

WESTERN SYDNEY AIRPORT

Preliminary Airspace Management Analysis

FINAL REPORT

10 April 2015

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For further information contact:

Manager, Corporate communications
Airservices Australia
GPO Box 367
Canberra ACT 2601

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This report has been prepared by Airservices Australia for the limited purposes of assessing airspace implications and air traffic management approaches for airspace in the Sydney Basin arising from the potential introduction of flights to and from an airport in Western Sydney.

The design and analysis presented in this report is intended to meet a narrow scope focussed on demonstrating a proof of concept. It does not present a comprehensive airspace and air route design and does not consider all essential components that would be necessary to implement an air traffic management plan for the Sydney basin. Certain assumptions have been made and significant additional steps would be required to develop air traffic management plans suitable for implementation.

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1 Executive summary

In June 2014, the Department of Infrastructure and Regional Development (the Department) approached Airservices to assess airspace implications and air traffic management approaches for airspace in the Sydney Basin arising from the potential introduction of flights to and from an airport at Badgerys Creek in Western Sydney (WSA). A scope of work was subsequently agreed which this report addresses.

The principal objective of this work was to establish whether safe and efficient operations could be introduced at WSA through the development of indicative proof-of-concept air traffic management designs.

The analysis has been conducted in two stages:

1. a basic assessment of the viability of WSA airport operations at the site owned by the Commonwealth with a runway orientation 05/23; and
2. modelling and analysis of a terminal area concept for the Sydney Basin, including air route interactions between WSA and Kingsford Smith Airport (KSA)

As the initial operation of the airport is potentially more than ten years away (and construction of more than one runway potentially more than 30-40 years away), the findings presented in this report are based on conceptual air traffic management designs that have not been developed to a level of detail that would be necessary for implementation. Certain assumptions have been made and significant additional steps would be required to develop air traffic management plans suitable for implementation.

Importantly, the conceptual designs have not been developed to consider all potential noise abatement opportunities and this would form a major part of any subsequent design work leading up to implementation. Similarly, the design process for implementation would be extensively consulted with airlines and other stakeholders.

The design work and analysis has been conducted using the current standards and procedures that apply to air traffic management at the time of analysis. This includes all relevant provisions of the Australian Civil Aviation Safety Regulations and the International Civil Aviation Organisation Procedures for Air Traffic Management (Doc 4444) and Aircraft Operations (Doc 8168). Unless a clear regulatory change path has been identified, the analysis has not considered the potential improvements in standards and procedures that might be introduced in the period up until operation of the airport.

1.1 Key Findings

The key findings of analysis indicate:

1. There are no apparent physical impediments for the site that would preclude safe and efficient operations for aircraft arriving or departing WSA.
2. Concept designs for approach and departure routes have been able to demonstrate that WSA and KSA could operate independently as high capacity aerodromes.
3. Fast-time simulation has demonstrated that with parallel runways WSA could potentially achieve movement rates of around 100 movements per hour while KSA maintained movement rates of 80 per hour.

4. An airspace design could be implemented for a single runway operation at WSA without making significant change to the current design and route structure for KSA. The study did not identify any preference for either the northern or southern runway in this mode of operation.
5. An analysis of parallel runway operations at WSA suggests that the following areas would need to be addressed:
 - a. changes to existing air routes serving KSA in order to maintain independence of operation between the two airports and achieve the design capacity of the airport infrastructure
 - b. resolution of the constraint identified regarding the military restricted area at Orchard Hills

1.2 Conclusion

This assessment confirms the basic viability of WSA with both a single and parallel runway orientation of 05/23. It also confirms comments from the initial Environmental Impact Statement (EIS) of 1997-1999, that WSA 05/23 parallel aligned runways would require complex airspace management procedures.

The analysis has also demonstrated that Instrument Flight Rules (IFR) operations at Bankstown (BK) could be supported while there was a single runway at WSA, however this would reduce the capacity at WSA as flights would need to be sequenced between the two airports.

Conceptual air routes created for this report have been designed on the premise that WSA would operate independently to KSA in all cases. This ensures the selection of runways or operating modes at one airport can be made to suit local conditions without considering the operating mode at the other.

The design and analysis presented in this report was intended to meet a narrow scope focussed on demonstrating a proof of concept. It does not present a comprehensive airspace and air route design and does not consider all of the essential components that would be necessary to implement an air traffic management plan for the Sydney basin.

Many elements of a plan for implementation would need to be conducted closer to the commencement of operations and involve comprehensive consultation with industry, regulatory and community stakeholders.

2 Background

The close proximity of WSA and KSA (22.8nm/42km) and the convergence of the runway centre-lines, means that the arrival and departure operations could be highly dependent. In evaluating options for designs in this complex environment, Airservices examined many current and evolving international models.

Notably, a study (*NASA/CR-2011-216414*) conducted by the National Aeronautics and Space Administration (NASA) and the Federal Aviation Administration (FAA) in 2011 defined metropolitan areas of high demand served by a system of two or more airports whose arrival and departure operations are highly interdependent as a 'Metroplex'.

The report identified that the complexity of operations in a Metroplex requires that a solution for the airspace structure surrounding, and the traffic flows to and from these airports, must be solved cooperatively as a system. Understanding these parameters is critical to the realisation of full runway infrastructure.

The objective of the FAA study was to develop a deeper understanding of the constraints on Metroplex operations that reduce capacity. The study identified 12 major Metroplex issues, among them, "multi-airport departure merge over common departure fix" which was identified as the most critical issue across four Metroplex sites surveyed. Other issues of primary importance include:

- Major volume-based traffic-flow-management (TFM) restrictions;
- Proximate-airport configuration conflicts;
- Inefficient/high-workload airport configuration changes;
- Inefficient multi-airport departure sequencing;
- Major secondary-airport flow constraints;
- Effects of special-use airspace and terrain, which caused additional flow dependencies; and
- Severe limitations on instrument procedures due to a proximate airport.

Taking these issues into consideration, it is evident that to enable the full infrastructure benefit of a second Sydney airport, a more robust and thorough airspace design concept and analysis will be necessary closer to the commencement of parallel runway operations.

This report took into consideration the issues identified in the FAA study when preparing this airspace concept and analysis of indicative airspace and route interactions for WSA.

3 Scope

The scope of this analysis encompasses two stages of work.

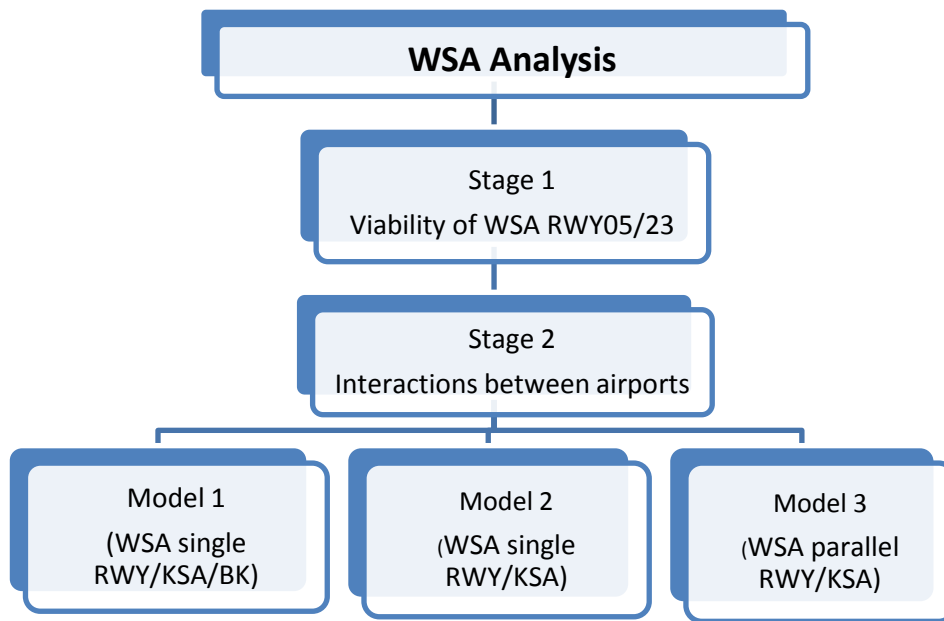


Figure 1

Stage One consists of a basic assessment of the viability of WSA airport operations with a runway orientation of 05/23. It included an assessment of terrain and man-made objects and their implications on airport operations and potential solutions where required.

Stage Two modelled and analysed a terminal area concept for the Sydney basin including air route interactions between WSA and KSA. It identified physical and operational constraints to safe and efficient operations of WSA and KSA.

Stage Two consists of three models as described below:

- **Model One** evaluates the introduction of WSA (single runway) while preserving the existing BK and KSA IFR flight paths.

This model will inform a potential scenario for the opening day operation of WSA in 2025 and may show significant operating restrictions on WSA runway operations caused by both the proximity of the right circuit to KSA RWY16R and by BK.

- **Model Two** evaluates the introduction of WSA (single runway) while preserving the existing KSA IFR flight paths, but will remove the constraint of BK IFR arrivals and departures.
- **Model Three** evaluates the introduction of WSA (parallel runway) without the constraints of BK IFR arrivals and departures.

This report consists of written descriptors and supporting tabulated data derived from Stage One and Stage Two studies. The document contains findings and comment only, and will not make recommendations. This report does not address noise issues

and should not be used for this purpose. It does not provide airborne or ground delay forecasts or quantification of costs.

4 Method of Analysis

The method of analysis used for both Stage One and Two comprises of:

- Agreed fundamental assumptions, constraints and dependencies;
- Compliance of ICAO Doc 4444 Air Traffic Management;
- Compliance of ICAO Doc 8168 Aircraft Operations;
- Peer review; and
- Fast time modelling using Total Airspace and Airport Modeller (TAAM).

The main consideration when designing the preliminary flight paths was air traffic management, particularly how the flight paths would interact with aircraft operating to or from KSA and to enable WSA to operate independently to KSA. Meaning, either WSA or KSA could change runway configuration without impacting on the other airport. Given the substantial lead time to the anticipated date of operation, only current technology solutions and current route structures were modelled to reduce risk in the design.

4.1 Assumptions

Airservices was provided with a series of preliminary parameters in July 2014 to undertake this analysis, notably runway spacing, runway length and orientation. The following parameters have been used for this report, however Airservices notes that these have been refined concurrently with this work.

None of the changes to these assumptions are considered material to the findings and results presented.

Runway width	60m
Runway spacing	> 1525m (ICAO minimum for independent operations)
Runway orientation	05/23
Rapid Exit Taxiway (RET)	Will support runway occupancy times (ROT) <50sec
Aircraft will not require vectoring to final to maintain separation in parallel operations	
Aircraft will fly standard arrival routes (STARs) then straight in from 10NM for an ILS approach	Nav: RNP1, CAT1 ILS
Aircraft will depart on standard instrument departures (SIDs)	Nav: RNP1
Airport demand was extrapolated from	Fleet mix: A320, A330, AT76, B717, B737,

existing KSA traffic mix with demand increasing proportionally	B763, B777, DH8D, E190, SF34 (possible new aircraft types)
Modelling used an arrival, departure, arrival mode	A (Arrival), D (Departure), A, D
ARP Coordinates (MGA)	6248091.04N, 289419.51E
Runway 05L Coordinates (MGA)	6247396.6687N, 286759.1977E
Runway 05R Coordinates (MGA)	6245875.66N, 287465.70E
Runway 23L Coordinates (MGA)	6247879.13N, 290928.72E
Runway 23R Coordinates (MGA)	6249399.9726N, 290221.9747E
ARP elevation	80m (262ft) Australian Height Datum
Runway 05L/R elevation	91m (298ft) Australian Height Datum
Runway 23L/R elevation	73m (239ft) Australian Height Datum
Runway length for 05L/23R and 05R/23L	4000m
Clearway allowance used for all runway ends	120m
Runway Strip Width for both runways	300m
Aircraft segregation	Departing and arriving Turboprop and Jet should be segregated until approximately 40NM
Aircraft performance	Performance of turboprops is comparable to jets within 40NM of the airport
Maps	1:100 000 scale maps used 20m contour intervals used 10m vertical error applied 1m LiDAR contour intervals used 0.3m LiDAR vertical error applied
Obstacles	Data derived from ADMS
	The standard 100ft of vegetation allowance was not applied when assessing the Basic Instrument Landing System (ILS) surfaces with the assumption that during the construction of the aerodrome, the area adjacent to the runways would be cleared of any vegetation. It was assumed that there would be some degree of levelling of the runways once construction begins, as the existing contours indicate a steep runway gradient.
Flight Paths	Flight paths were chosen which conformed with existing design criteria for Simultaneous Operations to Independent Runways The final approach paths were straight in approaches from 10 nautical miles to touchdown.

	The departure paths chosen for modelling diverged by 15 degrees from departure out to 10nm.
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Table 1

4.2 Constraints

All ATC design and operation standards applied will be existing approved procedures	CASA Air Traffic Management Manual of Standards Part 172 and Part 173 will be applied.
No simulation involving Air Traffic Controllers was undertaken	All operational procedures are yet to be developed
No consideration was given to fuel efficiency or track miles	

Table 2

4.3 Dependencies

Noise sharing was not required to be assessed	Longitudinal Runway sections will be drawn from the 1991 Badgers Creek (SSA) Concept Design Report Vol. 1 (Appendix B)
Infrastructure and basic environmental factors were drawn from the Summary of Key Aviation Infrastructure Parameters for Badgers Creek provided by the Department in July 2014 (Appendix A)	

Table 3

5 Stage One

Stage One consists of a basic assessment of the viability of WSA airport operations with a parallel runway orientation of 05/23. It consisted of an assessment of:

- ILS protection areas to all runways;
- SID paths from all runways;
- Modelled theoretical capacity; and
- Weather at WSA.

5.1 ILS protection areas to all runways

Assessments of the basic ILS surfaces were completed for each runway end in order to evaluate the feasibility of ILS (or equivalent satellite-based) approaches into WSA. In situations where either terrain and/or man-made obstacles penetrated these basic surfaces, a further assessment was completed against the Obstacle Assessment Surface (OAS). Any further penetrations of the OAS would require completion of a CRM assessment, which is the last layer of assessment in accordance with PANS-OPS.

For this assessment, the Department sourced LiDAR data¹ was used, which provided 1m contour intervals and an additional 0.3m of vertical error allowance.

Based upon the previously defined assumptions, findings indicate that the lowest possible Decision Height of 200ft with High Intensity Approach lighting (HIAL) installed and 250ft without HIAL installed is achievable.

Prior to any operational usage, Type A and Type B survey data will be required in order to obtain accurate threshold elevations and identify all terrain and man-made obstacles both in the approach area and within a certain radius around the aerodrome. It is anticipated that Category II or III ILS operations will be available subject to airport infrastructure. The granularity of the terrain data used for this assessment is inefficient to accurately assess Cat. II/III ILS operations. This assessment would follow completion of the airport and runway construction.

This assessment was conducted on the assumptions listed in table 4. Any change to these measurements would require reassessment.

Runway Length	4000m
ARP Coordinates (MGA)	6248091.04N, 289419.51E
Runway 05L Coordinates (MGA)	6247396.6687N, 286759.1977E
Runway 05R Coordinates (MGA)	6245875.66N, 287465.70E
Runway 23L Coordinates (MGA)	6247879.13N, 290928.72E
Runway 23R Coordinates (MGA)	6249399.9726N, 290221.9747E

Table 4

Appendixes C-F illustrates the Basic ILS surfaces that were assessed.

¹ Digital Elevation Model (DEM) derived from the Nepean River West LiDar survey. The zip file contains 312 ESRI ASCII GRID tiles of 1kmx1km size that can be joined to create a single dataset

5.2 Standard Instrument Departures

SIDs was designed for all four runway ends and the assessment identified no major constraints.

The following design criteria were adopted in the assessment:

- RWY 05L – 15° Left Turn Departure
- RWY 05R – Straight departure
- RWY 23L – Straight departure
- RWY 23R – 15° Right Turn Departure

Based upon the above criteria, the following are the minimum departure parameters required in relation to obstacle clearance:

- RWY 05L Departure – 3.3% climb gradient. Turn Altitude of 800FT
- RWY 05R Departure – 3.3% climb gradient. Turn Altitude of 800FT
- RWY 23L Departure – 3.7% climb gradient. Turn Altitude of 900FT
- RWY 23R Departure – 4.3% climb gradient. Turn Altitude of 1000FT

Appendixes G-K illustrates the departure area that was designed and assessed.

5.3 Airport capacity

Once the final approach paths and departure paths were evaluated for constraints, the final paths within 10 nautical miles were then modelled to identify potential airfield capacity.

The TAAM optimisation algorithm attempted to optimise the airport throughput. The modelling assumed that Rapid Exit Taxiways (RET) were positioned at the ideal location for aircraft accessing the airport and that aircraft fleet mixes accessing WSA were comparable to those accessing KSA in 2014. Due to the lack of ground layout, there was no linking of flights, allowing more departures than arrivals to exist in the model. This approximates a departure biased sequence.

Capacity with parallel runways was assessed at an initial demand level of 80 movements per hour and then increased to a maximum of 120 per hour with fleet mix extrapolated from the base KSA data.

The data was sourced from the Airservices' pre-tactical traffic scheduling system (Harmony) schedule for Monday, 11 August 2014 (UTC) which was considered a typical recent day of operation. The outcomes are described below in Table 5:

Hourly Demand Movements		Total	Hourly Actual movements		Total
Arrivals	Departures		Arrivals	Departures	
39	41	80	39	41	80
42	48	90	42	47	89
47	53	100	45	51	96
54	56	110	46	54	100
58	62	120	45	58	103

Table 5

The source timetable was weighted towards departures and therefore a bias towards departures is seen in the results. As demand increases, increasing numbers of arriving aircraft are moved into the next hour and airborne delay increases exponentially.

As demand increases, so does airborne delay. The highlighted line in Table 5 indicates the point at which airborne delay reached four minutes average per arriving aircraft.

The schedule utilised for this modelling was theoretical and based upon an inflation of the existing KSA traffic mix consisting of a non-homogenous blend of light, medium and heavy category aircraft. In order to push the modelling to its theoretical maximum, demand was increased beyond operational reality. A more accurate forecast schedule and realistic Air Traffic Flow Management would be expected to reduce the airborne below the four minutes average per aircraft during traffic peaks.

A more accurate assessment would require the expected traffic schedule and full airfield layout in order to accurately determine the demand capacity profile for the airport.

5.4 Weather

The weather data detailed below was used to identify basic assumptions in the development of the report. The detail used has been validated against the Draft WSA Useability report as supplied by the Bureau of Meteorology.

WIND

Mean wind speeds at WSA are relatively consistent throughout the year, ranging from 5 to 7 knots, with a slight increase in the mean wind speed from July through to February. The predominant wind direction at WSA in all seasons is south-westerly, suggesting that RWY 23 would be the predominant runway at WSA.

Wind conditions between KSA and WSA differ significantly due to the influence of the sea breeze at the more coastal location of KSA - this formed the basis for the assumption that airspace designs which allowed the airports to operate independently were required.

FOG

Fog is expected to occur more frequently at WSA, than at KSA, and commonly forms early in the night and dissipates early in the morning, with peak occurrence between 0300 AEST and 0700 AEST. In order to maintain maximum capacity at the airport, it is likely that a CATII or CATIII ILS (or equivalent) would be required.

