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SITE ASSESSMENT REPORT

Mills Memorial Hospital
Terrace, BC

PREPARED FOR:

Northern Health

January 6, 2020

BC20-01

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1.0 Introduction

Northern Health has commissioned the preparation of an Indicative Design for a replacement development of The Mills Memorial Hospital in Terrace, BC. Northern Health would like to consider the possibility of including a ground heliport for serving EMS helicopters as part of the new development. The Indicative Design site plan dated February 8, 2019 indicates a full build out of the site. The purpose of this assessment is to consider what possibilities exist to accommodate a ground heliport within the major elements of the Indicative Design.

Currently, the Terrace Airport is used for patient transfers with both airplanes and helicopters. Given the distance between Terrace and the closest major hospital, most medivac flights currently utilize fixed wing rather than helicopters. An onsite heliport at the Mills Memorial Hospital was closed in December of 2010 due to non-compliance issues. Significant upgrades would have been required to bring the heliport into compliance.

The new hospital will serve as the Northwest region's level-three trauma and inpatient surgery centre providing immediate assessment, resuscitation, surgery and intensive care for injured patients. Currently, the hospital is a level-five trauma centre, meaning patients are stabilized on-site before being transported elsewhere. The change to a level-three trauma hospital warrants the consideration of the possibility of providing for a heliport within the scope of the new development. Rather than a "sending hospital" in regard for some emergency patients, the hospital will be a "regional receiving centre" for those needing a high level of emergency care.

2.0 Definitions

ASL: Above sea level; in reference to an elevation.

Approach/Departure Path: An area consisting of a quadrilateral area on the surface of the earth lying directly below the approach/take-off surface.

CARs: Canadian Aviation Regulations

CAT A: Category A with respect to helicopters means a multi-engined helicopter designed with engine and system isolation features specified in the applicable airworthiness codes and capable of operations using take-off and landing data scheduled under a critical engine failure concept that assures adequate designated surface area and adequate performance capability for continued safe flight or safe rejected take-off in the event of engine failure.

Certified Heliport: A heliport located within a built-up area of a city, town or village, that is constructed and operated in accordance with the regulations and standards of CAR 305 and 325. A certified heliport will be issued an Operations Certificate by Transport Canada.

Elevated/Rooftop Heliport: A heliport elevated more than 75cm above the normal elevation of the ground.

Emergency Landing Area: An area where an unavoidable landing or ditching may take place with a reasonable expectancy of no injuries to persons or damage to property on the surface.

Final Approach and Take-Off Area (FATO): A defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced.

Flight Path aka Approach/Departure path: An area consisting of a quadrilateral area on the surface of the earth lying directly below the approach/take-off surface.

Flight Path Divergence: The outer edge of the flight path beginning at the outside edge of the safety area and diverging at a uniform rate (10% day use, 15% night use) from a line parallel to the center line of the flight path.

Flight Profile: Trajectory, or its graphic representation, followed by its altitude, speed, distance flown, and maneuver.

NVG: Night Vision Goggles

NVIS: Night Vision Imaging Systems

Non-Built-Up Area: Generally defined as having no development within the limits of the flight path, or transitional surfaces, and no development within a 180 degree sector. A building within the 180 degree sector that is associated with the heliport, such as the hospital, is generally permitted.

Non-instrument FATO: A FATO intended for the operation of helicopters under visual meteorological conditions (VMC).

Obstacle: An object that could have an adverse effect on the safe operation of aircraft in flight or on the ground.

Obstacle limitation surface (OLS): A surface that establishes the limit to which objects may project into an aerodrome's airspace, so that aircraft operations for which the aerodrome is intended may be conducted safely, and consists of a transitional surface, a take-off surface, an approach surface and an outer surface.

Operator or Helicopter Operator: The organization that owns or provides helicopters that can access the heliport; can also refer to the pilot of the helicopter when referring to flight operations.

PPR: Prior Permission Required. A helicopter pilot wishing to use the heliport must first contact the operator of the heliport via the number published in the Canada Flight Supplement to gain permission to use the aerodrome.

Registered Heliport: A heliport that is certified or an uncertified heliport located in a non-built-up area, where information regarding the heliport has been provided to NAV Canada for publication in the Canada Flight Supplement.

Safety area: A defined area surrounding the FATO which is kept free of obstacles other than objects required for navigation purposes.

Surface Level Heliport: A heliport located on the ground or a floating heliport located on the water.

