documented in NFPA 418 (Fire Protection) Standards for Heliports (which is therefore the Australian "default standard").

In most elevated HLS development, local fire brigades are usually invited to review the location, available fire-fighting capacity and also the pressures of the available hose reels on/adjacent to the HLS.

Deck Integrated Fire Fighting System (DIFFS). Whilst not a requirement for NMH, some rooftop HLS are also equipped with an automatic water deluge system or a DIFFS using up to 20,000lt of water as the deluge spreads from 19-25 nozzle points embedded into the HLS. DIFFS are more common and better integrated with perforated metal decks in offshore/maritime applications such as oil rigs (usually mandatory) and super-yachts. They can be integrated into concrete slabs and this application is most common in aircraft hangars. A DIFFS will incur a significant additional overhead in required space for plant (water and/or foam storage, pumping equipment etc.) and plumbing. In addition to up-front costs, an outdoor DIFFS also incurs higher through-life sustainment and maintenance overheads than either an FMS or composite system (water, CO_2, dry powder, foam and fire blanket).

Occasionally, foam may be considered as an additive to the water for an effective suppressant. In some cases, a build strategy may involve mitigating the HLS fire risk by having the fully fire protected plant room immediately below the HLS.

A DIFFS requires a much larger fuel-water separator to deal with the deluge when operated. Lismore Hospital has a prefabricated HLS deck and water DIFFS system installed. See Figures 9 and 10. A DIFFS is not recommended for NMH.

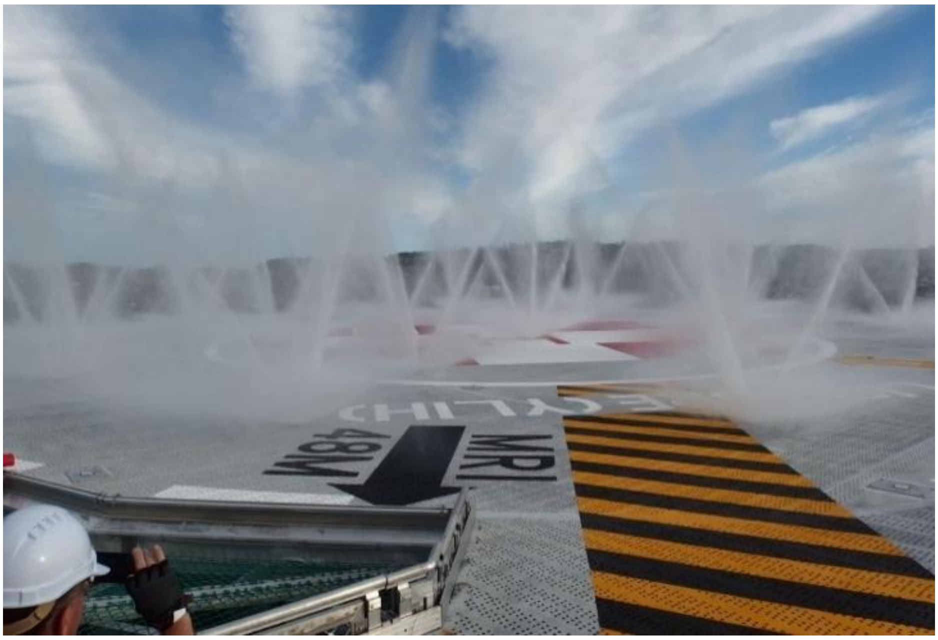

Figure 9: Example of an activated water DIFFS

Figure 10: Water DIFFS Storage Tank with Primary and Back-up Pumps

3.19. Security

Appropriate measures are required to restrict access to the HLS and this historically has been managed by the hospital security department. Access between the lift lobby and the HLS deck is normally via a swipe card. On the emergency egress exit, there is normally a grilled gate which may be opened from the HLS side, sprung closed and secure on the public side.

Under CASR Part 175, it is now a requirement to have a designated HLS Reporting Officer registered with Airservices. The HLSRO/Security Department would therefore be expected to manage the HLS on a day-to-day basis, including attendance at the HLS for all helicopter movements, daily inspections, the manual activation of at least flood lighting by night, and the coordination of HLS maintenance.

3.20. Local Approvals

The various legislative/regulatory requirements relating to HLS in NSW are complex. Current regulation excludes emergency service landing sites from the definition of “designated development” in the Environmental Planning and Assessment Regulation (which otherwise includes most HLS). Generally, hospital HLS are considered “ancillary-uses” to hospital purposes and are thus not separate “development”. The same cannot necessarily be said about off-site emergency medical HLS, e.g. local sports fields.

To ensure that all requirements are met, close consultation with the NSW Ambulance Aviation Consultant is to be maintained throughout the design and construction phase.

When construction of the HLS is complete, a final inspection on behalf of NSW Ambulance will be undertaken by the Aviation Consultant. When all is satisfactory, an acceptance letter from NSW Ambulance will be provided to Health Infrastructure.

3.21. Performance Class 1 Flight Paths Survey

Under proposed changes to CASA Rules, HEMS operations will fall under Medical Transport, an extension of a new Air Transport category. Operations are proposed to be undertaken to PC1. Both PC1 and PC2 require a Category A certified helicopter meeting the relevant Category A requirements, approaching and departing a PC1 accredited HLS along VFR approach and departure paths, which have been surveyed for obstacles. The survey must be "current" and be provided to the operator so that appropriate Category A procedures may be planned.

To meet PC1 requirements, VFR approach and departure paths are to have no obstacles penetrating 2.5º/4.5%/22:1. Likewise obstacles should not be penetrating the adjacent transitional surface; however, some penetration may be accepted depending on the amount of penetration and the proximity to the relative flight path.