RAINFALL

Results show similar rainfall patterns for both WSA and KSA, on average, for the months of November to March. For the months April to October WSA has lower monthly mean and monthly median rainfall than KSA site.

5.5 Restricted Area Proximity

The findings indicate that during the normal management of individual aircraft to depart from, or arrive using the ILS approaches to RWY23LR and RWY05LR, R536ABC Orchard Hills has no impact on operations.

This means that a single runway operation is not affected by the proximity of R536ABC. Figure 2 below illustrates

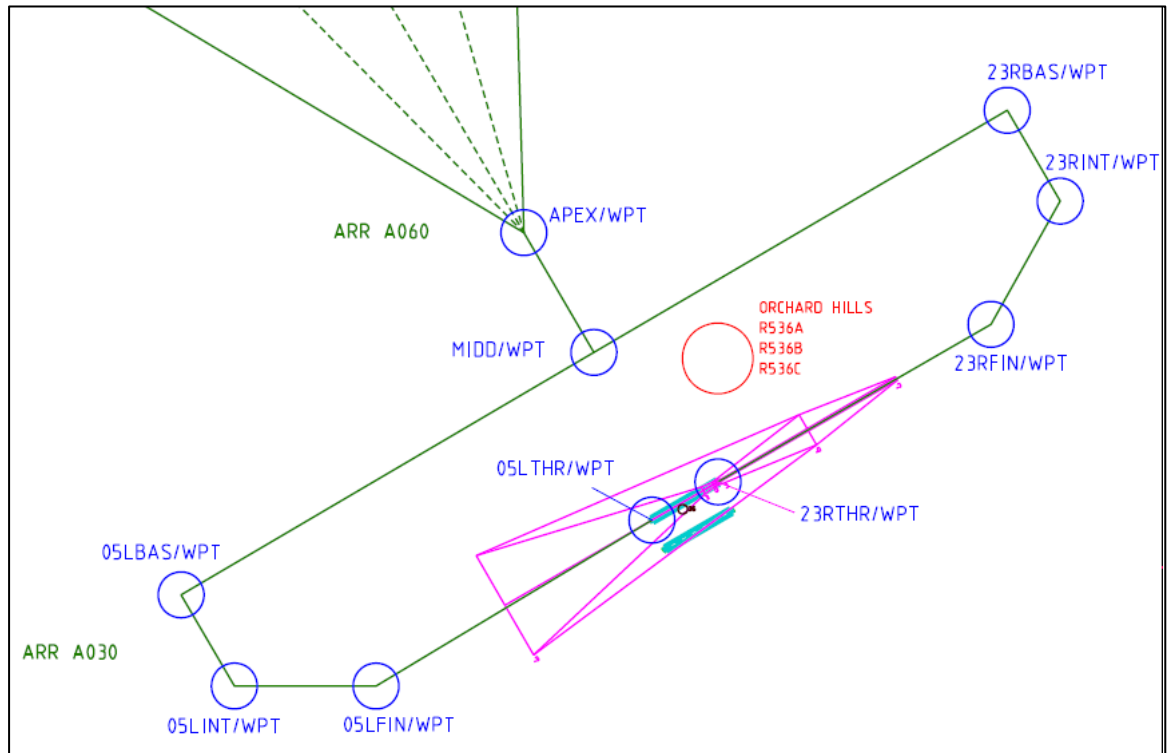


Figure 2

However, when parallel runway operations are in use, while departures from RWY23LR and RWY05LR are not affected by the proximity of R536ABC, the Breakout Areas required to operate these procedures would be in conflict with R536ABC when it is active. As per the PANSOPS Part II-1-1-App D-3 3.4.2, the following is recommended in relation to break-out procedures: "If possible, obstacles should be removed. Where obstacle removal is not feasible, air traffic operational rules shall be established to avoid obstacles, and a risk assessment shall be required to provide guidance on whether Independent simultaneous ILS/MLS operations to parallel runways should be approved."

Summarising, the status of R536ABC will need to be resolved in order for parallel runway operations to be implemented.

6 Stage Two

Stage Two modelled and analysed a terminal area concept for the Sydney basin including air route interactions between WSA and KSA. It identified physical and operational constraints to safe and efficient operations of WSA and KSA.

Runway configurations assessed in this analysis are:

- WSA RWY05 / KSA RWY16;
- WSA RWY05 / KSA RWY34
- WSA RWY23 / KSA RWY16;
- WSA RWY23 / KSA RWY34; and
- WSA RWY23 / KSA RWY25.

A number of conceptual designs and methods were considered for WSA single runway air route designs while maintaining the existing air route structure at KSA.

The following items were not in scope for this analysis:

- WSA RWY05 and KSA RWY07: due to the limited use of RWY07.
- WSA RWY05 and KSA RWY25 on the assumption that the weather conditions that dictate KSA RWY25 would not favour WSA RWY05.
- Curfew routes

Analysis of these configurations may become part of a later body of work.

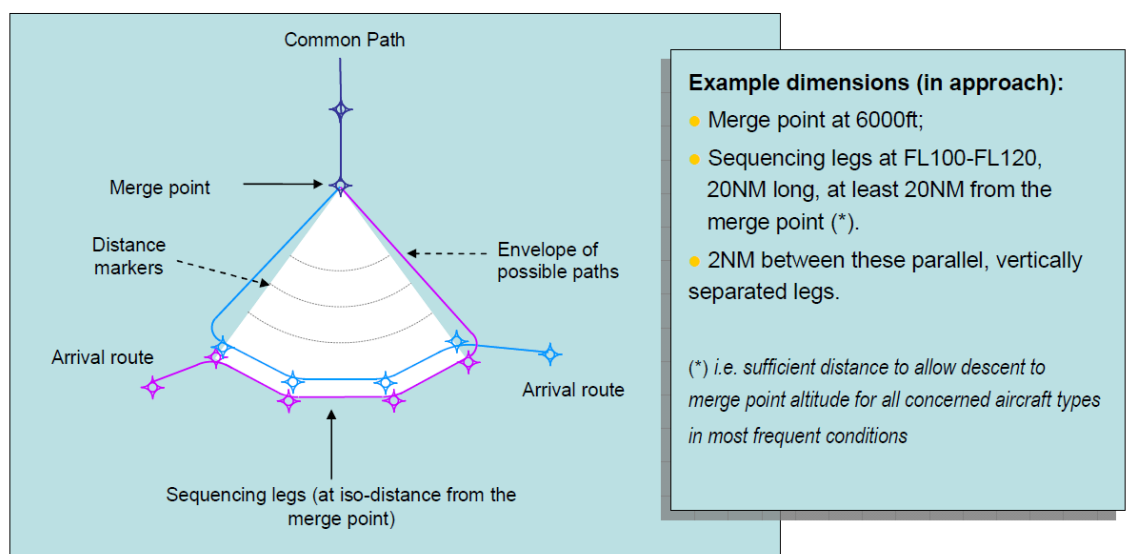
6.1 Stage Two consists of three models.

Arrival Management Options:

Three different arrival management options were considered:

- Open Star with Radar Vectoring to Final
 - The Open Standard Terminal Arrival Routes (STAR) with radar vectoring to final is a way of processing terminal aircraft which focuses primarily on achieving consistent arrival spacing by allowing the Approach Controller to adjust the approach path and aircraft speed. It is currently used at KSA.
 - STARS are used to process aircraft from approximately 65NM from touchdown to a position on downwind. From the downwind position, a radar vector is used to adjust final approach spacing.
 - As runway demand is consistently high at KSA, this method of processing arriving aircraft is used to accurately control arrival spacing and deliver maximum runway capacity.
 - As aircraft are not able to fly planned tracks while being radar vectored, Flight Management System (FMS) fuel management is not accurate. Fuel burn can increase and energy management can become more unpredictable.
 - This model of air traffic synchronisation is used when the maximisation of runway capacity is considered more important than access to Continuous Descent Profile (CDP). It is simple, but is unpredictable and unrepeatable as demand increases and vectoring introduces variable trajectories.

- Runway Connected STARs
 - Runway connected STARs are a way of processing terminal arrivals which enable CDP because the vertical and lateral path from Top of Descent (TOD) to the runway is defined in the FMS. Runway connected (Area Navigation) RNAV STARs are used at Brisbane, Melbourne, and Perth airports.
 - Runway connected RNAV STARs enable accurate fuel time and energy management for aircraft with FMS capability but they may not provide the flexibility required to maximise traffic throughput to the runway.
 - As a result, this model for air traffic synchronisation is used when the access to CDP is considered more important than the maximisation of runway capacity.
- Point Merge



- The Point Merge System (PMS) is a way of processing arriving terminal aircraft, synchronising them to the runway in a structured manner.
- Point Merge is now operational in Oslo (2011), Dublin (2012), Seoul (2012) and Paris (partially 2013). Point Merge at Gatwick and London City is still to come (2015). It is one of the ICAO developing block upgrades (ASBU) and is referenced as a technique to support continuous descent operations (CDO ICAO Doc 9931).
- Currently, where an airport has low demand, ATC is able to facilitate CDP along predictable routes to the runway with minimal intervention.
- This provides a more predictable operation as the FMS can more accurately calculate an optimum descent profile based on distance to go to landing.
- However as airport demand rises, more ATC intervention is required to maximise the landing rate. This intervention is currently delivered by radar vectoring. Radar vectoring may require flight crew to disregard FMS predictions.
- Without predictable routes, the vertical and lateral path is less accurate. This inaccuracy can result in extended level segments at low altitude, and increased fuel consumption and emissions.

- In contrast PMS processes aircraft along RNAV STARS to runways, utilising the capabilities of the FMS to accurately navigate and space the aircraft while minimising the use of radar vectoring to achieve the required final approach spacing. This procedure has been clearly demonstrated to result in fuel efficient flight paths at several busy international airports.

The Point Merge method is proposed to be adopted for WSA because it is simple, predictable and repeatable, offering economies in fuel, efficiency and standardisation of procedure. It also provided the easiest method for runway changes which are independent to KSA.

Terminal environment

A guiding principle of the development of the airspace designs for this report was that KSA and WSA should be able to operate independently of each other to enable operations on preferred runways appropriate to prevailing winds.

Enroute environment

No changes to the existing enroute arrival and departure routes were made in the design and modelling of WSA. This approach results in a less than optimal route structure due to increased number of converging and crossing tracks. There is opportunity to reduce the number of converging and crossing tracks and track miles in the future after Performance Based Navigation (PBN) is implemented. However, a thorough design and validation process would be required to ensure the enroute environment was not adversely affected by the changes.

Air Traffic Flow Management (ATFM)

Air Traffic Flow Management is a service aimed at achieving a balance between forecast air traffic capacity and actual air traffic demand.

ATFM operates in various phases relating to the time of operation of the flight. The ATFM process is applied consecutively through these phases to gradually refine the times at which a flight operates into a program airport.

These phases are:

- Strategic
 - Refers to the planning that occurs more than one day prior to the day of operation of a flight.
- Pre-tactical
 - Refers to the planning that occurs from the day prior to the day of a flight's operation until two hours prior to the flight's departure.
- Tactical
 - Refers to planning that occurs from two hours prior to a flight's departure until the end of a flight.

In the event of abnormal operations at the airport Traffic Management Initiatives (TMI) may be deployed including:

- Ground Delay Program (GDP)

- Initiated at a program airport for a specified time when forecast demand exceeds forecast capacity.
- Ground Stop (GS)
 - Designed to be used in the event of an unplanned and unforeseen event that either closes or severely constrains a program airport.

Runway acceptance rates are primarily determined by weather conditions and will reduce depending on weather deterioration. Specifically, this pertains to wind, visibility, cloud base and convective or mechanical turbulence conditions.

It is foreseeable that WSA could become an alternate airport for flights when a landing becomes unavailable at the airport of intended landing. Conversely, in the event that WSA becomes unavailable, whether due to weather or operational issues, traffic bound for WSA would divert to other suitable nearby airports.

When diversions occur, ATFM processes adjust to manage the changes in traffic flow to balance the demand where capacity becomes constrained. This procedure is currently in operation across Australian airspace.

6.2 Model One

Model One evaluates the introduction of WSA (single runway) while preserving the existing BK and KSA Parallel Runway IFR flight paths, including PRM break out procedure. This model will inform a potential scenario for the opening day operation of WSA. The study did not identify any preference for either the northern or southern runway in this mode of operation.

The existing KSA STARs were used in this analysis are published at Appendix FF.

Figure 3 below shows typical jet aircraft track plots for arrivals at KSA.

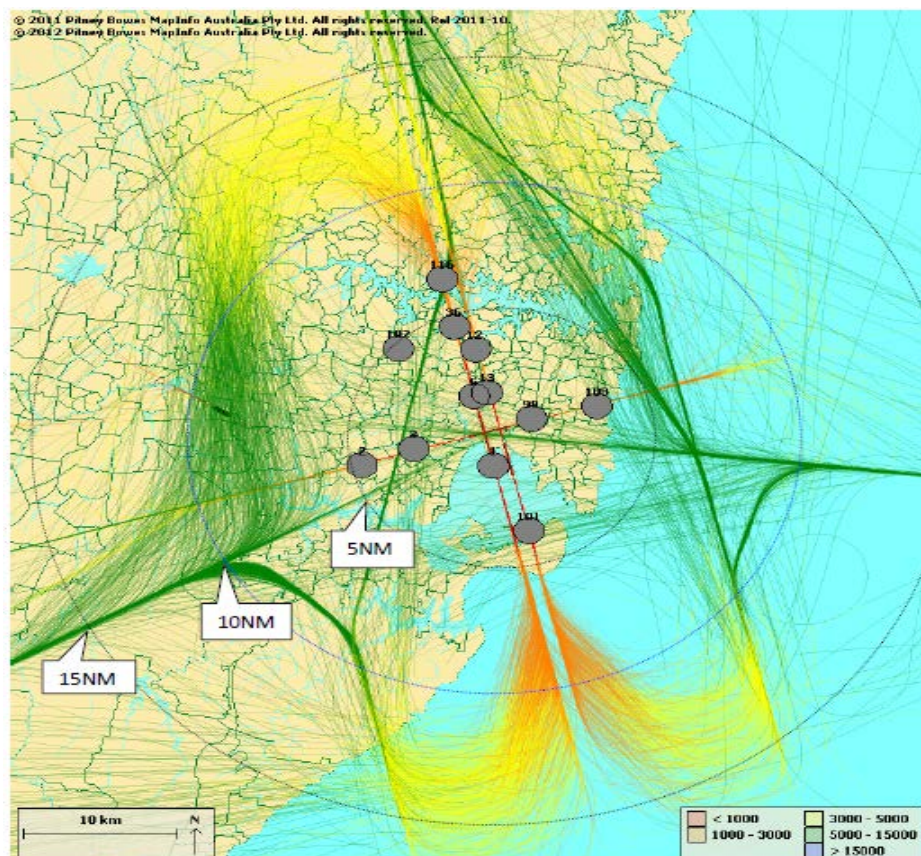


Figure 3

This model has assessed the busiest hour traffic schedules using the following data:

- KSA RWY16/34 - 80/hour (40 arrivals and 40 departures evenly spaced);
- KSA RWY25 – 48/hour (24 arrivals and 24 departures);
- BK RWY 11 - 8/hour (4 arrivals and 4 departures);
- WSA – 50/hour (25 arrivals and 25 departures evenly spaced, traffic randomly sampled from domestic and Pacific/Tasman international arriving traffic only);
- Traffic randomised from domestic KSA demand and;
- NZ international traffic only (80% domestic, 20% international).

The base timetable for KSA was generated analysing all KSA movements from 01Jan2014 – 30Nov2014. Aircraft were aggregated by:

- Arrivals/departures
- Aircraft type
- Departure fix/arrival fix
- International/Domestic

A loss of two WSA RWY23 arrival slots is required for every BK RWY11 arrival to ensure a landing and protect the missed approach path. (see figure 4)

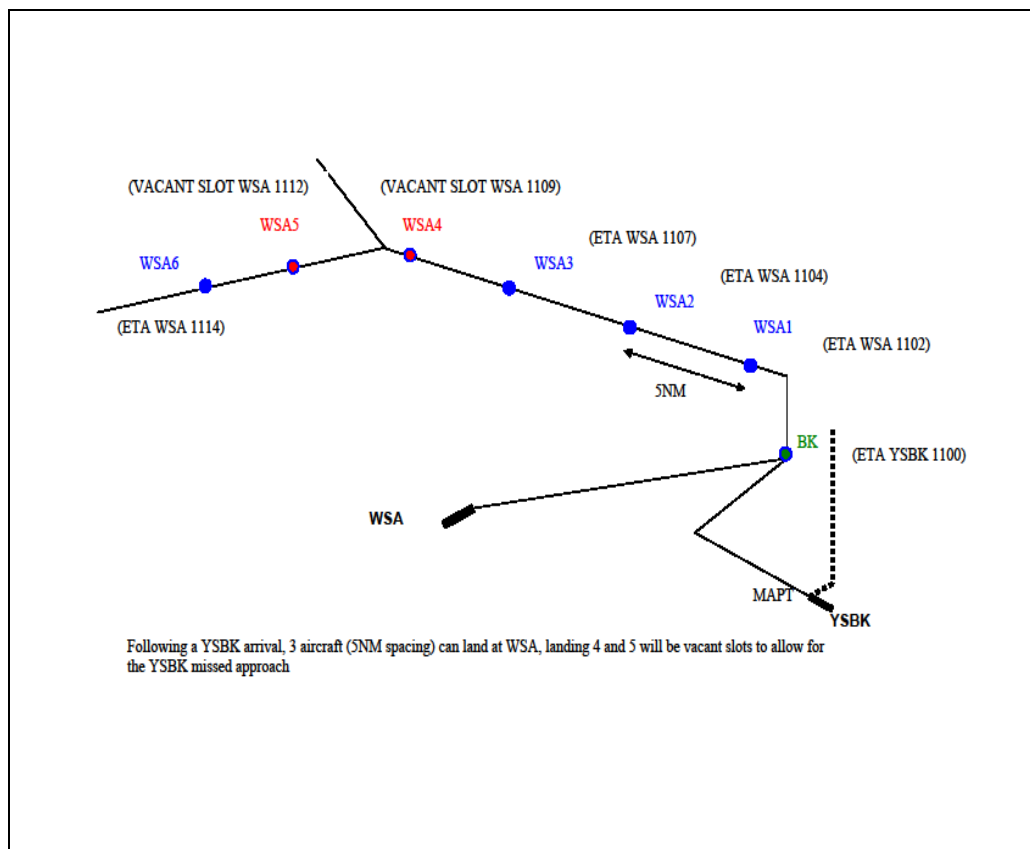


Figure 4

Table 6 below identifies the restrictions and consequences for Model 1.

