A new Central Otago airport

Preliminary Aeronautical Assessment

September 2021

Contents

As a geographically-isolated island nation, New Zealand has a unique dependence on aviation.

Aviation is critical to social connectivity, business, trade and tourism delivering $23 billion of exports and imports each year. It is critical to getting high-value, time-sensitive freight to and from New Zealand and the only practical way for Kiwis to explore the world.

The need and location for airports within Central Otago has been a topic of discussion over the past 30 years. Central Otago is one of the fastest growing regions in the South Island and its social and economic wellbeing is unlikely to be maximised within the current constrained airport infrastructure.

In July 2020 Christchurch Airport announced we had acquired 750 hectares of land at Tarras in Central Otago and our intention to assess the feasibility of building a new regional airport there.

Since this announcement we have undertaken a preliminary aeronautical assessment, this preliminary assessment is the first stage in affirming whether an airfield on site is aeronautically viable. This document presents the key findings of this work.

The preliminary findings contained in this document are encouraging but they are not final.

We have a lot more work to do to confirm technical viability, to determine commercial viability and the project's ability to gain the necessary operating and planning approvals.

Our interest in building a new airport is focussed on meeting the region's air capacity and connectivity needs for the next 50+ years therefore maximising the social and economic wellbeing of the region.

Building from scratch enables us to add the capacity the aviation network needs and enable safe and low-carbon air connectivity for future generations.

Michael Singleton
Project Director

CHRISTCHURCH AIRPORT

Proposed airport site

The proposed airport site comprises approximately 750 hectares of land near Tarras, Central Otago.

The site lies to the east of the Clutha River/Mata-Au, between State Highways 6 and 8. The northern side of the site is flanked by SH 8A which provides a linkage between SH 6 and 8.

It has a central location within the region it will serve, and proximity to:

- Cromwell (22km)
- Wānaka (25km)
- Queenstown (70km)
- Alexandra (58km)
- Twizel (108km).

Located 243m (800ft) above sea level the site is situated at the confluence of three valleys; the Hawea Valley aligned generally north to south, the Lindis Valley aligned generally north-east to south-west and the Cromwell Valley aligned generally north-east to south-west along Lake Dunstan and the Clutha River/Mata-Au.

The site was identified as the location that was most likely to meet the technical and safety requirements of an airport.

Assessment overview

A new airport provides a once-in-a-generation opportunity to design, build and operate a world-class facility. For that to occur and to ensure it benefits from informed decision-making, Christchurch Airport has committed to conducting thorough and robust investigations and sharing information as it becomes available.

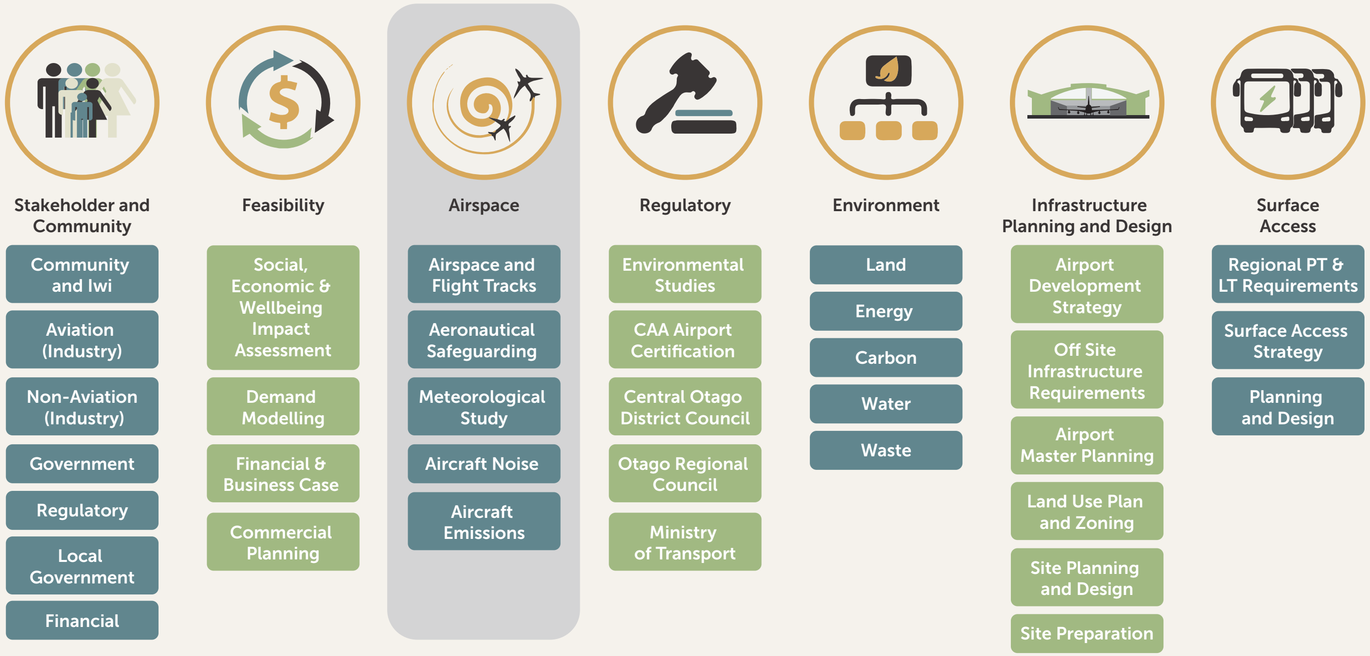
Investigating a potential new airport requires a range of studies and workstreams, as illustrated opposite. This assessment is initially focussed on the Airspace Workstream. The information contained in it is preliminary and will enable more detailed work to follow.

It was prepared with the assistance of Airbiz Aviation Strategies Ltd. Airbiz specialises in aviation consulting and has been supported by specialists in aircraft performance and airspace design, including Mike Haines Aviation Limited and Jerry Nicholas Aviation Limited. The assessment draws on meteorological data supplied by NIWA and detailed topographical data created by Landpro.

The information contained in this assessment does not yet address all of the studies which will form part of the remaining workstreams.

While aviation and tourism have been impacted by COVID-19, the preliminary work to test the aeronautical viability of the site has proceeded. Christchurch Airport is confident aviation will recover and the projected capacity constraints on air connectivity to the mid to lower South Island will eventuate over time.

Project Workstreams



Key findings

The preliminary outcomes of our work are set out below:

- The site is suitable for compliant and safe aeronautical operations by typical scheduled aircraft types operating in New Zealand.
- Preliminary weather data for the site indicates local conditions are suitable for scheduled aircraft operations with northerly wind conditions. Visibility data indicates generally good operating conditions.
- Considering topographical and wind conditions, there are two potential alignment options for a single runway on the site.
- A runway length in the order of 2,200m is achievable and possibly a longer runway length between 2,500m and 3,000m.
- The site is suitable for the key aircraft types expected to operate scheduled aviation services within New Zealand and on likely international routes now and in the future.
- Flight tracks can be designed to and from the site and the initial assessment indicates that efficient aircraft operating gradients can be designed.
- Integration of new flight tracks into the existing airspace environment will need to be carefully planned but is achievable.
- Both runway alignment options perform comparably in terms of carbon emissions.
- More work needs to be done to refine the runway options and airspace planning to ensure aircraft can operate in the most environmentally and operationally efficient way possible.

These preliminary outcomes are encouraging and now attention will turn to considering more detailed assessments of flight paths, airspace integration, aircraft performance, wind shear, environmental performance and noise impacts.

This will help us establish which runway alignment option is best suited to the types of aeronautical operations expected.

Planning a new airport

Assessment context

Airports are intergenerational assets and exploring the creation of a new airport is a detailed and complex task.

Successful airport planning provides a framework for airports to develop in response to changing needs over a long period of time. The success of that long-term thinking can be measured by how well the airport meets its immediate needs, while also adapting to changing trends, developing in stages to meet evolving demand.

Airport planning is future focused, providing a balance between reliance on known technological advances in areas such as air traffic control, avionics and security, the possibility of innovations enabling new ways of operating an airport, as well as the transition of New Zealand's aviation network to a low carbon future.

Airport planning also takes into account the regulatory context for airport operations. For this assessment the key regulatory reference is the Civil Aviation Act 1990 which sets out requirements to enable the certification of an aerodrome, as well as the Civil Aviation Rules and the International Civil Aviation Organization (ICAO) standards and recommended practices.

There will also be numerous land use planning and environmental regulations to consider, however these are not a direct requirement of this aeronautical assessment.

Key features

The key features of a safe and efficient airport at the site were considered to be:

- An airfield network featuring a single runway having a length not less than 2,200m, fully compliant 240m runway end safety areas, associated taxiways and aircraft parking aprons.
- Maximum flexibility to enable airlines to use the wide range of aircraft anticipated to be in operation at the airport over its lifetime.
- Ability to use the latest generation of aviation technology to maximise safety and efficiency, and to mitigate the effects of operations on communities and the environment.
- Ability to incorporate smart technology and innovation to enhance the customer experience and improve the reliability of flight schedules by enabling safe operations to continue during low-visibility conditions.
- Resilience to natural hazards including those associated with climate change.

Key contributing factors

A range of factors influence possible configurations of core airport infrastructure such as the runway, taxiways, aprons and passenger terminal.

Initial stages of planning have focused on scoping the suitability of the site for safe and efficient scheduled aeronautical operations and the ability of the site to meet preliminary runway length objectives.

Due to the location of the site, the amount of detailed and localised data was limited and needed to be improved, so our team engaged specialists to provide more detailed meteorological data (NIWA) and terrain data (Landpro) which has been analysed and informs this assessment.

We have not yet considered on-site ground conditions, land use or other environmental considerations which will be relevant for future decision-making.

Key initial factors to consider when investigating a new site:

Weather	What are the generally acceptable runway orientations based on the prevailing weather conditions?
Terrain	What is the height and proximity of terrain with and near the site?
Airspace Enroute	Can aircraft flight paths and procedures be designed for the runway orientation options enroute?
Runway	What are the initial runway threshold locations and runway length available for the alignment options?
Airspace Local	What are the aircraft climb gradients and approach slopes required and are they acceptable?
Aircraft Operations	What are the aircraft performance outcomes and engine-out requirements?

Runway alignment options

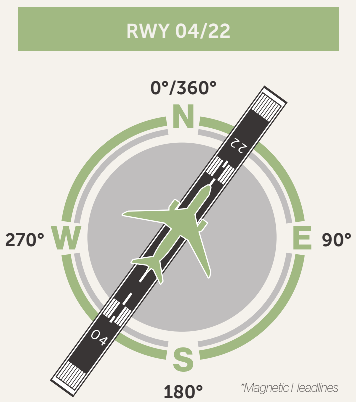
Two options for a single runway

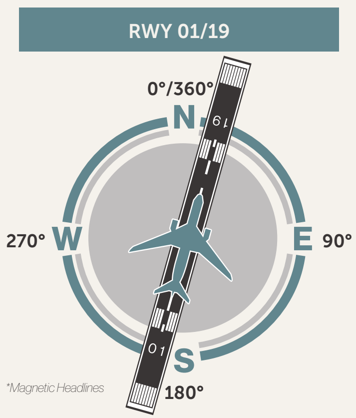
The site is located at the confluence of the Hawea Valley, the Lindis Valley and the Cromwell Valley.

On the site, optimal runway alignment is determined by a range of factors including the site geography and boundary, surrounding terrain and meteorological conditions.

These have allowed two preliminary alignments to be assessed for a single runway airport:

- **Lindis Valley – Lake Dunstan Alignment** (Runway 04/22) – aligned generally north-east/south-west using the Lindis and Cromwell Valleys, and
- **Hawea Valley – Lake Dunstan Alignment** (Runway 01/19) – aligned generally north/south using the Hawea and Cromwell Valleys.





Preliminary investigation indicates that both the Lindis Valley – Lake Dunstan Alignment and Hawea Valley – Lake Dunstan Alignment options are suitable for aircraft operations of varying types and flight paths can be designed and integrated into the existing airspace network.

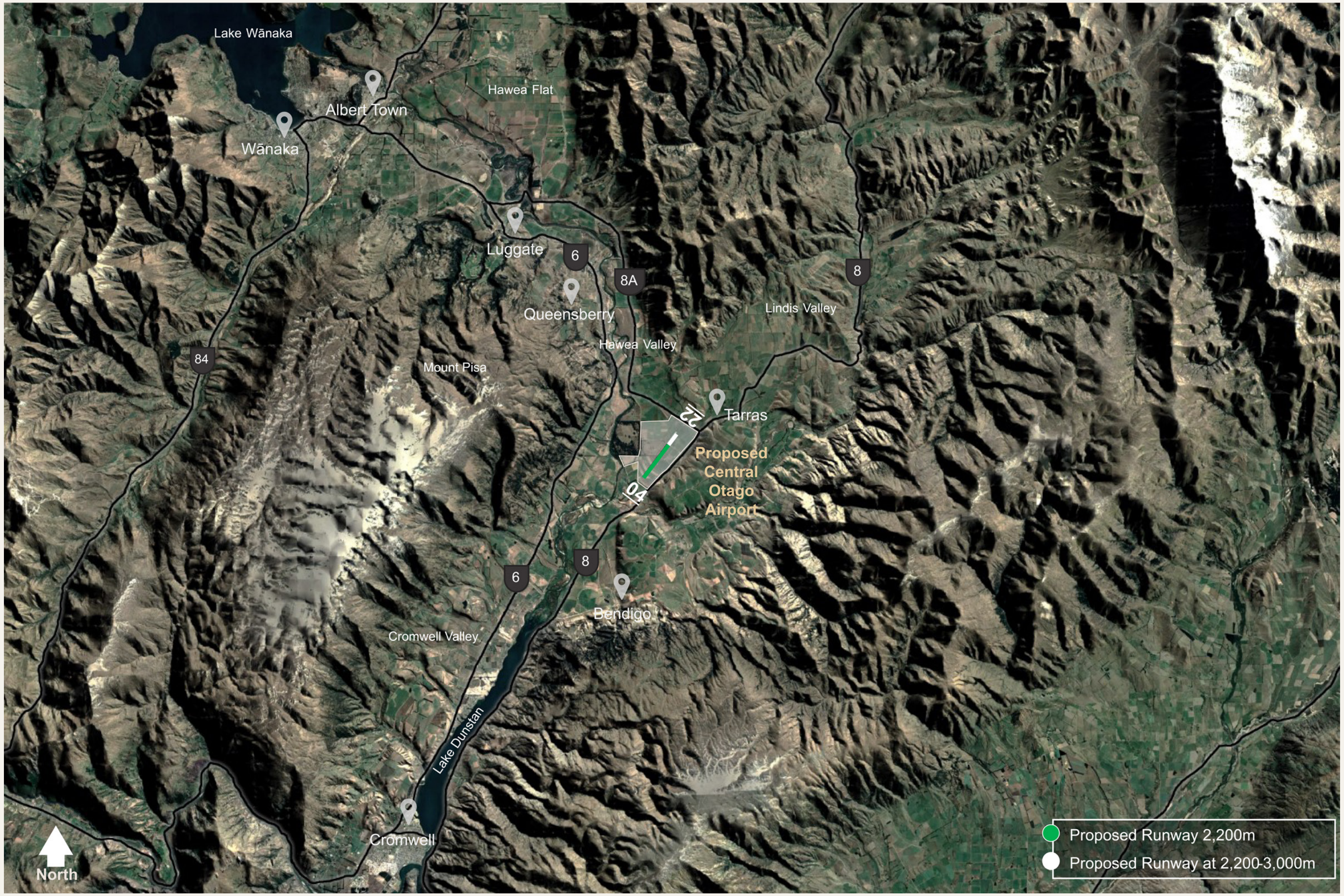
Next steps

The next steps will include more detailed technical feasibility examination of the options, refinements of the alignments, and consideration of key environmental effects such as aircraft emissions and noise impacts from each of the runway alignment options.