Touch Down and Lift-Off Area (TLOF): A load-bearing area on which a helicopter may touch down or lift off.

Transitional surface: A complex surface along the side of the safety area and part of the side of the approach/take-off surface that slopes upwards and outwards at a 1:2 slope to a height of 45m.

3.0 Evaluation Criteria

Where possible, evaluation criteria has been used as a benchmark in the assessment of locating a heliport within the content of the New Hospital Indicative Design. From a cost perspective, the proposed heliport location would be at ground level.

All heliports within Canada that are located within a built-up area must be certified under Transport Canada Regulations and Standards. Nearly all heliports located within the boundaries of cities and towns are considered to be in a built-up area. It is recommended that all hospital heliports also be registered. The information about the heliport is submitted to NAV Canada for publication in the Canada Flight Supplement. The Canada Flight Supplement is a publication carried by pilots that lists all registered aerodromes in Canada. It is intended that a new Mills Memorial Hospital Heliport described in this report be both registered and certified.

Under CAR 305 the Heliport Regulations and CAR 325 Standards, non-instrument heliports are classified as H1, H2 or H3:

- An H1 heliport is defined as a heliport located within an obstacle rich environment where there are no emergency landing areas within 625 m from the FATO. The multi-engine helicopters using the heliport must have the performance capability to safely fly to an appropriate landing area or land safely on the FATO or TLOF area if an engine fails. This type of heliport is restricted to use by only about 5% of the total types of helicopters;

- An H2 heliport can be used only by multi-engine helicopters. Suitable and reachable emergency landing areas have been identified on the approach path(s) within 625 m from the FATO for emergency use in the event of an engine failure and;

- An H3 heliport is designed for the performance capabilities of both multi and single engine helicopters. Suitable and reachable emergency landing areas have been identified on the approach path(s) within 625 m from the FATO for emergency use in the event of an engine failure. The object-free flight path angle is shallower than that of an H2 heliport.

3.1 HELIPORT DIMENSIONS

It is anticipated that the primary service provider of helicopter air ambulance services will be twin engine helicopters from a base in Prince Rupert. The airport would be used for single engine helicopter EMS missions since it is not possible to obtain an H3 helicopter classification on the hospital site. A ground ambulance would be used to transfer patients from the airport to the hospital as occurs now.

The objective with every hospital heliport location and design is to provide the least restrictive conditions for helicopters and patient movements. The heliport must be sized to accommodate the helicopter that will commonly use the facility. In Canada, full time helicopter air ambulance providers use only multi-engine helicopters. Currently, BC Air Ambulance Service utilizes a Bell

412 helicopter at 17.1m overall length for the interior of BC and a Sikorsky S76C+ helicopter based out of Prince Rupert. It would be prudent to also consider the potential for other medium sized helicopters that could, in the future, enter the marketplace of EMS helicopters. Designing a heliport to accommodate helicopters up to 17.5 metres is recommended.

3.2 AVIATION CRITERIA

Helicopters, like airplanes, achieve maximum performance when flown nose first into the prevailing wind during landing and take-off. Crosswind or downwind flight not only requires more power but exposes the aircraft to increased risk of dynamic flight hazards such as settling with power (especially following the loss of the critical engine on a multi-engine helicopter), vortex ring state, and loss of tail rotor effectiveness. The heliport should consider these factors by providing, when possible, open or opposing approach/departure path quadrants and fly-through areas which can be used by the pilot during an aborted landing or take-off emergency to maintain flight. The prevailing winds for the Terrace area are from the south and northeast which represents the preferred corresponding orientation of heliport flight paths.

Notwithstanding these conditions, heliport site and obstacle constraints may restrict the available approach/departure paths and fly-away areas. When no other feasible options are available, a single one-way-in/one-way-out approach/departure path may be considered. Transport Canada criteria provides an additional margin of safety at a single approach/departure path heliport by requiring a reduction in the obstacle clearance slope and the addition of a 2:1 transitional surface to provide the pilot greater flexibility when operating “out of wind”. Flight operations at a single approach heliport may be restricted during adverse wind conditions, especially under high density altitude conditions such as hot, thin air.