Restriction	Consequence
WSA v BK	
Dependant operations between arrivals WSA RWY23 with BK RWY11 to allow for BK Missed approach.	BK arrival must be assured a landing before WSA RWY23 arrival can be sequenced.
Cannot use BK NDB approach due to conflicting profiles with WSA RWY23 arrivals and WSA RWY05 departures.	Only use RNAV-Z RWY11 at BK.
Remove CN IAF to RNAV-Z RWY11 due conflict with missed approach WSA RWY23.	Only approach to BK via RIC to SBKWI (IF).
Remove straight in approach via SBKWB for RNAV-Z RWY11 due to conflict with missed approach WSA RWY23.	Only approach to BK via RIC to SBKWI (IF).
Both missed approach procedures for WSA RWY23/05 will have requirement to climb to 5000FT.	Effect on adjacent routes
WSA RWY05 v KSA RWY34/16	
All departures WSA RWY05 will be both jet and non-jet routes.	Departure delays due to faster following.
WSA RWY05 departures to the east have height requirements to be above KSA RWY34 arrivals.	More track miles.
WSA RWY23 v KSA RWY34/16	
Most departures WSA RWY23 are both jet and non-jet routes.	Departure delays due to faster following.
WSA RWY23 departures to the east have height requirements to be above KSA RWY16 arrivals.	More track miles.

Table 6

6.2.1 Airport Capacity

Based on the same assumptions as Stage One, RETs positioned at the ideal location for aircraft exiting the runway and aircraft fleet mix for WSA is an extrapolation from KSA, the TAAM attempted to validate the WSA capacity prediction based on 3NM standard while maintaining the capacity at KSA. Table 7 shows the capacity predictions noting the impact of BK RWY11 arrivals on WSA RWY23 arrivals.

This analysis used an extrapolation from the KSA fleet mix which included a range of aircraft types (Annex FF-JJ).

Scenario	Aerodrome	Scheduled Movements	Achieved Movements
WSA R05/KSA R16	KSA	80	80
	WSA	50	50
	BK	8	8
WSA R05/KSA R34	KSA	80	80
	WSA	50	50
	BK	8	8
WSA R23/KSA R16	KSA	80	80
	WSA	42*	42
	BK	8	8
WSA R23/KSA R34	KSA	80	80
	WSA	42*	42
	BK	8	8
WSA R23/KSA R25	KSA	48^	48
	WSA	42*	42
	BK	8	8

Table 7

*Reduced arrival rate due to interaction with BK arrivals

^Reduced arrival rate due to single runway operation

6.2.2 Constraint Points

The table below highlights constraint points for Model 1. These constraint points are typically areas where an aircraft could be in conflict due to aircraft profiles. Through further design and procedure development these constraint points would be mitigated to ensure safety.

RWY Configuration	Same-Direction	Reciprocal Track	Crossing Track	Total
WSA R05/KSA R16	6	11	6	23
WSA R05/KSA R34	3	7	7	17
WSA R23/KSA R16	5	6	8	19
WSA R23/KSA R34	3	7	6	16
WSA R23/KSA R25	2	6	6	14

Table 8

The most frequent constraint points are:

RWY Configuration	Constraint
WSA RWY05 / KSA RWY16	WSA RAZZI departure with KSA RIVET arrivals
WSA RWY05 / KSA RWY34	WSA RAZZI departure with KSA ODALE arrivals
	WSA BTH departure with KSA RIC departures
WSA RWY23 / KSA RWY16	WSA arrivals with BK arrivals
WSA RWY23 / KSA RWY34	WSA arrivals with BK arrivals
WSA RWY23 / KSA RWY25	WSA arrivals with BK arrivals

Table 9

Appendix L-P illustrates the constraint points for Model 1.

6.3 Model Two

Model Two evaluates the introduction of WSA (single runway) while preserving the existing KSA Parallel Runway IFR flight paths, including PRM break out procedure, but will remove the constraint of BK IFR arrivals and departures.

This model has assessed the busiest hour using the following data:

- KSA - 80/hour (40 arrivals and 40 departures);
- KSA RWY25 – 48/hour (24 arrivals and 24 departures);
- BK RWY 11 - 0/hour;
- WSA – 50/hour (25 arrivals and 25 departures);
- Traffic randomised from domestic KSA demand, and;
- NZ international traffic only.

Initial design work for Model 2 has identified an increase to WSA RWY23 arrival rate due to the removal of BK IFR arrival constraint. Restrictions to WSA departures will remain to accommodate KSA operations.

6.3.1 Airport Capacity

Based on the same assumptions as Stage One, RETs positioned at the ideal location for aircraft exiting the runway and aircraft fleet mix for WSA is an extrapolation from KSA, the TAAM attempted to validate the WSA capacity prediction while maintaining the capacity at KSA. The table below confirms the capacity predictions. The data illustrates a clear difference between Model 1 and 2 with the removal of BK IFR arrivals permitting the predicted maximum capacity at WSA.

Scenario	Aerodrome	Scheduled Movements	Achieved Movements
WSA R05/KSA R16	KSA	80	80
	WSA	50	50
WSA R05/KSA R34	KSA	80	80
	WSA	50	50
WSA R23/KSA R16	KSA	80	80
	WSA	50	50
WSA R23/KSA R34	KSA	80	80
	WSA	50	50
WSA R23/KSA R25	KSA	48	48
	WSA	50	50

Table 10

6.3.2 Constraint Points

The table below highlights constraint points for Model 2. These constraint points are typically areas where an aircraft could be in conflict due to aircraft profiles. Through further design and procedure development these constraint points would be mitigated to ensure safety. The table below shows a reduction in constraint points due to the loss of BK IFR traffic. The overall complexity has reduced.

RWY Configuration	Same-Direction	Reciprocal Track	Crossing Track	Total
WSA R05/KSA R16	2	4	6	12
WSA R05/KSA R34	2	4	6	12
WSA R23/KSA R16	1	7	3	11
WSA R23/KSA R34	0	4	3	7
WSA R23/KSA R25	0	5	4	9

Table 11

The most frequent constraint points are:

RWY Configuration	Constraint
WSA RWY05 / KSA RWY16	WSA RAZZI departure with KSA RIVET arrivals
WSA RWY05 / KSA RWY34	WSA KAMBA departure with KSA northern arrivals
	WSA EXETA and RAZZI departure with KSA southern arrivals
WSA RWY23 / KSA RWY16	WSA EXETA and RAZZI departures with KSA RIVET arrivals
WSA RWY23 / KSA RWY34	WSA EXETA and RAZZI departure with KSA southern arrivals
WSA RWY23 / KSA RWY25	WSA EXETA and RAZZI departure with KSA southern arrivals

Table 12

Appendix Q-U illustrates the constraint points for Model 2.

6.4 Model Three

Model Three evaluates the operation of a WSA parallel runway without the constraints of BK IFR arrivals and departures.

The conceptual designs and methods considered for WSA parallel runway air route designs were the same as Model 1 & 2.

This model has assessed the busiest hour using the following demand data:

- KSA - 80/hour (40 arrivals and 40 departures);
- KSA RWY25 – 48/hour (24 arrivals and 24 departures);
- WSA – 100/hour (50 arrivals and 50 departures);
- Traffic randomised from domestic KSA demand and;
- NZ international traffic only.

Initial design priority was given to the existing air routes for KSA. Following extensive designing, this approach was rejected due to the western side circuit down winds at KSA being too restrictive to WSA runway 23 arrivals. To accommodate parallel operations at WSA a redesign of both WSA and KSA was deemed necessary. These designs also made allowance for ICAO PRM break out procedures for KSA and ICAO parallel break out procedures for WSA.

6.4.1 Airport Capacity

Based on the same assumptions as Stage One, RETs positioned at the ideal location for aircraft exiting the runway and aircraft fleet mix for WSA is an extrapolation from KSA, the TAAM attempted to validate the WSA capacity prediction while maintaining the capacity at KSA. The table 13 confirms the capacity predictions.

Scenario	Aerodrome	Scheduled Movements	Achieved Movements
WSA R05/KSA R16	KSA	80	78
	WSA	100	99
WSA R05/KSA R34	KSA	80	79
	WSA	100	99
WSA R23/KSA R16	KSA	80	78
	WSA	100	94
WSA R23/KSA R34	KSA	80	79
	WSA	100	94
WSA R23/KSA R25	KSA	48	48
	WSA	100	94

Table 13

6.4.2 Constraint Points

The table below highlights constraint points for Model 3. These constraint points are typically areas where an aircraft could be in conflict due to aircraft profiles. Through further design and procedure development these constraint points would be mitigated to ensure safety.

	Same-Direction	Reciprocal Track	Crossing Track	Total
WSA R05/KSA R16	3	1	4	8
WSA R05/KSA R34	1	1	3	5
WSA R23/KSA R16	5	1	7	13
WSA R23/KSA R34	5	4	5	14
WSA R23/KSA R25	0	1	5	6

Table 14

Most frequent constraint points are:

RWY Configuration	Constraint
WSA RWY05R / KSA RWY16R	WSA 05R ENTRA departure with KSA 16R ENTRA departure
WSA RWY05R / KSA RWY34R	WSA 05L RAZZI departure with KSA 34L WOL departure
WSA RWY23R / KSA RWY16R	WSA 23L arrivals with KSA arrivals via CULIN and MARLN
WSA RWY23R / KSA RWY34R	WSA 23L arrivals with KSA departures via TW
WSA RWY23R / KSA RWY25R	WSA 23R DIPSO departures with KSA ENTRA departures

Table 15

Appendix V-Z illustrates the indicative route structure diagrams and constraint points for Model 3. These designs have not been fast time modelled to assess capacity or constraint points at the airports.

7 Conclusion

This report presents conceptual designs and analysis for the viability of a second high capacity airport within the Sydney Basin. These air route designs represent one concept of many that could be considered and analysed to provide an optimum outcome for Air Traffic Management, airspace users, the community and the environment.

The designs contained herein are not intended to be implemented operationally and are to be used within the context outlined in the scope of works.

Initial analysis confirms the basic viability of WSA with a single runway orientation of 05/23 but confirms comments from the initial EIS of 1997-1999, that WSA 05/23 parallel aligned runways “would require complex airspace management procedures”.

WSA could operate a single runway with minimal effect on KSA capacity. Single runway configurations at WSA could operate independently from KSA.

IFR operations at BK will reduce the capacity at WSA on runway 23. The influence of BK IFR operations at WSA does not present as a consistent hourly impact. For example, existing BK arrival traffic typically peak in the evening.

Analysis indicates that if BK was confined to VFR operations only, WSA could realise full capacity of 50 movements per hour for both runway 05 and 23.

Initial concept designs for WSA parallel runway operations suggest that the KSA air route structure would need to change to accommodate two close proximity high capacity parallel runway airports. Confirmation of airport capacity in this configuration is yet to be analysed.

In addition, the status of R536ABC will need to be resolved in order for parallel runway operations to be implemented.

All designs and analysis was based on aircraft flying an ILS approach to WSA intercepting final at approximately 10-12NM. ICAO is progressing approvals for parallel runway procedures which allow aircraft to intercept final on their own navigation. This approval is expected to be available in Australia by 2016. GLS and RNP-AR technologies will be available to constrain the tracks of arriving and departing aircraft.

In future, designs could include closer intercepts for final, resulting in potentially different environmental impacts.

It is acknowledged that the Model 3 designs are significantly different to Model 1 & 2. These designs demonstrate that two close proximity high capacity parallel runway airports could co-exist as assessed within the scope of the Statement of Works.

With further design development including consideration of noise and environmental impacts, consultation with airspace users, the regulator and a more comprehensive operational assessment an optimised route structure will be developed.

8 Definitions

Within this document, the following definitions, acronyms and abbreviations apply:

Term	Definition
ADMS	Airways Data Management System
AHD	Australian Height Datum
ARP	Aerodrome Reference Point
ATC	Air Traffic Controller
BK	Bankstown
BoM	Bureau of Meteorology
CASA	Civil Aviation Safety Authority
CDP	Continuous Descent Profile
CN	Camden
DIRD	Department of Infrastructure and Regional Development (the Department)
FAA	Federal Aviation Administration
FT	Feet
GLS	GNSS Landing System
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organization
IF	Intermediate Fix
IFR	Instrument Flight Rules
ILS	Instrument Landing System
KSA	Kingsford Smith Airport
LiDAR	Light Detection and Ranging data
MGS	Map Grid of Australia
NASA	National Aeronautics and Space Administration
NDB	Non Directional Beacon
NZ	New Zealand
PRM	Parallel Runway Monitor
RNAV-Z	Area Navigation non precision approach
RWY	Runway
RNP-AR	Required Navigation Performance-Authorisation Required
SID	Standard Instrument Departure
STAR	Standard Terminal Arrival Route
TAAM	Total Airspace and Airport Modeller- is a fast time simulation program that allows the user to create a

	virtual environment to simulate real world concepts and evaluate the impact. It is a very detailed software package which includes aircraft performance data, ground movements (gate to gate), terminal operations including Standard Instrument Departures (SIDs), Standard Terminal Arrival Routes (STARs), and airspace. Each object in the simulation can be called upon and given unique properties on how it should respond to certain conditions. The ability to assign properties to each object in the simulation provides the user flexibility to create various 'what-if' scenarios and assess the outputs.
TFM	Traffic-flow-management
TOD	Top of Descent
WSA	Western Sydney Airport

9 References

No	Title and version	Number/Link
1	Characterization of and Concepts for Metroplex Operations	NASA/CR-2011-216414
2	Eurocontrol PMS update	
3	Western Sydney Airport Climatological Review	
4	Western Sydney Usability Report Draft	
4	PANSOPS	

Appendix A

Summary of Key Aviation Infrastructure Parameters for Badgerys Creek Provided July 2014

	1999 Environmental Impact Statement (based on Option A)	2012 Joint Study on aviation capacity in the Sydney region	Notes sourced from reference documents	Source location																								
Assumed aircraft fleet mix/size	Airfield planning criteria adopted for the Second Sydney Airport are based on allowing unrestricted access to Code F aircraft. The design would also allow landings and take offs by Code G aircraft, with limitations on taxi routes and parking at the passenger terminal.	Localities were assessed to find a site suitable for either a: • Type 1 airport – a full service airport with a runway length up to 4,000 meters, capable of serving all market segments and accommodating a future parallel runway layout; or • Type 3 airport – a limited service airport with a runway length of up to 2,600 meters, capable of serving all market segments but with a single runway layout only.	<p>The larger aircraft categories that have been considered in the planning of the Second Sydney Airport are:</p> <ul style="list-style-type: none">• Code E aircraft, which has a wingspan up to 65 meters and includes the B747-400, B777 and Airbus A330/340;• Code F aircraft, which has a wingspan up to 84 meters and would include the new large aircraft types currently being considered by Boeing and Airbus; and• Code G aircraft, with a wingspan up to 95 meters. Planning for Brisbane Airport and the previous design (Gutteridge Haskins and Davey, 1991) for an airport at Badgerys Creek were based on this design aircraft. <p>The Joint Study assumed that consistent with historical trends, aircraft sizes will increase. Forecasts were developed based on an analysis of historical trends in aircraft seat capacity, together with the fleet mix, aircraft orders and aircraft retirement plans of the main airlines currently operating in, to and from Australia.</p> <p>Demand forecasts</p> <p>The demand analysis undertaken by Booz & Co found that 9.2 million passengers per annum will use aviation services at a Badgerys Creek airport when it first opens in 2025.¹¹ This will increase to 28.5 million passengers by 2040 and ultimately reach 54 million in 2060.¹²</p> <p>Around 150,000 tonnes of freight will pass through the airport by 2040, increasing to 773,000 tonnes of freight in 2060. Approximately 85% of the freight forecast to move through a second airport at Badgerys Creek will have international origins or destinations.</p> <p>By 2060, the number of daily passenger aircraft movements is expected to increase to 10 regional flights servicing five locations, 176 domestic flights servicing 11 locations and 99 international flights servicing 18 locations. Flights to/from Melbourne and China will be the most frequent domestic and international services respectively.</p> <p>The annual estimates prepared by Booz and Co, including the 2040 estimates (including annual estimates of movements) have been included in the spreadsheet below “Demand Forecast and Intl Dom Split”. This also includes the split in passenger projections between Domestic and International movements.</p> <table><tr><th colspan="2">TRIP DISTRIBUTION BY SLA</th><th>2035</th><th>2060</th></tr><tr><th colspan="2">DOMESTIC</th><th></th><th></th></tr><tr><th colspan="2"><u>KSA</u></th><th></th><th></th></tr><tr><td>Total</td><td></td><td>34,774,578</td><td>53,438,891</td></tr><tr><th colspan="2"><u>BADGERYS CREEK</u></th><th></th><th></th></tr><tr><td>Total</td><td></td><td>14,335,053</td><td>29,408,455</td></tr></table>	TRIP DISTRIBUTION BY SLA		2035	2060	DOMESTIC				<u>KSA</u>				Total		34,774,578	53,438,891	<u>BADGERYS CREEK</u>				Total		14,335,053	29,408,455	Environmental Impact Statement, 1999, Main Report, page 8-3. Joint Study, 2012, page 60 and 272. Booz and Co: Department's 2013 report, A Study of Wilton and RAAF Base Richmond for Civil Aviation Operations. Ernst & Young—Economic and social analysis of potential airport sites
TRIP DISTRIBUTION BY SLA		2035	2060																									
DOMESTIC																												
<u>KSA</u>																												
Total		34,774,578	53,438,891																									
<u>BADGERYS CREEK</u>																												
Total		14,335,053	29,408,455																									

			<div> <div>INTERNATIONAL</div> <div> <div>2035</div> <div>2060</div> </div> </div> <div> <div><u>KSA</u></div> <div>Total</div> <div>20,370,940</div> <div>37,958,538</div> </div> <div> <div><u>BADGERYS CREEK</u></div> <div>Total</div> <div>10,720,382</div> <div>24,570,323</div> </div>	
Number of runways	2 parallel runways	2 parallel runways and a cross wind runway	Operations expected to commence with a single runway only. Second runway to be operational when required by demand.	Environmental Impact Statement, 1999, Main Report, page 9-6 (Option A proposal). Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports, page 33.
Runway alignment	05/23 alignment (approximately north-east to south-west) (62°T/242°T)	05/23 alignment (approximately north-east to south-west) for parallel runways 14/32 alignment (approximately north-west to south-east)	<p>North-east to south-west alignment (also aligned with the site ridge line) preferred, allowing for optimal use of the existing Commonwealth-held land, alignment of 05 departures and 23 landings over Prospect Reservoir, and the prevailing winds. In considering the prevailing winds, the selected runway alignment should maximise the usability of runways.</p> <p>However, the 1985 Second Sydney Airport site selection programme noted that the 'principal basis for selecting the north-east to south-west alignment for the preliminary master plan was its lesser noise impact on people in surrounding areas'. Surrounding areas have since been protected to some extent by NSW planning overlays based on this alignment.</p> <p>Attachment: Commonwealth owned land at Badgerys Creek with coord points</p>	<p>Environmental Impact Statement, 1999, page 8-4 (Airfield – airport layout) Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports, page 33.</p> <p>Second Sydney Airport site selection programme,</p>

										1985, page 167.
Runway Thresholds and alignments	The exact location of the runway is yet to be determined. Airspace modelling can be undertaken using the 1994 Concept Design Report coordinates included in the table at right, noting that these are draft only and are likely to change (with the general bearing of 05/23 remaining). The most likely change to these coordinates is the relocation of the runways to the north west of the location provided here, with the alignment remaining the same.		Mapping system	Runway bearing	Runway 05L threshold coordinates		Runway 23R threshold coordinates		Runway length	DoIRD Brief to Airservices 2014
			Australian Mapping Grid System	59°56'58"	287,086.997 E	6,247,456.27 2N	289,251.399 E	6,248,708.439N	2500m	
			ARP location		Runway 05R threshold coordinates		Runway 23L threshold coordinates			
			289,314.5 15E	6,247,900.267 N	287,360.713 E	6,245,684.88 3N	290,823.728 E	6,247,688.362N	4000m	
			Noting that 05L/23R is only 2500m and not a matching 4000m length, for the purposes of this work Airservices should assume an additional 500m to the threshold at the 05L end and 1000m at the 23R end. With additional airstrip safety requirements the layout should, nevertheless be bounded within the Commonwealth's land holdings.							
Airport elevation	Average site elevation is "in the vicinity of 80m above sea level".		Master plan studies carried out by Airplan and Connell Wagner and referenced in the 1999 Environmental Impact Study indicate ground levels from approximately 70 meters to 90 meters above sea level for the runways rising to the north or to the north-east depending upon the alignment. The Bureau of Meteorology's Badgerys Creek site is at the north-east end of the airport site at an elevation of 81 meters, approximately at the same level as the airport runways would be.							Environmental Impact Statement, 1999, Supplement, page D1-5.
Runway elevation	05R/23L (2,900 metre runway only): 91.0 meters to 73.0 meters AHD (when levelled)									Runway Requirement Assessment (GHD 1994)
Runway gradient	Similar 05/23 aerodrome layout to Option A – 1.6% upwards incline from north-east to south-west		Attachment: 1991 08 2nd Sydney Airport at Badgerys Creek Concept Design Report Vol 1 Part B - Domestic-International Development - longitudinal sections							Second Sydney Airport site selection programme, page 168
Runway length	1 x 4,000 metre runway (south eastern) 1 x 3,000 metre runway (north western) The 1999 Environmental Impact Statement noted that a longer (north western) runway could not be provided within the site boundaries. However land currently owned by the Commonwealth may permit the second runway to be longer than 3,000 meters.	1 x 4,000 metre runway (05/23) (south eastern) 1 x 2,500 metre runway (05/23) (north western) 1 x 2,500 metre runway (14/32)	A survey of a number of overseas airports showed that runways of about 4,000 meters are commonly provided. A desirable runway length of 4,000 meters has been adopted for the main runways at the Second Sydney Airport (Environmental Impact Statement, 1999, page 8-4). It is difficult to predict how quickly the Second Sydney Airport would grow. For the purposes of this environmental assessment, the air traffic forecasts adopted assume three different levels of aircraft movements that may occur by 2006, which is assumed to be a few years after the opening of the airport. This first stage of the airport development would not require all the facilities outlined in the master plans to be constructed. Only a single 3,600 metre long runway and associated taxiways and aprons would be required (Environmental Impact Statement, 1999, page 8-9).							Environmental Impact Statement, 1999, page 9-6 (Option A Proposal – major elements). Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports.