Estimated completion date: Q2 2022

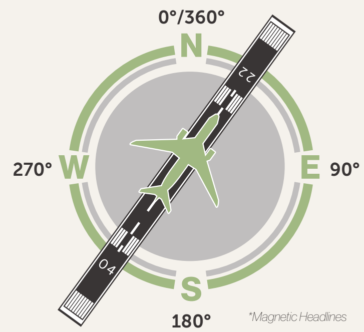
Lindis Valley – Lake Dunstan alignment option

Runway 04/22



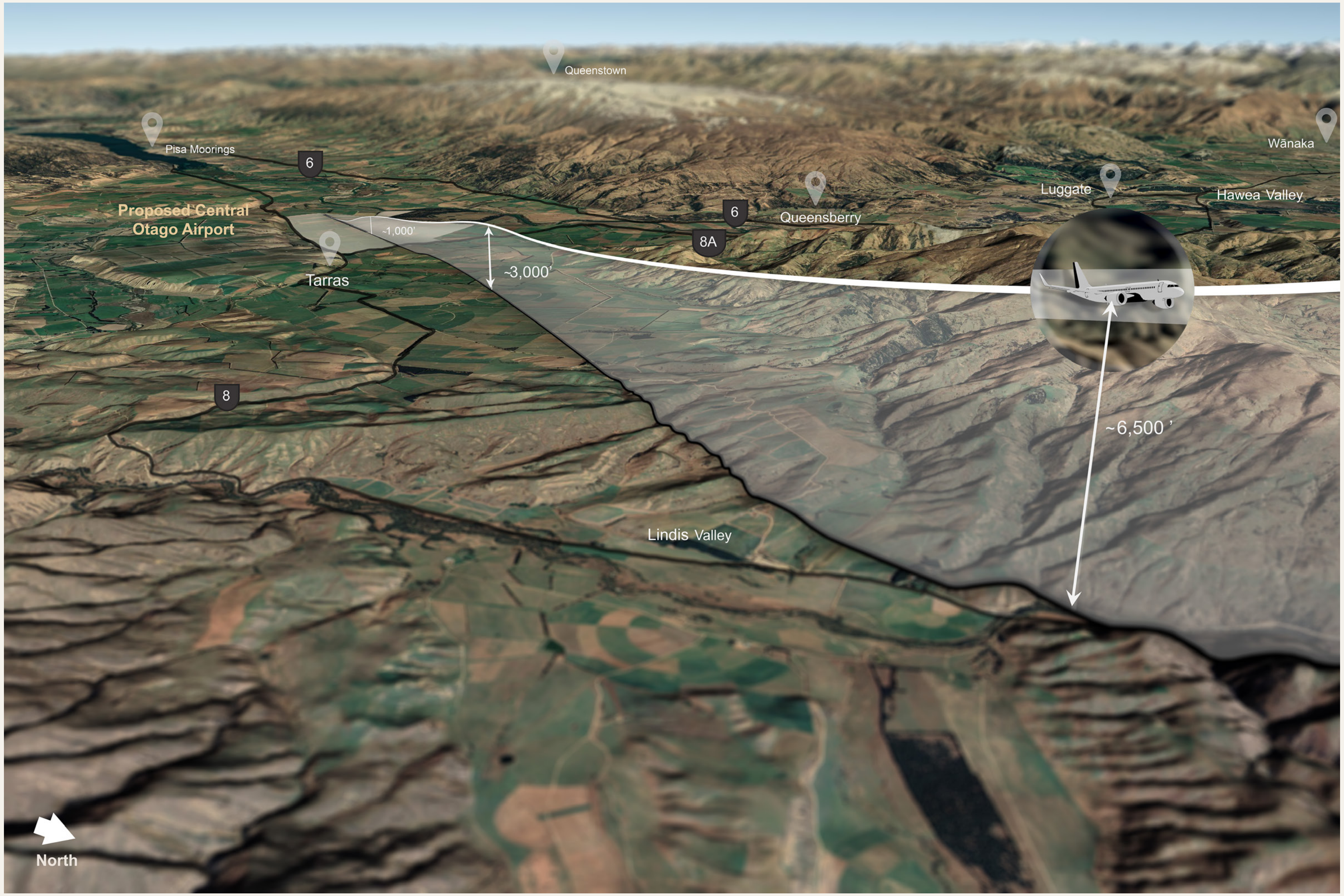
The illustration opposite shows the proposed airport site and the Runway 04/22 alignment option.

- This option is aligned generally north-east/south-west using the Lindis and Cromwell Valleys.
- The runway length is shown for an approximately 2,200m runway and a longer length between 2,200m and 3,000m.
- Aircraft performance requirements are influenced by terrain immediately north of the site.



Lindis Valley – Lake Dunstan alignment option

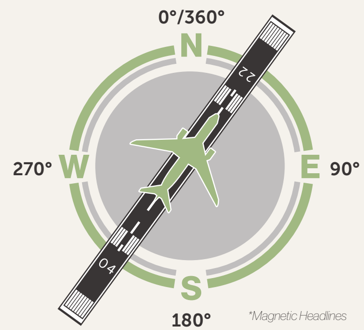
Lindis Valley Departure Flight Track (Runway 04)



The illustration opposite shows a preliminary northern departure flight track for Runway 04 of an A320neo departing through the Lindis Valley.

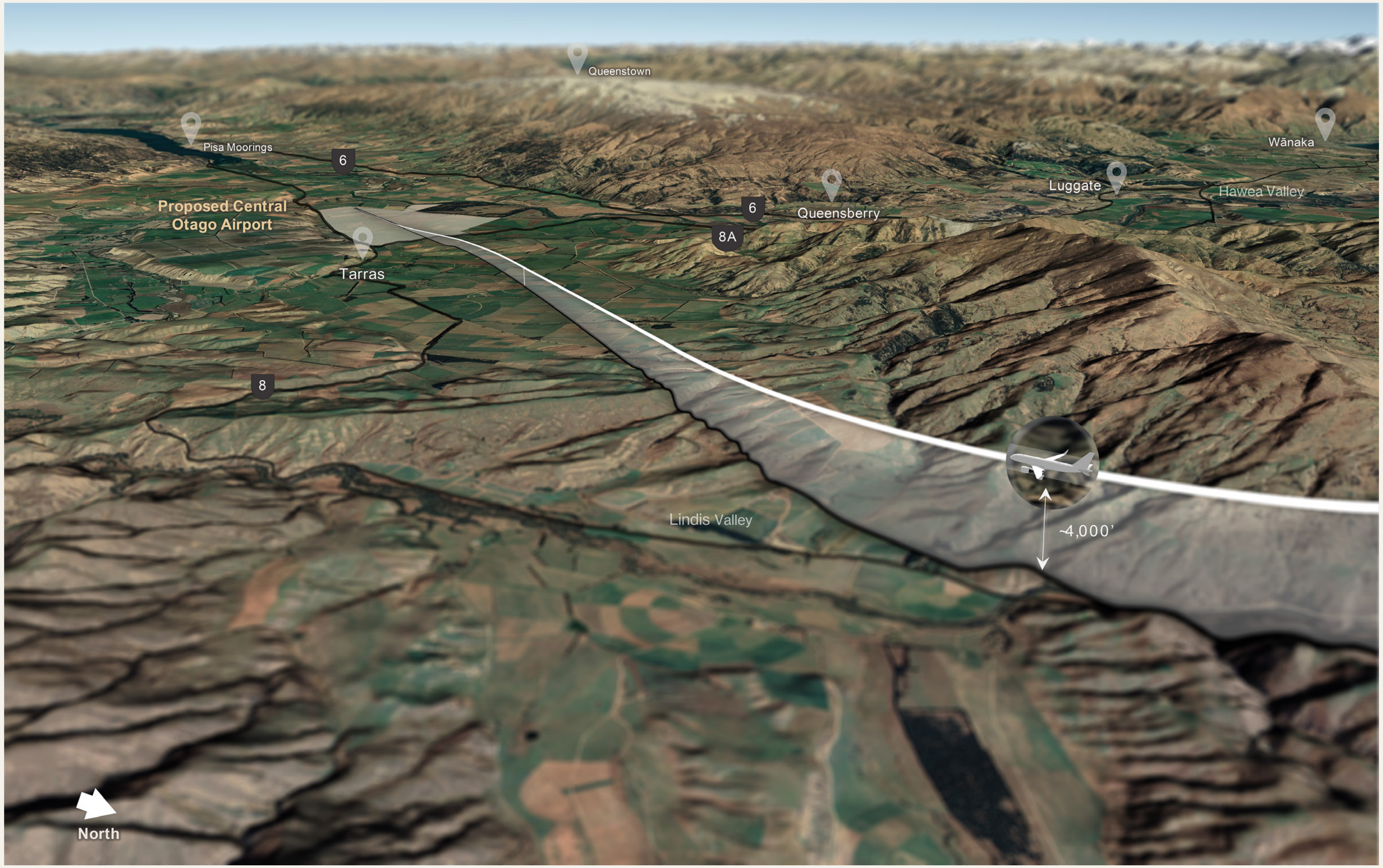
Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*



Lindis Valley – Lake Dunstan alignment option

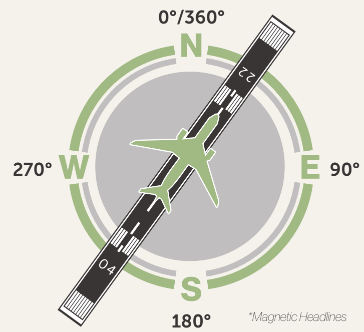
Lindis Valley Arrival Flight Track (Runway 22)



The illustration opposite shows a preliminary northern arrival flight track for Runway 22 of an A320neo arriving through the Lindis Valley.

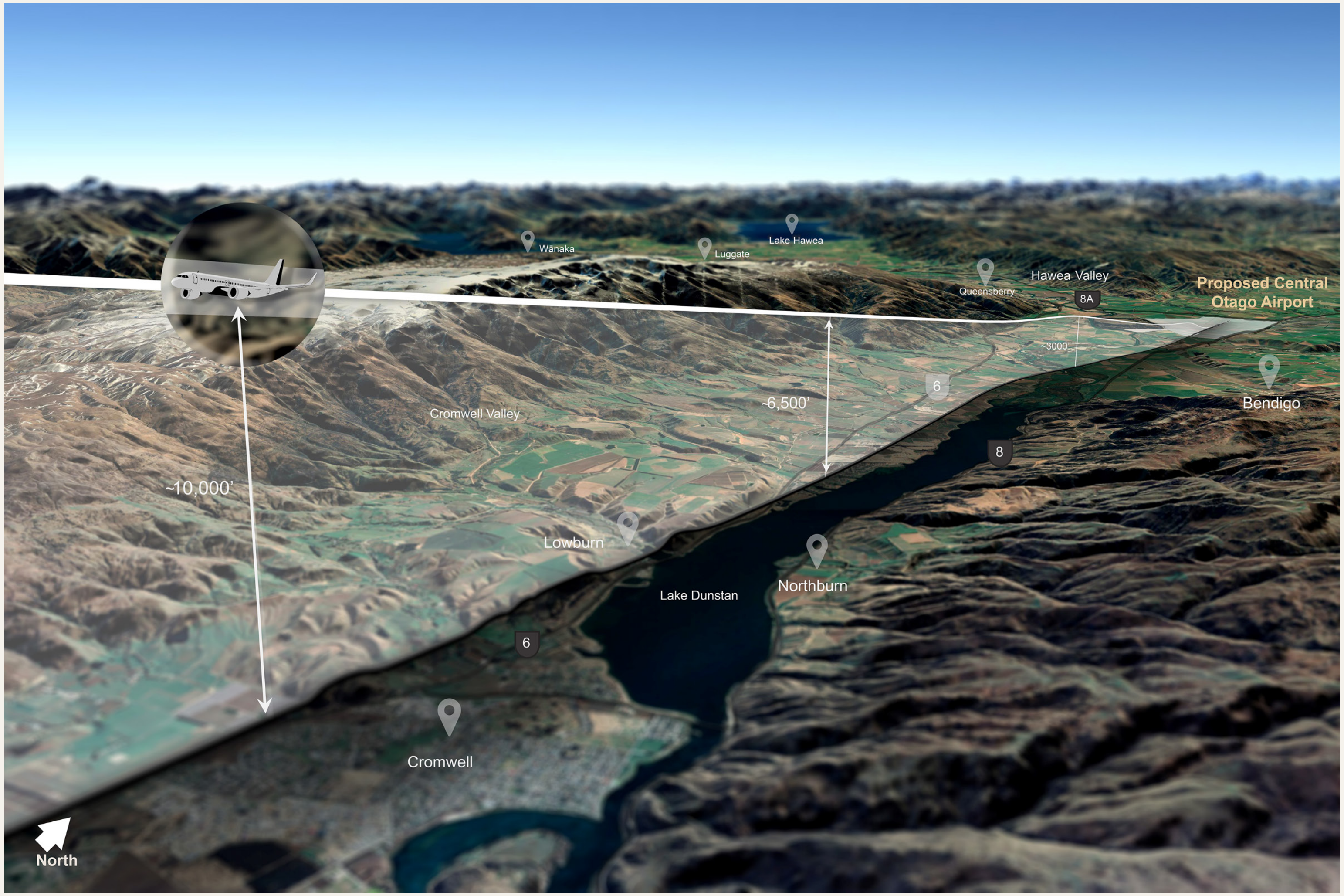
Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*



Lindis Valley – Lake Dunstan alignment option

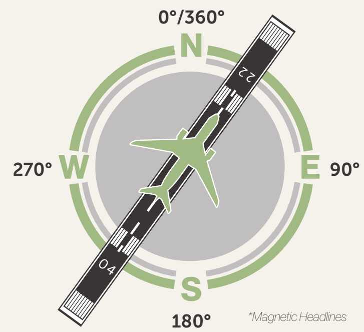
Lake Dunstan Departure Flight Track (Runway 22)



The illustration opposite shows a preliminary southern departure flight track for Runway 22 of an A320neo departing through the Cromwell Valley.

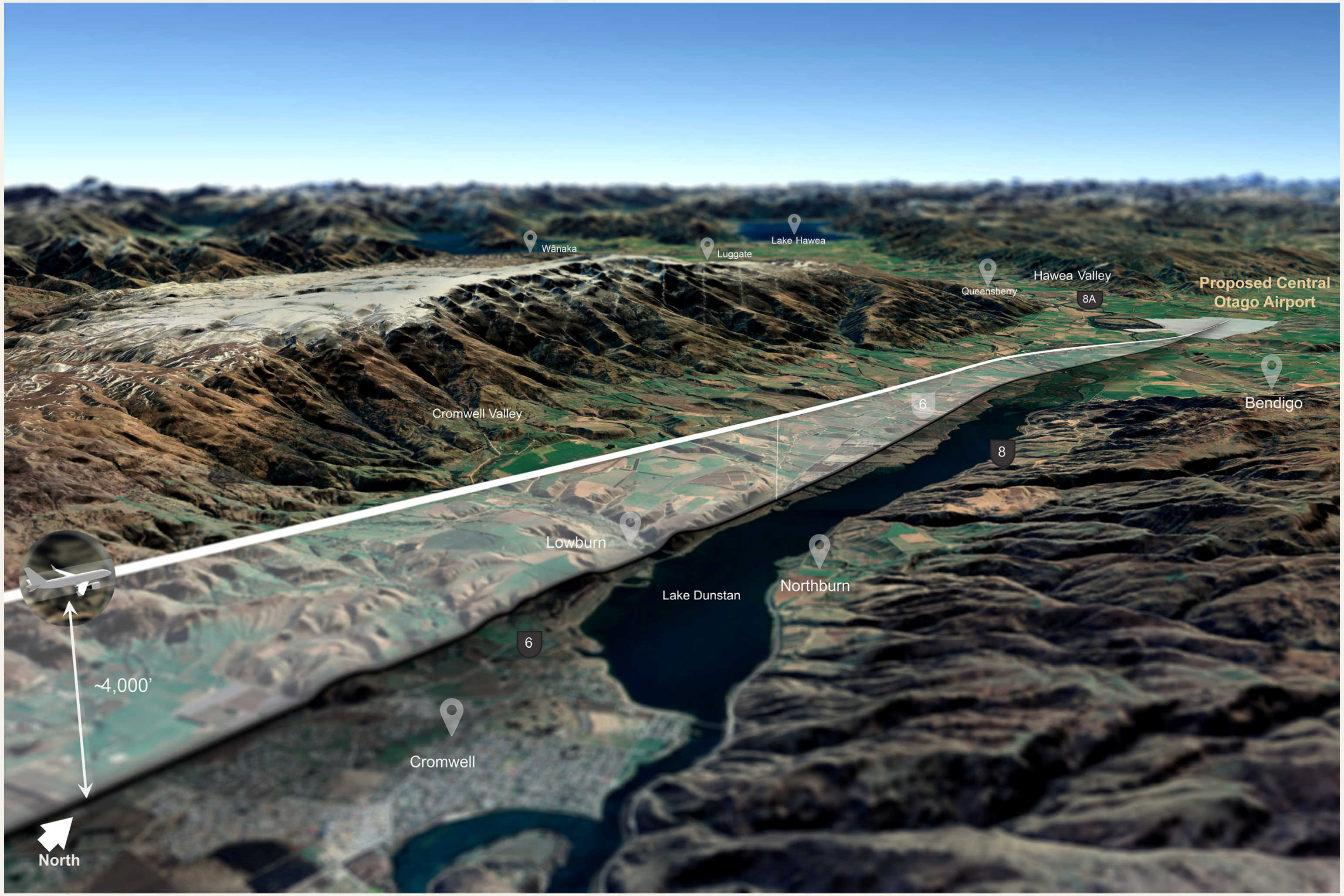
Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*



Lindis Valley – Lake Dunstan alignment option

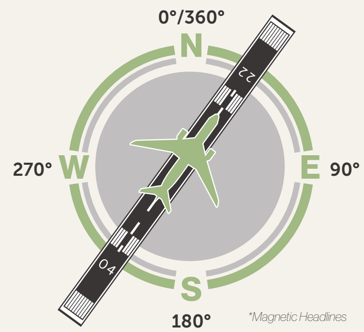
Lake Dunstan Arrival Flight Track (Runway 04)



The illustration opposite shows a preliminary southern arrival flight track for Runway 04 of an A320neo arriving through the Cromwell Valley.

