AVIATION REPORT: NEPEAN HOSPITAL AND INTEGRATED AMBULATORY SERVICES REDEVELOPMENT

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Prepared for
NSW Health Infrastructure

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Document title: Aviation Report – Proposed Rooftop Helicopter Landing Site

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This Report is prepared for NSW Health Infrastructure for the Nepean Hospital and Integrated Ambulatory Services Redevelopment SSDA 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 .................................................................................................................. 6
   1.1. Establishment .............................................................................................................. 6
   1.2. HLS Terms of Reference and Applicability ................................................................. 6
   1.3. Background Material .................................................................................................. 8
   1.4. Methodology .............................................................................................................. 9
   1.5. Explanation of Terms .................................................................................................. 9
   1.6. Applicable Abbreviations .......................................................................................... 12
   1.7. List of Figures ............................................................................................................ 13

2. EXECUTIVE SUMMARY AND RECOMMENDATIONS ...................................................... 15

3. AVIATION REQUIREMENTS AND CONSIDERATIONS .................................................. 16
   3.1. Design Helicopter ....................................................................................................... 16
   3.2. Helicopter Landing Site Loading and Dimensions ....................................................... 17
   3.2.1. Elevated (Rooftop) HLS Strength ............................................................................ 17
   3.2.1.1. Dynamic load due to impact on touchdown ....................................................... 17
   3.2.1.2. Sympathetic response on the FATO .................................................................. 18
   3.2.1.3. FATO ................................................................................................................ 19
   3.2.2. TLOF ..................................................................................................................... 19
   3.2.3. Safety Area ............................................................................................................ 19
   3.3. Object Identification Surfaces (OIS) .......................................................................... 21
   3.4. VFR approach/Departure Paths .................................................................................... 22
   3.5. VFR approach/Departure and Transitional Surfaces ...................................................... 23
   3.6. Obstructions on or in the Vicinity of the HLS .............................................................. 24
   3.7. Obstructions in close Proximity but Outside and Below the Approach/Departure Surface 24
   3.8. Prevailing Winds ....................................................................................................... 25
   3.9. Turbulence ................................................................................................................ 25
   3.10. Exhaust Gas Ingestion .............................................................................................. 26
   3.11. HLS Deck Covering and Marking ............................................................................. 26
   3.12. HLS Lighting ............................................................................................................ 26
   3.12.1. TLOF Perimeter Lights .......................................................................................... 26
   3.12.2. FATO Perimeter Lights ........................................................................................ 27
   3.12.3. Landing and Take-Off Direction Lights ................................................................. 27
   3.12.4. Windsock Lighting ............................................................................................... 27
   3.12.5. Flood Lights ......................................................................................................... 28
   3.12.6. HLS Identification Beacon ................................................................................... 28
   3.12.7. Lighting Activation ............................................................................................... 29
   3.12.9. Slope and Drainage .............................................................................................. 29
   3.13. Fuel/Water Separator ............................................................................................... 29
   3.14. HLS Access Points .................................................................................................. 29
   3.15. Airspace .................................................................................................................. 30
4. NEPEAN HOSPITAL REDEVELOPMENT – HLS .......................................................... 36
   4.1. Rooftop HLS Option .................................................................................. 36
   4.2. HLS and Emergency Department Proximity ................................................. 37
   4.3. Prevailing Winds....................................................................................... 38
   4.4. Turbulence on an Elevated HLS Deck....................................................... 39
   4.5. Exhaust Gas Ingestion .............................................................................. 40
   4.6. Obstructions and VFR Approach/Departure Paths and Transitional Surfaces ........ 40
   4.7. Acoustic Mapping ................................................................................. 41
   4.8. HLS Object Identification Surfaces (OIS) .................................................. 41
   4.9. HLS Deck Design .................................................................................. 42
       4.9.1. Size and Loading ........................................................................... 42
       4.9.2. Lighting ......................................................................................... 42
       4.9.3. Perimeter Safety Net ..................................................................... 43
       4.9.4. HLS Deck Access and Emergency Egress ...................................... 43
       4.9.5. Safety Area .................................................................................. 45
       4.9.6. Markings ....................................................................................... 45
       4.9.7. HLS Deck Drainage and Spill Collection ....................................... 46
   4.10. Prescribed Airspace ............................................................................... 46
   4.11. HLS Parking Area Discussion ................................................................ 47
5. SAFETY IN DESIGN .......................................................................................... 49
   5.1. Introduction ............................................................................................. 49
   5.2. Fall from height ....................................................................................... 49
   5.3. Working around helicopters ................................................................... 49
   5.4. Spill Containment .................................................................................. 50
   5.5. Slipping due to water ............................................................................. 50
   5.6. Rotorwash ............................................................................................. 50
   5.7. Noise and Vibration .............................................................................. 51
   5.8. MRI Location ........................................................................................ 51
6. HOSPITAL ROOFTOP HLS EXAMPLES ....................................................... 51
   6.1. HLS Layout .......................................................................................... 51
1. **BACKGROUND**

1.1. **Establishment**

CBRE has been engaged by Health Infrastructure NSW as the company responsible for the Planning of the Nepean Hospital and Integrated Ambulatory Services Redevelopment SSDA Stage 1 Building.