Runway width	Both 60 meters	All 60 meters		page 33. Environmental Impact Statement, 1999, page 8-6 (Figure 8.4) Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports, page 33.
Lateral separation of runways	1,670 meters		<p>The minimum distance required between parallel runways for independent operations is 1,035 meters. However, this is dependent on the availability of suitable radar and communications equipment. A more typical minimum runway separation specified in international standards for independent parallel approaches is 1,525 meters. To allow suitable space for terminals and other supporting facilities, a greater separation is desirable. Previous planning for the Badgerys Creek airport site (Gutteridge Haskins and Davey, 1991) was based on a runway separation of 1,670 meters. Given the increased passenger capacity now being considered, and the need to provide for a range of possible terminal configurations, a distance of 2,300 meters between parallel runways is considered desirable for the Second Sydney Airport (Environmental Impact Statement, 1999, page 8-4).</p> <p>The 1985 Environmental Impact Study identified 1,660 metre runway separation after reviewing separation distances between parallel runways at other existing or planned airports around the world for a variety of terminal layout concepts. Although these separations ranged from 1,311 meters to over 2,500 meters, it was found that many of the busy airports with activity levels similar to the maximum assumed for a second Sydney airport (275,000 annual aircraft movements) had separations of 1,500-1,600 meters. This separation dimension was reviewed for a variety of terminal concept configurations and for the spatial requirements of large aircraft with 95 metre wing-spans. It was concluded that a distance of 1,660 metre would be a minimum but adequate separation which balanced all airfield operational requirements, and ensured that a second Sydney airport did not occupy more land than was needed (Second Sydney Airport site selection programme, 1985, page 167).</p>	Environmental Impact Statement, 1999, page 8-4. Second Sydney Airport site selection programme, 1985, page 167.
Passenger movement capacity	Proposal considered in the 1999 Environmental Impact Study was for an airfield with capacity up to 30 million passenger movements per annum (Environmental Impact Statement, 1999: Proposal, page 1-6).	<p>Up to 65 million passengers per year (based on 195 people per aircraft on long runway and 140 people per aircraft on short runway)</p> <p>Up to 42 million passengers per year (based on 130 people per aircraft on long runway and 80 people per aircraft on short runway)</p>		<p>Environmental Impact Statement, 1999: Proposal, page 1-6.</p> <p>Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports, page 33.</p>

Aircraft movement capacity	Proposal considered in the 1999 Environmental Impact Study was for an airfield with capacity up to 360,000 aircraft movements per annum (based on 1999 aircraft fleets) (Environmental Impact Statement, 1999: Proposal, page 1-6).	Up to 100 aircraft movements per hour or 370,000 movements per annum (Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports). Maximum Airport ~60-70 movements per hour; Type 3 ~40-50 movements per hour (Airservices Australia input to Worley Parsons work, Joint Study, 2012, Technical Paper 4, Worley Parsons, page 102).	Estimated 280 movements per day (single runway) by 2030 and 824 movements per day (parallel runway) by around 2060 (A Study of Wilton and RAAF Base Richmond for civil aviation operations, 2013, page 56).	Environmental Impact Statement, 1999: Proposal, page 1-6. Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports.
Runway usability	Based on 05/23 alignment cross wind tolerance – at 20 knots estimated at 99.84% usability; at 13 knots estimated at 97.25% usability; and at 10 knots estimated at 94.15% usability. Note that larger aircraft able to cope with higher cross wind components (20 knots) than small (10 knots) (Environmental Impact Statement, 1999, page 14-6). Badgerys Creek is not prone to high intensity precipitation events. Therefore runway usability would not be reduced significantly by		Note that Option C (roughly 01/19), which was more aligned with KSA's 16/34 and the preferred option in the 1997 Draft EIS from an airspace management perspective, still has 98.52% usability in an area where KSA provides a suitable alternative. The availability of KSA also obviates the necessity of a crosswind runway at Badgerys Creek.	Draft Environmental Impact Statement, 1997 Section 6.3.2

	precipitation. Badgerys Creek is slightly less prone to lightning strikes and thunderstorms than surrounding areas. The impact of thunderstorms and lightning on aircraft operations would depend upon take-off and landing flight paths used (Environmental Impact Statement, 1999, page 14-7).																	
Location of terminal	Between parallel runways.			Environmental Impact Statement, 1999, page 8-4 (Airfield – airport layout).														
Flight paths	<p>Aircraft departing runway 05 or landing on runway 23 would interact with aircraft operating in the same modes on runways 34 and 16 respectively at Sydney Airport. The area of interaction would occur approximately 28 kilometres north-west of Sydney Airport. There would be a significant number of aircraft in this general area which covers a well populated part of Sydney. As this area of convergence is close to each airport and directly related to the critical operational phases of final approach and initial departure, only limited flexibility exists in devising acceptable air traffic management procedures.</p> <p>It could be anticipated, therefore, that there would be a significant increase in the number of aircraft operating in the lower altitudes below about 1,800 meters than</p>	<p>Major impact on airspace interactions. Potential impact on flight training areas and Camden Airport (Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports, page 36).</p> <p>Flying training areas and Wilton Parachute Jumping Exercise (PJE) may close (Joint Study, 2012, Technical Paper 4: Worley Parsons, page xii).</p>	<p>The existing north-west general aviation access to and from Bankstown Airport might not be possible because of the operation of Option A. An alternative access would be via the south-west. This would involve an increased transit distance of approximately 37 kilometres for aircraft travelling to and from the west. Modifications would be needed to current instrument approach and departure procedures at Bankstown. Existing flying training areas used by aircraft based in the Sydney basin would also need to be relocated (Environmental Impact Statement, 1999, page 22-22).</p> <p>Camden Airport's control zone might be reduced to accommodate departures and the current instrument approach would cease. The airport would revert to operations under Visual Flight Rules only. Powered aircraft operations could take place only to the south of Camden and circuit height would be limited to 305 meters. Glider flying operations would also need to be relocated from Camden Airport (Environmental Impact Statement, 1999, page 22-22).</p> <p>Modifications would be required to the RAAF Base Richmond military control zone to accommodate a civil control zone around Option A. In addition, there would be increased use of Richmond military airspace to accommodate arriving and departing civil aircraft, because of its close proximity to the proposed site (Environmental Impact Statement, 1999, page 22-22).</p> <table border="1"> <thead> <tr> <th colspan="5">Badgerys Creek 05/23</th></tr> </thead> <tbody> <tr> <td>05</td><td>05 L Arrival 05 R Departure</td><td>05 L Arrival 05 L & R Departure</td><td>n/a</td><td rowspan="2">Mixed mode using any eastern circuit for arrivals (05R or 23L) is very difficult due proximal inter-relationship with western KSA circuit. The 23R arrival circuit may suffer limitations during IMC operations. Re-alignment to west (at least an 18/36 type) would be a better combination.</td></tr> <tr> <td>23</td><td>23 R Arrival 23 L Departure</td><td>23 R Arrival 23 L & R Departure</td><td>n/a</td></tr> </tbody> </table> <p>(Airservices Australia input to Worley Parsons work, Joint Study, 2012, Technical Paper 4, Worley Parsons, page 107).</p> <p>For further detailed information, see pages 387-392 of Joint Study, 2012, Technical Paper 4 PDF.</p> <p>Attachments: 1985 EIS Dept of Aviation Second Environmental Impact Statement 197 1999 EIS - NE Ops Approach and Departure Tracks 1999 EIS - SW Ops Approach and Departure Tracks</p>	Badgerys Creek 05/23					05	05 L Arrival 05 R Departure	05 L Arrival 05 L & R Departure	n/a	Mixed mode using any eastern circuit for arrivals (05R or 23L) is very difficult due proximal inter-relationship with western KSA circuit. The 23R arrival circuit may suffer limitations during IMC operations. Re-alignment to west (at least an 18/36 type) would be a better combination.	23	23 R Arrival 23 L Departure	23 R Arrival 23 L & R Departure	n/a	<p>Environmental Impact Statement, 1999, pages 22-21 to 22-22.</p> <p>Joint Study, 2012: Comparative assessment of suitable sites analysed in Phase 4, Type 1 airports, page 36</p> <p>Joint Study, 2012, Technical Paper 4: Worley Parsons, page xii</p>
Badgerys Creek 05/23																		
05	05 L Arrival 05 R Departure	05 L Arrival 05 L & R Departure	n/a	Mixed mode using any eastern circuit for arrivals (05R or 23L) is very difficult due proximal inter-relationship with western KSA circuit. The 23R arrival circuit may suffer limitations during IMC operations. Re-alignment to west (at least an 18/36 type) would be a better combination.														
23	23 R Arrival 23 L Departure	23 R Arrival 23 L & R Departure	n/a															

	at present. For example, aircraft departing runway 05 in Option A would be in conflict with aircraft departing runway 34 left at Sydney Airport and consequently, one of the departing aircraft would be required to maintain a given level while the other reached a level of 300 meters above it. The complex air traffic management procedures required to handle this would result in airborne and ground delays under peak traffic conditions, to the extent that the capacity of each airport would experience additional constraint (Environmental Impact Statement, 1999, page 22-21).			
Noise contours	ANEF Noise contours were modelled for the Badgerys Creek site as part of the 1985/86 EIS.	<p>It was estimated the following number of residents lived within each of the following ANECs:</p> <ul style="list-style-type: none"> 20 ANEC – 840 residents 25 ANEC – 380 residents 30 ANEC – 140 residents 35 ANEC – 70 residents 40 ANEC – 40 residents. <p>Further noise metrics were also analysed. (See Joint Study, 2012, Technical Paper 4: Worley Parsons, page 127).</p>	<p>Noise contour maps were not prepared as part of the Joint Study. The most recent contour map prepared for the Badgerys Creek site was in 2013. A 20 ANEF contour map for an airport on the Badgerys Creek site was prepared as part of A <i>Study on Wilton and RAAF Base Richmond for civil aviation operation</i>. It was based on 20 million passenger movements per day (280 aircraft movements), similar hours of operation as KSA in 2030. See Richmond Wilton Study, Figure 26, Page 60.</p> <p>Attachments:</p> <ul style="list-style-type: none"> 1985 ANEF for the Ultimate Airport Development 1999 EIS ANEC 2012 Richmond Wilton ANEF for Badgerys 	
Consequences for	Yet to locate Airservices	Comments from		

Long-Term Operating Plan (LTOP)/alternative noise sharing arrangements	Australia EIS comments referred to in the Joint Study (next column)	EIS remain valid and aerodrome is further constrained by Sydney parallel operations, LTOP and PRM rendering the NE/SW alignment unsuitable for integration (Airservices Australia input to Worley Parsons work, Joint Study, 2012, Technical Paper 4, Worley Parsons, page 102).		
Separation in Instrument Meteorological Conditions (IMC) for precision approaches		ASA advice indicated 23 R may suffer limitations during IMC operations. (Airservices Australia input to Worley Parsons work, Joint Study, 2012, Technical Paper 4, Worley Parsons, page 107).		
Obstacle Limitation Surface (OLS)	<ul style="list-style-type: none"> • Transgrid high-tension power lines in the south-west sector (330kV Yass-Sydney) • Bringelly Hill and radio masts at Prestons. • Blue Mountains escarpment especially to the south-west • Telstra and Defence masts off-site, East of Badgerys Creek Road (if not yet decommissioned) • Potential onsite preservation/removal of trees, especially along Badgerys Creek 	330kV power line needs re-alignment.	<p>The Department does not have detailed terrain or OLS maps for the Sydney basin. Contour maps do exist for the site, and can be provided however are considered to provide limited value for airspace management concept development. The best source for topographic maps will be the NSW Government. The Department can assist with sourcing these maps if required.</p> <p>OLS maps in the 1996 report have limited detail and given time which has passed since development are likely to have limited value. A copy of this map has been attached for information.</p> <p>Earlier work looking at OLS considered the location of Telstra mobile phone towers in 1996. However, given the expansion of mobile phone usage and establishment of new carriers into the market, more towers are likely to be in the area included from other operators. A map of all mobile phone towers can be found at the Australian Geographical RadioFrequency Map at Spench.net.</p> <p>An initial review of this information has identified several towers around the site, one on Elizabeth Drive, two to the west and several to the north east and south east.</p>	<p>Planning and Design Summary Report – Second Sydney Airport Project (Dec 1997 - Airplan/Connel I Wagner/O'Brien-Krietzberg</p> <p>Joint Study, 2012: Comparative assessment of suitable sites</p>

				analysed in Phase 4, Type 1 airports, page 37.
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Appendix B

1991 Badgerys Creek Concept Design Report Vol 1.

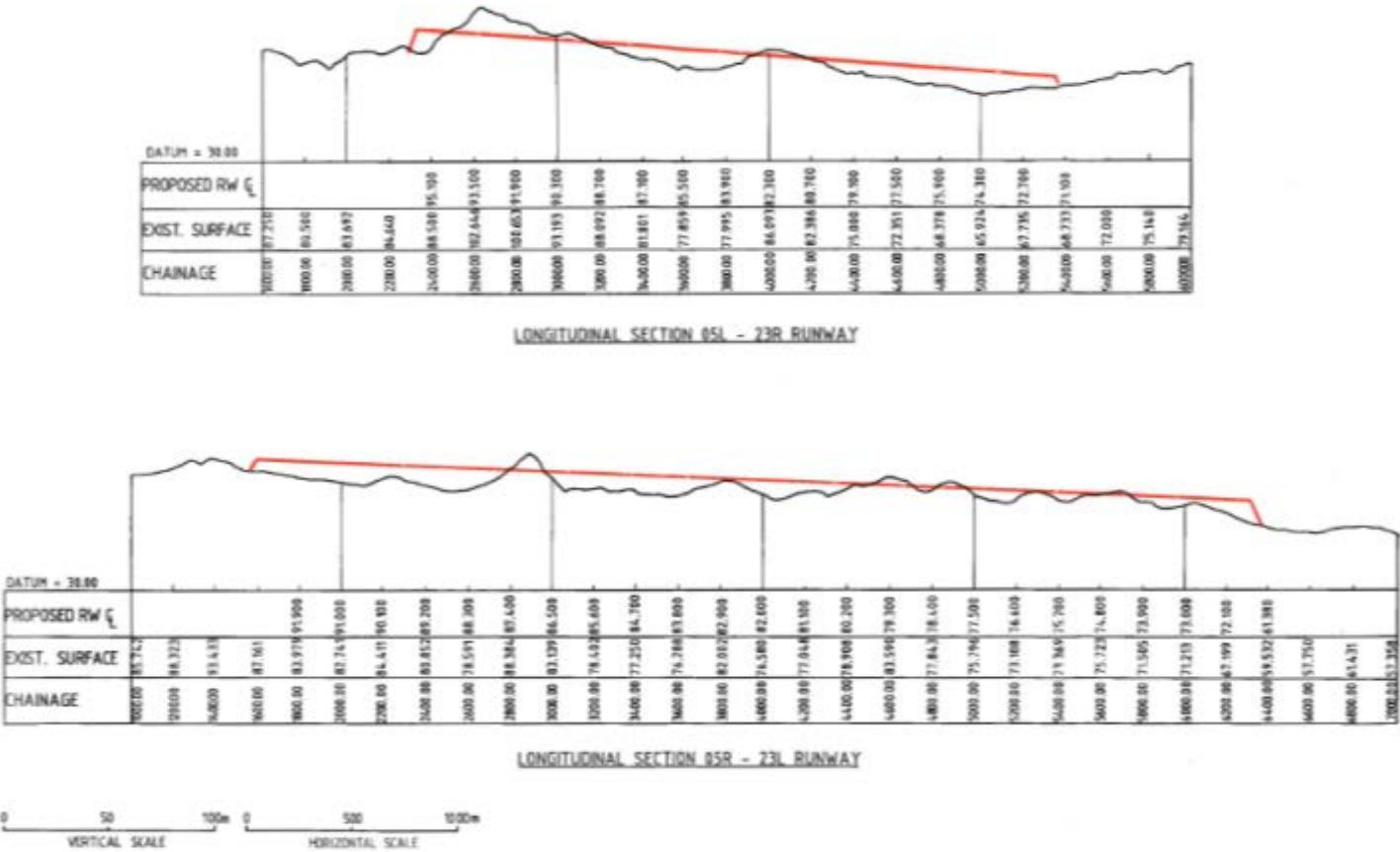
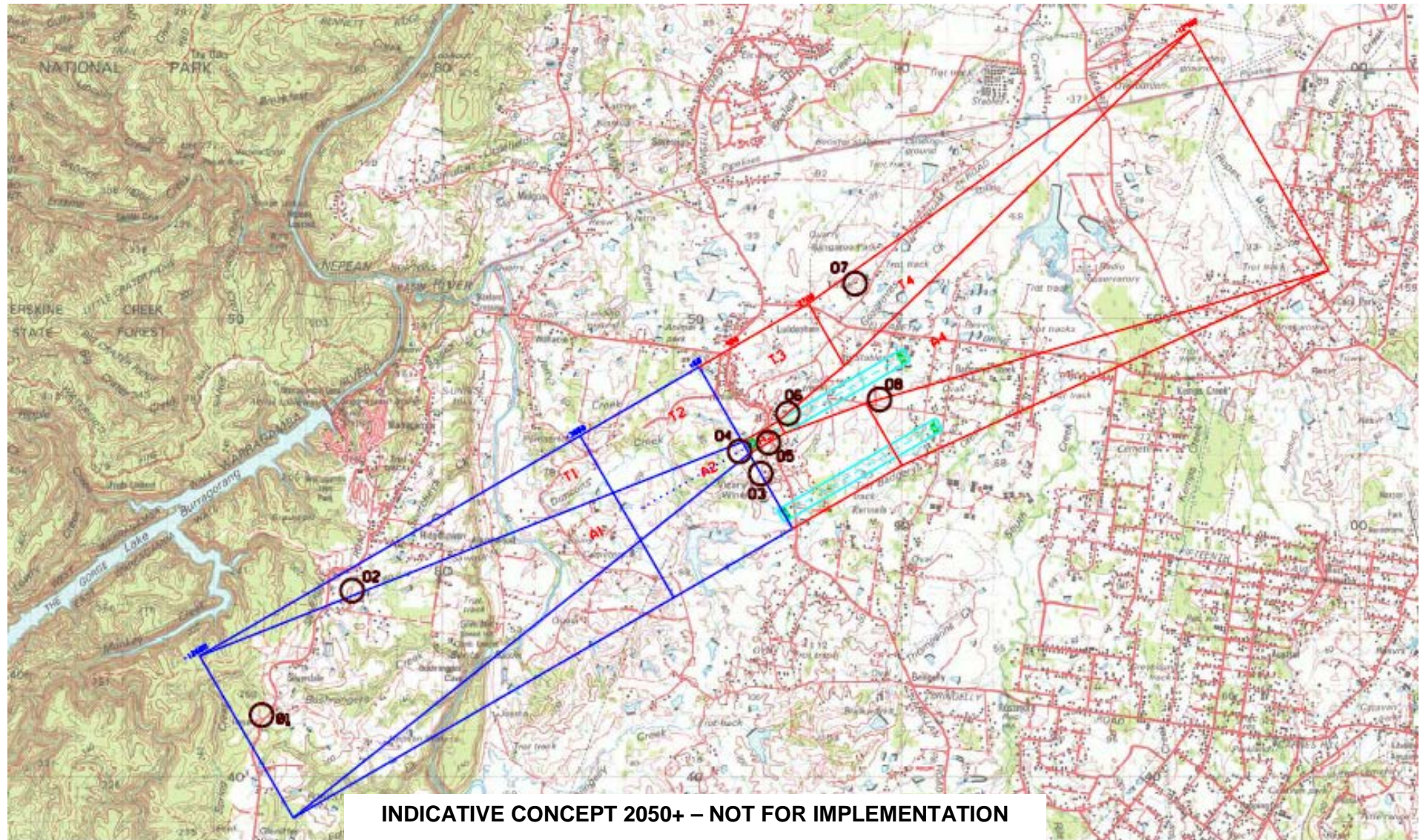