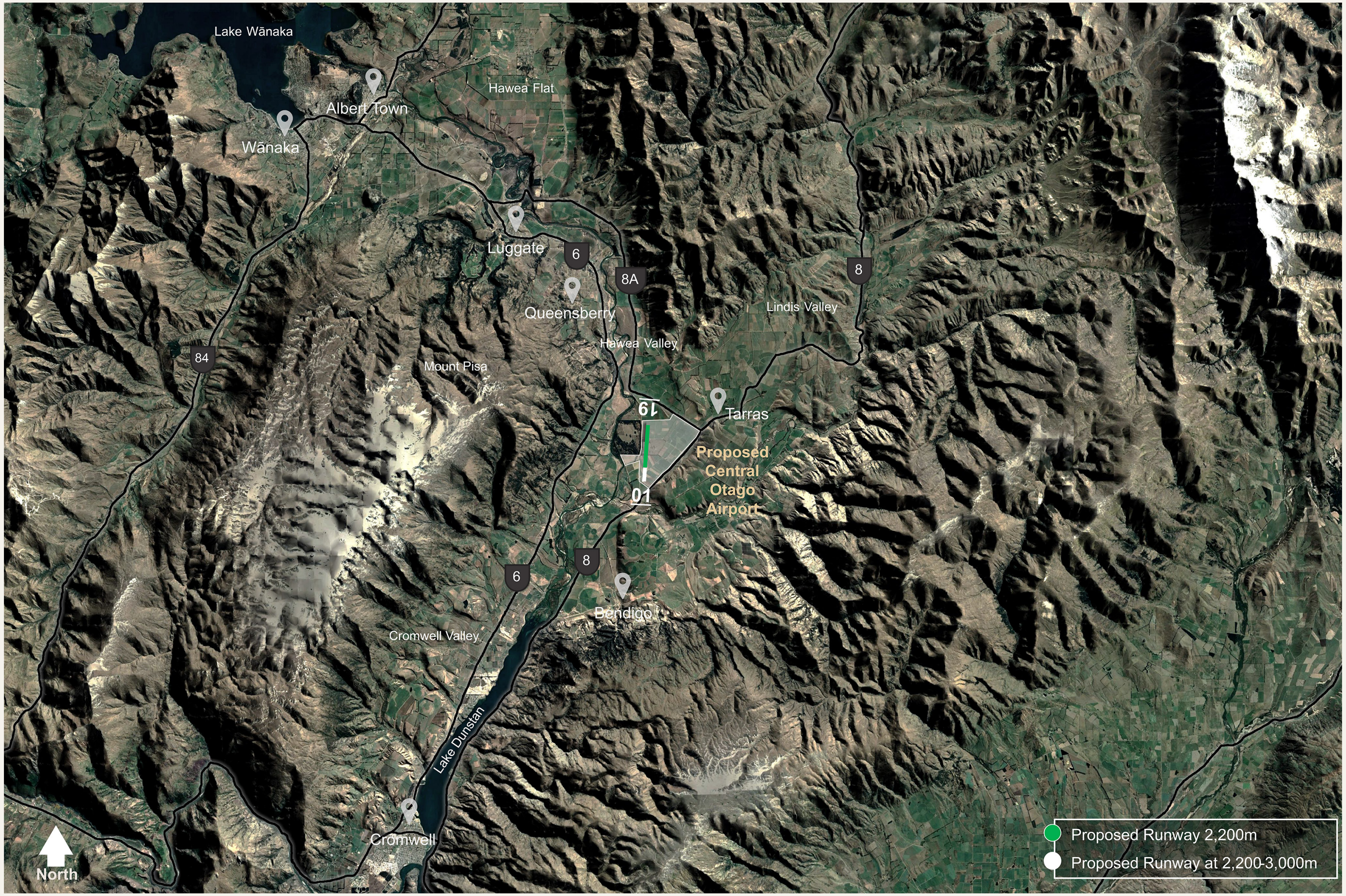
Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*



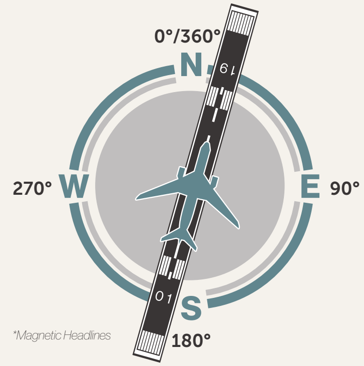
Hawea Valley – Lake Dunstan alignment option

Runway 01/19



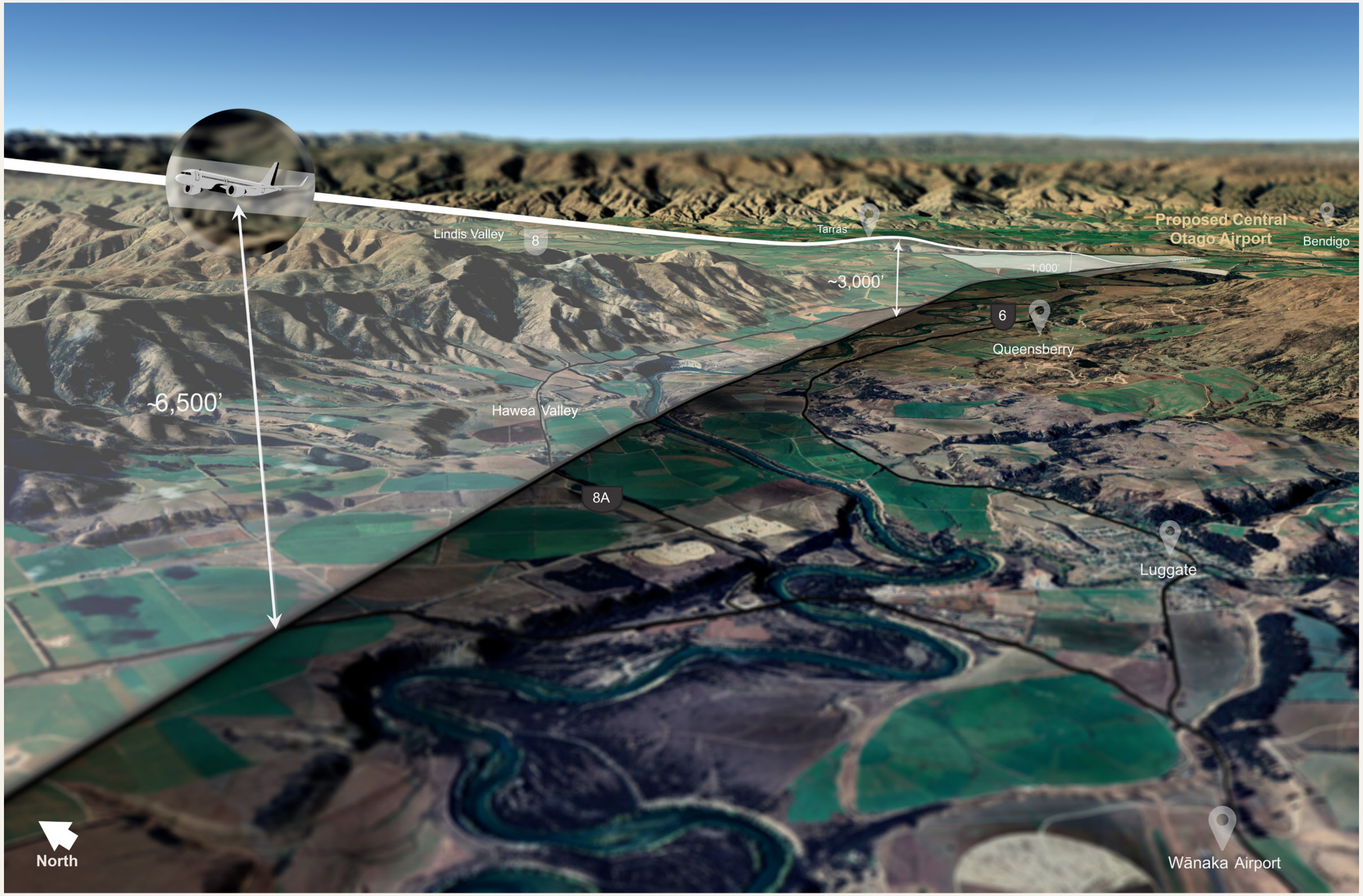
The illustration opposite shows the proposed airport site with the Runway 01/19 alignment option.

- This option is aligned generally north/south with associated aircraft flight tracks within the Hawea and Cromwell Valleys.
- The runway length is shown for an approximately 2,200m runway and a longer length between 2,200m and 3,000m.
- Aircraft performance requirements are influenced by terrain directly south of the runway and to some extent by terrain to the north.



Hawea Valley – Lake Dunstan alignment option

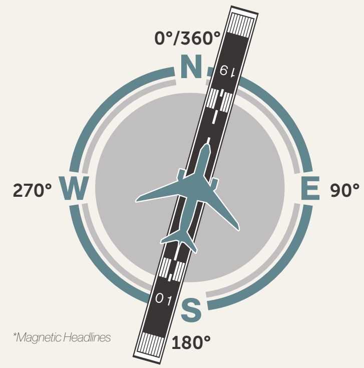
Hawea Valley Departure Flight Track (Runway 01)



The illustration opposite shows a preliminary northern departure flight track for Runway 01 of an A320neo departing through the Hawea Valley.

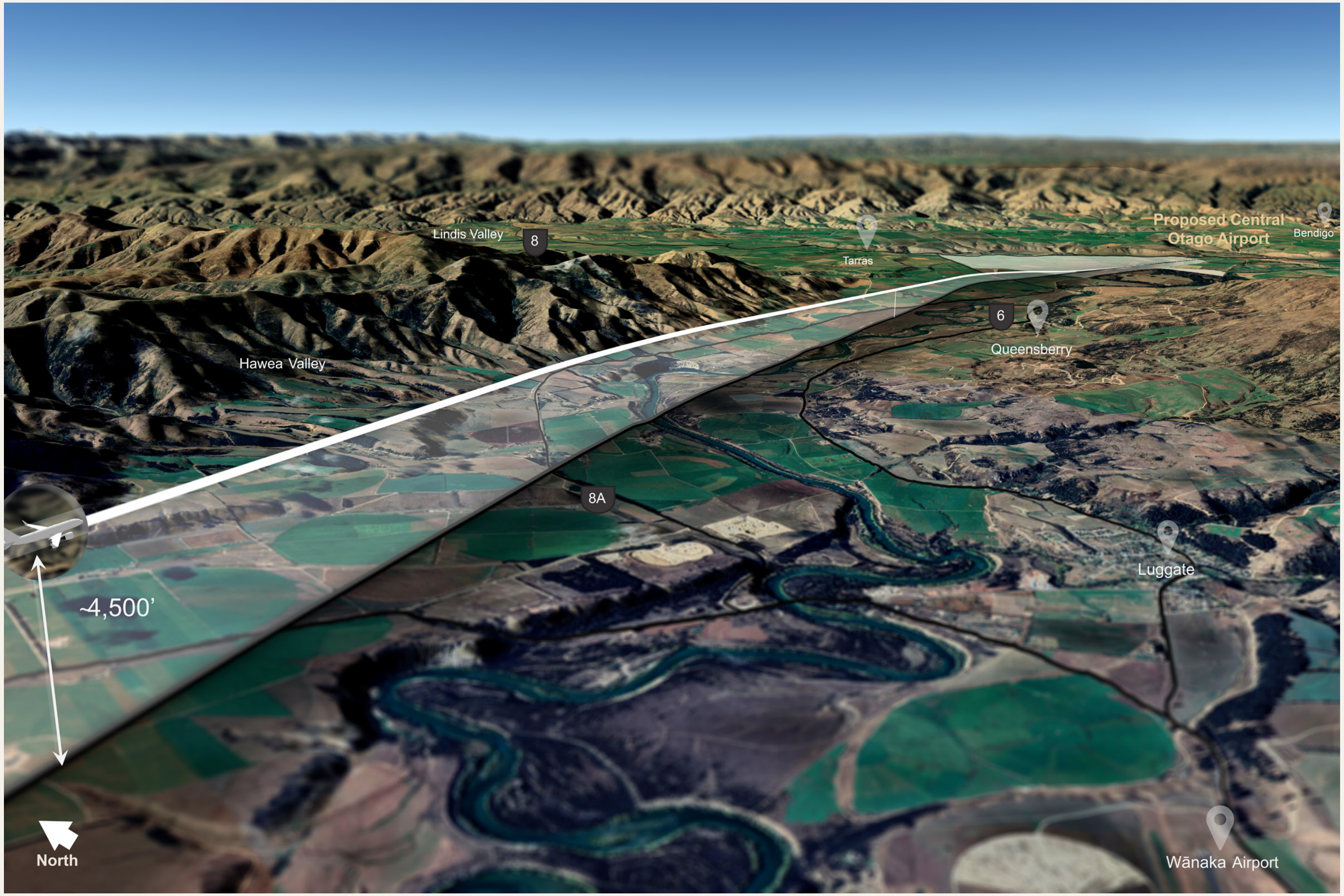
Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*



Hawea Valley – Lake Dunstan alignment option

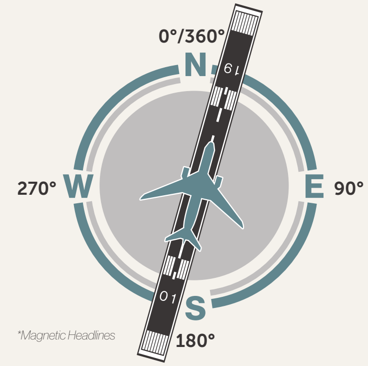
Hawea Valley Arrival Flight Track (Runway 19)



The illustration opposite shows a preliminary northern arrival flight track for Runway 19 of an A320neo arriving through the Hawea Valley.