Basing the design to accommodate a multi-engine helicopter of a maximum 17.5m total length, the performance capability of BC Air Ambulance twin engine helicopters, the following list of aviation criteria represents the criteria for heliport design. Some criteria are listed as mandatory and others considered optimal if site conditions permit. These criteria have been used as a benchmark in the assessment of the potential heliport location:

- Mandatory – TLOF slope – no greater than ±2%;
- Mandatory – FATO slope – no greater than ±3%; if considered coincidental with TLOF ±2%;
- Mandatory – Safety area slope – no greater than +4%;
- Mandatory for 17.5m helicopter - FATO – Ø26.25m;
- Mandatory for 17.5m helicopter - Safety area – Ø35.0m;
- Optimal – 135° between approach/departure paths or 135° of flight path arc eliminates the need for an approach/departure path transitional surface;
- Mandatory – The take-off and approach surface for an H1 heliport classification commences at the edge of the safety area and extends a total distance of 625 metres. No flight path slope is declared. The helicopter using the H1 flight path must have the performance capability of clearing all obstructions on the flight path by 4.5 metres with

only one engine operative. No obstructions penetrating a 16% slope or less is considered to be optimal. Identification of emergency landing areas is not required.

- Optimal – If possible, provide for an H2 flight path. The take-off/approach surface for an H2 heliport classification shall commence at the edge of the safety area extending to a distance of 245 metres at a slope of 12% if only one flight path direction, and 16% if two flight paths are provided. Flight path separation of 90 degrees or greater is considered to be two flight paths. Emergency landing areas must also be identified within the flight path.
- Mandatory – Flight Path Divergence – 10% for day-only and 15% for NVG approach/departure paths;

3.3 MEDICAL CONSIDERATIONS

Medically-based design considerations are listed as follows. This set of criteria has been used as a benchmark in the assessment:

- Locate heliport as close to the hospital emergency as possible. The optimal maximum travel distance from the heliport to the nearest suitable entrance is 60m. In some instances, site conditions and existing infrastructure will not feasibly permit the location of a heliport meeting this criterion. In the majority of cases, the patient will be transported via stretcher directly to the hospital emergency.
- The patient travel route should be along a level, hard surface free of curbs, steps or other obstacles which may trip or unbalance the stretcher and its attendants.
- The route should be wide enough to allow unobstructed passage of the stretcher and at least one attendant at the side. Minimum width of 2.6m.
- Hazards caused by vehicles, bystanders, ice/snow or water should be controlled or eliminated.
- The nearest suitable hospital entrance should be wide enough to accommodate a patient on a stretcher and two attendants. A single 1.2m wide door or two 0.9m wide double doors are adequate. Ideally, the entrance should be segregated from the public and equipped with an automatic opener or other means to hold the door fully open for unobstructed access.
- The suitable route of patient travel within the hospital should as much as possible be segregated from public access. Corridors, doorways and elevators should be wide and long enough to accommodate the stretcher, equipment, and attendants.
- Site secure from public access including pedestrians and vehicles.
- Proximity to vibration-sensitive medical equipment.

3.4 ENGINEERING AND MAINTENANCE CONSIDERATIONS

The engineering and maintenance design considerations are listed as follows:

- Physical space available and required for the heliport; and, does it work with current offsite development projects;

- Logistics of maintenance in the location (How easy will it be to maintain?);
- Proximity to electrical service, if heliport lighting is provided;
- Effects on existing offsite development; and
- Proximity to air intakes and ventilation systems that may cause helicopter exhaust to enter the hospital.

4.0 Findings

The Indicative Design Site Plan and Landscape Plan indicate a nearly full build out of the site. There is no physical space large enough to accommodate a heliport and the associated airspace. Revision of the current plan would be necessary for a heliport to be considered on the site.

A heliport location near the middle of the site would provide for the highly desired north and south flight path orientation. Since the building footprint occupies nearly the full width of site, provision for a heliport near the middle of the site is not possible without reconfiguration of the building. An area of approximately 45 metres square as well as the provision of an unobstructed north and south flight path slope of 16% would be required. A 16% flight path slope is the requirement for an H2 heliport with two flight paths. The 16% slope also represents the maximum that would be considered viable for an H1 ground heliport.

Without significant revision to the building footprint, the only heliport location options would be either toward the north or south ends of the site. The hospital building, where it is currently shown, would be a significant obstruction that would likely negate the provision of two flight paths. A heliport located at either the north or south part of the property would have only one flight path from which the helicopter would approach and depart. In the case of a single flight path, the flight path slope would be 12% slope in accordance with the requirements of Transport Canada CAR 325 for an H2 classification.