Figure 6.8
MASTER PLAN
LONGITUDINAL SECTIONS
BADGERYS CREEK

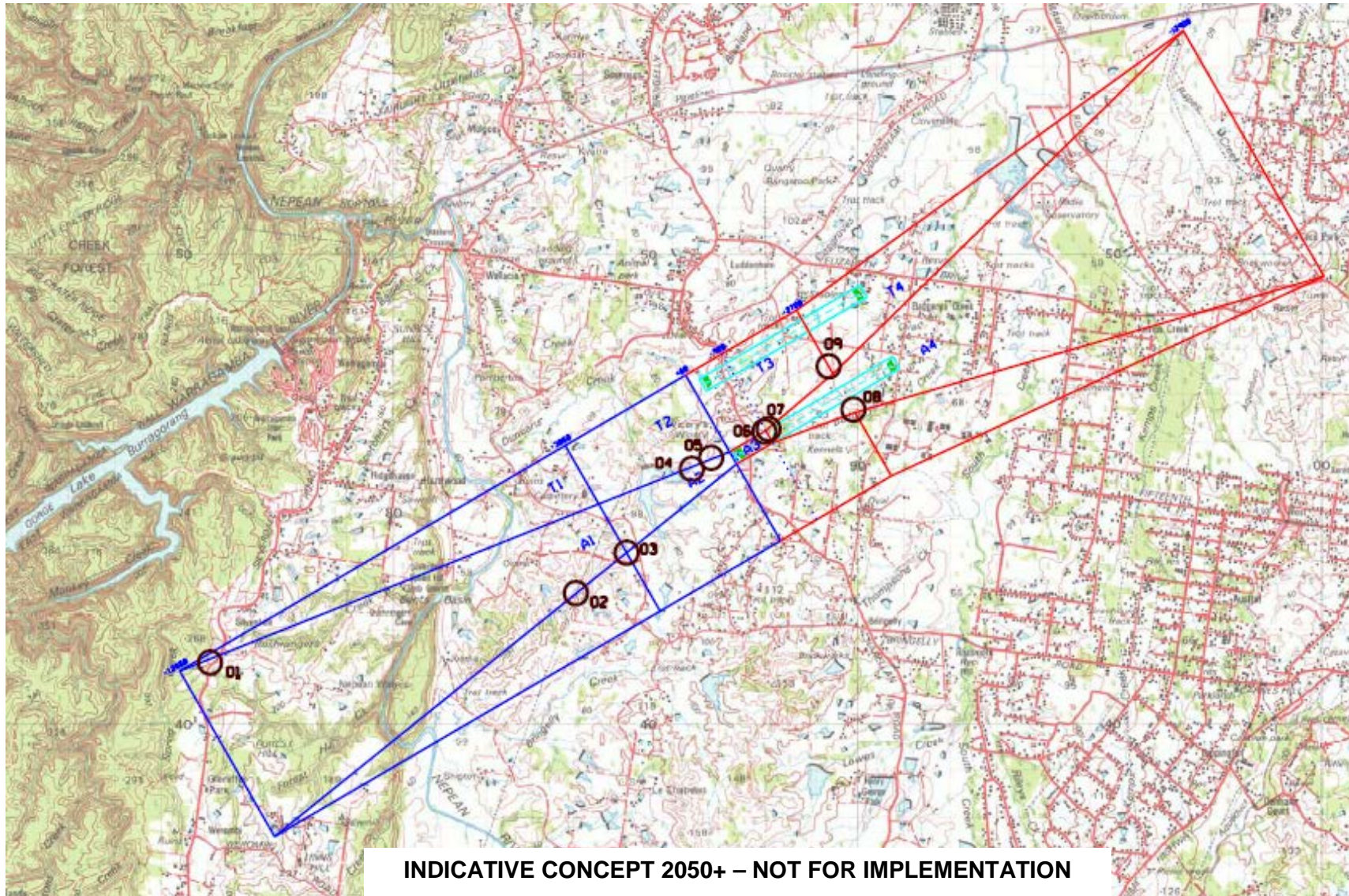
Appendix C

Basic ILS RWY 05L



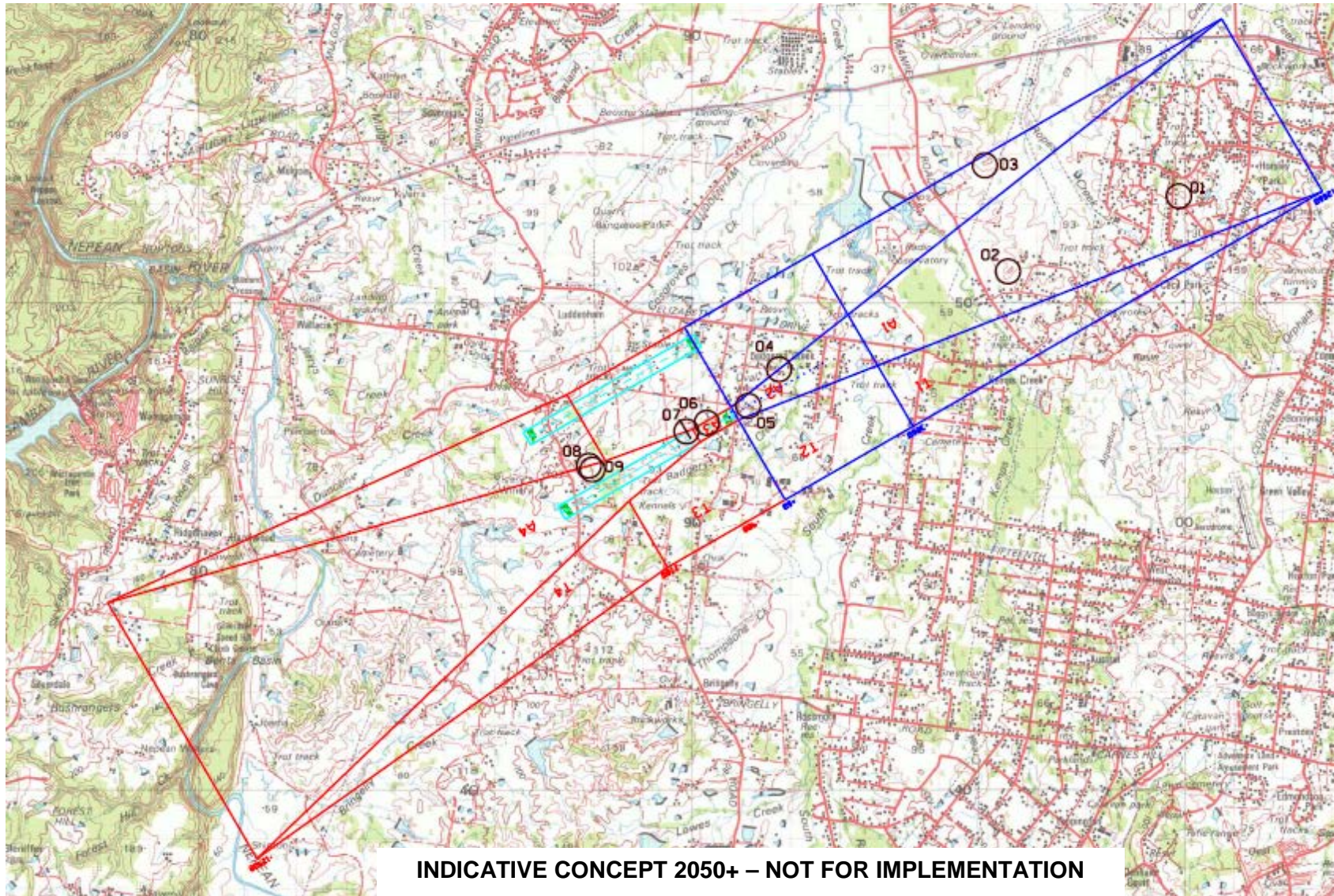
Appendix D

Basic ILS RWY 05R



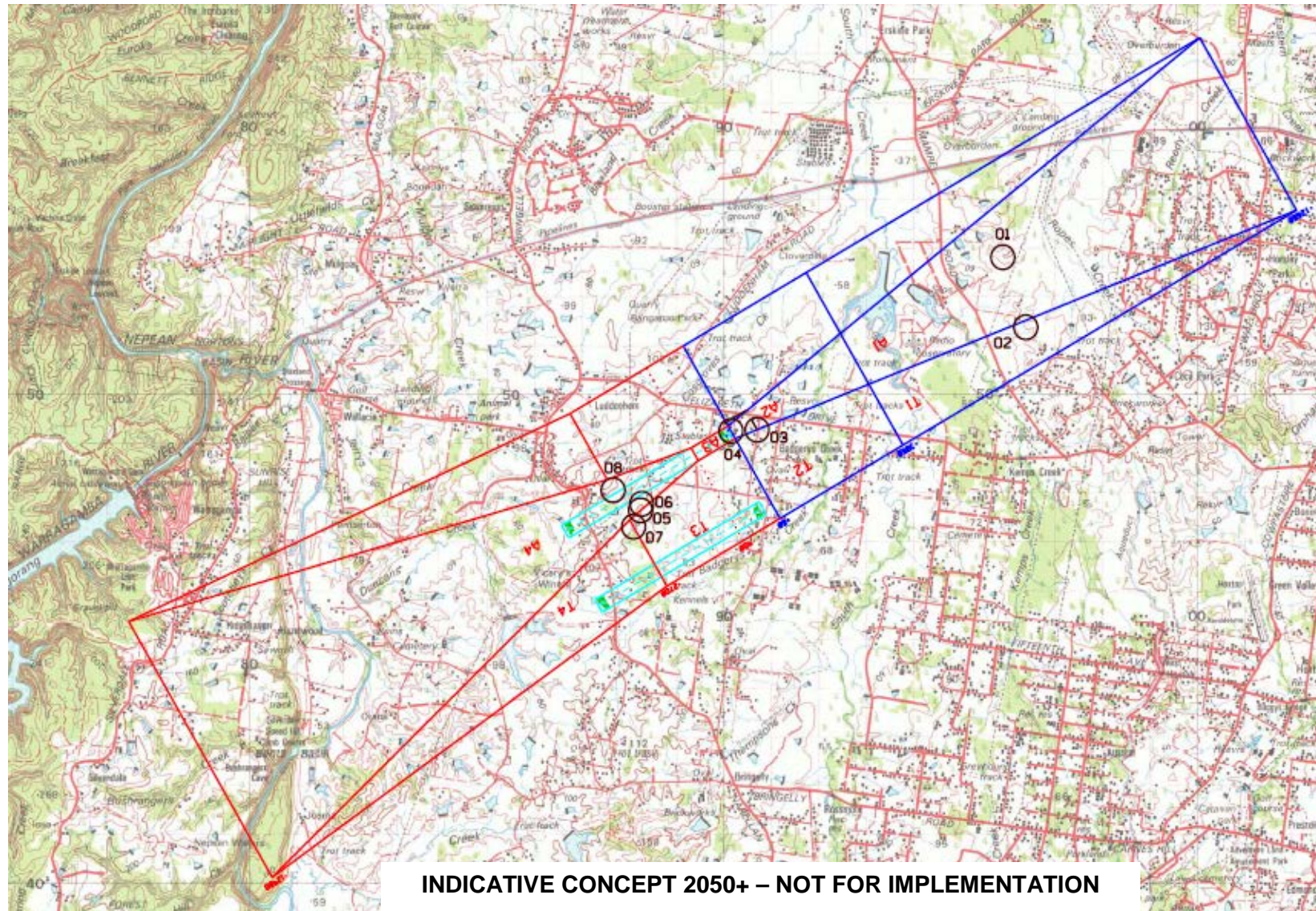
Appendix E

Basic ILS RWY 23L



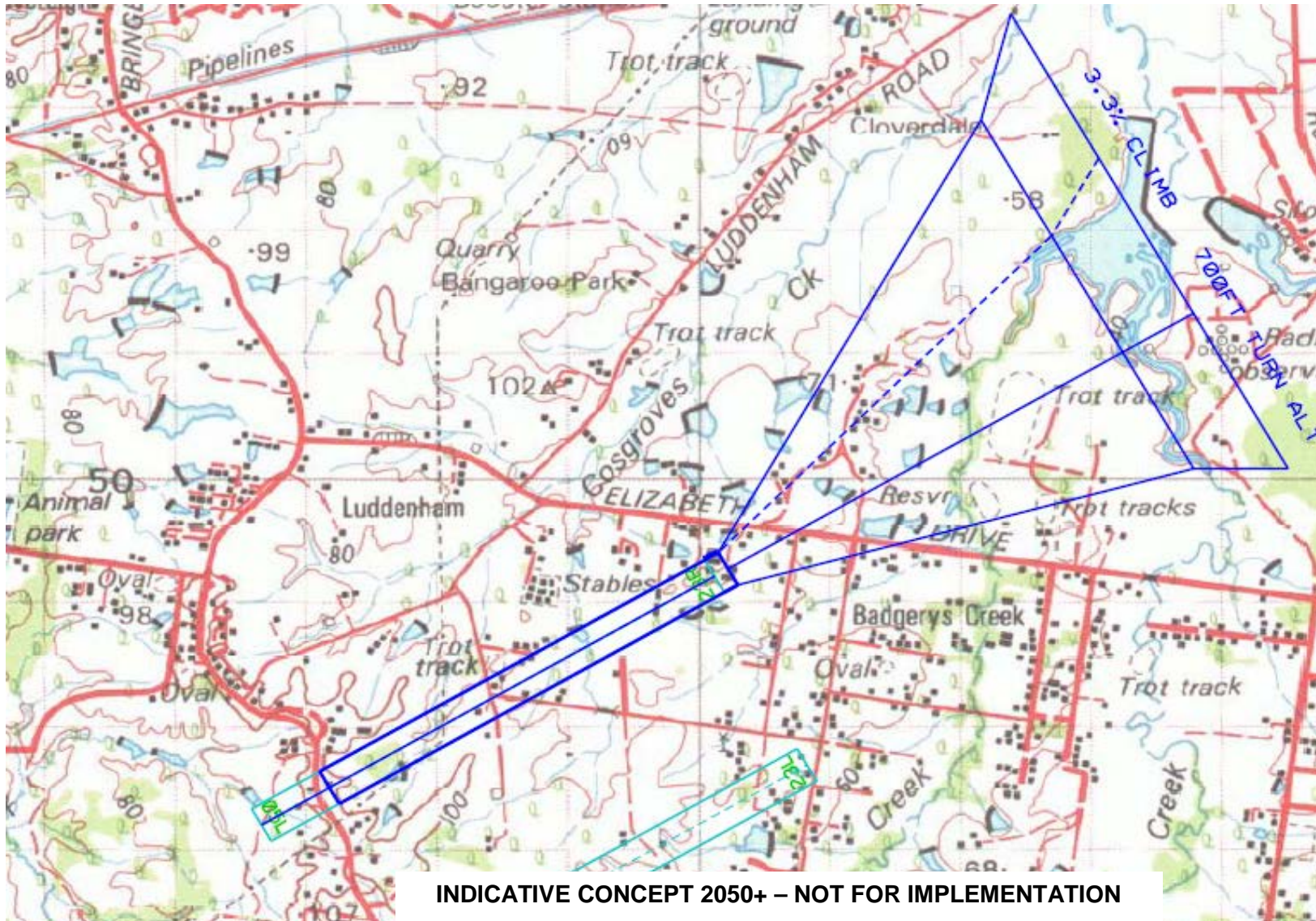
Appendix F

Basic ILS RWY 23R



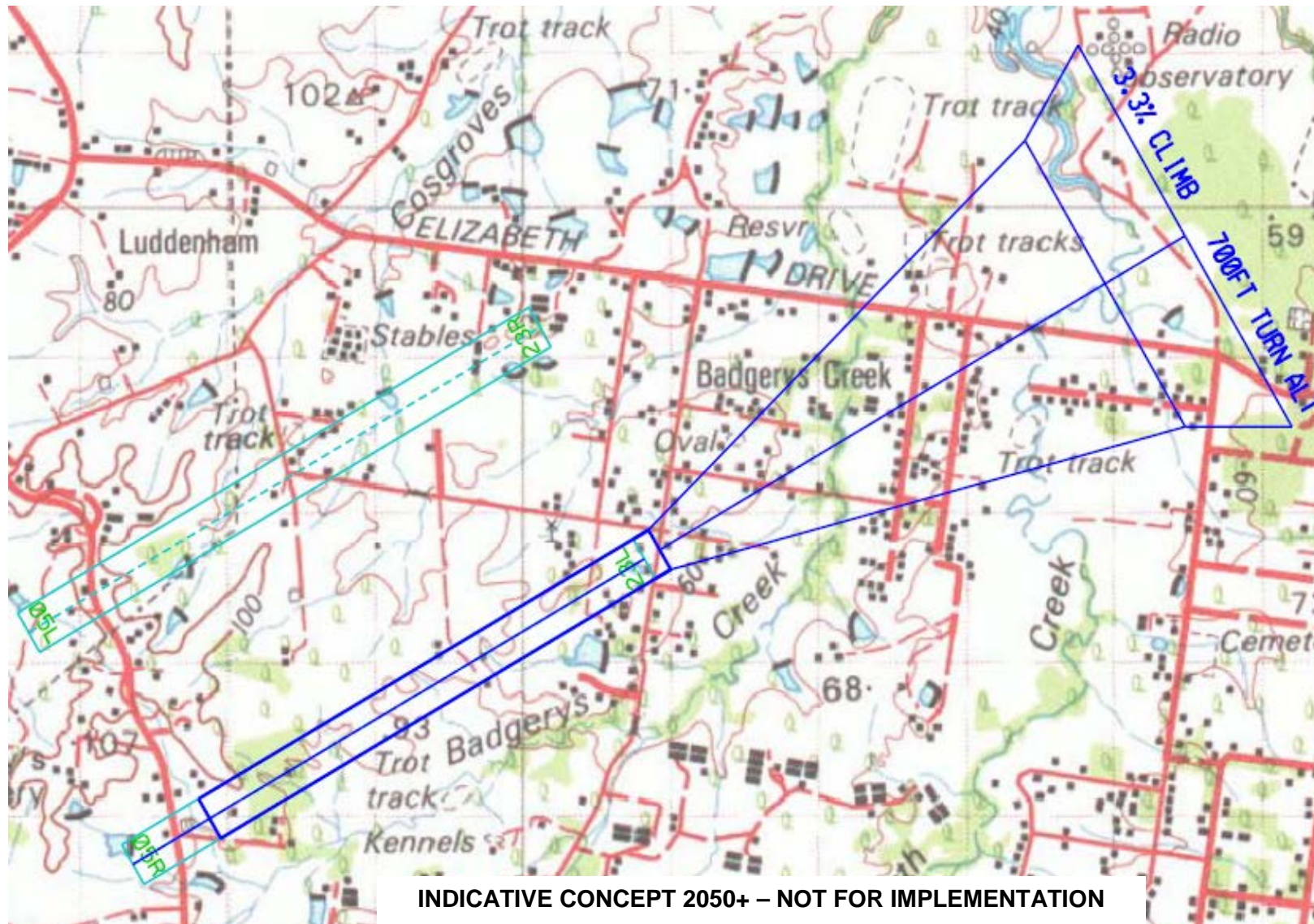