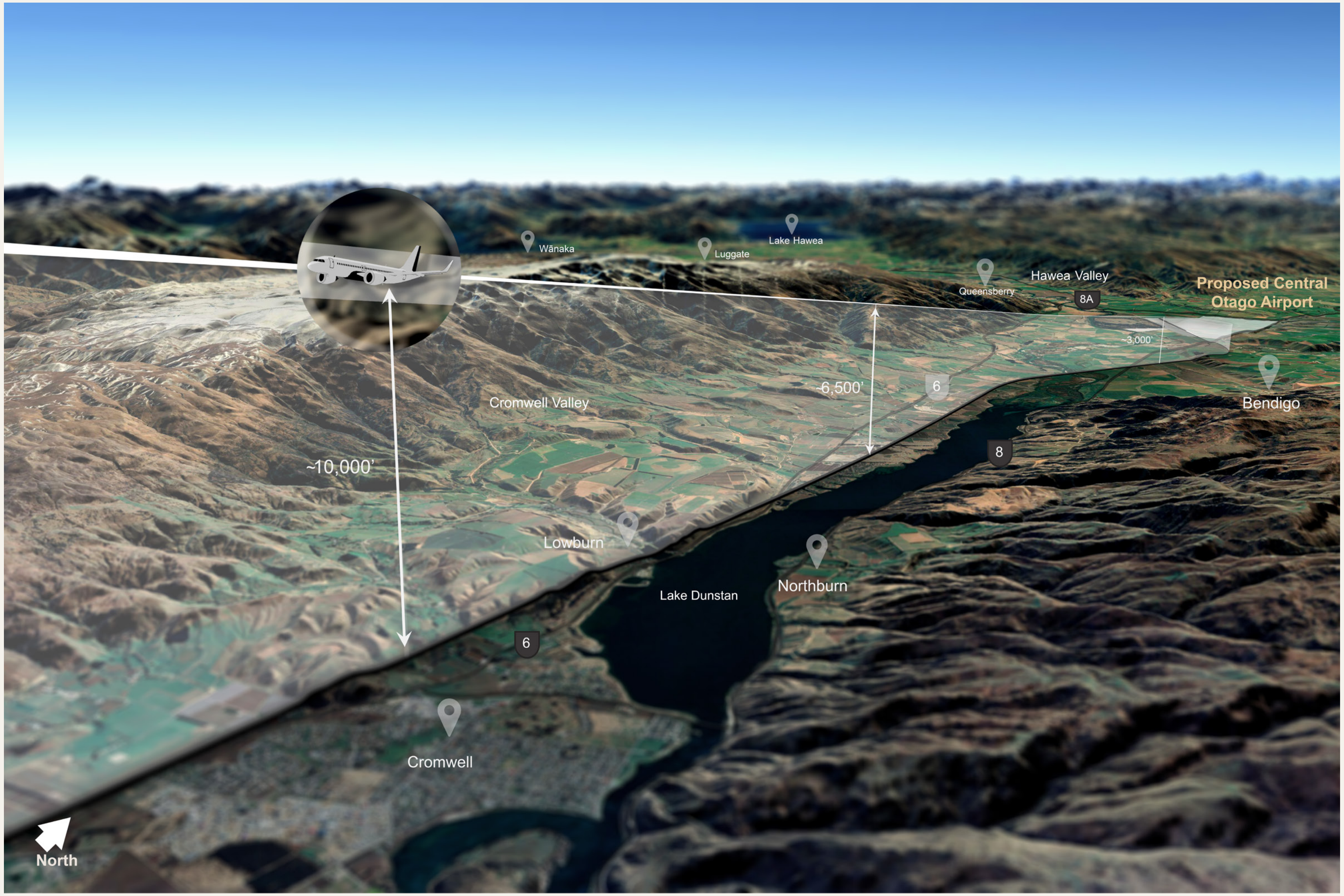
Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*



Hawea Valley – Lake Dunstan alignment option

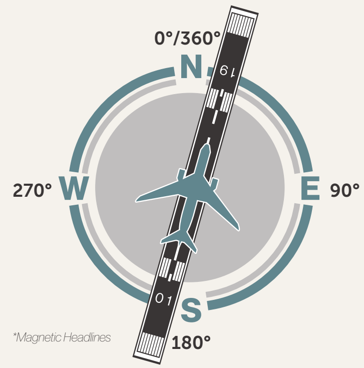
Lake Dunstan Departure Flight Track (Runway 19)



The illustration opposite shows a preliminary southern departure flight track for Runway 19 of an A320neo departing towards Cromwell.

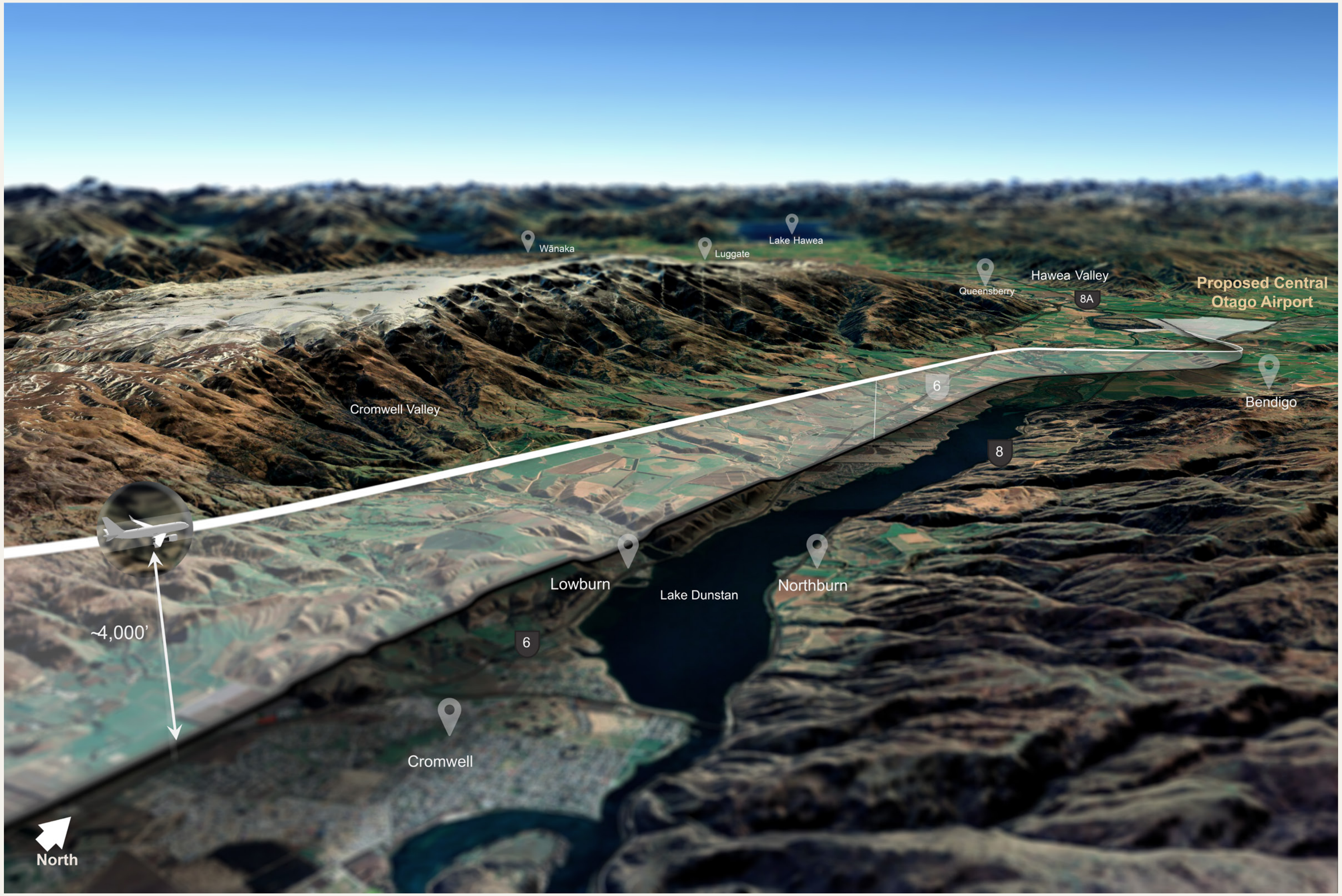
Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*



Hawea Valley – Lake Dunstan alignment option

Lake Dunstan Arrival Flight Track (Runway 01)



The illustration opposite shows a preliminary southern arrival flight track for Runway 01 of an A320neo arriving through the Cromwell Valley.

Notes:

- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
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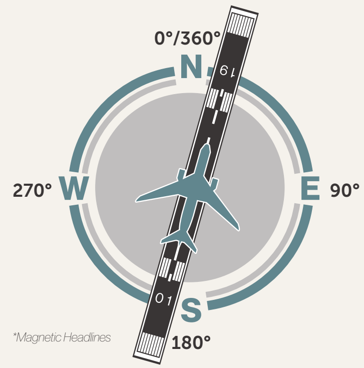


Runway length options

Sufficient runway length is required to ensure an aircraft can, after starting a take-off manoeuvre, either complete the take-off safely, or be brought safely to a stop on the runway.

Runway length will determine the aircraft types that can be used from the location and the destinations that can be served. It will influence aircraft operational performance.

Runway length is determined by a range of factors, including site geography and boundary, surrounding terrain, temperature and precipitation.

The preliminary assessment indicates the site is suitable for a runway length in the order of 2,200m, capable of serving all domestic routes and short haul international operations such as trans-Tasman, parts of the Pacific and possibly further afield, for new generation aircraft types.

The site is also able to accommodate fully compliant 240m Runway End Safety Areas (RESAs) at each end of the runway and a parallel taxiway.

As a runway is one of the most expensive and significant pieces of infrastructure on an airport, it is important to consider at the planning stage the maximum length achievable to fully realise the opportunities for the airport and the community it serves.

Retrospectively expanding or altering a runway can be disruptive and costly to communities and airport operations. Our analysis has found the site may be suitable for a maximum runway length between 2,500m and 3,000m.

While freight can be carried in the hold of most aircraft, consideration was given to dedicated freight aircraft such as Boeing B777F. The preliminary assessment indicates that dedicated freight aircraft will be able to connect with Australian freight hubs and, depending on the final runway length, a number of longer haul destinations, although with some payload restrictions.

Next steps

The next steps involve establishing the technical feasibility of the runway length options that have been identified, more detailed aircraft operating requirements and implications assessments, associated environmental impacts such as aircraft emissions, noise impacts and engagement with key users and aircraft manufacturers.

Consideration will be given to ground conditions such as airport site hydrology and geomechanics.

Estimated completion date: Q2 2022

Aircraft operations

A core component of project planning is to confirm the site is suitable for relevant current and future aircraft types to operate in a safe and efficient manner.

Initial analysis has focused on confirming a runway length of 2,200m is suitable for the candidate aircraft types expected and identifying if this may result in operating constraints.

Further analysis has assessed additional opportunities created from a longer runway length.

Preliminary outcomes indicate the site is suitable for a range of aircraft types including; new generation narrowbody and widebody jets such as the A321, B737, A350 and B789, dedicated air freight aircraft such as the B777F (runway length dependant) as well as turboprop aircraft such as the ATR72-6, Q300 and smaller passenger aircraft types. More detail is shown opposite.

A runway length of 2,200m should be suitable for narrowbody and widebody operations to domestic New Zealand, east coast Australia and Adelaide, and parts of the Pacific, with minimal operating restrictions.

Preliminary analysis of runway lengths between 2,500m and 3,000m indicates that the site could accommodate further afield. Some operational restrictions may be required to safely navigate local terrain.

Key Representative Aircraft		Type	Typical Runway Length (m)	Typical Range (km)	Typical Seat Range (no.)	Typical Freight Capacity (tonnes)	Typical $kgCO_2e$/Pax km
	ATR72-600	Turboprop *(Code C)*	<2,200	1,400	68	0.2-0.5	64
	A320neo	Narrowbody Jet *(Code C)*	~2,200	6,300	162-178	2-3	58
	A321neo	Narrowbody Jet *(Code C)*	~2,200	7,400	180-220	2-3	47
	B737-800	Narrowbody Jet *(Code C)*	~2,200	6,570	160-180	2-3	65
	A350-900	Widebody Jet *(Code E)*	~2,300-3,000+	13,950	290-310	8-11	83
	B787-9	Widebody Jet *(Code E)*	~2,300-3,000+	15,000	300-350	13-17	71

Notes:

- *For comparative purposes the typical aircraft kgCO2e/Pax km are based on a short 1,500km flight sector.*
- *The typical kgCO2e/Pax km values shown may differ from actuals due to rounding.*
- *As the flight stage length distance increases so does the kgCO2e/Pax km.*
- *Other factors that influence flight CO2e flight emissions include aircraft type, weight and age; destination and fuel load; flight and cruise profile; weather; and piloting.*

Next steps

Next steps will involve refining the runway options and lengths. This will include discussions with key airline and industry stakeholders and more detailed aircraft operational performance assessments such as engine-out requirements (where aircraft might have to operate on one engine due to the unlikely event of an engine failure on take-off).

Estimated completion date: Q2 2022

Airspace

Flight path design for the airport must provide safe, compliant and efficient procedures, while mitigating noise and environmental impacts.

The airspace which an aircraft flies through can be considered in three broad categories:

1. Local airspace in the immediate vicinity of an airport during aircraft take-off and landing;
2. Controlled airspace designed to protect aircraft during transit between the aerodrome and the enroute environments; and
3. Enroute airspace at cruising altitudes connecting between airports.

Planning for safe aircraft operations must be integrated with existing aircraft operations and aerodromes in the area. This includes scheduled passenger transport (airline) operations transiting the area to access the existing Queenstown and Wānaka airports, gliding activities, topdressing, helicopter operations serving flightseeing and viticulture, agricultural aviation, hot-air balloons, scientific weather balloons, warbirds, paragliding and hang-gliding.

Preliminary analysis of the local airspace considering the local terrain and prevailing weather conditions indicates that safe and efficient flight paths can be designed for both runway alignment options:

- The Lindis Valley – Lake Dunstan (Runway 04/22) option aligns with flight paths that would use the Lindis and Cromwell Valleys.
- The Hawea Valley – Lake Dunstan (Runway 01/19) option aligns with flight paths that would use the Hawea and Cromwell Valleys, with curved approaches to land from the south (and north to a lesser extent), or a curved departure when taking off to the south (and north to a lesser extent).

Airspace planning will need to integrate existing airspace users into the airspace design, which may need to be designated as controlled airspace with appropriate transit lanes for visual flight rules (VFR) traffic, as there would be a need for an air traffic control service to ensure the safety and efficiency of aircraft operations.

The preliminary analysis indicates connections into the existing enroute airspace network can be integrated with the existing domestic and trans-Tasman routes. The enroute flight paths should continue to avoid the Aoraki Mackenzie International Dark Sky reserve located north of the site and the area of controlled airspace to the east released by air traffic control for glider activity, specifically avoiding gliding areas to the east of the proposed location and to the north at Omarama.

The proposed airport site can accommodate the newest airspace technology and management tools such as RNP and RNP-AR supported by ground and or satellite based navigation systems. An Instrument Landing System (ILS), if required, is more likely to be suitable for the Lindis Valley – Lake Dunstan alignment (Runway 04/22). These technologies are described further.

- RNP (Required Navigation Performance) - RNP is a series of navigation specifications which permit the operation of an aircraft along precise flight paths with a high level of accuracy and with the ability to determine the aircraft's position with both accuracy and integrity.
- RNP-AR (Required Navigation Performance - Authorisation Required) - Amongst the highest standards of accuracy and integrity. Authorised by the Civil Aviation Authority.
- ILS (Instrument Landing System) - A ground-based facility associated with a particular runway and using airborne equipment to interpret the landing systems localiser and glide slope . A precision runway approach aid based on two radio beams that provide vertical and horizontal guidance for an approach to the runway.

Next steps

Next steps will include detailed airspace design by Aeropath, Airways New Zealand's specialist navigation procedure design service, and engagement with key airspace stakeholders including the wide spectrum of users as well as safety and regulatory agencies.

Future airspace planning and design will evaluate each flight path option against key criteria of safety, aircraft operation efficiency, capacity, emissions, noise and other environmental impacts.