A north heliport location would need to be positioned approximately 125 metres from the north property line along Keith Avenue in order for the flight path slope to clear a 60 foot high power line on the north side of the roadway. The northerly flight path would overlay the railway lands that could be used as emergency landing areas for an H2 classification. The flight path would be curved to align with the railway in a west direction. The in order to meet the Transport Canada dimensional requirements for the flight path curve, the north flight path would be angled to the west. The building footprint illustrated in the Indicative Design Site Plan would likely need to be revised to provide the necessary flight path clearance. There would also need to be an emergency landing area designated on the hospital site between the heliport location and Keith Avenue.

In the event of an H1 classification, the powerline along Keith Avenue would represent the most significant obstruction within the flight path to clear by 4.5 metres should a helicopter have an engine failure. There would be more flexibility in regard to the orientation of the flight path since

the designation of emergency landing areas would not be required, The principal disadvantage of the H1, especially a heliport at ground level with only one flight path, is the potential for operational restrictions. Under some wind, temperature, and load conditions the EMS helicopter will not meet the performance conditions of an H1 heliport.

A heliport located on the south end of the site would need to be approximately 105 metres from the south property line. This assumption is based on the height of the power poles on Haughland Avenue being 40 feet. The flight path would be orientated in a direction that overlays the school yard and the open fields beyond Graham Avenue. In order to obtain the H2 heliport classification, the school yard would need to be designated as an emergency landing area. There would need to be an operational policy in place that the school yard be vacated prior to helicopter arrival and prior to departure.

The southerly flight path as H1 classification would be perhaps more optimal from an operational perspective than the north flight path. A helicopter would need to have the performance capability to clear the power line along Haughland Avenue by 4.5 metres under an engine failure condition, however after this point would face few obstructions beyond that.

An east/west flight path orientation would not be in alignment with prevailing winds and would also require helicopter approach and or departure over residential area. There would be no possibility of obtaining a H2 classification under these conditions. Flight path clearance of the power line along Tetrault Street would require a setback distance in the order of 105 metres from the property line positioning the heliport in a location that is not compatible with developmental utilization of the site. To the west, the heliport flight path would be required to clear housing along Eby Street. Tree removal on these private properties may be met with contention.

The need to construct the heliport as a raised mound design is dependent on the requirement for flight path clearance of obstructions that are closer to the heliport such as parking lots, roadways, and buildings. A raised mound heliport design is typically considered valuable design consideration in providing clearance of obstructions that are closer to the heliport than those at a distance. The determination of a raised mound heliport design would ultimately be based on the efforts of detailed design.

A flight path direction arrow will be required in the event that only a single H2 or single H1 flight path is provided. Two H1 flight paths would eliminate the need for the arrow.

The maximum linier distance of patient travel from the heliport to a suitable hospital entrance should be 60 metres. A distance greater than 60 metres typically requires the use of ground ambulance; negating one of the principal advantages of an onsite heliport.

The heliport would need to be fully enclosed by a fence that will keep bystanders and onlookers out of the heliport area and at a safe distance. The fence also serves to keep small domestic animals and wildlife out of the heliport area.

The heliport design would not necessarily include a perimeter lighting system. BC Air Ambulance helicopters have the ability to use NVG. Approval from Transport Canada in the

form of replacement conditions under CAR 305 and a documented flight path analysis would be required to permit NVG operations.

To meet the conditions of NVG operations, obstruction lights are to be installed on the prominent obstructions. All obstruction lights would have an IR component that would allow for improved visibility under NVG.

Power lines and power poles within the heliport flight path(s) would require both day markings and the installation of obstruction lights. A lit windsock would be installed; comprised of a ground-mounted mast and LED lighted windsock with an integral top-mounted obstruction light.

The placement of new trees and shrub plantings would need to consider the requirement of the flight path clearance requirements.