Appendix G

Departure RWY 05L



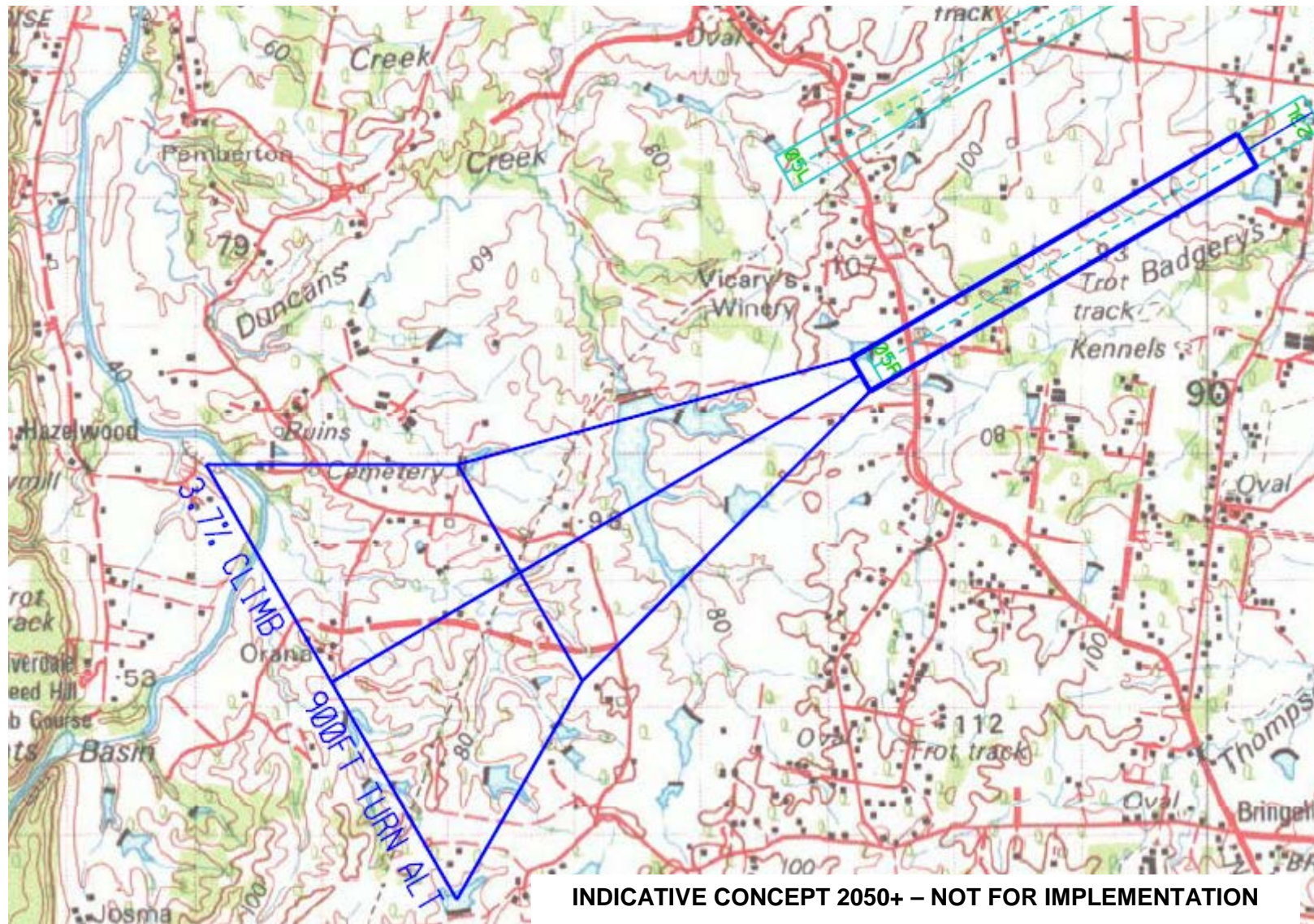
Appendix H

Departure RWY 05R



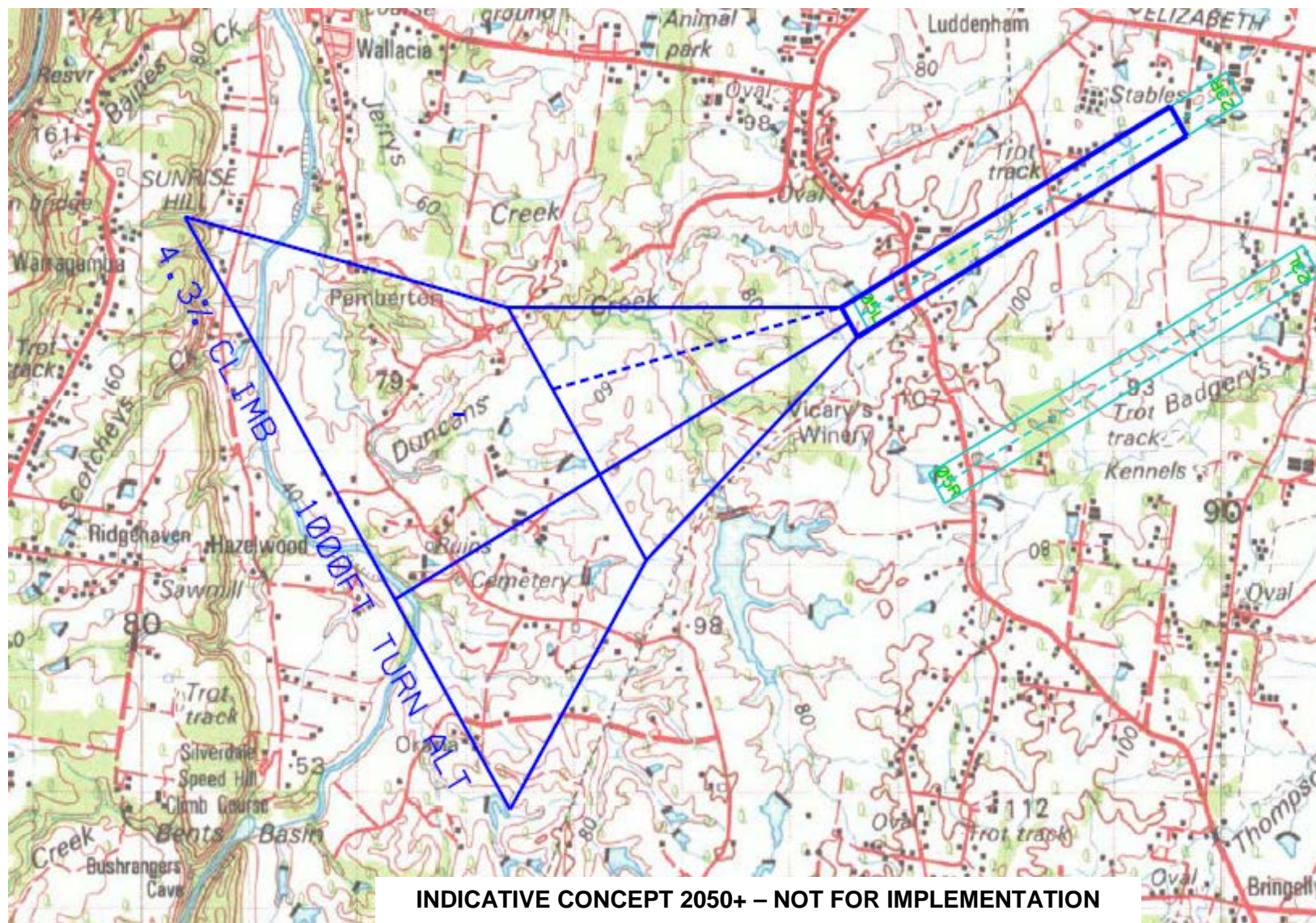
Appendix I

Departure RWY 23L



Appendix J

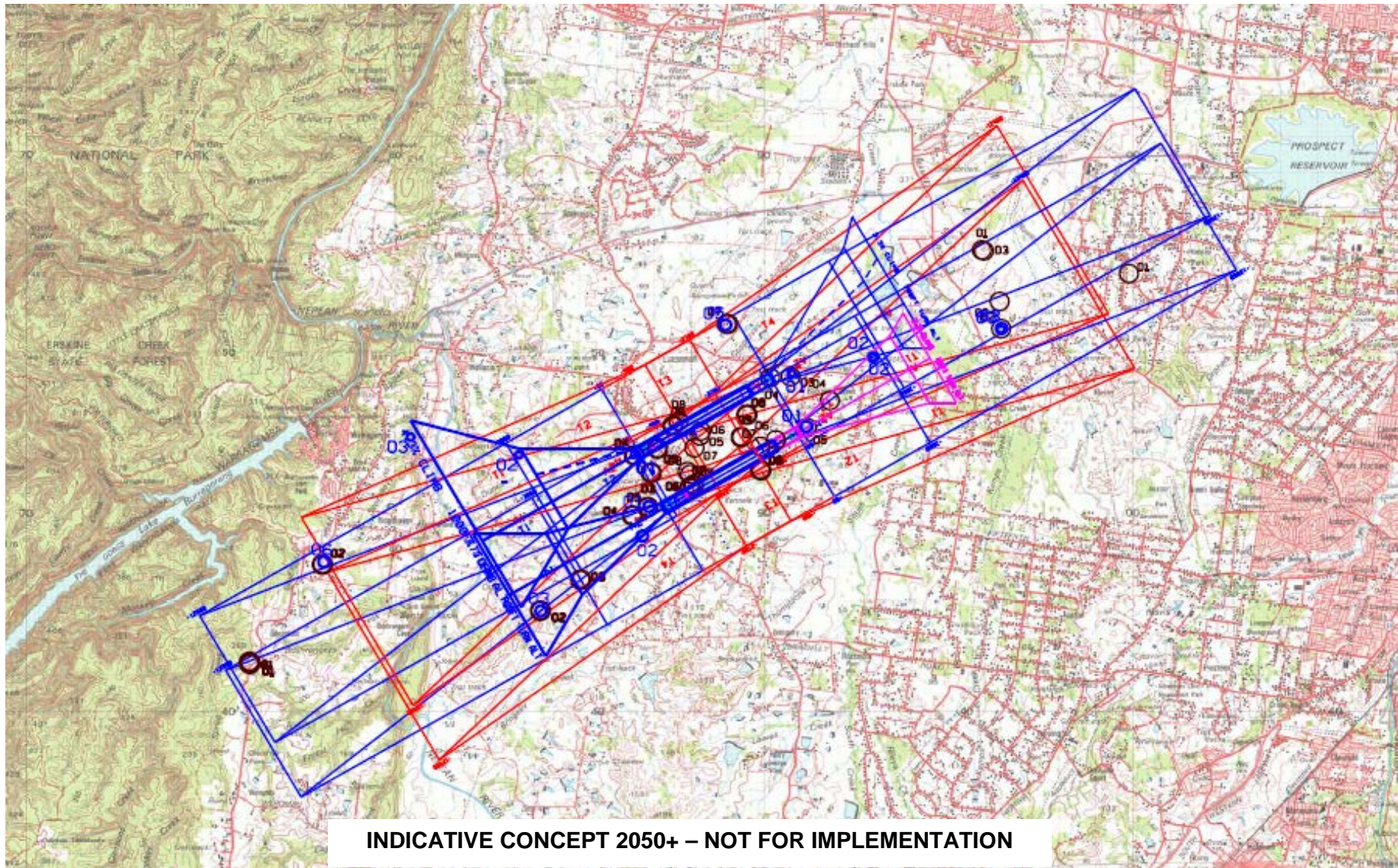
Departure RWY 23R

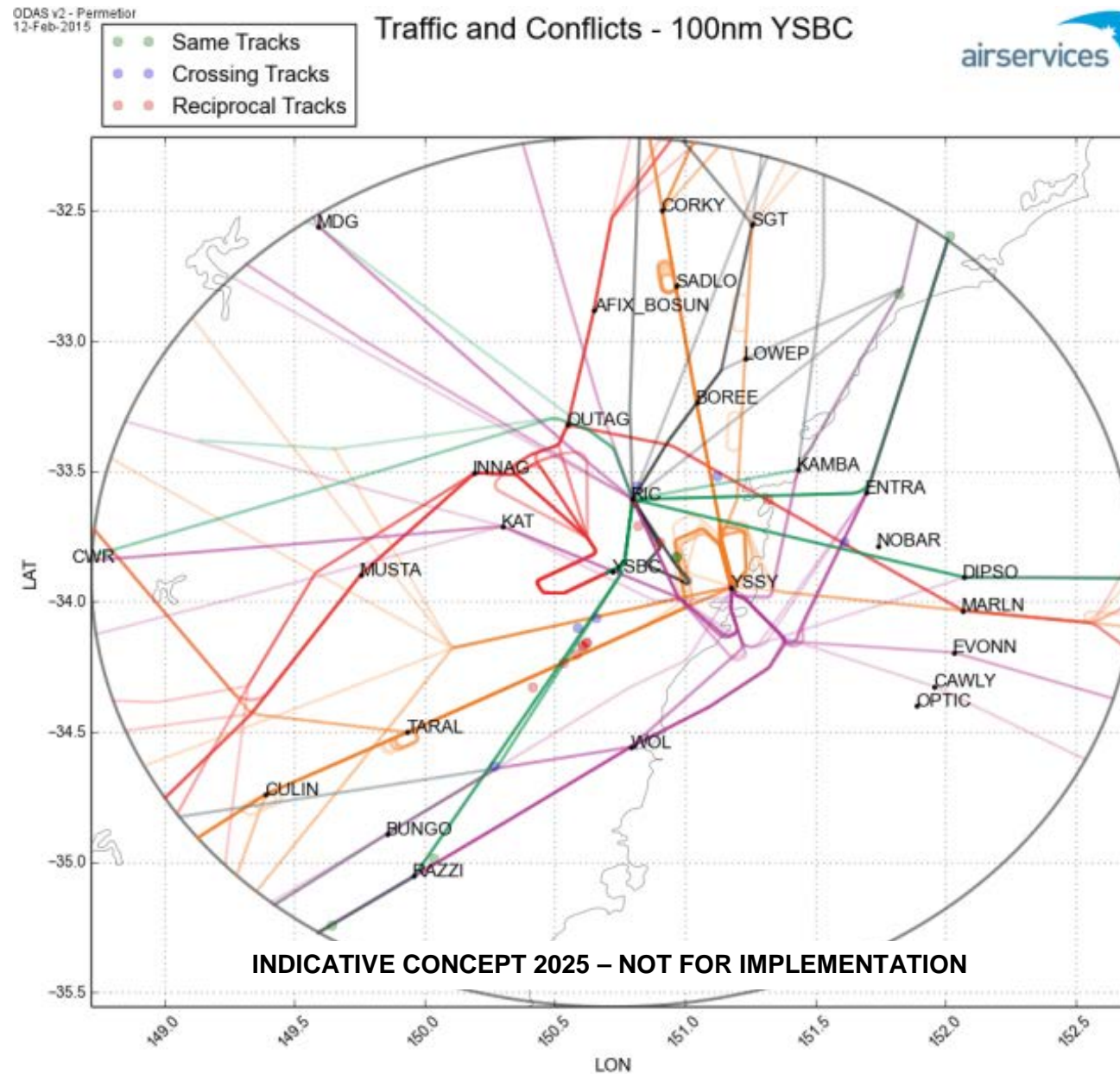


INDICATIVE CONCEPT 2050+ – NOT FOR IMPLEMENTATION

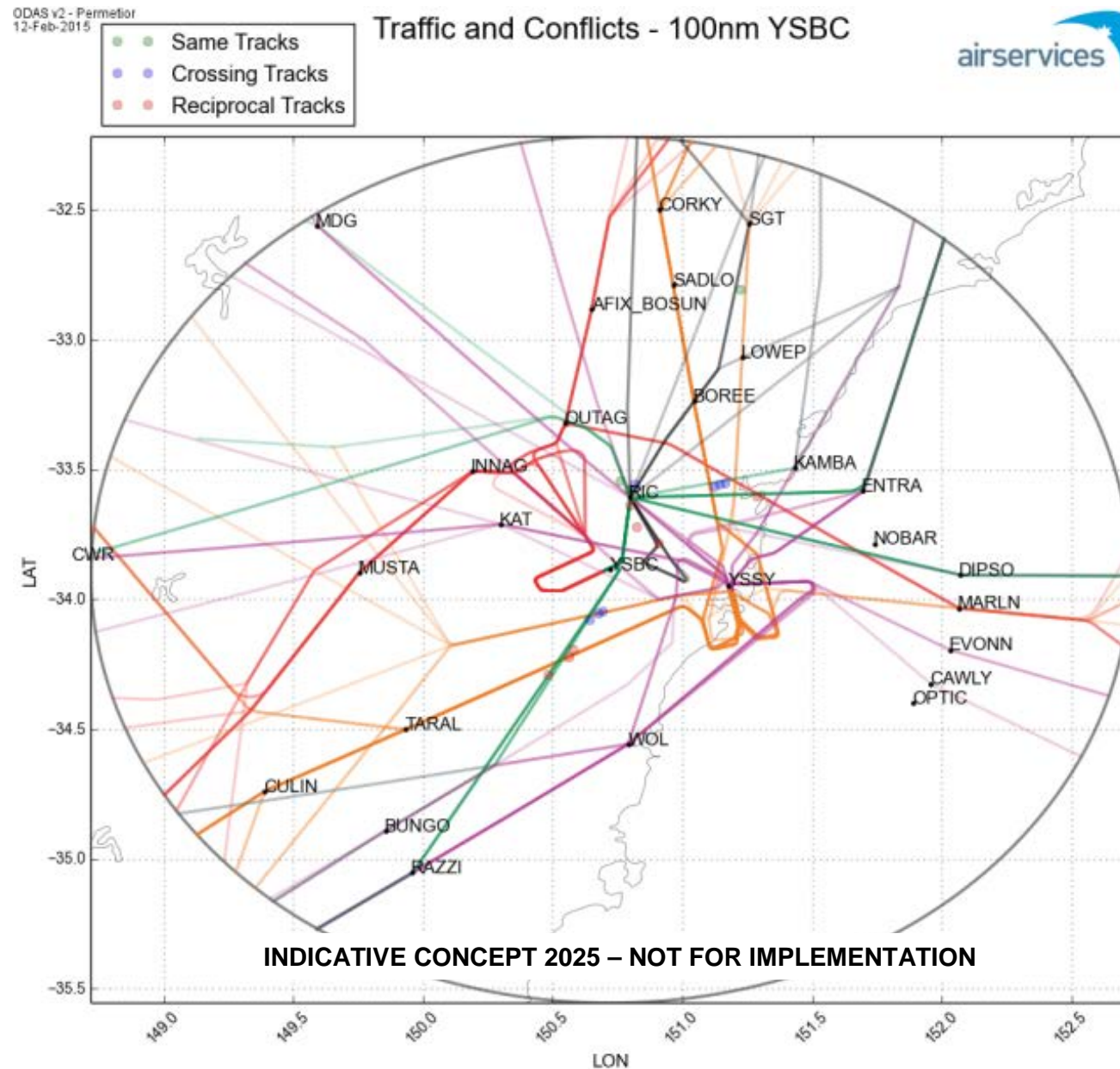
Appendix K