Estimated completion date: Q2 2022

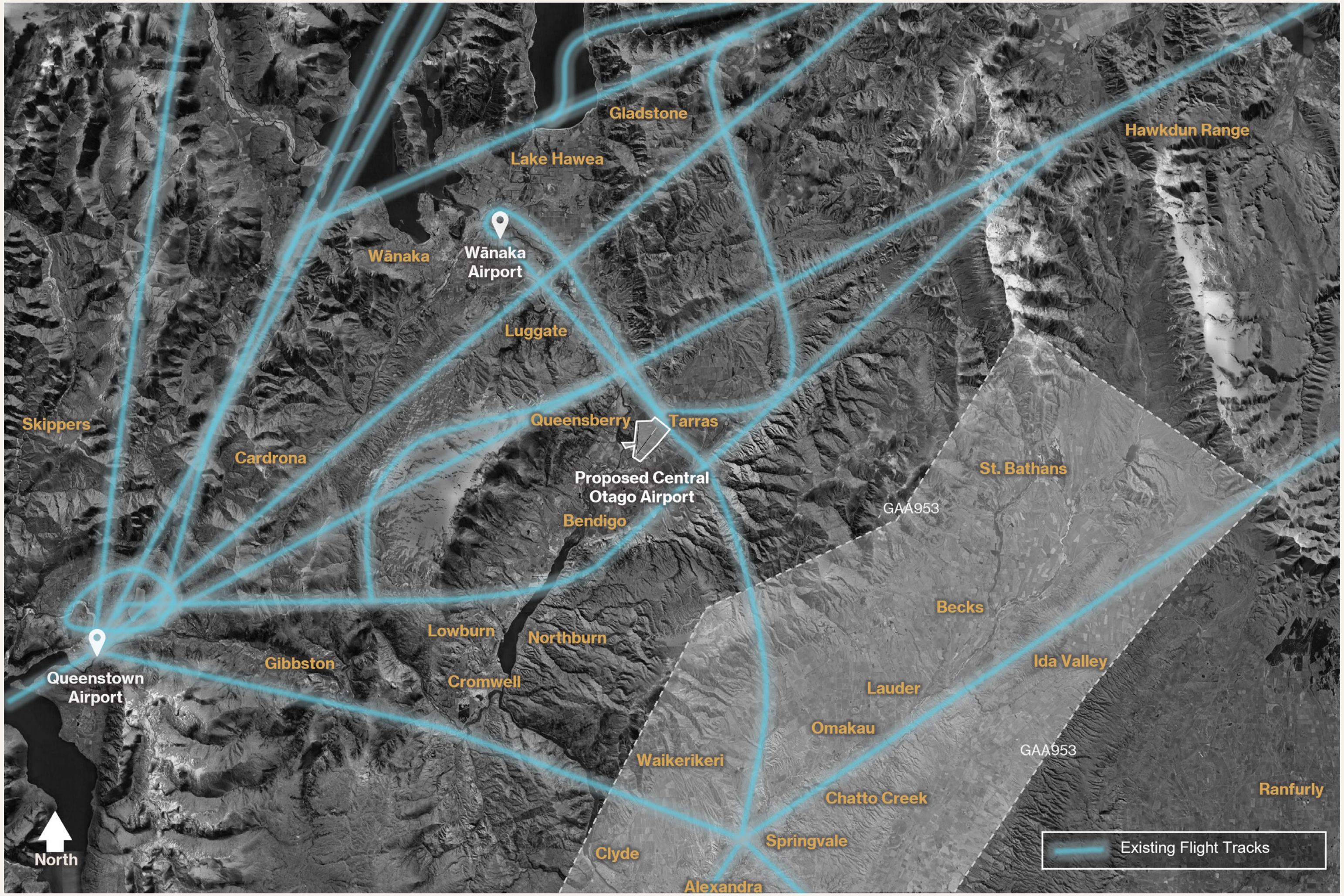
Existing flight paths

The airspace around the site is already used by scheduled aircraft accessing other airports in the region or enroute to other destinations, as shown opposite.

The preliminary analysis has identified that integration of new flight tracks for the proposed airport into the existing airspace environment will need to be carefully planned and consider these and other uses such as general aviation and gliding, but is ultimately achievable. Preliminary flight tracks for the site avoid the gliding area GAA953.

Notes:

- *This graphic is illustrative*
- *GAA953 is an area of controlled airspace released by air traffic control for glider activity*
- *Flight tracks are a general representation of some of the key scheduled aircraft flight tracks in the area*
- *Preliminary new flight tracks are not illustrated*



Weather

Meteorological conditions have a significant influence on airport planning and operations with wind direction and strength, wind shear, visibility, temperature, ice and precipitation all needing to be considered, as well as climate change.

The prevalence and detail of extreme weather events, whilst infrequent, also needs to be understood and considered during the planning process to enable air traffic control, airlines and airport operators to develop appropriate operational rules and procedures to ensure a safe operating environment during these events.

Wind direction plays an important role in determining runway orientation and alignment as aircraft generally take-off and land into the wind, with consideration of crosswind conditions and associated aircraft tolerances being an important factor to assess.

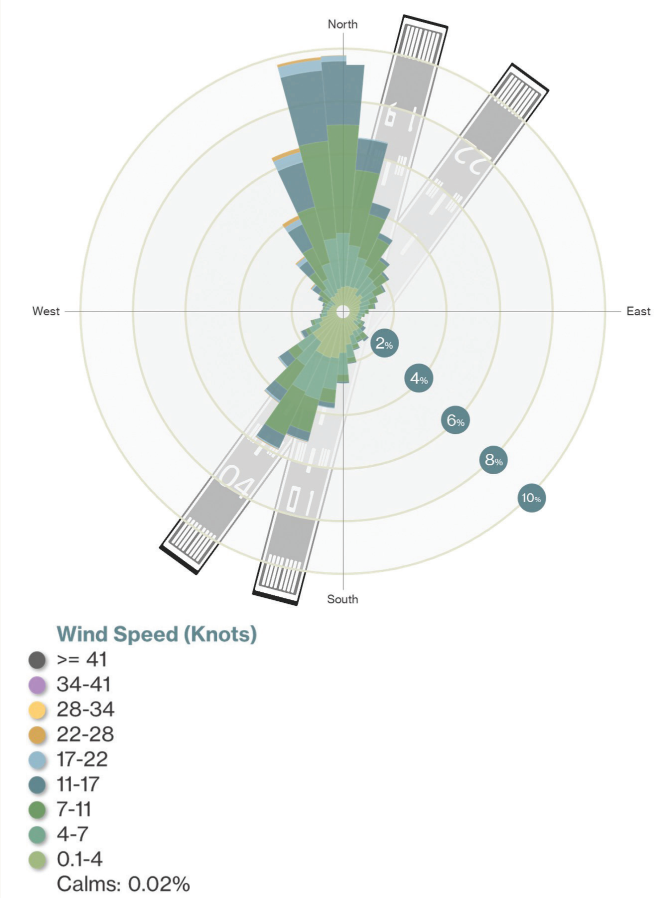
As there is no weather station on the site, NIWA has been engaged to provide modelled historical meteorological data over a 10-year period for the site to understand potential prevailing weather conditions required for the preliminary analysis. This requires site validation with an onsite weather station to gather site specific data under development by MetService.

The preliminary analysis of the modelled NIWA data is presented below.

Wind

- The prevailing wind conditions at the site are north and north / north-west, shown opposite.
- Aircraft operations are likely to favour northerly operations with departures using either the Hawea or Lindis Valleys and arrivals using the Cromwell Valley.
- Predominant wind speeds were between 0.1 and 15 knots. Windspeeds above 15 knots occurred less than 5% of the time and tend to come from a northerly direction.
- Crosswinds do not appear to be a limiting factor for either runway alignment and a preliminary assessment of runway usability meets International Civil Aviation Organization (ICAO) and Civil Aviation Authority (CAA) recommendations for most aircraft categories.

Wind conditions are within normal operating parameters.

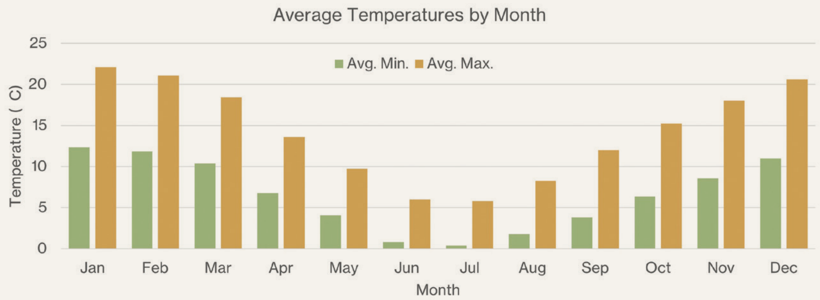


Based on Airbiz analysis of NIWA modelled data for 10 year period.

Temperature

- The average of the daily maximum temperatures for each month range from 6°C in July to 22°C in January.
- Temperatures above 30°C only occur occasionally.

Temperatures are within normal operating parameters.



Visibility

- Visibility data indicates generally good conditions with winter being the worst season for fog/low cloud (defined as visibility below 1000m at ground level). Analysis of fog/low cloud in winter indicates that fog/low cloud typically occurs overnight from midnight to 10am and for these hours fog/low cloud was present approximately 6-10% of the time.

Appropriate aircraft and airport infrastructure and crew training can be deployed to enable aircraft to operate in very low cloud conditions.

Future weather patterns

Key data sourced from NIWA's report, 'Climate Change Projections for the Otago Region' published in October 2019, are for Cromwell by 2040*:

- Expected increases in mean and maximum temperatures of approximately 1°C to 1.5°C
- Increase in annual extreme hot days (>30ºC) of 8-9 occurrences
- Increase in annual rainfall by approximately 6%
- Increase in extreme winds occurring each year (> 20kt) by approximately 4-6% .

** Data for Cromwell has been used as it is the closest location modelled by NIWA to the site.*

Future weather patterns are anticipated to be within normal aircraft operating parameters.

Next steps

Next steps involve gathering site specific meteorological data from an onsite weather station and refining the preliminary analysis. A wind shear assessment will be undertaken.

These will enable a more detailed understanding of actual site conditions and expected site specific risks associated with changing meteorological conditions.

Estimated completion dates:

- On-site weather station - Q4 2021
- Wind shear analysis - Q4 2021
- Refined weather analysis - Q4 2022

Carbon emissions

Context

A new airport needs to ensure New Zealand's aviation network has both the capability and capacity to deliver low carbon aviation in the future to align with the national carbon emissions reduction pathway out to 2050 and beyond.

Carbon emissions from aircraft operations are of increasing concern to governments, policymakers and the flying public. Christchurch Airport recognises the need to transition New Zealand's aviation sector to a low carbon future. The new generation of sustainable aviation technology is likely to require changes to much of New Zealand's existing airport infrastructure.

Christchurch Airport is committed to building one of the most environmentally sustainable airports in the world with the infrastructure and smart technologies to support the operation of new generations of low to zero carbon aircraft embedded in its design philosophy.

This initial assessment indicates the site will support some of the latest technology advancements in air navigation, enabling aircraft to fly the most direct routes with greater precision, enhancing safety, efficiency and improving fuel economy and reducing emissions.

Regulatory approvals

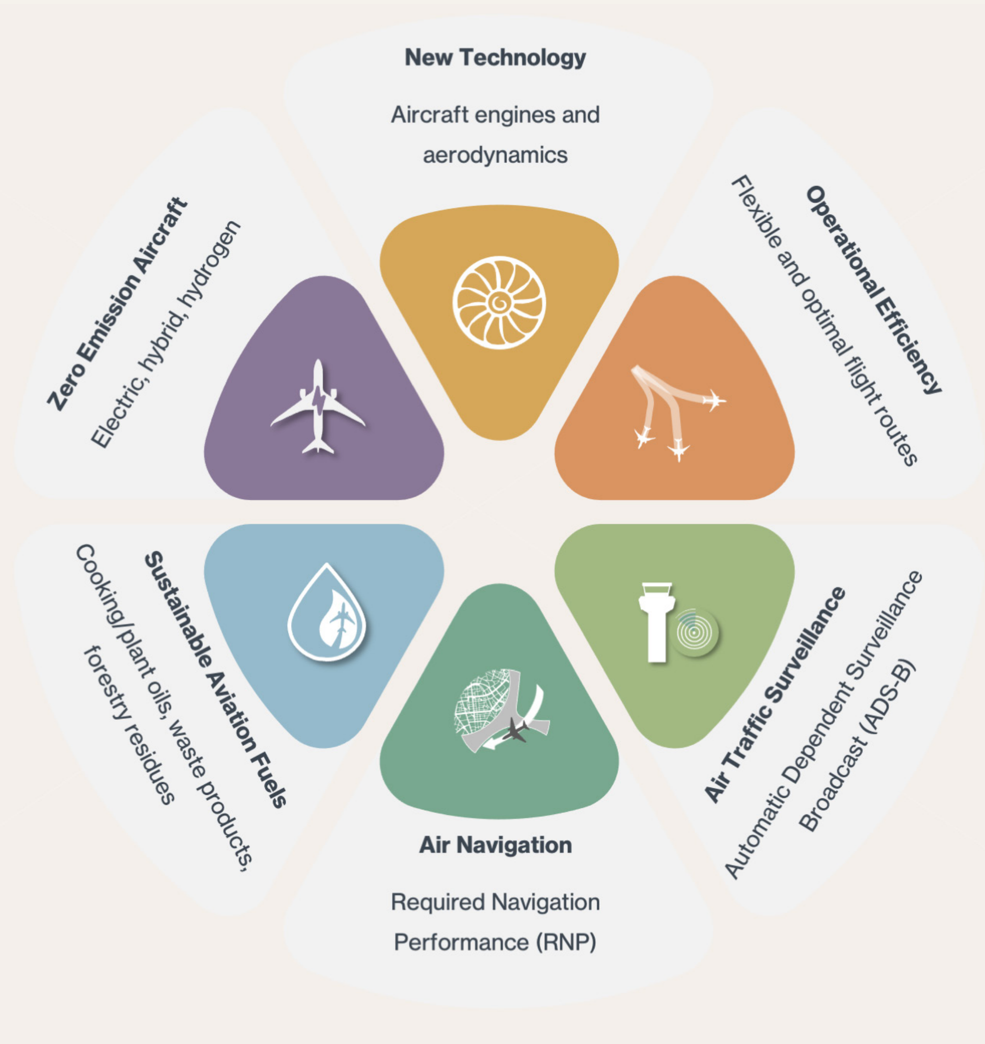
New infrastructure, such as the airport this project is exploring, will have to demonstrate how it supports the national emissions reduction objectives out to 2050 and beyond. Failure to do so will likely mean the project will be unlikely to secure the required planning and operating approvals to proceed.

Cleaner operations

Drivers of change

Globally aviation continues to take significant action to decarbonise the sector. It is therefore important this project is designed to enable the solutions which are currently being developed, such as:

- **Designing an efficient airfield and flight paths.** Aircraft turnarounds, airfield taxiing and the initial climb-out are the most energy intensive part of the flight journey consuming as much as 25% of an aircraft's total fuel on short-haul sectors.
- **Being able to utilise new technology to manage air traffic in a more efficient manner.** These include continuous climb and descent operations and performance based navigation. In combination these solutions can deliver reductions in aircraft fuel burn of between 250 kg and 500 kg per flight corresponding to a reduction of between 0.8 to 1.6 tonnes in carbon emissions per flight.
- **Designing approaches and departures that enable fuel efficient flight paths.** Many airlines are starting to plan and fly the most efficient route between their origin and destination in accordance with aeronautical safety, air traffic control requirements and prevailing weather conditions. This is improving fuel economy and reducing carbon emissions.
- **Enabling low-emission and zero-emission technology.** This includes battery electric and hydrogen-fuel-cell technologies. Together with sustainable aviation fuel (SAF), these technologies form the key pillars of the new generation aircraft propulsion systems and the longer-term decarbonisation of the aviation sector.