The hospital is a teaching hospital and provides inpatient services including coronary and intensive care, orthopedic, general medical, surgical, obstetric, mental health, paediatric and emergency services.

Outpatient services include allied health (physiotherapy, occupational therapy and social work) as well as community health, dental and podiatry clinics, child, adolescent and family health, drug and alcohol, health promotion and rehabilitation and aged care.

Within the redevelopment, it is proposed to 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 will be primarily from NSW Ambulance HEMS bases in Sydney, Orange and potentially Wollongong.

AviPro has been engaged to provide advice to NSW Health Infrastructure via CBRE, regarding aviation specific requirements relative to the construction of a suitable rooftop HLS on the Building to meet the development outcomes. Considerations include size, shape, structural design standards, markings, lighting, flight paths, obstructions and approvals etc.

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 HLSs. There may however be local council planning, location and movement Approvals required.

The appropriate legislation at present for the use of HLSs 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:


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 20 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:

- US FAA Advisory Circular AC 150/5390-2C, Heliport Design, (covers both operational and design criteria, particularly for hospital based HLSs 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 Ministry of Health (MoH) Guidelines for Hospital Helicopter Landing Sites in NSW, Rev 07d of August 2016.

The NSW MoH Guidelines for Hospital Helicopter Landing Sites in NSW were prepared primarily around the ICAO and FAA guidelines and standards, utilising the most appropriate recommendations and practical HEMS operating procedures. The NSW MoH Guidelines for Hospital Helicopter Landing Sites in NSW are the standards used in this report.

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. over a smooth concrete path, not less than 1.8 m. wide, with gentle turns and with an incline of less than 1:12 over < 10 m. If the path is longer than 10 m., an incline of less than 1:20 is required. The aim being that the path is easily traversed by a hospital trolley/gurney attended by a minimum of two assistants. The HLS is to be located such that the use of a road ambulance is not required.

1.3. **Background Material**

Reference material provided by the Project Team on behalf of Health Infrastructure in support of the report included:
• BVN Drawings
• DA Plans BVN (WIP) issued 4/12/17

1.4. Methodology
A desktop assessment of the current background material provided by the Project Team was completed. Criteria from all relevant references were assessed, with the NSW MoH Guidelines for Hospital Helicopter Landing Sites in NSW Rev 07d 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 a 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 2.5\(^\circ\) or 4.5\(^\circ\) or 1:22 vertical to horizontal, measured from the edge of 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 feet 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. The overall length and rotor diameter are similar to the former and older Bell 412 models.

Elevated Helicopter Landing Site. A 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 a HLS.

Final Approach and Takeoff Area (FAT0). 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 2.5° (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.

Note:

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.

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. For an elevated HLS, the reject area is that area within the FATO (25 m. diameter) and therefore this area is to be load bearing. 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 tangible mounted objects required for air navigation purposes. The Safety Area for the Design Helicopter extends 4 m. beyond the FATO circumference forming a 33m. 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/m². The outer edge is not to project above the HLS deck, and slope back and down to the deck edge at approximately 10 degrees. Both the 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 that may be 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