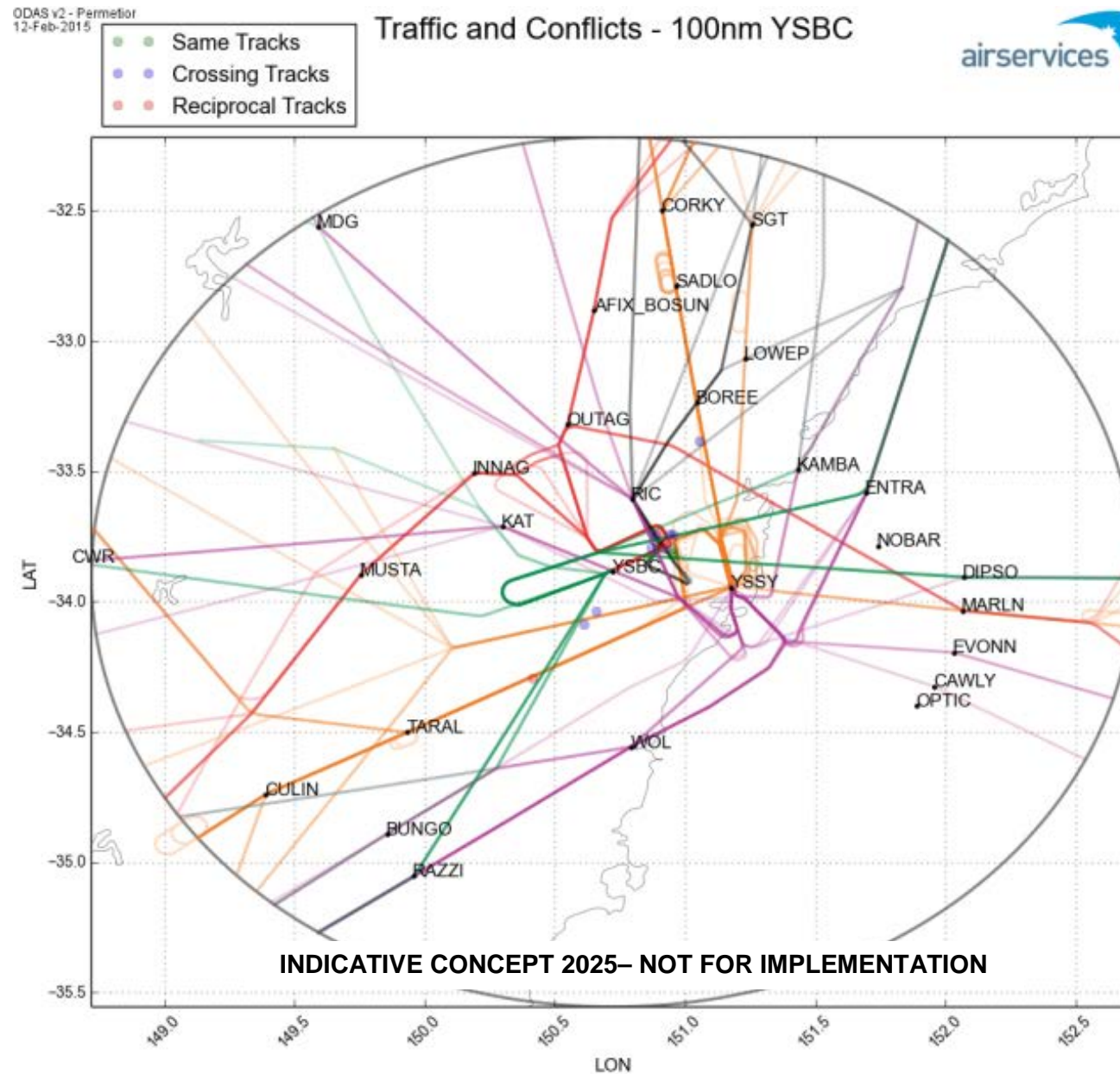
All Basic & Departure Surfaces



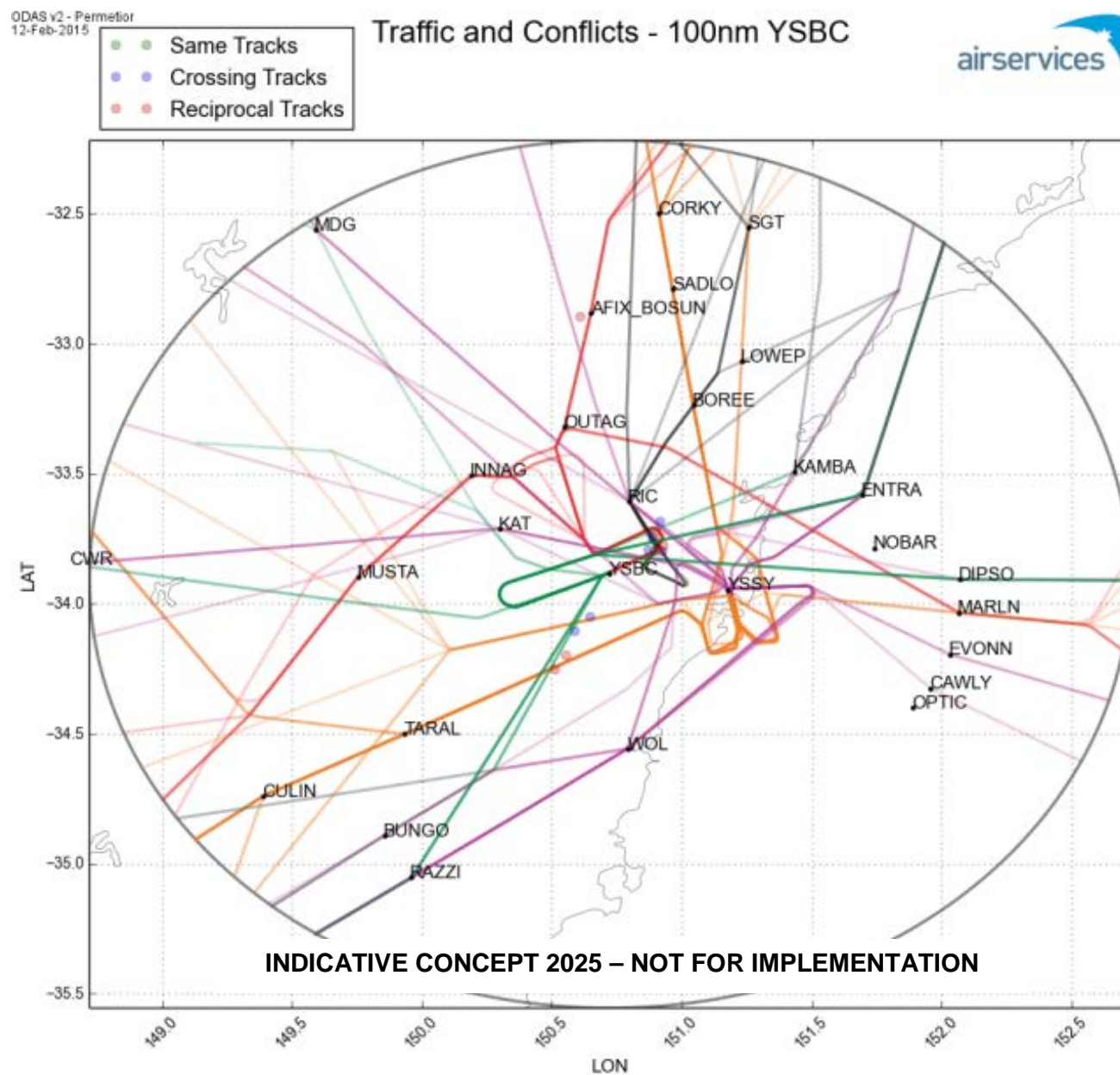
Appendix L – Model 1 Constraint Points WSA RWY05/KSA RWY16/BK RWY11

Appendix M – Model 1 Constraint Points WSA RWY05/KSA RWY34/BK RWY11

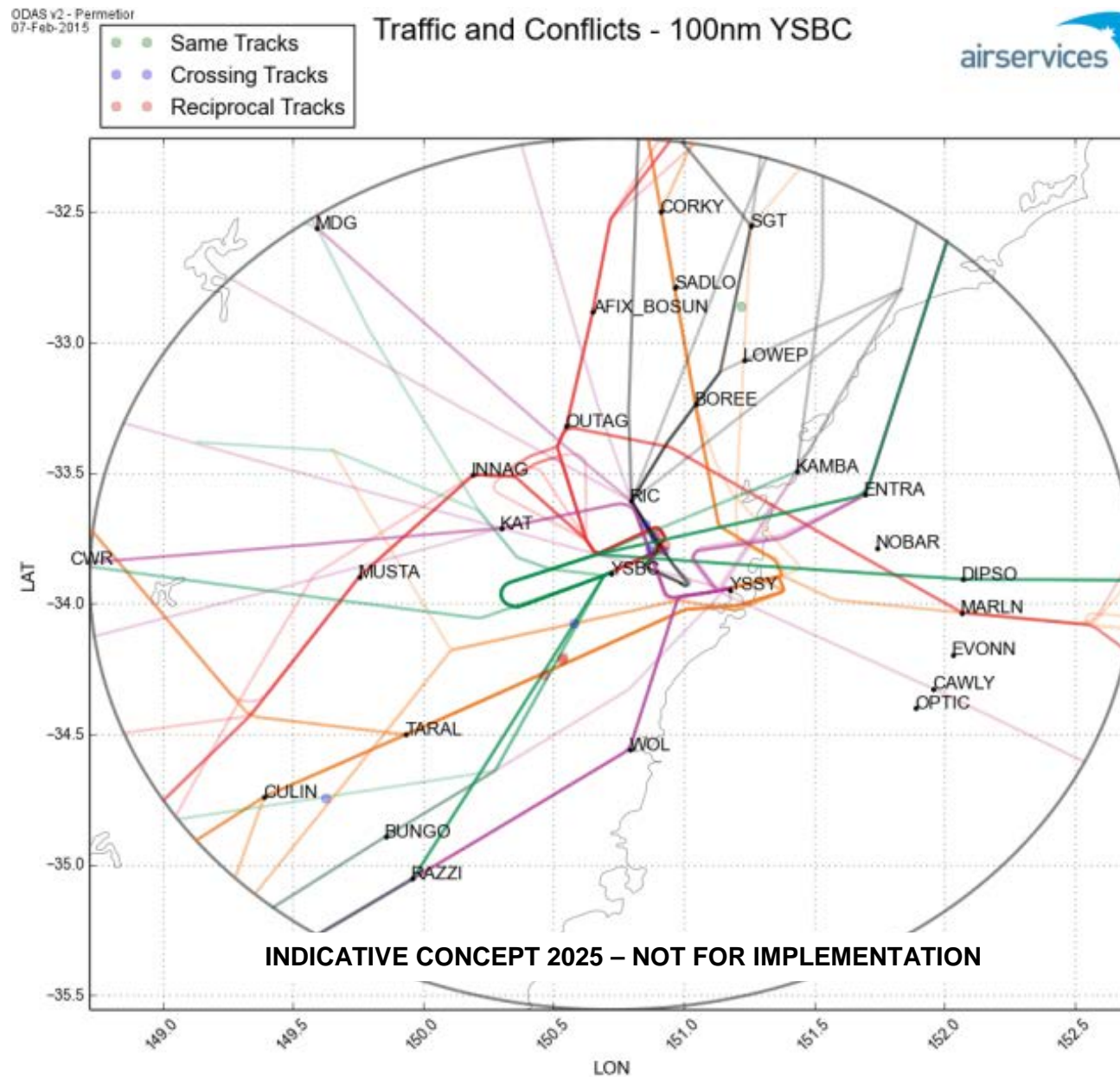


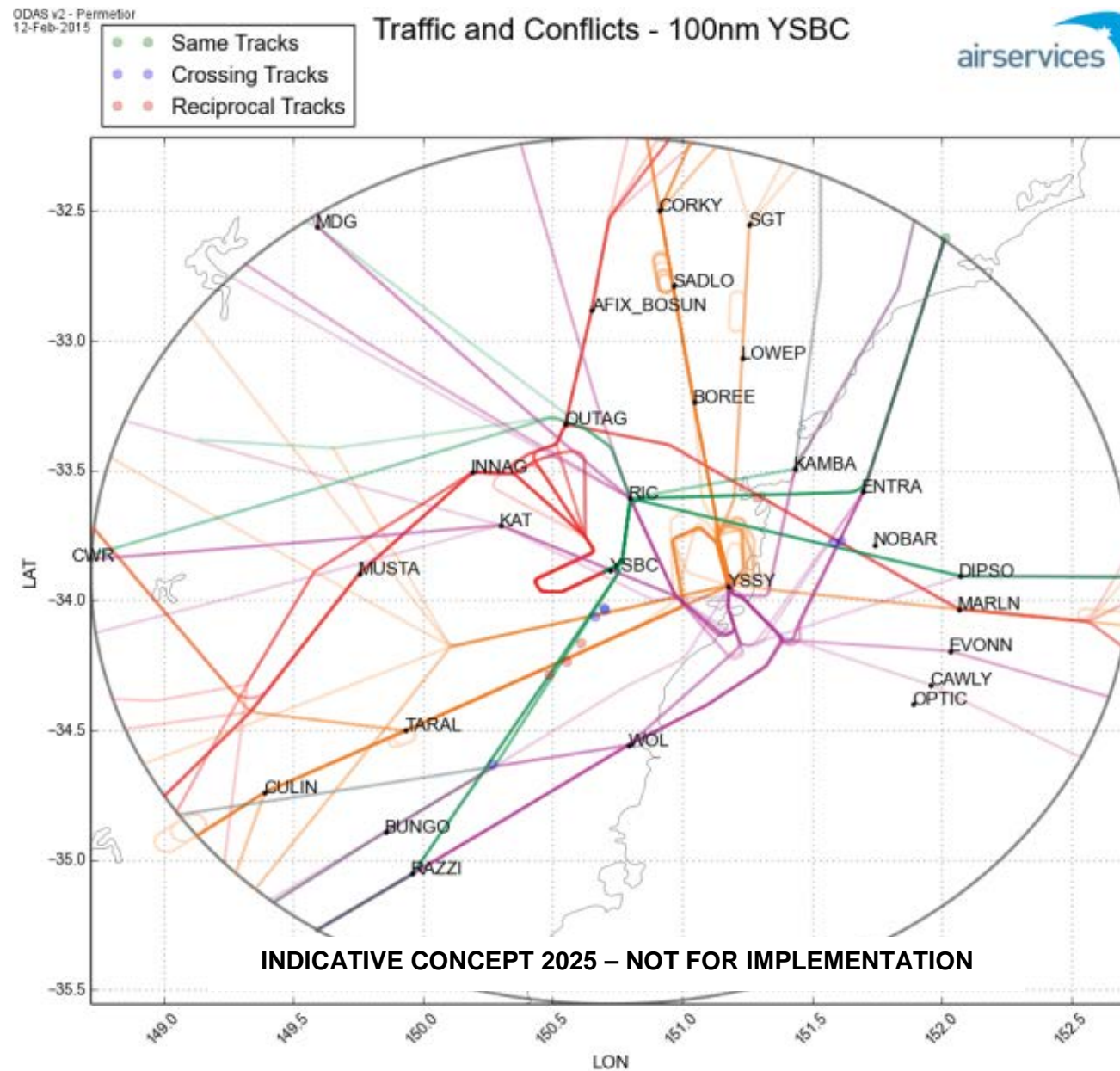
Appendix N - Model 1 Constraint Points WSA RWY23/KSA RWY16/BK RWY11