5.0 Summary

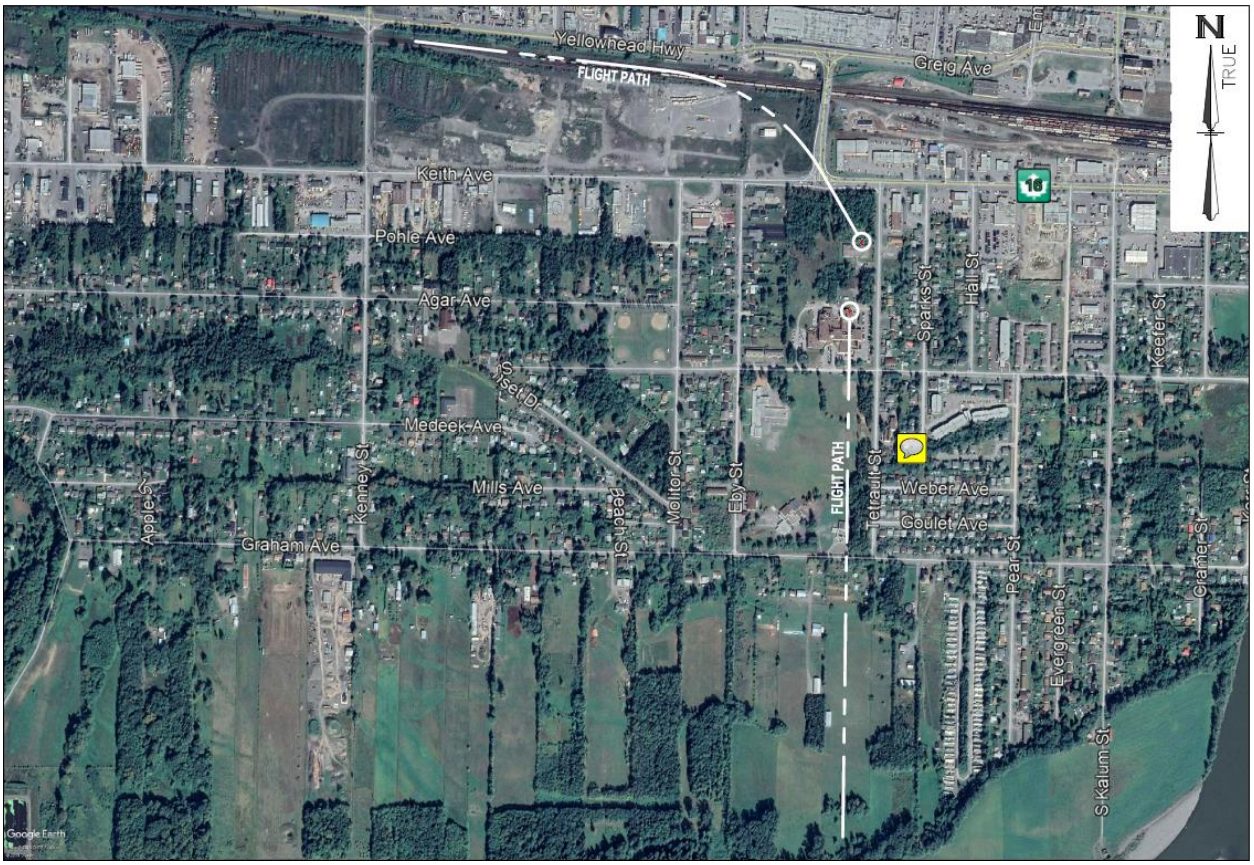
As stated in the outset of this report, the current site plan and landscape plan for the indicative design dated February 8, 2019 will require revision in order to accommodate a heliport within the project scope.

Although from a heliport operational perspective it is desired to provide flight path orientations in opposing directions in alignment with the prevailing winds, this simply may not be possible due to the requirements of the new building footprint as currently shown. An assessment of the importance of heliport for the new Mills Memorial Hospital will dictate if the significant step should be taken to revise the building configuration of the Indicative Design to provide compatibility with the most optimal location of an onsite heliport.

Alternatively, Northern Health may wish to consider revision to only the site infrastructure portion of the Indicative Design such as parking lots, internal roadways and green space in order to accommodate the requirements of a heliport. The sketch attached to this report suggests two prospective heliport locations along with the potential flight path orientations. It is recognised that a coordinated design effort would be required to integrate the needs of a heliport with a revised Indicative Design Site Plan. A ground heliport will require a significant amount of land area of the site in order to implement. Parking area and green space would need to be revised or perhaps reduced in order to meet the needs of a heliport. The impact to the Indicative Design as currently illustrated would need to be measured with the clinical importance of a heliport. An H1 heliport with only a single flight path will likely not be useable by BC Air Ambulance helicopters 100% of the time. The current EMS helicopter will not have the performance capability to conduct a take-off with a tailwind. Should the decision be made to include a heliport within the design development, every effort should be made to obtain an H2 classification. The required helicopter performance for H1 heliport classification will be more difficult to achieve for the EMS helicopters. The on and offsite conditions suggest the construction of a raised mound would help to address some of the required flight path clearance issues and assist in some regards to meeting the operational conditions of an H2 heliport.

6.0 Sketches

Flight Path Sketch of Potential North and South Heliport Locations



Heliport Site Plan Sketch Illustrating Potential Heliport Locations