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<tr>
<td>AC</td>
<td>US FAA Advisory Circular</td>
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<tr>
<td>ACC</td>
<td>Aeromedical Control Centre (HQ Eveleigh). Responsible for control and tasking of HEMS</td>
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<tr>
<td>CAAP</td>
<td>Civil Aviation Advisory Publication (Australia)</td>
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<tr>
<td>CASA</td>
<td>Civil Aviation Safety Authority (Australia)</td>
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<tr>
<td>ASB</td>
<td>Acute Services Building</td>
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<tr>
<td>CAOs</td>
<td>Civil Aviation Orders (Australia)</td>
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<tr>
<td>CARs</td>
<td>Civil Aviation Regulations (1988) Australia</td>
</tr>
<tr>
<td>CASRs</td>
<td>Civil Aviation Safety Regulations (1998) Australia</td>
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<tr>
<td>CTAF</td>
<td>Common Traffic Advisory Frequency (5 nm. Radius, ground level to 3,000')</td>
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<td>FAA</td>
<td>Federal Aviation Administration, USA</td>
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<tr>
<td>FATO</td>
<td>Final approach and Take-Off Area (1.5 x helicopter length)</td>
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<td>FARA</td>
<td>Final Approach Reference Area</td>
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<tr>
<td>FMS</td>
<td>Flight Manual Supplement</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>HAPI-PLASI</td>
<td>Pulse Light Approach Slope Indicator (see VGI)</td>
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<td>HEMS</td>
<td>Helicopter Emergency Medical Service</td>
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<tr>
<td>HLS</td>
<td>Helicopter Landing Site</td>
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<td>HLSRO</td>
<td>Helicopter Landing Site Reporting Officer (Airservices requirement)</td>
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<td>ICAO</td>
<td>International Civil Aviation Organisation</td>
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<tr>
<td>IFR</td>
<td>Instrument Flight Rules</td>
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<tr>
<td>IMC</td>
<td>Instrument Meteorological Conditions - requiring flight under IFR</td>
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<td>L</td>
<td>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</td>
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<td>LDP</td>
<td>Landing Decision Point (Category A/Performance</td>
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### 1.7. List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NSW Ambulance AW139 &quot;Design Helicopter&quot;.</td>
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<tr>
<td>2</td>
<td>AW139 Dimensions</td>
</tr>
<tr>
<td>3</td>
<td>TLOF and FATO/Safety Area Relationships and Dimensions</td>
</tr>
<tr>
<td>4</td>
<td>TLOF, FATO, &quot;H&quot; and Weight/Rotor Diameter Markings (ground level – no safety net)</td>
</tr>
<tr>
<td>5</td>
<td>Object Identification Surface</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>HLS VFR approach/Departure and Transitional Surfaces</td>
</tr>
<tr>
<td>7</td>
<td>Approach/Departure Directional Arrow and Lights</td>
</tr>
<tr>
<td>8</td>
<td>Example Windsock Lighting</td>
</tr>
<tr>
<td>9</td>
<td>Example of Activated Water DIFFS</td>
</tr>
<tr>
<td>10</td>
<td>Water DIFFS Storage Tank with Primary and Back-up Pumps</td>
</tr>
<tr>
<td>11</td>
<td>Main Building Rooftop and Proposed HLS Location</td>
</tr>
<tr>
<td>12</td>
<td>HLS Positioning and Proposed Flight Paths</td>
</tr>
<tr>
<td>13</td>
<td>Penrith Lakes AWS 0900 average Wind Rose</td>
</tr>
<tr>
<td>14</td>
<td>Penrith Lakes AWS 1500 average Wind Rose</td>
</tr>
<tr>
<td>15</td>
<td>Illustration of rooftop HLS area and exhaust pipe location</td>
</tr>
<tr>
<td>16</td>
<td>VFR Approach and Departure Path Directions</td>
</tr>
<tr>
<td>17</td>
<td>HLS Deck Lighting Override Switches</td>
</tr>
<tr>
<td>18</td>
<td>Example HLS Deck Emergency Egress Exit</td>
</tr>
<tr>
<td>19</td>
<td>HLS Deck Emergency Egress Exit</td>
</tr>
<tr>
<td>20</td>
<td>Typical Rooftop HLS Deck Markings</td>
</tr>
<tr>
<td>21</td>
<td>Example Fuel/Water Separator</td>
</tr>
<tr>
<td>22</td>
<td>Royal North Shore Hospital Rooftop HLS</td>
</tr>
<tr>
<td>23</td>
<td>Ballarat Hospital Elevated HLS Deck</td>
</tr>
<tr>
<td>24</td>
<td>Wagga Wagga Hospital Elevated HLS Deck</td>
</tr>
<tr>
<td>25</td>
<td>Aerial of Lismore Hospital HLS</td>
</tr>
<tr>
<td>26</td>
<td>Lismore Hospital Aluminium HLS Deck</td>
</tr>
<tr>
<td>27</td>
<td>Westmead Children’s Aluminium HLS Deck</td>
</tr>
<tr>
<td>28</td>
<td>Westmead Children’s Aluminium HLS Deck</td>
</tr>
<tr>
<td>29</td>
<td>HLS Deck Lighting</td>
</tr>
<tr>
<td>30</td>
<td>HLS Deck and Approach/Departure Path Lighting</td>
</tr>
</tbody>
</table>
2. EXECUTIVE SUMMARY AND RECOMMENDATIONS

The scope of work required of AviPro includes detailed advice on the rooftop helicopter landing site and any implications that such a facility may have on existing helicopter operations, 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 campus developments as they may affect HEMS.

The proposed development will not have an appreciable effect on the planned multi-level carpark HLS at Nepean. Whilst it is early to detail exact crane locations, the location of the multi-level carpark HLS on the western edge of the Campus should afford 24/7 helicopter access.

The contracted helicopter operators will be advised of the proposed work, with details of the dates the cranes will be erected on, RL and location. It will be necessary to establish safety protocols through a Helicopter Management Plan to ensure that information pertaining to crane activity is provided to NSW Ambulance/HEMS crews prior to all arrivals and departures.

During the construction phase care must also be taken to ensure that no loose material remains in the vicinity of the HLS flight paths. This information should also be incorporated within the construction company’s Helicopter Management Plan protocols.

The positioning of the HLS on the rooftop has been a result of the design program. The design of the rooftop HLS is based upon the current NSW Ministry of Health (MoH) Guidelines for Hospital Helicopter Landing Sites in NSW, Rev 07d.

The Guidelines relate to the structural requirements for the static and dynamic 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.

Early Design and Concept Drawings have been provided. As advised by the Project Team, the rooftop HLS is to cater for the operation of one emergency services helicopter. The HLS location allows for two obstacle free VFR approach and departure paths positioned up to 180° apart with directions generally North/South. The HLS will be well positioned for patient access to the new ED, ICU or NICU via the HLS deck lift.

A formal VFR approach and departure path and transitional surface survey is to be completed to meet Performance Class 1 requirements prior to operations from the new HLS. This needs to be included in the CPB Scope of Work. 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.