The survey is to be prepared by a licensed surveyor and involve:

- A survey covering the entire VFR approach and departure path and transitional surface area for each flight path. The entire area is a rectangle 150 m x 3,500 m, commencing from the forward edge of the FATO at eye height (1.5 m) extending out at 2.5° for 3.5 km. At 3.5 km, the flight path is Approximately 500 ft above the HLS elevation. The width of the flight path at the commencement (FATO edge) is 25 m, expanding uniformly to 150 m at a distance of 3.5 km.
- The transitional surface extends laterally from the outer edges of the flight paths at 2:1.
- A written report. Refer to NSW Ambulance for advice on content.
- A plan drawing out to the limit of any obstruction along the flight path/s accompanied by a statement to the effect that no obstructions exist beyond the relevant distance.
- A side elevation drawing out to the extent of the obstructions along the flight path/s. Drawings are to clearly show the horizontal distance to obstructions, the height of the obstruction above the HLS elevation and the height of the penetration above 2.5º.
- 3D modelling along the flight paths is a very effective method of showing obstacles and their relative position etc., and is to be provided.

Advice on survey providers who have met NSW Ambulance requirements can be provided. A completed survey and Design Development Overlay (DDO) report is required to meet NSW Ambulance HLS acceptance/certification requirements.

This survey should be included in the contractor's Scope of Work.

3.22. Flight Path Protection/Design Development Overlay

Currently no Federal or NSW State legislation is in place to protect VFR approach and departure paths and the transitional surfaces associated with hospital HLS. In Victoria, there is legislation through the Department of Planning and the MoH, requiring a DDO to be prepared to protect the area below hospital HLS flight paths. This is normally completed in association with the PC1 survey. In Victoria, any Development application to the local Council that could have an effect on a hospital HLS flight path must be passed via the MoH for a determination. No obstacle should penetrate the OIS below the flightpath. The Council are then required to follow the direction of the DoH.

In the absence of current formal NSW legislation, which is now under consideration, it is recommended that a DDO be prepared at the time of the PC1 VFR approach and departure paths and the transitional surface survey. Subsequently, the survey report and DDO should then be passed to the local Council with advice that the flight paths require protection and that any proposed development in the vicinity be referred to MoH.

3.23. Hospital HLS Operations Manual

Each hospital HLS is required to hold an HLS Operations Manual.

Under the proposed incoming CASA legislation CASR Part 139R, CASA will also require a “HLS Exposition” which is in effect an Operations Manual. The purpose of the HLS Operations Manual is to document the personnel responsibilities, activities and procedures necessary for the efficient and safe operation of the Hospital HLS.

Details include the Airservices Australia HLSRO requirements and procedures, inspection and maintenance procedures, and aircraft and clinical procedures on the HLS deck. Information is located within the Guidelines.

This is normally commissioned by the LHD or Hospital just before the handover of the facility to NSW MoH.

4. SPECIFIC NMH HLS CONSIDERATIONS

4.1. Rooftop HLS

Rooftop HLS are the most common form of HLS construction particularly in urban and built up areas and have been constructed at both existing and new hospitals. Rooftop HLS demonstrate significant advantages over ground level options. The positioning of an HLS on the rooftop,if sufficiently high enough, will normally resolve most obstruction issues. It will also allow for more approach/departure options to take account of the wind strength and direction.

Safety Areas around an elevated HLS are usually partially in “space”, except for the access path and therefore do not involve large loss of surface area.

Following a recent decision by the Health Infrastructure Executive Steering Committee, the HLS for the NMH is now to be located on the hospital rooftop. The location of HLS is shown in Figure 11.