Typical aircraft carbon emissions

In-flight

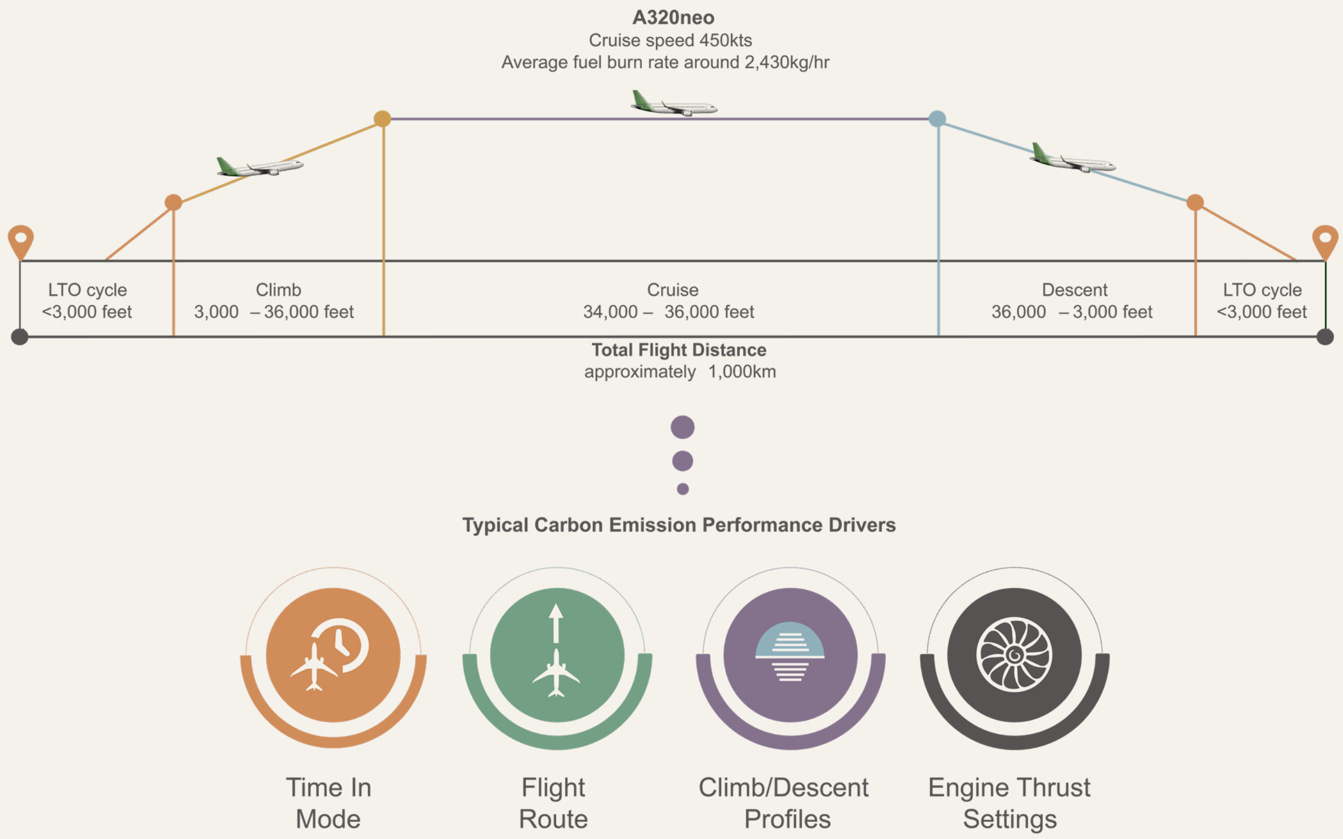
Many factors influence how an aircraft will operate along a flight path corridor. These include the type, weight and age of the aircraft; destination and fuel load; weather; piloting; and configuration of the airspace and ground infrastructure in a way that maximises safe and efficient operations, minimising delays and congestion.

Flight path lengths and vertical profiles determine how much power an aircraft will use during an arrival or departure, whilst maintaining a safe minimal clearance between the aircraft and surrounding terrain and/or any built obstacles. In the initial stages of flight, the steeper the rate and angle of climb, the more fuel an aircraft consumes and the more carbon it emits.

A breakdown of flight segments is shown for a typical A320neo operation across an entire flight cycle for a short haul, New Zealand domestic route of approximately 1,000 km in flight length and 90 minutes in flight time.

Notes:

- *An average fuel burn rate and typical flight profile was used for this calculation.*



Typical aircraft carbon emissions

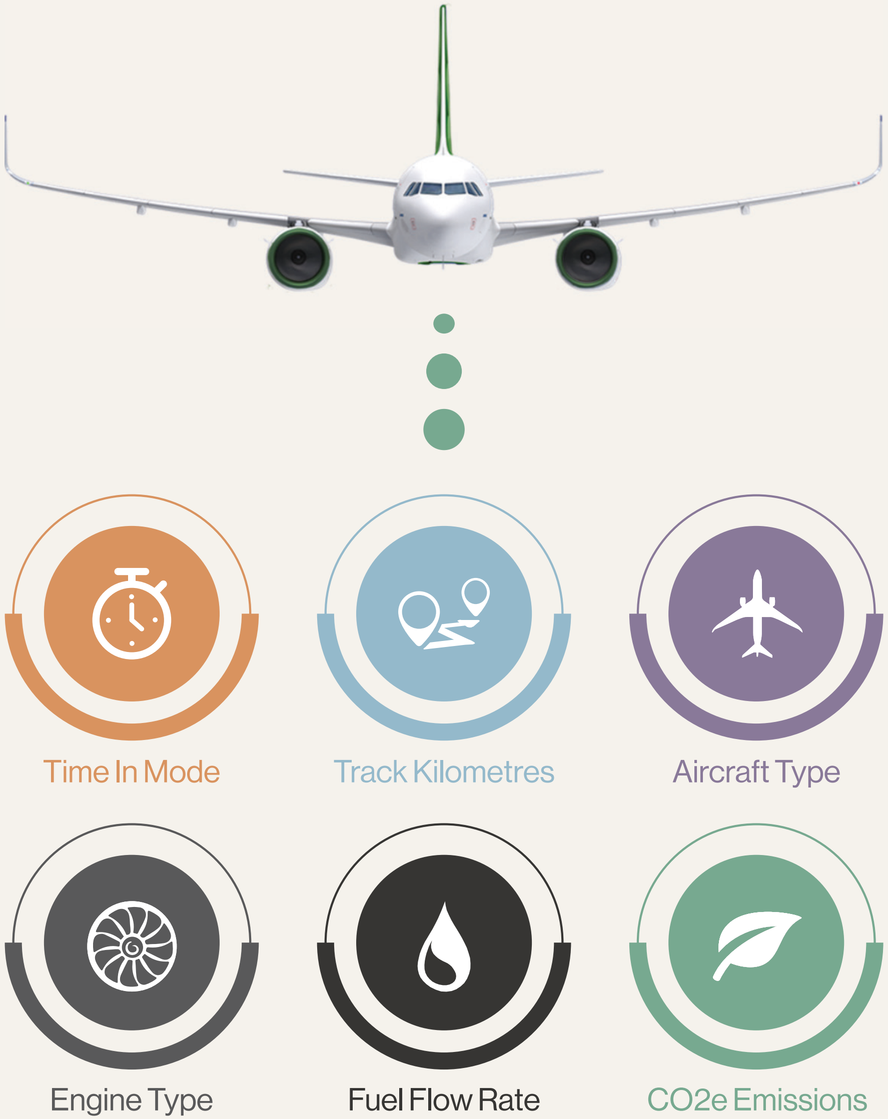
Aircraft Landing Take-Off cycle

Well-designed and operated airports can play a significant role in helping aircraft reduce the amount of carbon they emit for the portion of any flight where the aircraft is on the ground (taxiing, take-off and landing rolls) and up to 3,000 feet above this level (initial climb-out and final approach). This is known as the Landing Take-Off Cycle (LTO).

Airport design and operation can deliver improvements in local air traffic management, flight path and airfield use and taxiing time resulting in less operational carbon emissions.

An initial assessment has been undertaken to calculate and quantify the fuel burn and carbon dioxide equivalent (CO2e) emissions of key representative aircraft using each runway alignment. A key outcome of this analysis was identifying any potential improvements that could be made to the runway alignments and airspace profiles in line with aeronautical safety and operational efficiency requirements.

The illustration shows the key parameters used to undertake the preliminary aircraft carbon emissions assessment.



Carbon emissions

Our approach

Christchurch Airport does not shy away from climate change. We are New Zealand's most sustainable airport and a global leader in carbon reduction.

Designing a new low carbon airport aligns with New Zealand's national commitment for a low carbon future. Anything less is not an option.

We envisage a new Central Otago airport will play a key role in New Zealand's transition to a low carbon national aviation sector. In support of this transition we:

- chose our site as its flat topography enables existing aircraft to be flown more fuel efficiently
- are assessing aircraft operational carbon performance as we explore runway and flight path alignments
- will design the airfield to maximise operational efficiencies (for example, by minimising unnecessary taxiing and flight delays)
- will provide infrastructure to support low carbon aviation (for example, chargers for electric planes and fuel delivery systems for sustainable aviation fuels).

Not all New Zealand airports can support a net zero carbon future or are resilient and capable of adapting to withstand the anticipated impacts of climate change. While we have a lot more analysis to undertake, our initial assessment shows the site has real potential to deliver on both fronts.

Preliminary assessment

While the site is surrounded by high-terrain, runway alignment options and aircraft operating procedures have been developed to utilise the lower terrain of the Cromwell and Lindis or Hawea Valleys.

This provides opportunities to optimise the climb gradient profiles for aircraft departures, as a large proportion of fuel burn and emissions occurs during the initial climb phase of a flight.

The assessment indicates the site can support some of the latest technology advancements in air navigation. This includes aircraft equipped with onboard satellite-based navigation systems to operate RNP and RNP-AR procedures which enable aircraft to fly the most direct routes with greater precision, enhancing safety, improving fuel economy and reducing emissions.

Preliminary analysis has been undertaken to examine the amount of carbon emitted by representative aircraft types operating in the local airspace around the airport (up to 3,000ft), based on the initial flight path options.

Key conclusions from this preliminary analysis are:

- Flight paths can likely be designed that result in efficient aircraft climb gradients
- The analysis has demonstrated both runway alignment options perform comparably and should be retained for further evaluation and consideration.

Aircraft fuel burn and carbon emissions

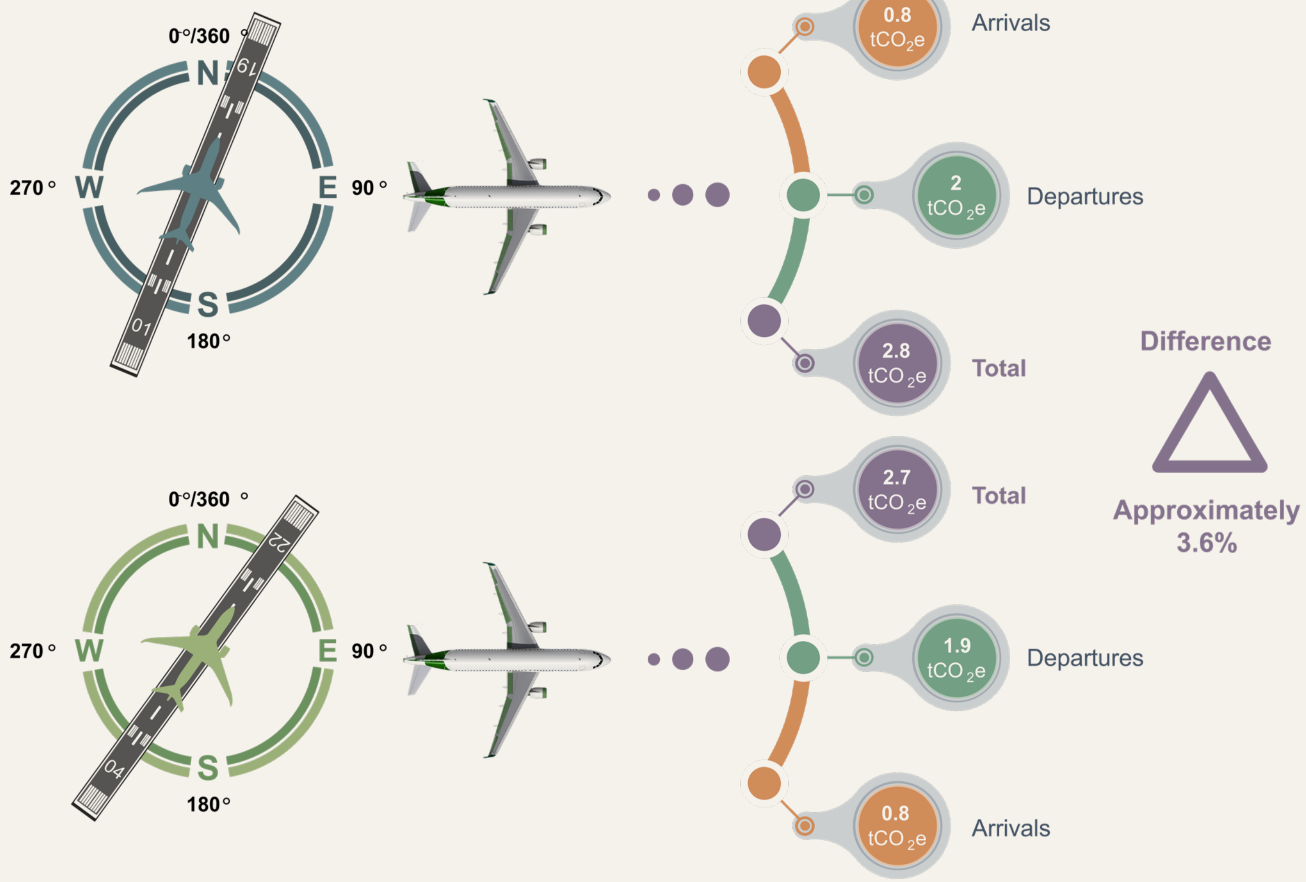
Summary of results

- Based on the assumptions and information used in the preliminary analysis, slightly less CO2e is emitted from aircraft departing off the Lindis Valley – Lake Dunstan Alignment (Runway 04/22) than the Hawea Valley – Lake Dunstan Alignment (Runway 01/19) in the LTO cycle up to 3,000 feet.
- For arriving aircraft descending from 3,000 feet to the touchdown threshold the performance of the Hawea Valley – Lake Dunstan Alignment (Runway 01/19) is comparable to the Lindis Valley – Lake Dunstan Alignment Runway 04/22.
- This demonstrates that both runway alignment scenarios perform comparably and should be retained for further evaluation and consideration

Next steps

1. Development of more detailed flight paths that consider opportunities to reduce aircraft flight times and track distances.
2. Further analysis of aircraft operational characteristics to strengthen the results of the emissions analysis.
3. Comparison with other regional airports will be undertaken on in-flight route emissions performance.

Estimated completion date: Q2 2022



Aircraft noise

The primary sources

Aircraft noise is produced in all phases of flight.

It is the sound caused by a moving aircraft which compresses the air around it to create noise waves by reverberating against the aircraft's surface.

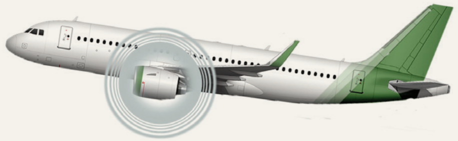
This compression is generated by the various components of the aircraft engine but also the airframe and the landing gear.

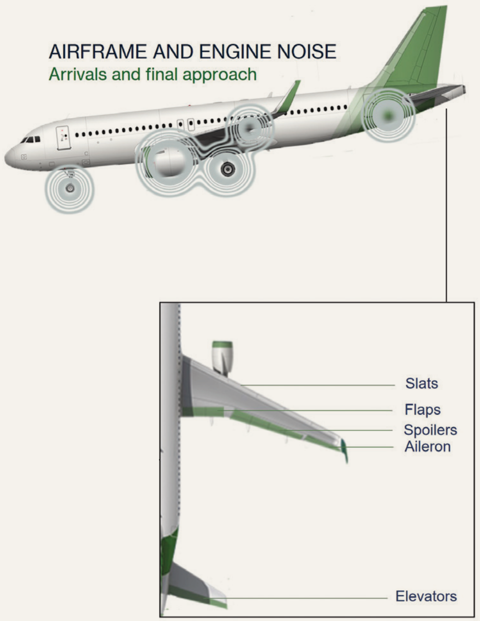
The three main components of aircraft noise are:

1. The engine components.
2. The aerodynamic drag or resistance of airflow around the aircraft's fuselage or wings.
3. The deployment of nose and main wheel landing gear from the undercarriage and aircraft control surfaces (i.e., flaps, slats, ailerons and elevators).

Generally, larger aircraft such as the widebody Airbus A350-900 make more noise than smaller, narrowbody aircraft like the Airbus A320.

ENGINE NOISE
Departure and climb-out





How aircraft noise is experienced

Aircraft noise is most noticeable in the immediate vicinity of a runway and on the extended centrelines when aircraft approach to land at the airport or climb on take-off.

In general:

- The propagation of aircraft noise and resulting sound waves travel equally in all directions,
- As sound waves travel away from a source, the sound intensity decreases as the energy is dispersed over a greater area reducing the power of the sound wave,
- This is dependent on a range of factors, such as wave divergence, atmospheric absorption and ground attenuation.

Meteorological conditions can change the way that noise is experienced.