The HLS level will be below the OLS and PANS OPS level for airport operations (Sydney and Bankstown). Sydney Airport who act on behalf of the Department of Infrastructure and Transport, and Bankstown airport should be informed of crane activity and levels as a courtesy. NSW Ambulance helicopters will be informed once dates and locations of the obstructions are known.
3. AVIATION 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.

![Design Helicopter Image]

**Figure 1: NSW Ambulance AW139 “Design Helicopter”**

The external dimensions of the AW139 are seen at Figure 2.
3.2. Helicopter Landing Site Loading and Dimensions

The primary reference for the following information is the NSW MoH Guidelines for Hospital Helicopter Landing Sites in NSW Rev 07d. All loadings and dimensions are based upon the Design Helicopter at Maximum Take Off Weight (MTOW) of 6.8 tonnes.

The minimum acceptable static loading for the HLS is 6.8 tonnes.

3.2.1. Elevated (Rooftop) HLS Strength

When designing a FATO on an elevated HLS, and in order to cover the bending and shear stresses that result from a helicopter touching down, the following is to be taken into account:

3.2.1.1. Dynamic load due to impact on touchdown

This should cover the normal touchdown, with a rate of descent of 6 feet per second, which equates to the serviceability limit state. The impact load is then equal to 1.5 times the maximum takeoff mass of the design helicopter.
The emergency touchdown should also be covered at a rate of descent 12 feet per second, which equates to the ultimate limit state. The partial safety factor in this case should be taken as 1.66.

Hence, the ultimate design load:

\[ \text{load} = 1.66 \times \text{service load} \]

\[ = (1.66 \times 1.5) \times \text{maximum takeoff mass} \]

\[ = 2.5 \times \text{maximum take-off mass.} \]

To this should be applied the sympathetic response factor discussed at b) following.

### 3.2.1.2. Sympathetic response on the FATO

The dynamic load should be increased by a structural response factor dependent upon the natural frequency of the roof top slab when considering the design of supporting beams and columns. This increase in loading will usually apply only to slabs with one or more freely supported edges.

It is recommended that the average structural response factor (R) of 1.3 should be used in determining the ultimate design load, i.e. \(1.66 \times 1.5 \times 1.3 = 3.23\) (rounded up to 3.25).

Other design considerations involving the over-all superimposed load from personnel and equipment on the HLS etc. are in this case negligible; however, the ICAO Heliport Manual provides an allowance of 0.5 kilo newtons per square metre.

In essence, the following should be considered in the structural design of an elevated HLS:

- static loads due to the helicopter at rest;
- dynamic loads on particularly the TLOF and out to the FATO, due to impact of the helicopter on touchdown;
- sympathetic response (resonance) of the HLS structure;
- personnel, freight and equipment load;
- wind loads;
- lateral loading on supports;
- the dead load of structural members; and
- punching shear.

When all factors are taken into account, the total impact load factor (dynamic loading) for the Design Helicopter (AW139) is in the vicinity of 3.25, i.e. 3.25 x 6.8 (22 tons). It is recommended that the structural design based on the ICAO Heliport Manual specifications are followed\(^1\)

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\(^1\) Heliport Manual Doc 9261-AN/903
3.2.1.3. FATO
Diameter minimum $1.5 \times \text{Length} = 1.5 \times 16.62 \text{ m.} = 24.93 \text{ m.}$, 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 $1 \times \text{main rotor dia.} \text{ of} \ 13.8 \text{ m.}$
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, $0.3 \times L (13.8 \text{ m.}) = 4.14 \text{ m.}$ 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 $(25 + 8\text{ m.}) = 33\text{ m.}$ (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 3° or 5% outwards from the edge of the FATO.

The surface of the Safety Area abutting the FATO shall be continuous with the FATO and the whole of the Safety Area
when on-grade shall be treated to prevent loose items and any other flying debris caused by rotor downwash. 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”.

The Safety Area surrounding an elevated HLS may incorporate the Safety Net and may be partially in space.

Figures 3 and 4 following are examples of round HLSs showing the dimensions².

![Figure 3: TLOF and FATO/Safety Area Relationships and Dimensions](image)

**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.)

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² AC 150/5390-2C
Figure 4: TLOF, FATO, “H” and Weight/Rotor Diameter Markings (ground level – no safety net)

**Note:**
1. The “H” is orientated to Magnetic North.
2. The perimeter of the TLOF is defined with a continuous, 30cm. wide white line.
3. The perimeter of the FATO is defined with a 30cm. dashed white line approximately 1.5m. in length, and with end-to-end spacing of approximately 1.5m.
4. VFR approach/departure path direction are examples only.
5. HLS deck static weight limit for the AW139 is 6.8 tons.
6. The rooftop HLS will not have a road ambulance pick-up area.

### 3.3. Object Identification Surfaces (OIS)

Where possible, the object identification surfaces as specified in the Guidelines are to be met. However, at most hospital HLS, particularly at ground level, 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 object identification surfaces can be described as:

- In all directions from the Safety Area, except under the approach/departure paths, the object identification surface starts at the Safety Area.
perimeter and extends out horizontally for a distance of ~30 m.