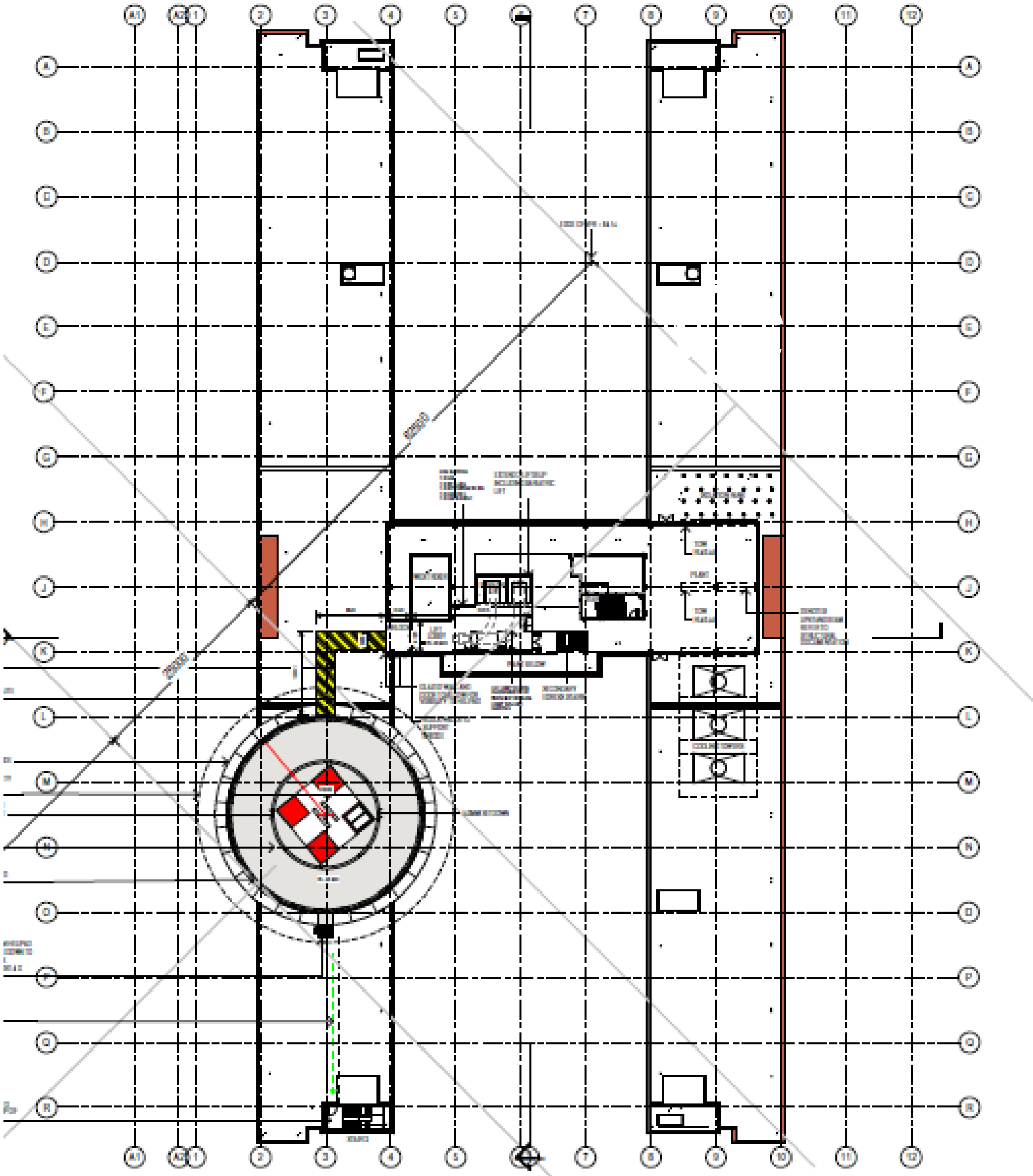

Figure 11: Proposed HLS Location

To meet helicopter PC1 requirements, the design of HLS must consider the helicopter type Category A certification requirements as detailed in the relevant Rotorcraft Flight Manual (RFM). To meet Category A requirements, HLS must meet specific dimensions, have the necessary lighting and meet static weight limitations for the “Design Helicopter”. There are also minimum HLS height requirements above obstacles, to allow for emergency situations.

4.2. HLS and Emergency Department Proximity

It is a requirement that an emergency services HLS be within 100 m of the ED, ICU or NICU as the case may be and allow ready access to these areas. In the case of an elevated HLS, there is normally a need for one or more lifts and appropriate passageways at least 1.8 m wide. The location of the ED is within an appropriate distance of the HLS.

4.3. Prevailing Winds

The Bureau of Meteorology has a weather station at Cessnock Airport, 22 km from the hospital site. Readings show that average annual predominant winds in the area are from the North-West in the morning and change to the South-East in the afternoon. See Figures 12 and 13. This information is relevant during planning to account for any obstructions along the paths.