The trend towards quieter aircraft

Technology and operational improvements

Aircraft built today are about 75% quieter than they were 50 years ago.

Aircraft manufacturers and airlines continue to work together to further reduce aircraft noise at the source. Today, the aircraft in the skies above New Zealand are some of the most modern and quiet in the world.

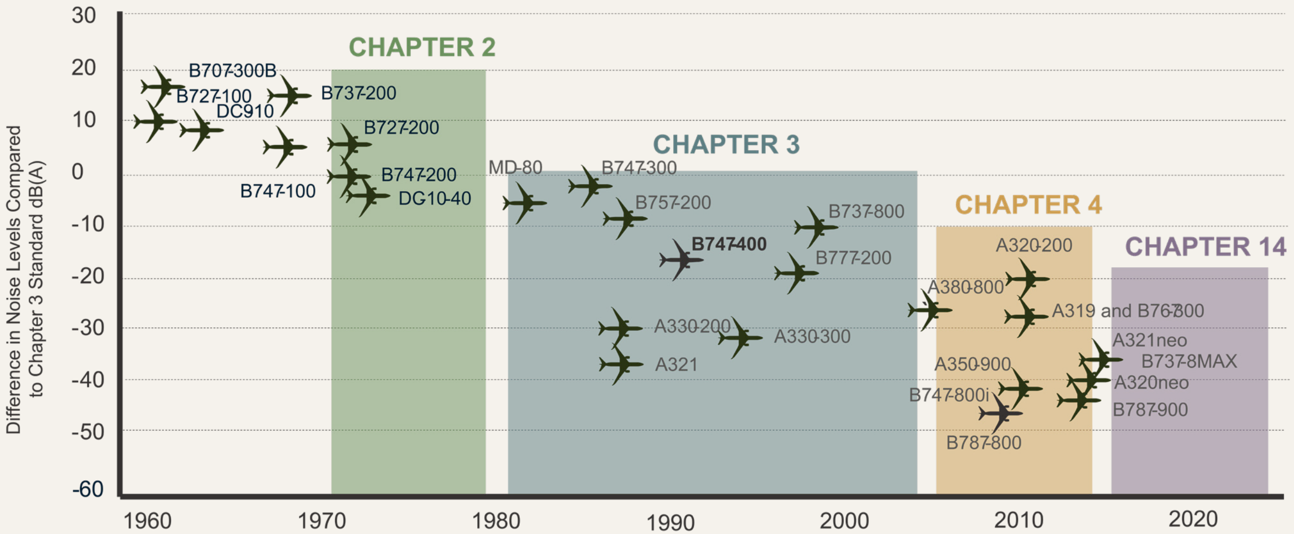
Through the ongoing replacement of older, noisier aircraft, airlines are helping to reduce the noise impacts from aircraft operating across New Zealand and offset the predicted growth in air traffic movements.

It is important to note that there can be no guarantee that aircraft will continue to get quieter in the future so the project's assessments are utilising the noise profiles of aircraft currently in operation.

Managing aircraft noise

There are several strategies that are used to manage the impacts of aircraft noise around an airport, including land use planning controls such as:

- Working with local government to ensure development of land in areas affected by aircraft noise is limited to compatible uses,
- Where required, considering noise insulation for existing properties under the approach and departure paths closer to the airport, to minimise indoor noise intrusion,
- Designing airports so that airlines can use the latest generation quieter aircraft, and
- Designing efficient aircraft operations so that on the ground movements are optimised (this has cost and carbon benefits too).



Aircraft noise

Our approach

A factor in the selection of the site was the low population density and the rural land zoning in the immediate surrounding area.

While small population numbers may lower the overall impact a new airport would have, nearby residents will become the airport's neighbours. Christchurch Airport is committed to identifying, quantifying and finding solutions.

The preliminary assessment started by:

- Investigating the land use in the general areas around the site and their relationship to the preliminary flight path options,
- Identifying the natural and man-made noise generating activities in the area around the site,
- Demonstrating the indicative noise exposure on the surrounding area from a single aircraft movement for each of the potential runway alignments.

Outputs of these assessments are illustrated in the following pages.

Preliminary flight path options

The flight paths planned to date are preliminary and will be refined to consider environmental and noise impacts in more detail.

Areas under flight paths immediately adjacent to the site, when aircraft are operating closest to the ground, will be subject to higher levels of aircraft noise than those further from the site where aircraft are at higher altitudes.

A preliminary assessment has been made of the general land uses around the site (for example, residential, commercial, horticultural and agricultural) to inform flight path options.

This has enabled us to understand how the initial flight paths options and aircraft operations will interact with surrounding areas.

Land use and zoning

Land zonings are important. In urban areas, planning rules are developed to discourage noise sensitive activity (including medium to high density residential developments) around airports. This protects communities from the impacts of airport noise and helps ensure airports can operate safely and efficiently.

The land around the site and its flight paths is already largely zoned rural. This means there are a limited range of permitted land uses with restrictions on the density of residential development. This is generally compatible with an airport operation, meaning it is unlikely that existing land use zonings would need significant alteration.

The local noise environment

The context for aircraft noise

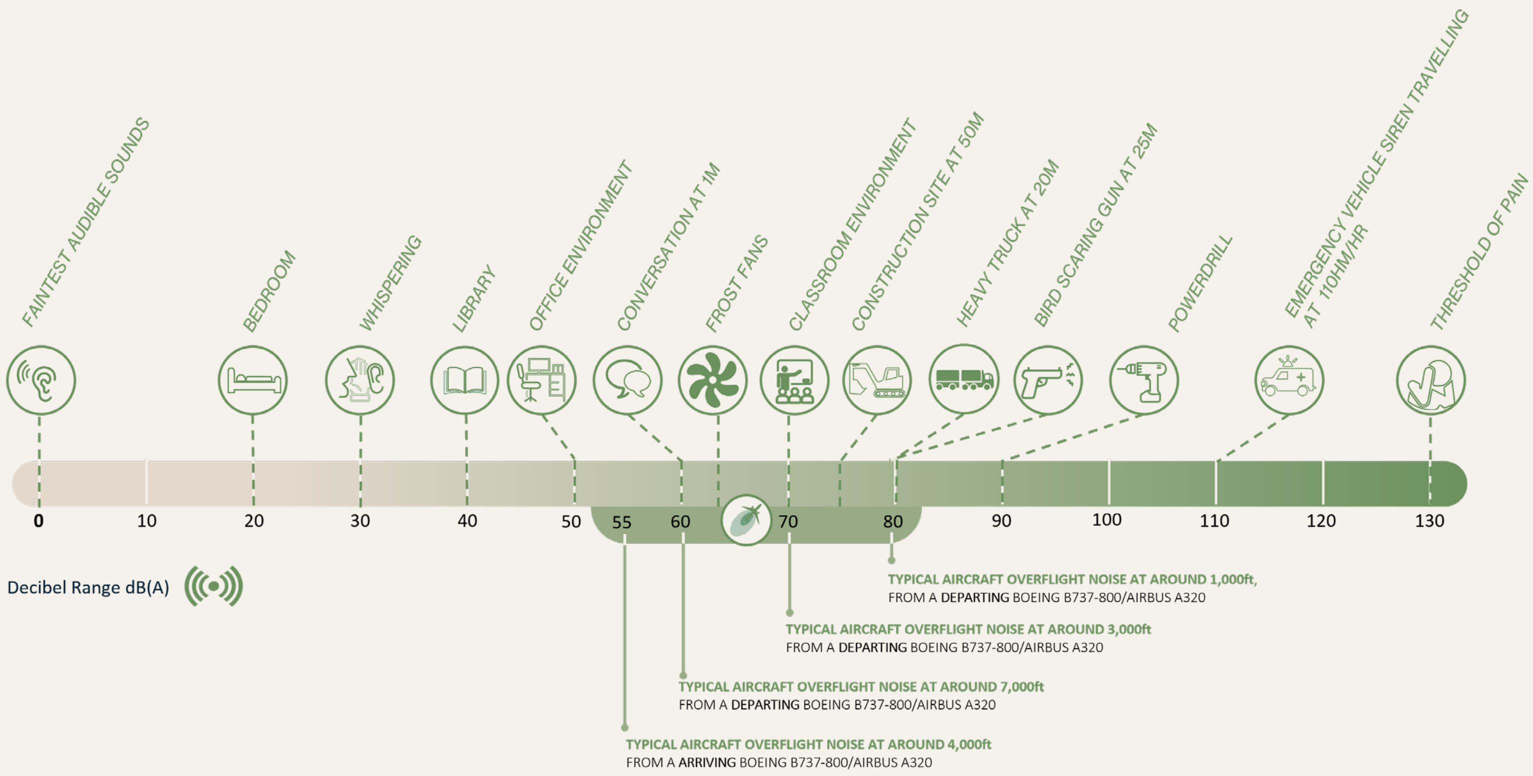
How aircraft noise is perceived depends very much on where it is experienced.

On a typical day, the combination of multiple man-made and natural sound occurrences creates an ambient noise setting. Importantly, the ambient noise level does change throughout the day and night-time hours.

Depending on the sound level of a given aircraft noise event, the extent and nature of the ambient sounds will impact how aircraft noise is perceived. This means that a loud aircraft noise event may go unnoticed for the person walking down a busy street while a quieter aircraft noise event may be more distinctively perceived by a person walking in the countryside.

Therefore a first step in assessing the potential aircraft noise impacts is scoping the existing local noise environment.

The illustration shows indicative sound levels for a selection of man-made sounds, many of which already exist in the local area, and shows how the noise from various aircraft at differing heights would compare.



Note:

Some selected sound levels are sourced from Waka Kotahi NZ Transport Agency

Local noise levels are indicate and require specific site validation

Initial noise profiles

Based on a single aircraft movement

The graphics on the following pages illustrate indicative noise profiles and how noise from a single arrival or departure may be experienced on the ground for each runway alignment option.

The coloured areas outline where the noise from the aircraft may be experienced above 60 decibels (dBA). Aircraft create a noise shadow as they move through their flight cycles. People on the ground will experience noise at maximum levels for a period of seconds while the aircraft passes overhead.

The key for the colour coding is:

Colour	Maximum dBA experienced	Comparative sound
(orange)	80	Heavy truck/B-Train at 20m
(yellow)	70	Typical classroom environment
(turquoise)	60	Conversation at 1m

The graphics that follow are a preliminary assessment of noise and the illustrations are intended to demonstrate that the areas likely to be impacted by aircraft noise are generally limited.

Next steps

Next steps will involve defining and understanding in more detail the projected aircraft noise impacts related to alternative flight path options, various aircraft types and operations and assessment of specific noise sensitive areas.

Once the arrival and departure flight paths are more clearly defined, the project will focus on more accurately assessing potential noise impacts. It will include the likely noise levels on the ground, duration and time of day.

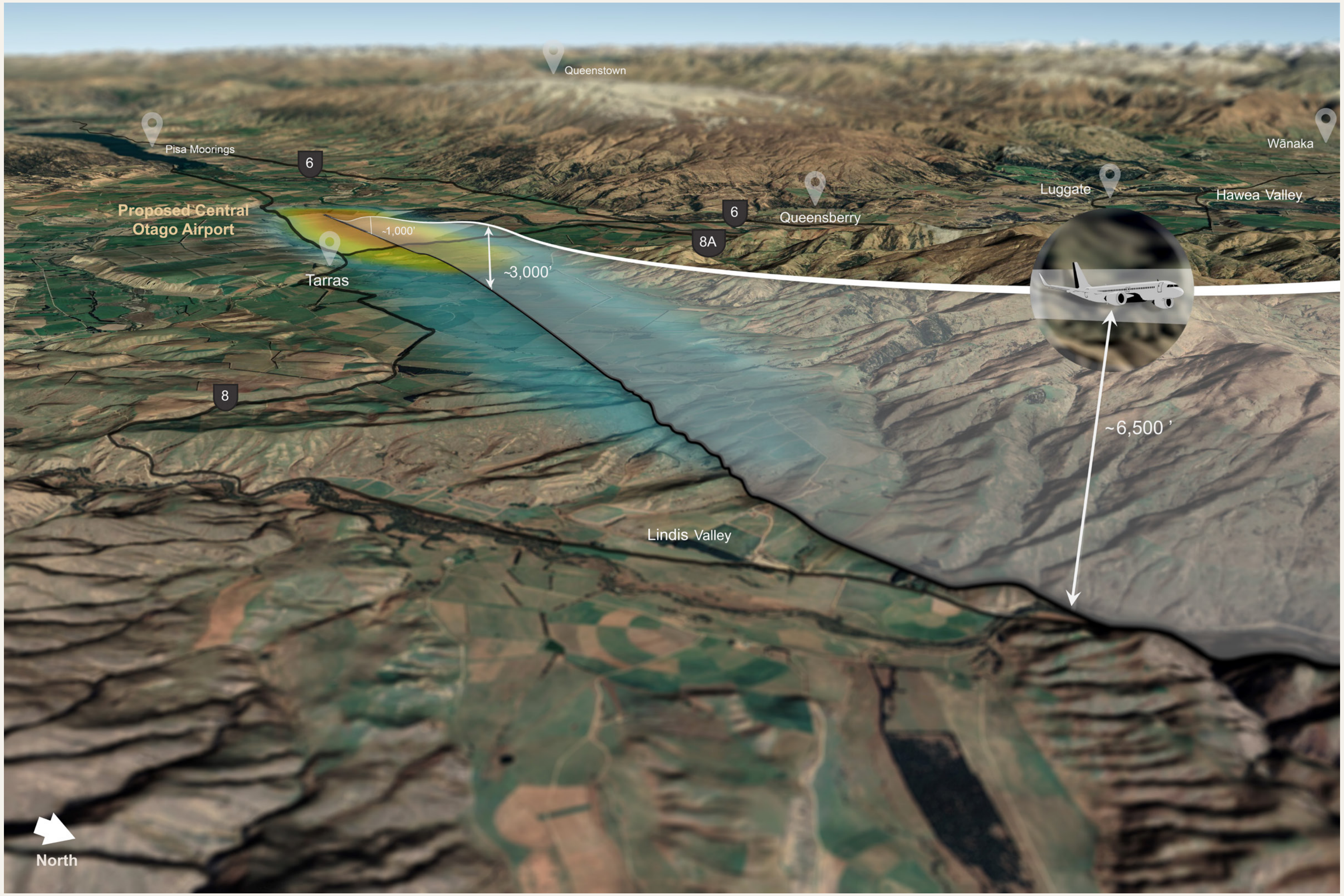
This will involve modelling potential flight schedules (including details such as aircraft type, time of day and destination).

This will enable the project to quantify how much noise the airport operations could produce and any impacts of that noise. Once that information has been established we will be able to look at how noise can be mitigated for individual properties.

Estimated completion date: Q2 2022

Lindis Valley – Lake Dunstan alignment aircraft noise

Lindis Valley Departure Flight Track (Runway 04)



The illustration opposite shows typical aircraft noise along an indicative northern departure flight track for Runway 04 of an A320neo departing through the Lindis Valley.