- Under the approach/departure surface, the object identification surface starts from the outside edge of the FATO and extends horizontally out for a distance of ~700 m. From this point, the object identification surface extends out for an additional distance ~2,800 m. while rising on a 2.5° or 22:1 slope (22 units horizontal in 1 unit vertical). From the point ~700 m. from the FATO perimeter, the object identification surface is ~30 m. beneath the approach/departure surface.

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

![Diagram of Object Identification Surface](image)

**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, a 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 preferably 180 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.
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 and Below the Approach/Departure Surface**

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

Where possible obstructions are to be moved, however if this is impractical, markings and/or obstruction lighting is to be placed.
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 (disk) which provides its first positive performance benefit during takeoff at Approximately 15kts. (translational lift) depending on the type of helicopter. The performance improves until best rate of climb speed is achieved at approximately 70kts depending on the helicopter type. The transition from hover to takeoff safety speed (VTOSS) during takeoff is the most critical phase of flight. VTOSS is dependent on the helicopter type and is generally between 40-50 kts.

It is therefore important to review the prevailing wind direction and speed when considering Approach and departure paths to and from a HLS. It is however even more important to achieve two Approach and departure paths which are at least 150° apart and preferably 180° apart. Achieving two Approach/Departure paths 180° 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 a HLS would be unusable due to wind direction if two paths 180° 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). TAMP 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.

Turbulence from wind effect is usually more pronounced on a rooftop HLS, when compared with a HLS which is elevated on pylons 1.8 m. or more above the level of the rooftop. The reason is that the turbulent effect of air flowing over the roof edge is minimised if the HLS is elevated with an “air gap” above a rooftop.

Strong winds can cause considerable updrifting on the windward side of a building supporting a rooftop HLS due to the vertical slab sides. Turbulence on the leeward side of the deck is normally much reduced.

Reference to a Qualitative Turbulence and Air Quality Study of the area may be relevant.
Normally, the placing of an elevated HLS deck on pylons over a roof top will reduce the effect of updrafting turbulence. Examples of such a process are the RNSH HLS in St. Leonards and Lismore Base Hospital HLS.

3.10. Exhaust Gas Ingestion

Hospital air conditioning air intake systems should not be positioned in the vicinity of a rooftop HLS deck. 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. 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 Deck Covering and Marking

The HLS deck is to be sealed/covered 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 a MRI, its direction and distance are to be marked on the deck. Figure 4 provides an example of markings for a ground level HLS. Markings for an elevated HLS are similar, with the exception that there is no adjacent vehicle parking.

Complete marking details are found in the current NSW Ministry of Health (MoH) Guidelines for Hospital Helicopter Landing Sites in NSW Rev 07d.

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.

A statement relating to Ambulance NSW 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 both surface and elevated HLSs. 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](image)

**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.
3.12.5. Flood Lights

Flood lights are to be Appropriately positioned to 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 lights are often mounted on the near wall of the lift lobby on an elevated HLS. 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°, and unless there is no option, it should not be positioned on the top of the lift lobby close to the HLS. If the beacon is positioned on the top of the lift lobby adjacent to the HLS, it will be necessary to include a manual override switch so that the beacon may be turned OFF for Approaches and departures. 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. At an elevated HLS, this switch and the manual flood light switch, are normally co-located in the lift lobby. 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.

3.12.8. Perimeter Safety Net

A perimeter safety net is required to surround the edge of an elevated HLS. It must be not less than 1.5 m. wide and have a minimum load carrying capability of 122 kg/m². The Safety Net is not to project above the HLS deck and is to slope back towards the deck at ~10°. Both the inside and outside edges of the safety net are to be secured to a solid structure. The net needs to cover ‘fall from height’ risk from the HLS area.

3.12.9. 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.

3.13. 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. Ground level HLS will also require a drainage system which incorporates a contaminant/water separation arrangement consistent with local regulations.

3.14. HLS Access Points

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.

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.

### 3.15. Airspace

Civil Aviation Safety Authority/Airservices Australia Approvals may be required if primary prescribed airspace could be impinged. Primary prescribed airspace includes an airport’s Obstacle Limitation Surfaces (OLS) 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. In this case, CASA and Air Services have already indicated the development is below OLS and PANS-OPS.

If applicable, the instrument approach procedures into this precinct also need to be reviewed in regard to the crane heights and their obstructing lower segments of the final stage of the instrument approaches.

The review process takes 4-6 weeks.

The normal contacts for this process follow however local councils may also take the lead role in the application process.

[Airport.Developments@AirservicesAustralia.com](mailto:Airport.Developments@AirservicesAustralia.com)

[IFP@AirservicesAustralia.com](mailto:IFP@AirservicesAustralia.com)

### 3.16. 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 development, the urban area surrounding the hospital makes overflight over occupied housing and 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 MoH HLS Guidelines.

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

3.17. 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 downwash for the AW139.