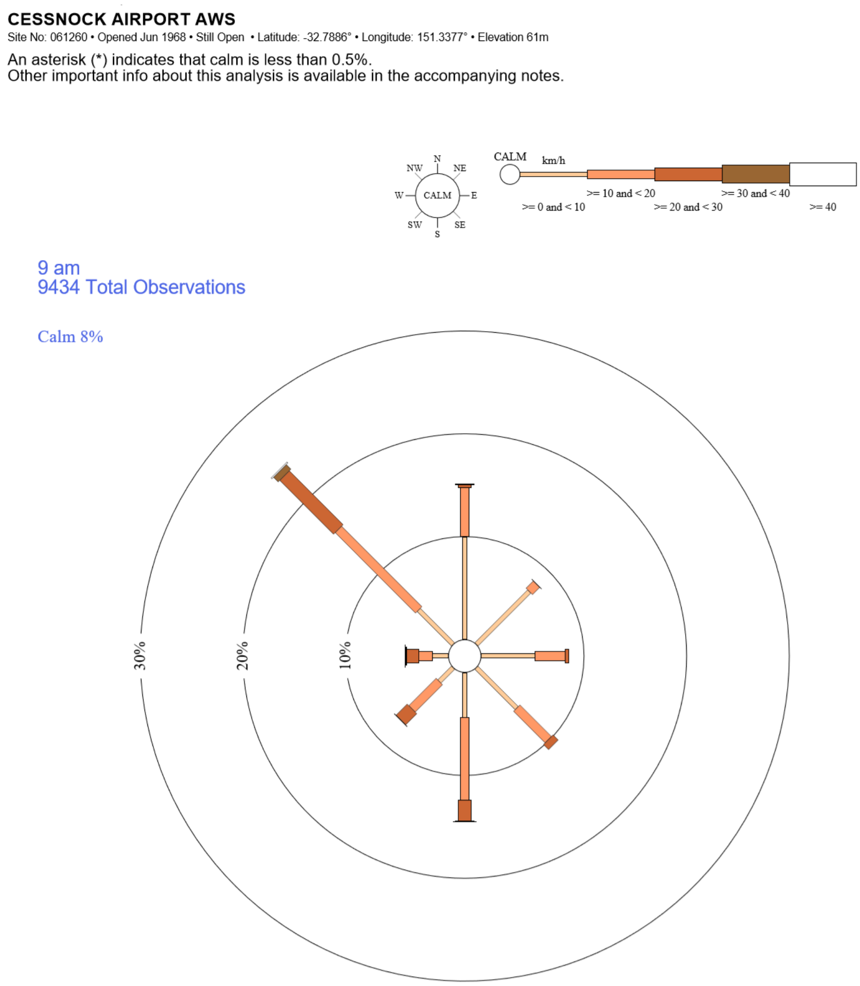

Figure 12: Cessnock Airport AWS 0900 Wind Rose – Annual Average

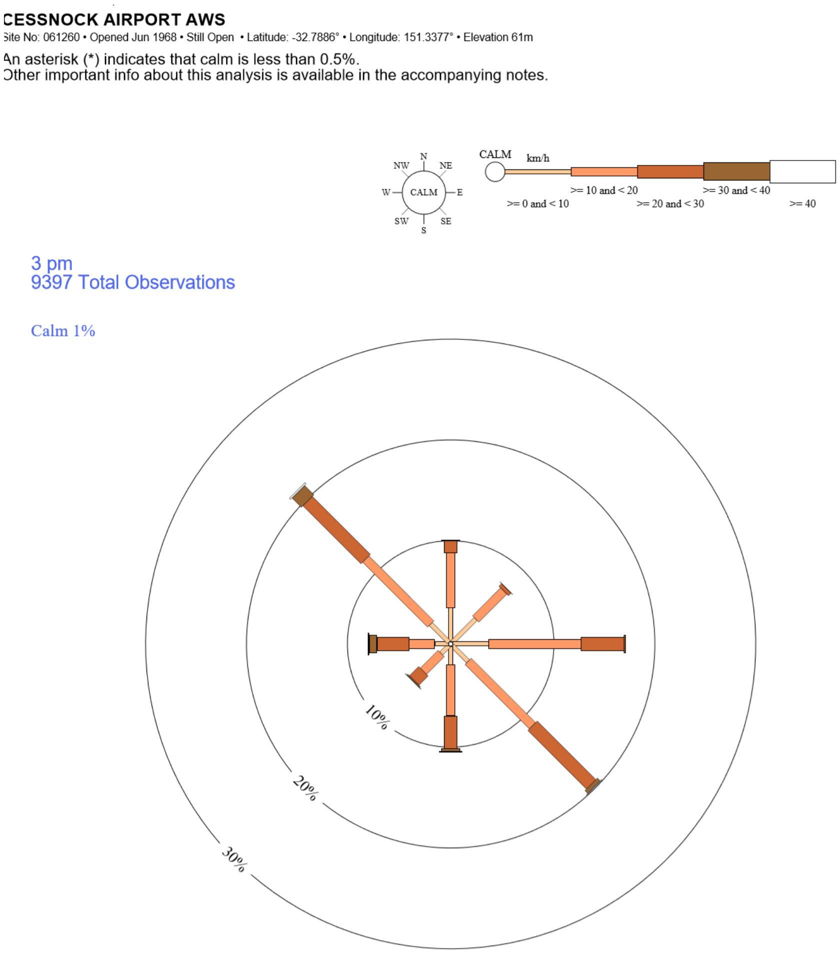

Figure 13: Cessnock Airport AWS 1500 Wind Rose – Annual Average

Important criteria for approach/departure paths is that there be a minimum of two that are at least 150° apart. In this scenario, the two main paths are 180° apart, which is the ideal. The helicopters can accommodate quite strong quartering tail winds and therefore there would be few if any occasions when wind direction alone would lead to the HLS being unusable. The preference however, is to have some component of head wind when landing or departing.

Extremely strong wind conditions on the other hand may cause a temporary closure regardless of direction. The two flight paths should allow for acceptable head wind components at almost all times.

The elevated HLS positioning above Level 6 provides for additional approach/departure path options whereby the pilot can land or takeoff into wind from most directions where infrastructure permits.

Prior to acceptance by NSW Ambulance, a VFR approach and Departure Path and Transitional Surface survey combined with a Design Development Overlay survey will need to be completed.

4.4. Turbulence on the HLS

The proposed HLS is positioned on the rooftop of the hospital building. There may be some turbulence caused by the profile of the building. The design that is proposed together with the capability of the helicopter should allow for the use of the HLS at most times other than severe squalling winds.

4.5. Hazards to Safe Flight and Sensitive Receivers

In selecting suitable approach and departure directions, significant safety hazards and community/environmentally sensitive areas are considered, and where possible avoided. The NMH has a significant set of electricity power lines running along the southern boundary of the property. A model aircraft flying field is located to the north-east of the HLS. A number of flying fox and bat locations exist in the general area of the NMH. The location of these "avoid" areas, in relation to the HLS location, is shown in Figure 14 below.

Figure 14: Flight safety hazards and sensitive receivers near the HLS

Model aircraft flown from the Don Macindoe Memorial Flying Field are quite large and may present as a serious hazard to safe flight. See Figure 15 below. Helicopter operations could also interfere with model aircraft flights so these two activities are a high priority for deconfliction. This is best achieved by HLS approach and departure path design and through development of common procedures between helicopter operators and the model aircraft flying club as part of HLS commissioning.

Figure 15: Model aircraft at Don Macindoe Memorial Flying Field

HLS approach and departure path design should avoid known bird and flying mammal camping/roosting areas. Whilst collision with flying animals is unlikely to cause damage to modern helicopters, there is a maintenance overhead for inspection, as well as helicopter "down time". Equally, environmental concerns must be addressed and where safe and feasible, approach and departure paths should provide for maximum separation.

4.6. Exhaust Gas Ingestion

The positioning of exhaust ducts, ventilation outlets and air conditioning systems need to be considered relative to the HLS location. See Section 3.10. Exhaust ducts/vents and other outlets, as well as intakes may also act as transporters of helicopter noise deep into the hospital building. Maximum distance is advisable between the HLS and such fixtures.

4.7. Obstructions and VFR Approach/Departure Paths and Transitional Surfaces

Taking into account wind, hazards and avoid areas, the proposed VFR approach and departure path (see Figure 16) is oriented slightly towards the North-West and South-East. Subject to formal survey, it is apparent that there are no obstructions along the proposed VFR approach and departure paths. These final VFR approach and departure paths will need to be selected to achieve an obstacle free gradient of 2.5º (4.5% or 1:22 vertical to horizontal), measured from a point 1.5 m above the forward edge of a 25 m diameter FATO, to a height of 500 feet above the FATO at a distance of ~3,500 m.

The VFR approach and departure surfaces commence at 25 m width at the FATO forward edge and splay out to 150 m width at ~3,500 m distance. Overlaid on the VFR approach and departure paths, are the transitional surfaces. They commence 75 m either side of the centre of the FATO and extend effectively as a rectangle 150 x 3,500 m with the centre of the flight path longitudinally through the middle.