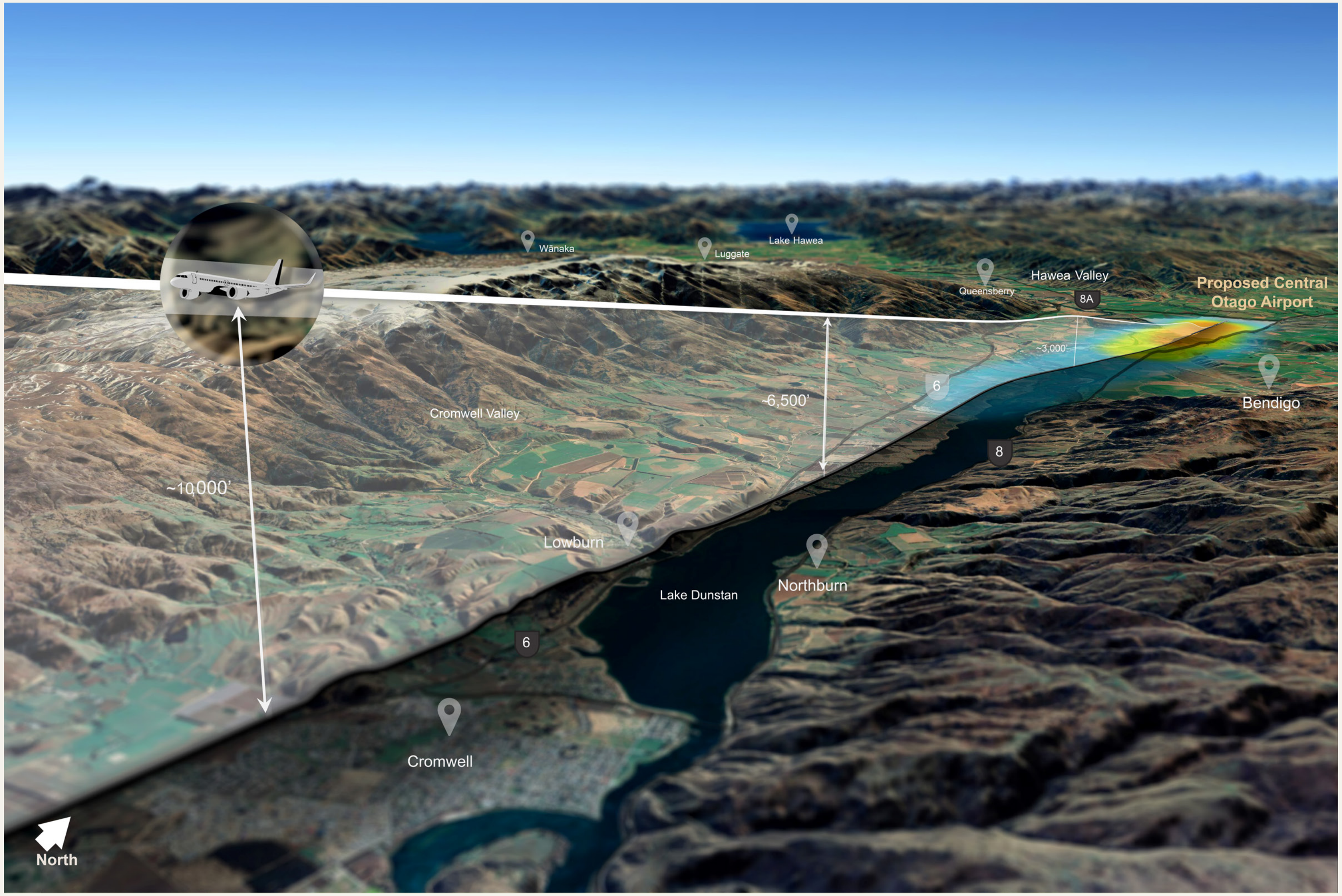
Notes:

- *Noise levels are illustrative*
- *Noise illustrated is LAmax for a single A320neo departure*
- *Aircraft noise will be audible outside of the illustrated profiles, although at lower levels than illustrated for the example aircraft type*
- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Noise impacts are yet to be assessed*

	80 (dBA)
	70 (dBA)
	60 (dBA)

Lindis Valley – Lake Dunstan alignment aircraft noise

Lake Dunstan Departure Flight Track (Runway 22)



The illustration opposite shows typical aircraft noise along an indicative southern departure flight track for Runway 22 of an A320neo departing through towards Cromwell.

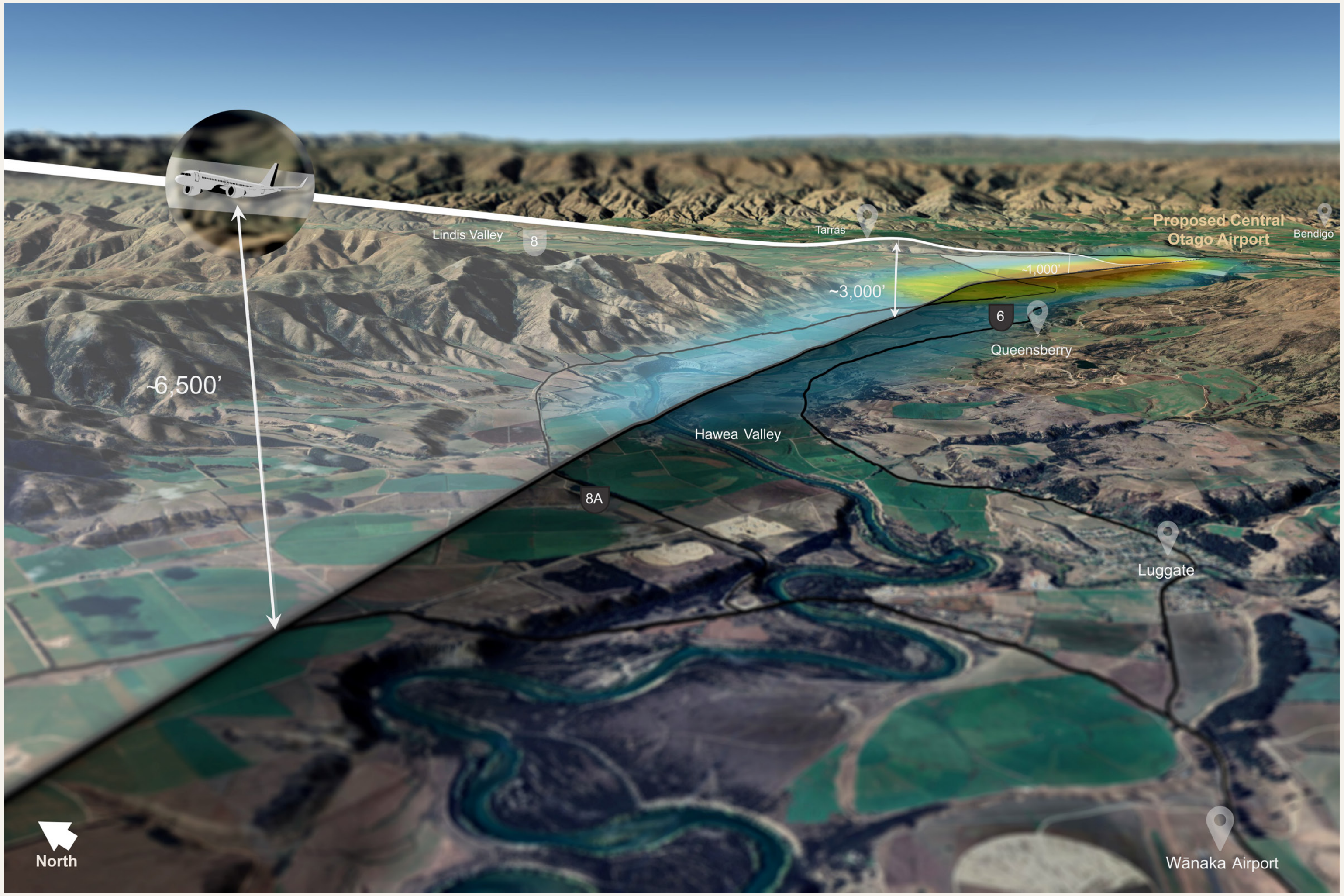
Notes:

- *Noise levels are illustrative*
- *Noise illustrated is LAmax for a single A320neo departure*
- *Aircraft noise will be audible outside of the illustrated profiles, although at lower levels than illustrated for the example aircraft type*
- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*

	80 (dBA)
	70 (dBA)
	60 (dBA)

Hawea Valley – Lake Dunstan alignment aircraft noise

Hawea Valley Departure Flight Track (Runway 01)



The illustration opposite shows typical aircraft noise along an indicative northern departure flight track for Runway 01 of an A320neo departing through the Hawea Valley.

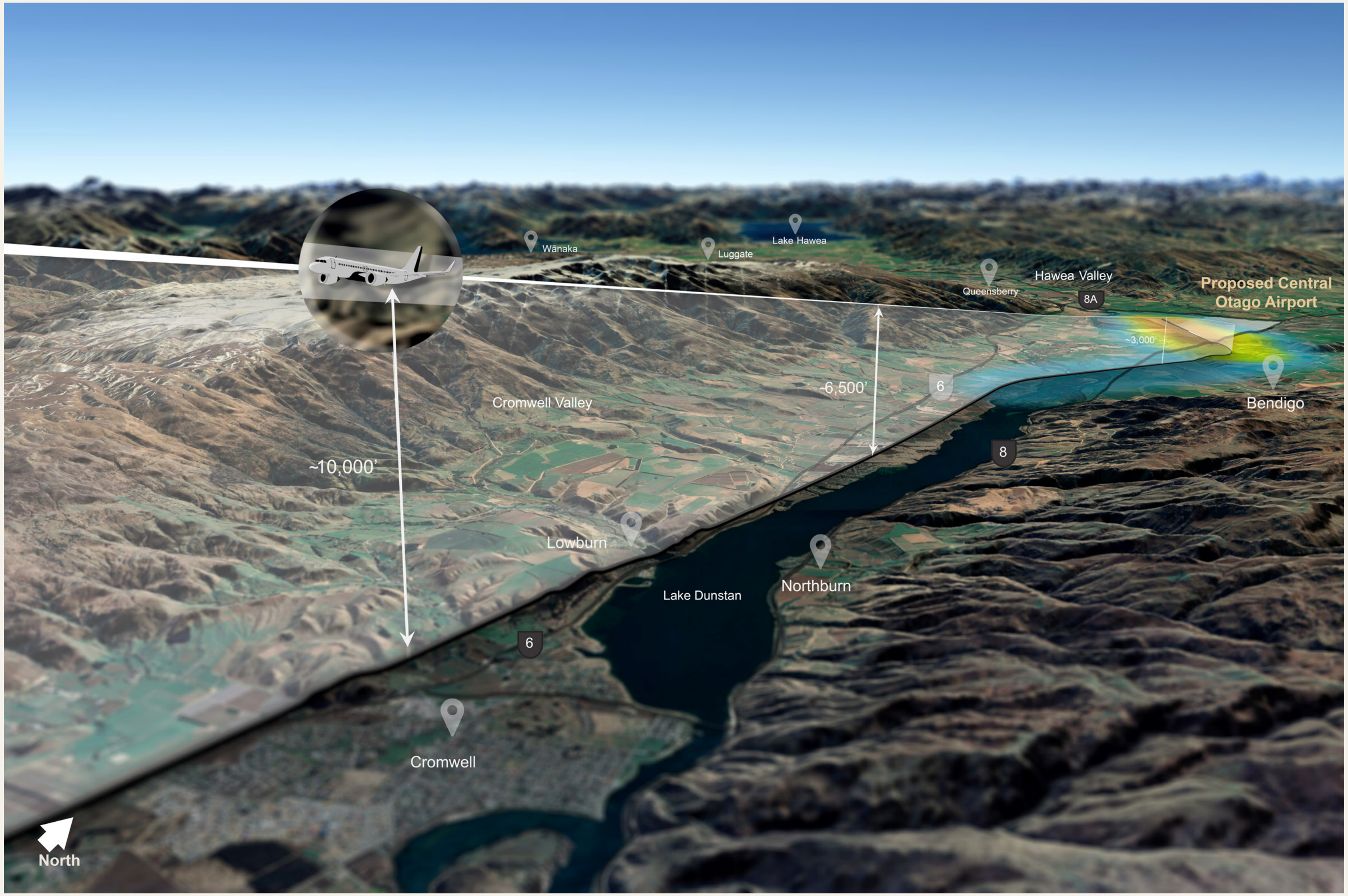
Notes:

- *Noise levels are illustrative*
- *Noise illustrated is LAmax for a single A320neo departure*
- *Aircraft noise will be audible outside of the illustrated profiles, although at lower levels than illustrated for the example aircraft type*
- *Flight tracks are preliminary and subject to change*
- *The flight track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specific noise exposures are yet to be assessed*

	80 (dBA)
	70 (dBA)
	60 (dBA)

Hawea Valley – Lake Dunstan alignment aircraft noise

Lake Dunstan Departure Flight Track (Runway 19)



The illustration opposite shows typical aircraft noise along an indicative southern departure flight track for Runway 19 of an A320neo departing towards Cromwell.

Notes:

- *Noise levels are illustrative*
- *Noise illustrated is LAmax for a single A320neo departure*
- *Aircraft noise will be audible outside of the illustrated profiles, although at lower levels than illustrated for the example aircraft type*
- *Flight tracks are preliminary and subject to change*
- *The flght track illustrates an indicative height above aerodrome elevation for an A320neo on this track. Aircraft may be lower or higher than illustrated*
- *Indicative aircraft heights are in feet*
- *Departures and arrivals should generally follow similar lateral paths*
- *Location specifc noise exposures are yet to be assessed*

	80 (dBA)
	70 (dBA)
	60 (dBA)

Preliminary findings and outcomes

We've validated that the site results in two potential alignment options for a single runway and is suitable for the key types of aircraft expected to operate scheduled aviation services within New Zealand and on likely international routes.

More detailed analysis needs to be done to assess any operating restrictions for larger aircraft off the longer runway options.

	Lindis Valley – Lake Dunstan Alignment (Runway 04/22)	Hawea Valley – Lake Dunstan Alignment (Runway 01/19)
Weather	Preliminary weather data for the site indicates that local conditions are suitable for scheduled aircraft operations with a prevalence of northerly wind conditions. Visibility data indicates generally good operating conditions. Crosswinds are acceptable for both runway alignments.	
Runway	The runway alignment is suitable for a 2,200m runway.	The runway alignment is suitable for a 2,200m runway.
Terrain	A runway extending beyond 2,200m will be influenced by terrain to the north of the site. This is less of an issue than for the Hawea Valley – Lake Dunstan Alignment (Runway 01/19).	A runway extending beyond 2,200m will likely be influenced by terrain to the south of the site, probably more so than the Lindis Valley – Lake Dunstan Alignment (Runway 04/22).
Airspace	Flight paths to and from the north-east, using the Lindis Valley, are suitable for aeronautical operations, are expected to be generally straight and are expected to be able to be integrated into the existing airspace network. Flight paths to the south along Lake Dunstan are suitable for aeronautical operations, are expected to be generally straight and are expected to be able to be integrated into the existing airspace network.	Flight paths to and from the north using the Hawea Valley are suitable for aeronautical operations, are expected to be curved closer to the airport and able to be integrated into the existing airspace network Flight paths to and from the south along Lake Dunstan are suitable for aeronautical operations and are expected to be able to be integrated into the existing airspace network. These require curved approaches and departures which, while not being an issue from a technical point of view (for suitably equipped (RNP) aircraft), are not as preferred as a straight approach or departure.
Aircraft Operations	Suitable for advanced RNP-AR aircraft operations. If required an Instrument Landing System may also be able to be used on this runway.	Suitable for advanced RNP-AR aircraft operations. It is unlikely that an Instrument Landing System can be used for this runway.
CO_2e Emissions	The emissions performance of an aircraft using Lindis Valley – Lake Dunstan Alignment (Runway 04/22) and the associated flight tracks to 3,000ft is comparable to that of Hawea Valley – Lake Dunstan Alignment (Runway 01/19).	The emissions performance of an aircraft using Hawea Valley – Lake Dunstan Alignment (Runway 01/19) and the associated flight tracks (to 3,000ft) is comparable to that of Lindis Valley – Lake Dunstan Alignment (Runway 04/22).
Noise	Apart from the Tarras village, there are no towns located up the Lindis Valley.	There are several towns and residential areas located further up the Hawea Valley.

Next steps

The outcomes of the preliminary assessment are encouraging.

This is a long-term project and Christchurch Airport still has a lot of work to do before it could advance any of the approvals required to develop and operate a new airport. This assessment is significant but is one of a number of interconnected studies across the project's workstreams that need to be undertaken.

Each workstream is critical. An airport cannot proceed unless it is able to secure approvals and warrant the level of investment required to create it.

Those approvals include planning approvals for the change of land use, air, water, noise and building consents as well as aeronautical approvals to commence operations.

The next airspace planning phase will take place over the next 6–9 months and be aimed at validating and refining the outcomes of this preliminary phase and determining a preferred single runway alignment.

This preference will be based on a range of factors such as; safety, the maximum runway length achievable, efficiency of the associated airspace and flight tracks, aircraft performance outcomes, emissions performance, noise impacts, environmental impacts and engineering requirements.

It will include using more detailed and newly acquired data to technically assess with greater confidence the outcomes presented here and form a view of a preferred runway alignment.

Work will continue to progress the other Project Workstreams (see page 3) alongside the further airspace work.

We will continue to share information and engage with the community and stakeholders.

For further information

centralotagoairport.co.nz