<table>
<thead>
<tr>
<th>Disc loading</th>
<th>Air Density at S.L.</th>
<th>Final Velocity</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Metric Kg/m²</td>
<td>Imperial Lbs/ft²</td>
</tr>
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<td>AW139</td>
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</tr>
<tr>
<td>EC155</td>
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<td>7.96722166</td>
</tr>
</tbody>
</table>

3.18. Fire Fighting Equipment

Firefighting equipment is to be available at all hospital HLSs. 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 HLSs, 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. 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 foam installation on elevated HLSs. 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 412 (Fire Protection) Standards for Heliports.

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.

This rooftop HLS will also be fitted with an automatic water deluge system using 20,000l of water as the deluge spread from 25 nozzle points embedded into the HLS.

The Deck Integrated Fire Fighting System (DIFFS) is detailed below. If the HLS deck is prefabricated aluminium, a water or foam Deck Integrated Fire Fighting System (DIFFS) with 19 water heads may be employed. This involves nineteen spray heads which are flush mounted across the deck, which when activated spray either water or foam over the deck. A DIFFS system requires an independent 20,000 litre water tank mounted below the deck and operated by a diesel engine and pump. Lismore Hospital has a prefabricated HLS deck and water DIFFS system installed. See Figures 9 and 10.

Figure 9: Example of Activated Water DIFFS
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 key pad lock or 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 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 requirements relating to HLSs in NSW are complex. Current legislation excludes emergency service landing sites from the definition of “designated development” in the Environmental Planning and Assessment Regulation (which otherwise includes most HLSs). Generally, hospital HLSs 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/4.5º/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 2.5º for 3.5 km. At 3.5 km., the flight path is Approximately 500 feet 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., 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 HLSs. 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.


Each hospital HLS is required to hold a 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 NSW MoH Guidelines for Hospital Helicopter Landing Sites in NSW, Rev 07d.
4. NEPEAN HOSPITAL REDEVELOPMENT – HLS

4.1. Rooftop HLS Option

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.

Based on current planning, the option for an on-site HLS involves the positioning of a HLS on Level 14. See Figure 11.

Figure 11: Main Building Rooftop and Proposed HLS Location

The positioning of a HLS on the rooftop reduces the obstruction incidence and if sufficiently high enough, will normally resolve most obstruction issues. Elevated HLS also allow for more approach/departure options to take account of the wind strength and direction.

Safety Areas around an elevated HLS are usually in “space”, except for the access path area and therefore do not involve lost surface level ground.

To meet helicopter Performance Class 1 (PC1) requirements, the design of HLSs will need to take into account the particular helicopter type Category A certification requirements as detailed in the relevant Rotorcraft Flight Manual (RFM). To meet Category A requirements, HLSs must meet particular dimensions, have the necessary lighting and meet the static and dynamic weight limitations for the “Design Helicopter”. For particular types of helicopters, there are also minimum HLS height requirements above the ground and obstacles, to allow for emergency situations.
When the Appropriate considerations and requirements are taken into account at an early stage of planning, their incorporation within a new design can be accommodated with a minimum of difficulty.

4.2. HLS and Emergency Department Proximity

It is preferred 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 elevated HLS, there is normally a need for one or more lifts and Appropriate passageways at least 1.8 m wide.

The proposed location for the HLS is on the eastern wing of the rooftop with the elevator core slightly to the west.

In this situation, the primary approach/departure paths would be in a north/south direction (green flight path arrows). The secondary approach and departure path will be in the east/west directions (blue flight path arrows).

As the site is surrounded on most sides by occupied buildings, it would not be possible to provide approach/departure paths which did not overfly occupied buildings including private residences. See Figure 12.

![Figure 12: HLS Positioning and Proposed Flight Paths (preferred are green)](image)

The proposed HLS will serve a single helicopter and is to be positioned on the roof of the structure at Level 14.

CASA proposes introducing new rules, potentially during 2018, for helicopter operations through CASRs Part 133 incorporating Medical Transport, and Part 138 for Aerial Work functions. Part 133 involves the carriage of passengers and is to be more stringent and include Ambulance functions, whereas Part 138 is proposed to cover search and rescue operations and the current Aerial Work, but exclude Ambulance functions.
Part 133 is proposing that PC1 be required at particular times in particular locations and will affect HEMS operations. The proposed positioning and design of this HLS has taken account of proposed Rule changes and thus such Rule changes should have no effect on the HLS or its operations.

4.3. Prevailing Winds

The Bureau of Meteorology does not have a weather station at the Nepean Hospital but has a station at Penrith Lakes, 3.5km from the hospital.

The readings show that average annual predominant winds in the area are from the west and north-west in the morning and swing around to the south and east (sea breeze) in the afternoon. Refer to Figures 13 and 14. Readings taken at midday show that the wind can come from any direction during the changeover and is also essentially less than 15 knots. This information is relevant during planning to account for any obstructions along the paths.

Figure 13: Penrith Lakes AWS 0900 Wind Rose – Annual Average
Figure 14: Penrith Lakes 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 HLS positioning on Level 14 provides for additional approach and departure paths whereby the pilot can land or takeoff into wind from most directions.