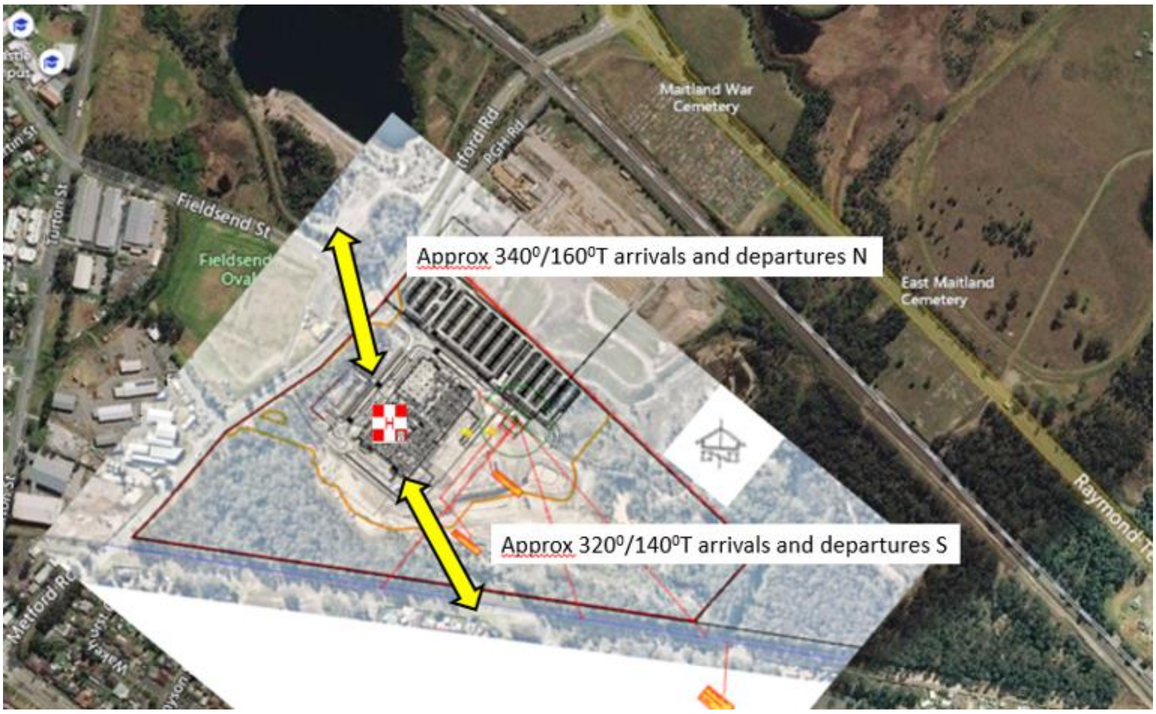

Figure 16: 'Indicative' VFR Approach and Departure Path Directions

Due to the urban environment to the south of NMH, it is not possible to position the VFR approach and departure paths totally clear of housing or occupied buildings. It will be necessary in some instances to overly the suburb of Metford to the South/South-East of the development. Approach and departure paths in relation to hazards, environmentally sensitive areas and other sensitive receivers are shown in Figure 17 below.

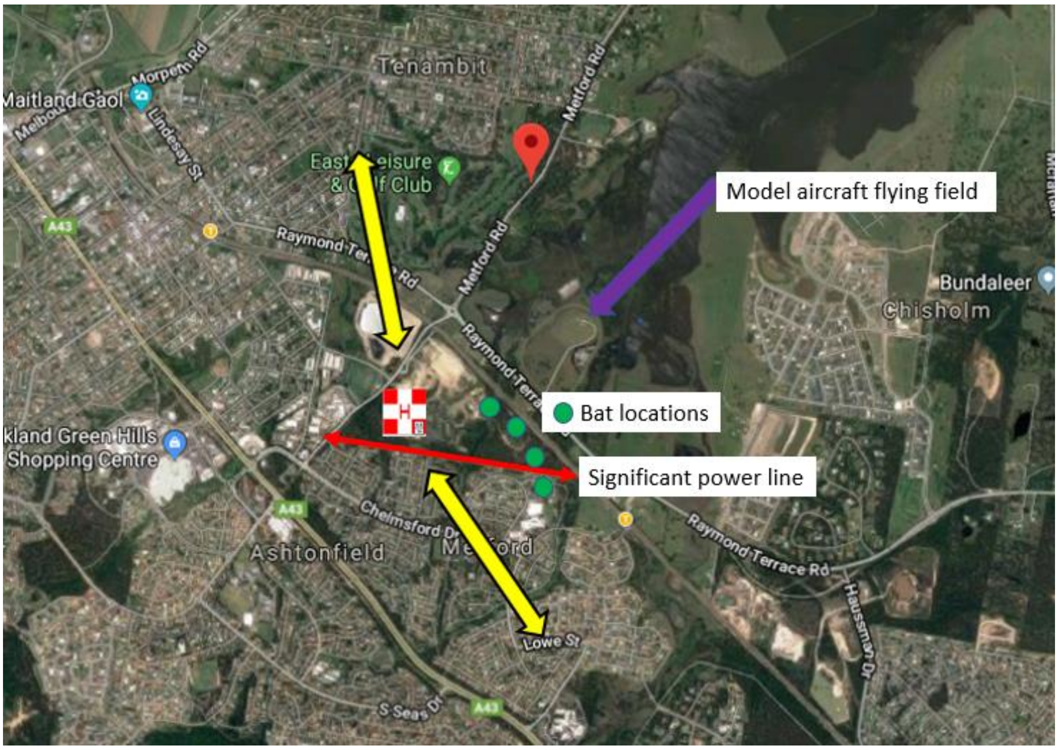

Figure 17: Approach and Departure Paths in relation to hazards and sensitive areas

4.8. HLS Object Identification Surfaces (OIS)

The area surrounding the hospital when viewed from the proposed HLS position should allow for the OIS recommendations to be met, with the exception of a potential lift lobby, the accompanying windsock and the HLS identification beacon. That is, a horizontal circle of diameter 93 m (33 m Safety Area + 30 m + 30 m) around the HLS centre without the penetration of obstructions, extending horizontally below the approach and departure paths for ~700 m, also without the penetration of obstructions, and then climbing at 2.5º out to a total distance from the FATO of ~3,500m without obstruction penetration.

4.9. Acoustic Mapping

If acoustic mapping is required for the DA, the flight paths depicted in Figure 16 are to be used. The Acoustic Engineer also needs to utilise the data for the Leonardo Agusta Westland AW139 helicopter.

4.10. HLS Design

The design criteria are detailed in The Guidelines.

4.10.1. Size and Loading

The proposed HLS comprises of a single-spot operational area. It will be load bearing to facilitate approach/departure operations.

Concept drawings will be required to accommodate the rooftop HLS with a load bearing FATO of 25 m diameter meeting the requirements of the Design Helicopter and adequate to accommodate a dual HLS.

It is a requirement that an emergency services HLS be within 100 m of the ED, ICU or NICU (as applicable) and allow ready access to these areas. The proposed positioning of the HLS meets the requirements.

4.10.2. Lighting

The HLS requires flush mounted NVG compliant green FATO and TLOF perimeter lighting, as well as in-deck flush mounted NVG compliant yellow directional lighting.

An illuminated windsock with a steady red low intensity obstruction light will be required and is best mounted at the furthest point from the FATO boundary to minimise the obstruction. The windsock must be mounted a minimum of 2 m above the highest point and within 30 m of the HLS.

HLS lighting is to be on two separate circuits, a flood light circuit and a pilot activated lighting (PAL) circuit. The PAL circuit is to include the FATO, TLOF and VFR approach/departure lighting, the wind sock illumination, hospital HLS identification beacon and directly associated red obstruction lights. A manual override switch is to be located within the lift lobby/reception room. Refer to the example lighting override switching arrangement at Figure 18.

Figure 18: Example HLS Lighting Override Switches

An application to the Australian Communications and Media Authority (ACMA) must be made for the frequency allocation of the pilot activated lighting (PAL). AviPro will make this application.

Two flood lights for the illumination of the HLS during patient loading unloading are normally positioned on an adjacent building or pole to illuminate the area along the access path to the centre of the HLS.

Flood lights are to be on a separate circuit and only illuminated when the helicopter is on the deck and shut down for patient loading/unloading. A manual control switch is to be located adjacent to the HLS.

The hospital HLS identification beacon is on the PAL circuit and likely to be positioned close to the HLS. The lights are very bright and can affect the NVG screens within the goggles when within 50-100 m. It may therefore be necessary to provide a manual override switch in the circuit to turn the beacon OFF prior to the helicopter approach to the HLS. In such a case the PAL manual override, flood light and beacon override switches are normally co-located. Refer to Figure 18.

In this case, the beacon and windsock may be positioned on the rooftop to fit with other services as required.

4.10.3. Perimeter Safety Net

The HLS deck is longitudinal with a FATO diameter of 25 m for the operating and parking ‘spots’. The entire deck (wherever a fall from height risk exists) is to be load bearing and surrounded by a 1.5 m wide safety net (Figure 19).

Figure 19: Example of a safety net on a rooftop HLS

An access walkway will be required between the deck and the lift lobby /reception room. This is to be marked in black/yellow chevrons. It is necessary to ensure all areas where a fall from height risk exists are protected by a safety net.

4.10.4. HLS Deck Access and Emergency Egress

An elevated HLS requires two access points. The primary access point is at deck level into a patient lift lobby/reception room and involves security controlled double doors with an entry width of at least 1.8 m. The access path must be at least 1.8 m wide and allowances made for any tight turns. The path would normally lead directly into the Emergency Department or a lift. This access is to be suitably marked (Figure 20).

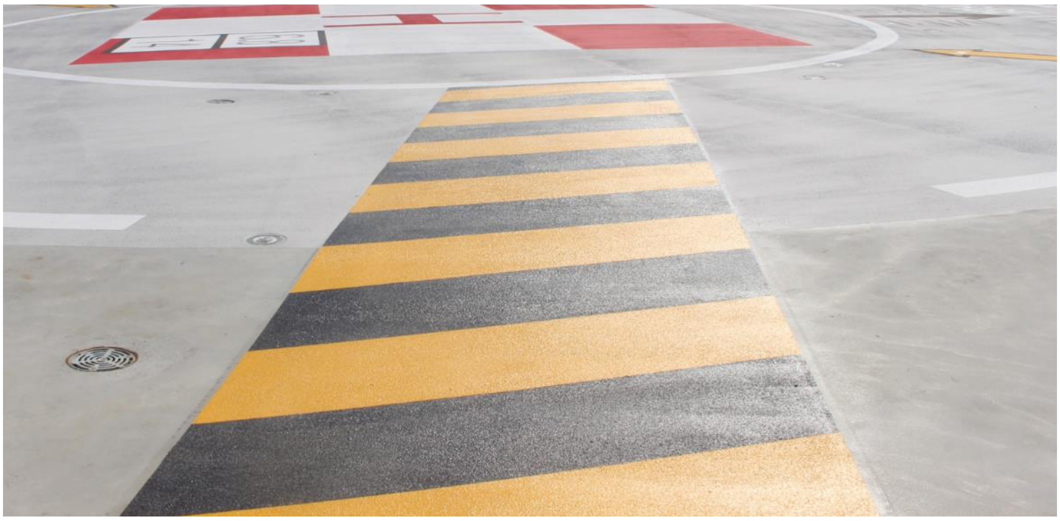

Figure 20: Example of a walkway between the TLOF and the lift vestibule

The second access point is to be on the opposite side of the HLS deck and allow for emergency evacuation of the HLS if necessary. This access would normally be in the form of stairs leading down from deck level to an emergency egress stair well. It is commonly located outside the FATO boundary and within the Safety Net area. There should be no protrusions above the deck level at the access point other than perhaps an illuminated emergency exit sign no more than 300 mm high.

Figure 21 is an example of an emergency egress exit on an elevated HLS deck, with the access next to the safety net. It is also common to have access through the safety net.

Figure 21: Example of an HLS Deck Emergency Egress Exit

4.10.5. Safety Area

The FATO is surrounded by a safety area extending out 4m from the FATO perimeter. The safety net extends out 1.5m and falls within the safety area. The remaining 2.5m of safety area will be effectively in space where the rooftop is only 25m wide.

4.10.6. Markings

Markings, including, FATO, TLOF, approach/departure paths, name and identifier, MRI, walkways and escape exits are all covered within the Guidelines.

The final drawings for the HLS deck layout are to incorporate:

- HLS orientated to Magnetic North;
- Safety net;
- Emergency egress exit on the opposite side of the deck to the access walkway;
- Safety fence or wall and safety net as required surrounding the walkway;
- Windsock positioned;
- Hospital HLS identification beacon positioned;
- Deck lighting meeting NVG specs and correctly positioned;
- VFR approach/departure path arrows correctly aligned;
- HLS name and designator;
- MRI indicator;
- Maximum static loading and rotor diameter marked; and
- Walkway markings.