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 an Elevated HLS Deck

The proposed HLS is positioned on the rooftop of the hospital tower. The elevation provides for a steady flow of any wind over the helideck without the creation of turbulence. There may be some turbulence caused by the profile of the building however in addition to any mechanical turbulence caused by the lift well. The proposed design therefore should allow for the use of the HLS at most times other than severe squalling winds.
4.5. Exhaust Gas Ingestion

The positioning of exhaust ducts, ventilation outlets and air conditioning systems must be considered relative to the HLS deck. Exhaust gasses from the helicopter’s turbine engines can easily be ingested into a hospital air inlet or exhaust system if provision is not made for prevention. A number of hospitals have a system in place to close vents for helicopter movements.

The current plan has the exhaust ducts/pipes situated on the opposite side of the HLS from the lift well (Figure 15). This will need close management and design due to the rotorwash from the helicopter will be 6.8 tonne down force.

![Figure 15: Illustration of rooftop HLS area and proposed exhaust pipe location (red)](image)

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

The proposed VFR Approach and departure paths run southwest to northeast (025°/205°M). The selection of these paths aims it to achieve an obstacle free gradient of 2.5° (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 flight paths 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.

Due to the urban environment, it is not possible to position the VFR approach and departure paths clear of housing or occupied buildings. Also in this case, clear of Sydney Airport runway extensions. It has however, been possible to achieve two flight paths 180° apart and aligned sufficiently with the prevailing winds. See Figure 16.
Subject to formal survey, it is apparent that there are no obstructions along the two proposed VFR Approach and departure paths when measured from the estimated HLS deck PC1 survey datum point.

On a rooftop HLS, the wind sock and hospital HLS identification beacon are normally mounted above the lift lobby/reception room, however due to the early stage of design, this has not yet been established.

4.7. Acoustic Mapping

The flight path directions where acoustic mapping need to occur are depicted in Figure 16. The Acoustic Engineer will need to use the data for the Leonardo Agusta Westland AW139 helicopter.

4.8. HLS Object Identification Surfaces (OIS)

The area surrounding the hospital when viewed from the proposed HLS deck 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 2.5° out to a total distance from the FATO of ~3,500 m. without obstruction penetration. It is however, normal for the lift lobby, the windsock and beacon, which are close to the FATO boundary and within the OIS, to impinge the Transitional Surface in the area of the FATO. This situation is acceptable.

4.9. HLS Deck Design

4.9.1. 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. in diameter meeting the requirements of the Design Helicopter and adequate to accommodate a dual HLS. Refer to Sub-section 3.2 for all loading and dimensions requirements.

It is preferred that an emergency services HLS be within 100 m. of the ED, ICU and NICU and allow ready access to these areas. The proposed positioning of the HLS deck meets the requirements. The area within the lift lobby must be such that maneuvering of the patient/gurney is unimpeded and associated further passageways are to be at least 1.8 m. wide.

4.9.2. Lighting

The HLS requires in-deck 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 within 30 m. of the windsock.

HLS lighting is to be on two separate circuits, a flood light circuit and a 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 17.
4.9.3. 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.

An access walkway will be required between the deck and the lift lobby/reception room. This is to be marked in black/yellow chevrons. If the walkway is not on the HLS deck surface but as a narrow walkway (bridge), it will be necessary to position a safety net either side of the walkway for Approximately 8 m. from the edge of the FATO, and then a 1,200 mm. high safety fence or wall either side of the walkway, extending to the lift lobby.

4.9.4. HLS Deck Access and Emergency Egress

There must be a minimum of two access/escape points at the HLS deck. The primary access will be via the HLS lift lobby/reception room. There must be a further escape access located on the deck.

Figure 17: HLS Deck Lighting Override Switches

Two flood lights for the illumination of the deck during patient loading/unloading are normally positioned high on the lift lobby wall to illuminate the area from the lift lobby along the access path to the centre of the HLS deck.

Flood lights are 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 within the lift lobby.

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 17.
perimeter, ideally on the opposite side of the deck to the primary access. This access is to be suitably marked for emergency escape purposes. 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 18 shows an example of where the emergency exit egress location should be situated on the opposite side of the HLS deck (single spot referenced in this example) to the normal patient access path.

Figure 18: HLS Deck Emergency Egress Exit (red)

Figure 19 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 19: HLS Deck Emergency Egress Exit
4.9.5. **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.

4.9.6. **Markings**

Markings, including, FATO, TLOF, approach/departure paths, name and identifier, MRI, walkways and escape exits are all covered within the NSW Ministry of Health (MoH) Guidelines for Hospital Helicopter Landing Sites in NSW Rev 07d.

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 20](#) are typical. Note that HLS deck lights are not shown.

![Figure 20: Typical Elevated HLS Deck Markings](#)
4.9.7. 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 will be required at a point below the level of the HLS deck.

An example of the fuel/water separator is at Figure 21.

![Figure 21: Example Fuel/Water Separator](image)

4.10. Prescribed Airspace

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

Civil Aviation Safety Authority/Airservices Australia approval is not required as the site structures and cranes WILL NOT penetrate the OLS or the PANS OPS lower limit for Sydney and Bankstown Airports.

Engagement with Airservices Australia for any impact of the cranes supporting the development will be required. The following information, as a minimum, needs to be supplied:

- The dates of crane erection and disassembly,
- The location (in MGA94 reference) of the crane base,
- The type of crane
- The RL of the base,
- The RL of the top of the crane,
- The RL of the highest point CHHC development

AirServices will require 4-6 weeks to assess the application.