The example HLS markings at Figure 22 are typical. Note that HLS deck lights are not shown.

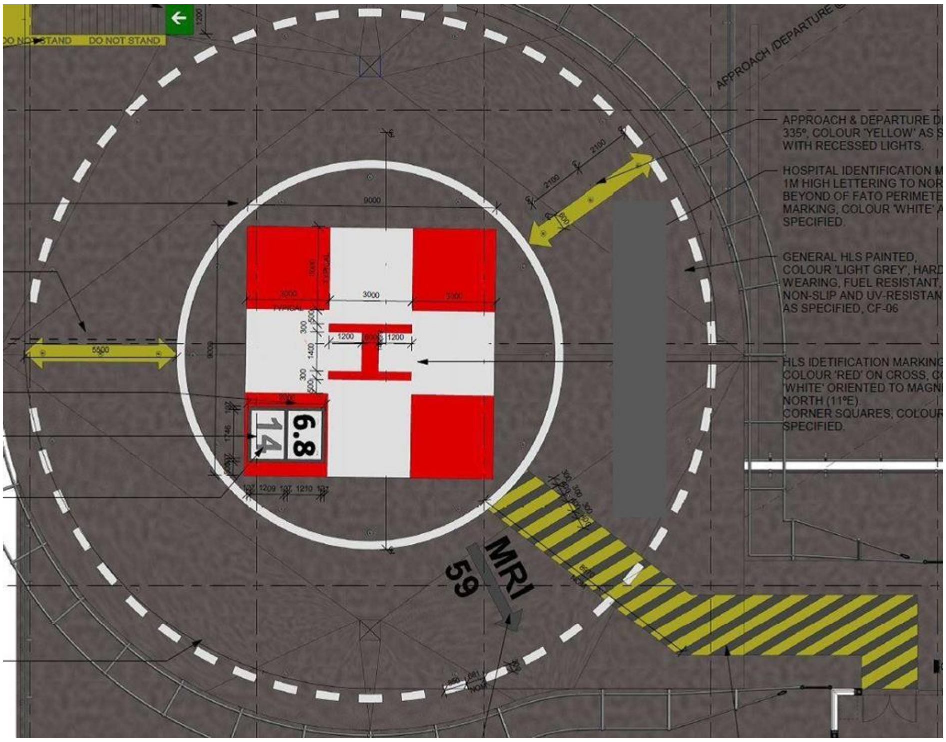

Figure 22: Typical HLS Deck Markings

4.10.7. HLS Deck Drainage and Spill Collection

To ensure adequate drainage the slope from the centre of the HLS should be between 2% and 3%, with a suitable number of drainage points. In the event of a spillage of aircraft fuel and/or lubricants, a fuel/water separator (puraceptor) will be required at a point below the level of the HLS deck. An example of the fuel/water separator is at Figure 23.

Figure 23: Example Fuel/Water Separator (Puraceptor)

4.10.8. Prescribed or Protected Airspace

The NMH is clear of Williamtown controlled airspace. Restricted airspace above NMH associated with RAAF Williamtown has a lower limit of 3500 feet above mean sea level. See Figure 24.

Figure 24: Airspace in the vicinity of NMH

The airspace over the site has been initially reviewed for compliance with OIS and Procedures for Air Navigation Services – Aircraft Operations (PANS OPS).

The OIS are a set of imaginary surfaces associated with an aerodrome. They define the volume of airspace that should ideally be kept free from obstacles in order to minimise the danger to aircraft during an entirely visual approach. These surfaces are of a permanent nature and comprise the reference datum which defines an obstacle. Anything above the vertical limits of the OIS is regarded as an obstacle.

The CASA Manual of Standards (MOS) Part 139 defines the OIS for registered aerodromes such as Cessnock Airport.

There are three airports in the lower Hunter that were reviewed in the due-diligence process. They are:

a. Newcastle (RAAF Williamtown),
b. Maitland, and
c. Cessnock.

Following contact with the relevant points of contact at the three airports, there appears to be no conflict with protected airspace from any of these airports.

5. SAFETY IN DESIGN

5.1. Introduction

The following section identifies hazards associated with the HLS and presents risk mitigations. The HLS is inherently a hazardous work place from a structural and operational setting. Training, inductions and physical measures are used to ensure the risks associated with the operation of the HLS are minimised.

5.2. Fall from height

This is the primary hazard associated with an elevated HLS.

Physical Barriers and Security. Due to the requirement to have an obstruction free level for safe helicopter operations, there are no vertical barriers in position to protect persons from falling off the roof structure. A horizontal safety net is used to offer fall from height protection and this replaces the vertical barrier.

Lift and fire stair access to the HLS must be controlled.

Lift access through the patient lift needs to be limited to essential staff (detailed below).

Fire stair access from below must be locked. The fire stair egress path is ‘lock-free’ from the HLS downwards to facility emergency evacuation.

Essential Staff. It is critical to ensure only those essential personnel with duties on the HLS are granted access. All others must be escorted by suitably trained staff.

Access to the HLS must be limited to essential staff only. These may include:

- Security staff – flight reception
- Porters or orderlies – patient transfer
- Maintenance staff – periodic inspections and maintenance work
- Aviation audit staff – training, audit and compliance inspections

Training. In all cases, the hospital staff need to be appropriately inducted with a formal HLS orientation, risk awareness and emergency procedures training package. This would normally be conducted during the HLS commissioning process by the contracted Aviation consultant.

Signage and Markings. Appropriate signage is used on the HLS to indicate exits and the location of fire appliances. Markings on the HLS surface indicate walkways and paths to normal and emergency egress locations.

The emergency egress location is well marked and care must be exercised when entering the stair well as there are no vertical hand holds until well into the stair well itself.

Procedures. Training, safety and emergency procedures associated with the HLS are to be included in the HLS Operations Manual will address fall from height risk mitigation.

5.3. Working around helicopters.

This is the second major hazard associated with the HLS.

From a hospital staff perspective, induction and helicopter awareness training will be conducted as part of the HLS commissioning program.

Staff will be required to remain inside the lift vestibule whenever the helicopter rotors are running. It is NOT an NSW Ambulance policy to conduct a 'rotors-running' patient unload/load activity. In all cases, helicopter rotors must be stopped before the crew will invite the porter/orderly onto the HLS.

The HLS has appropriate markings that indicate the walking areas for staff during the normal conduct of their duties.

Procedures. The HLS Operations Manual will address 'working around helicopters' risk mitigation in further detail.

5.4. Spill Containment.

There are two types of spill that may occur on the HLS. They are:

a. Fuel/oil spill, and
b. Bodily fluid spill.

Fuel/Oil. The hazards associated with the fuel/oil spill include:

- slipping and potential personal injury
- slipping and further patient trauma
- potential environmental contamination

The likelihood of the above hazards occurring are low and are mitigated in the following ways:

- the helicopter does not drop fuel/oil when it shuts down
- helicopter maintenance is normally NOT conducted on the HLS
- refueling activities are NOT conducted on the HLS
- the surface of the HLS (including the painted HLS markings) is coated with a slip-resistant grit that is very course
- there will be a fuel/water separator included in the water catchment system that ensures any fuel/oil that may be present is contained and disposed of in an environmentally correct manner.

Bodily Fluids. This type of spill is highly unlikely as the clinical aircrew will always have the patient stabilized and appropriately contained prior to exiting the helicopter. The hazards associated with a bodily fluid spill include:

- potential bio-hazard contamination
- slipping and potential personal injury
- slipping and further patient trauma

The likelihood of the above hazards occurring are low and are mitigated in the following ways:

- the surface of the HLS (including the painted HLS markings) is coated with a slip-resistant grit that is very course
- clinical helicopter staff manage the patient appropriately prior to exiting the helicopter
- the helicopter is washed and decontaminated following each mission

Procedures. The HLS Operations Manual and the Operator's Procedures Manual will address 'spill containment' risk mitigation in further detail.

5.5. Slipping due to water.

The HLS is open to the elements and will be subject to rain. The design of the HLS includes a maximum of 3% slope to ensure water pooling does not occur. In addition, the surface of the HLS including all walkways, is to be coated with a slip-resistant grit (in accordance with Guidelines Section 3.9.1) that is very course. The slip hazard due to water is therefore very low.

5.6. Rotorwash.

The rotorwash effect can be quite pronounced in some wind conditions especially on exposed areas of a hospital campus. The hazards are the strong wind events created by the rotors from arriving and departing helicopters.

A 7 tonne helicopter has 7 tonne downwash in certain conditions.

Personnel Risk. Some hospitals have open area atriums for patient care, outdoor children play areas, or restaurant use. In all cases, individual site review will be needed to assess the potential for effects of the rotorwash and potentially the need for strong and effective shielding (roof/louvers) from the rotorwash. From a HLS perspective, the mitigation is to keep personnel on the HLS level inside the lift vestibule whenever rotors are operating.

Infrastructure Risk. Many hospitals utilise rooftop areas to vent air, gases and other exhaust products. If these are strong, they can affect the stability of the helicopter on the approach or departure phase of the flight.

Early discussion during design phases of projects can mitigate the effect of this hazard. Grouping rising exhaust vents near the lift well is a preferred mitigation and that leaves a greater degree of un-obstructed directions to/from the HLS.

If, however, the grouping of rising exhaust vents if not possible, horizontal discharge or reverse-flow protection needs to be considered. This is also applicable for air-conditioning cooling towers.

Some designs include balconies or outdoor areas where patients, visitors or furniture may be exposed to the effects of rotorwash. This must be considered in the planning stages of a project.

Procedures. The HLS Operations Manual will need to address ‘rotorwash’ risk mitigation in detail.

5.7. Noise and Vibration.

Noise and vibration are not insignificant hazards. This is true for both the hospital structure and also the surrounding community (medical precinct and residential).

Engineering solutions are to be used to mitigate noise and vibration issues for the HLS and building below the HLS when it is an occupied structure.

Assessment of the surrounding obstructions, prevailing wind directions and potential ‘no-fly’ areas (mental health facility, sensitive residential areas) will normally determine the flight paths to and from the HLS. The contracted helicopter operator will develop specific procedures for the HLS that will take into consideration noise minimalization.

Whilst all attempts are made to minimise flight path and noise impact, the safety of the helicopter (and occupants) is the prime responsibility of the pilot and therefore in certain weather conditions, overflights of noise sensitive areas may not be avoided.

5.8. MRI Location.

MRI within the hospital campus need to be identified and marked on the HLS. The hazard posed by the MRI is on aircraft instrumentation and therefore the pilot needs to understand the location of strong electro-magnetic forces.

6. HOSPITAL ROOFTOP HLS EXAMPLES

6.1. HLS Layout

The following photograph at Figure 25 shows the Royal North Shore Hospital rooftop HLS which is designed for a single helicopter, and which meets all requirements of the Guidelines. This HLS is of concrete construction and on concrete pylons. The HLS was constructed prior to the increase in the Design Helicopter MTOW from 6.4 to 6.8 tonnes, thus the “6.4” markings on the deck. The HLS however, meets the 6.8 tonnes requirement.

Figure 25: Royal North Shore Hospital Rooftop HLS

Figures 26 and 27 show concrete HLS at Ballarat and Wagga Hospitals.

Figure 26: Ballarat Hospital Elevated HLS Deck

Figure 27: Wagga Wagga Hospital Elevated HLS Deck

Figures 28-31 show pre-fabricated aluminium HLS decks at Lismore and Westmead Hospitals.

Figure 28: Aerial of Lismore Hospital HLS

Figure 29: Lismore Hospital Aluminium HLS Deck

Figure 30: Westmead Children’s Aluminium HLS

Figure 31: Westmead Children's HLS

Figures 32 and 33 show NVG compliant deck lighting at night.

Figure 32: HLS Deck Lighting

Figure 33: HLS Deck and Approach/Departure Path Lighting

Figures 34 shows Lismore Hospital HLS with associated services

Figure 34: Lismore HLS with 26,150 litre fuel/water separator and escape stairs