Any airspace obstruction query can be communicated directly to:

pds.obs@airservicesaustralia.com

A number of areas within Airservices Australia monitor this site.
4.11. HLS Parking Area Discussion

By way of completeness, detail of a ‘two-place’ HLS has been included in this report.

A two-place HLS normally has an operational area and a parking area. The parking area needs to be able to accommodate the size and weight of the design helicopter and does not require HLS lighting set into the concrete. Therefore, the parking spot is a relatively low-cost element of the construction. In some cases, two (2) operational pads may be created but compliant lighting and the dynamic load structural requirements make this option more expensive.

There are a number of operational justifications and financial mitigations that would support the argument to develop a two place HLS (one operational ‘H’ and one parking ‘P’) in a hospital precinct and these include:

- The size of the destination Campus and the region it services will normally determine the volume of helicopter traffic. Western Sydney for example, is expected to grow and so will the helicopter response frequency. The Minister’s 2013 Reform Plan for Aeromedical (Rotary Wing) Retrieval Services in NSW identifies a 25% growth in aeromedical retrievals moving forward.

- If a helicopter was conducting a NETS mission, it may require up to 90 minutes on the deck as the transfer of the patient to the Hospital’s care is affected. This would close the single HLS for that time. If it had a parking area, the HLS would remain open for subsequent retrieval arrivals. This is a single spot HLS however and there is no potential for a second helicopter.

- Should the single HLS be occupied, patients in subsequent helicopters may be placed at risk due to the extended time before hospital intervention due to the helicopter needing to fly to an alternate destination. The absence of a HLS parking area is not a zero-cost option. In the event of a helicopter not being able to land due to the HLS being occupied, there are three options that may occur:
  - The aircraft may circle until the HLS is available with the true cost to NSW Health of approximately A$8,000 per hour,
  - The incoming aircraft may land at a nearby park requiring an ambulance with a cost of the extra airtime plus the ambulance journey (A$2,500), or
  - The aircraft may proceed to another hospital that may require a further transfer of the patient or the movement of another less urgent patient to another hospital according to the Intensive Care Bed Management Plans with ensuing costs.

- If a helicopter was to become technically unserviceable on the single HLS, that HLS would remain closed until either the helicopter is repaired or the helicopter is moved off the HLS by a ground-based crane or a larger heavy lift helicopter if one was in the country. If a suitable alternative not be available, this may close the HLS for days.
Finally, the number of hospitals in the precinct may determine the frequency and ‘on-ground’ duration of the helicopter. Hence a parking area would be advised.

Helicopter retrieval services have now been standardised across NSW with 9 operational AW139 helicopters on 24/7 duty. It will be more common moving forward that multiple helicopters may be sent to incidents with the resultant transfers to hospital ED. Given Nepean’s geographic location on the western edge of the Sydney Basin, adding a parking area to the top of the structure would add significant capacity to the hospital’s critical care reception capability.

The question will always be one of cost. If the design layout allows for a parking area adjacent to the HLS, direct costs would include:

- Roof top structured to hold the static load (minimum 6.8 tonne)
- Potential additional safety net
- Paint work ‘P’

From an operational perspective, a parking area on a rooftop HLS is highly recommended. It allows for multiple helicopters and importantly allows for lengthy occupation of the HLS due to clinical or mechanical reasons.

Should a direct operational perspective be required, contact should be made with the Deputy Director Helicopter Retrieval Services for the NSW Ambulance, Chief Superintendent Garry Sinclair

(garry.sinclair@health.nsw.gov.au and 0417679320)
5. SAFETY IN DESIGN

5.1. Introduction

The following section identifies the hazards associated with the HLS and also presents risk mitigations. The HLS is inherently a hazardous workplace 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 the HLS.

**Physical Barriers.** 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 a NSW Ambulance policy to conduct a 'rotors-running' patient
unload or load activity. In all cases, the 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.** A highly unlikely occurrence 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 coated with a slip-resistant grit 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, gasses 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.

**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 22 shows the Royal North Shore Hospital rooftop HLS which is designed for a single helicopter, and which meets all requirements of the NSW Ministry of Health (MoH) Guidelines for Hospital Helicopter Landing Sites in NSW. RNSH 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 22: Royal North Shore Hospital Rooftop HLS

Figures 23 and 24 show concrete HLS at Ballarat and Wagga Hospitals.

Figure 23: Ballarat Hospital Elevated HLS Deck
Figure 24: Wagga Wagga Hospital Elevated HLS Deck

Figures 25-28 show pre-fabricated aluminium HLS decks at Lismore and Westmead Hospitals.

Figure 25: Aerial of Lismore Hospital HLS
Figure 26: Lismore Hospital Aluminium HLS Deck

Figure 27: Westmead Children’s Aluminium HLS
Figure 28: Westmead Children’s HLS

Figures 29 and 30 show NVG compliant deck lighting at night.

Figure 29: HLS Deck Lighting
Figure 30: HLS Deck and Approach/Departure Path Lighting