Appendix O - Model 1 Constraint Points WSA RWY23/KSA RWY34/BK RWY11

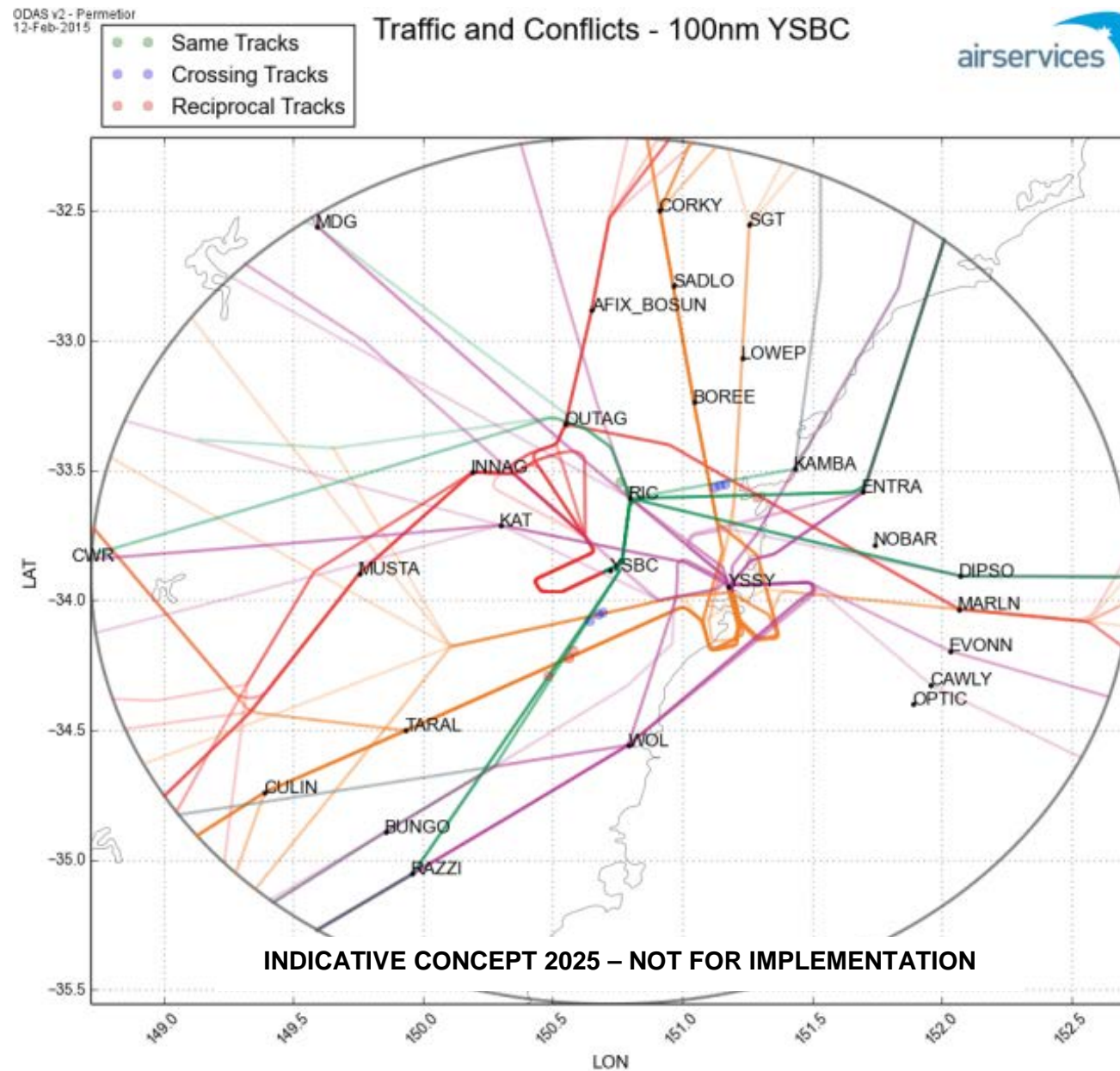


Appendix P - Model 1 Constraint Points WSA RWY23/KSA RWY25/BK RWY11

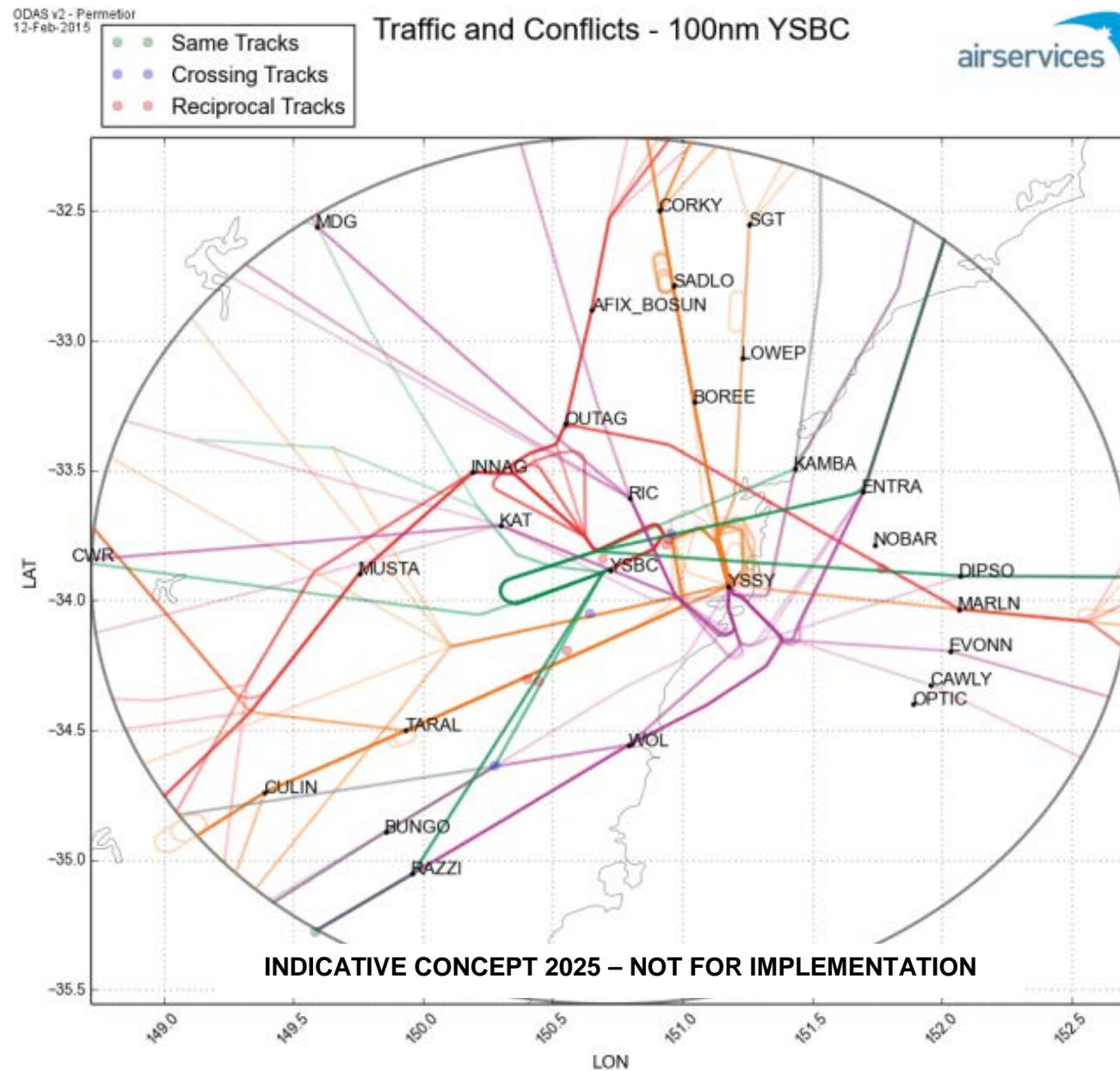


Appendix Q – Model 2 WSA RWY05/KSA RWY16

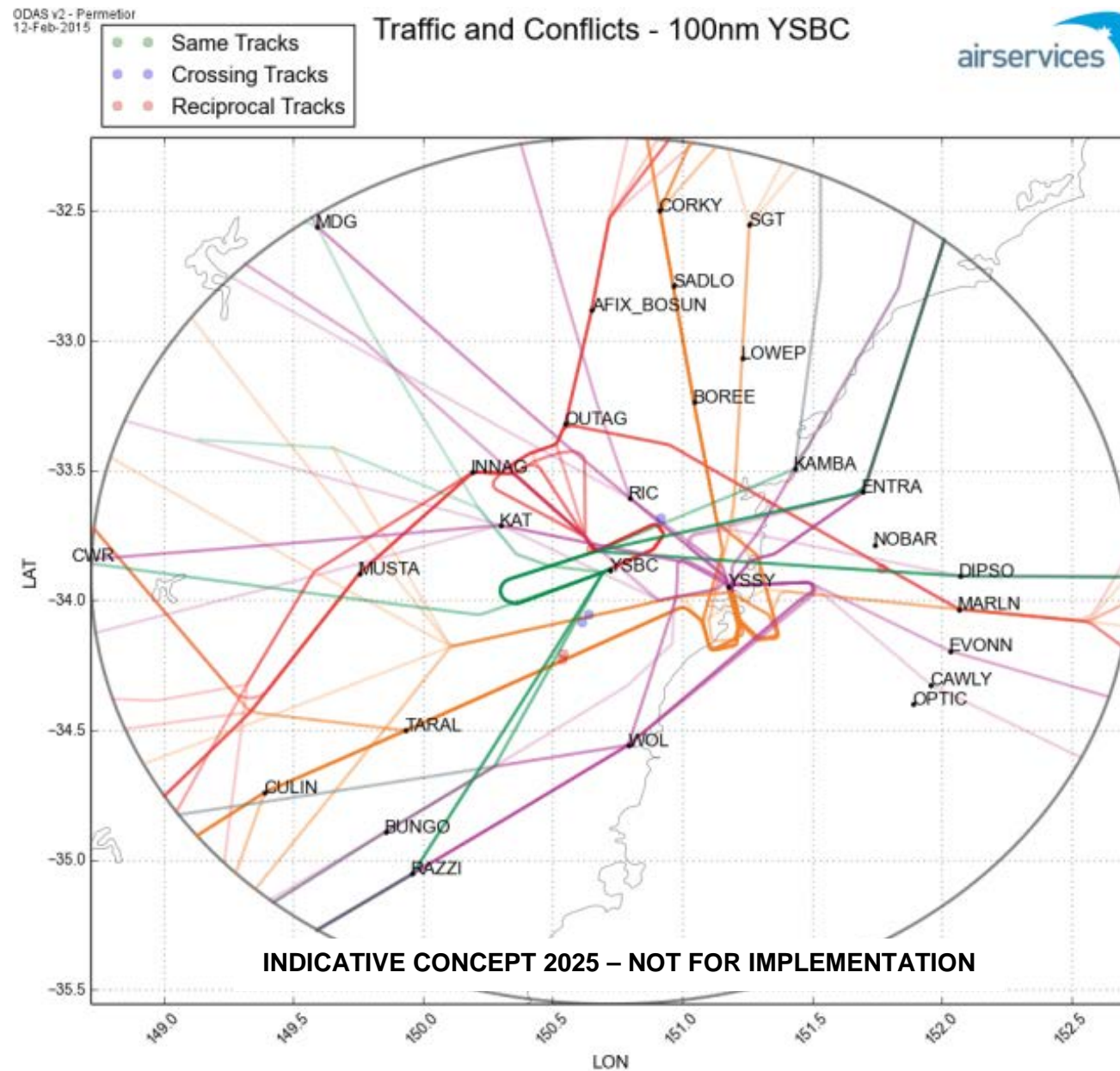
Appendix R - Model 2 WSA RWY05/KSA RWY34



Appendix S - Model 2 WSA RWY23/KSA RWY16



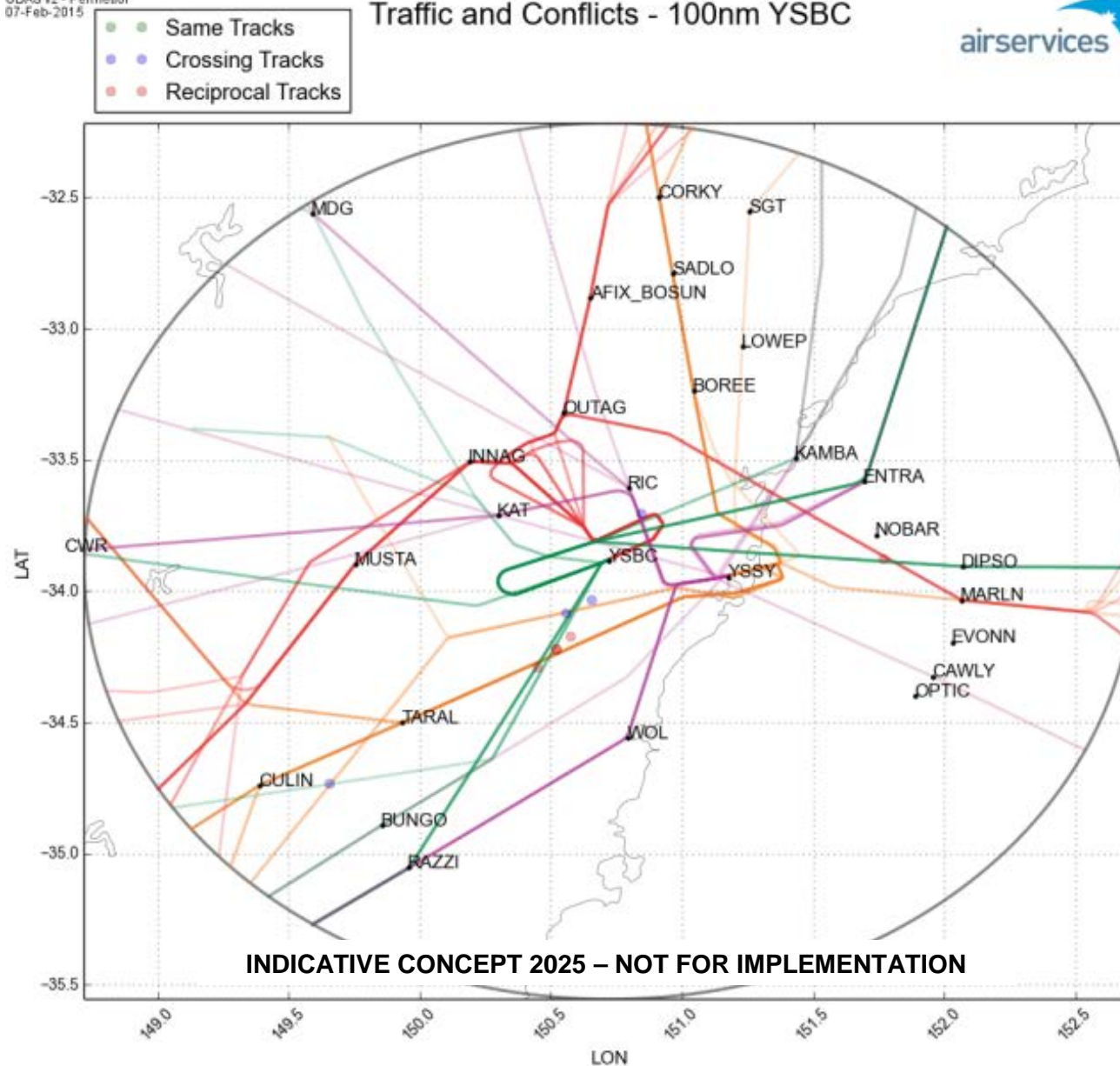
Appendix T - Model 2 WSA RWY23/KSA RWY34



Appendix U - Model 2 WSA RWY23/KSA RWY25

ODAS v2 - Permetior
07-Feb-2015

Traffic and Conflicts - 100nm YSBC

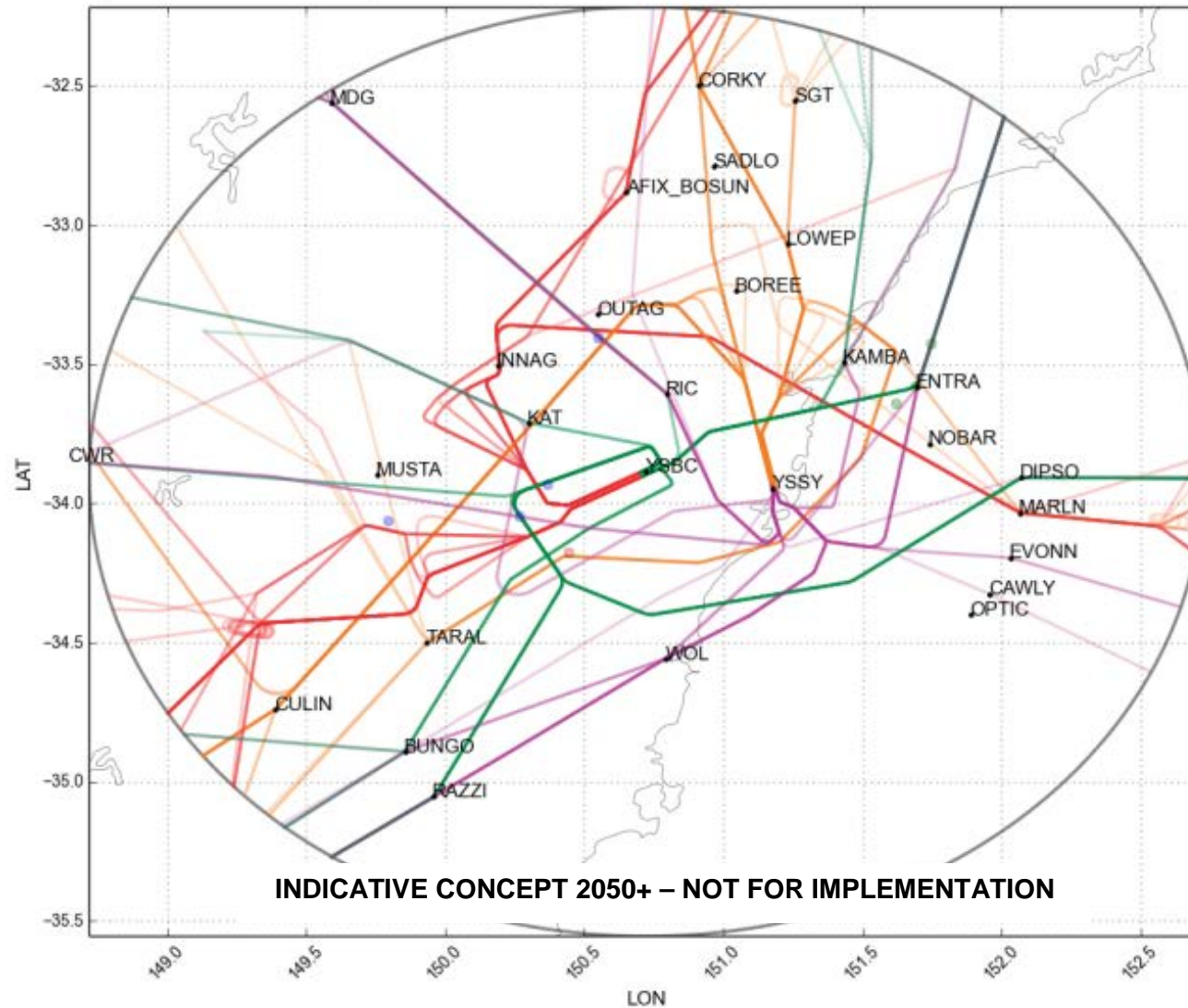


Appendix V - Model 3 WSA RWY05R/KSA RWY16R

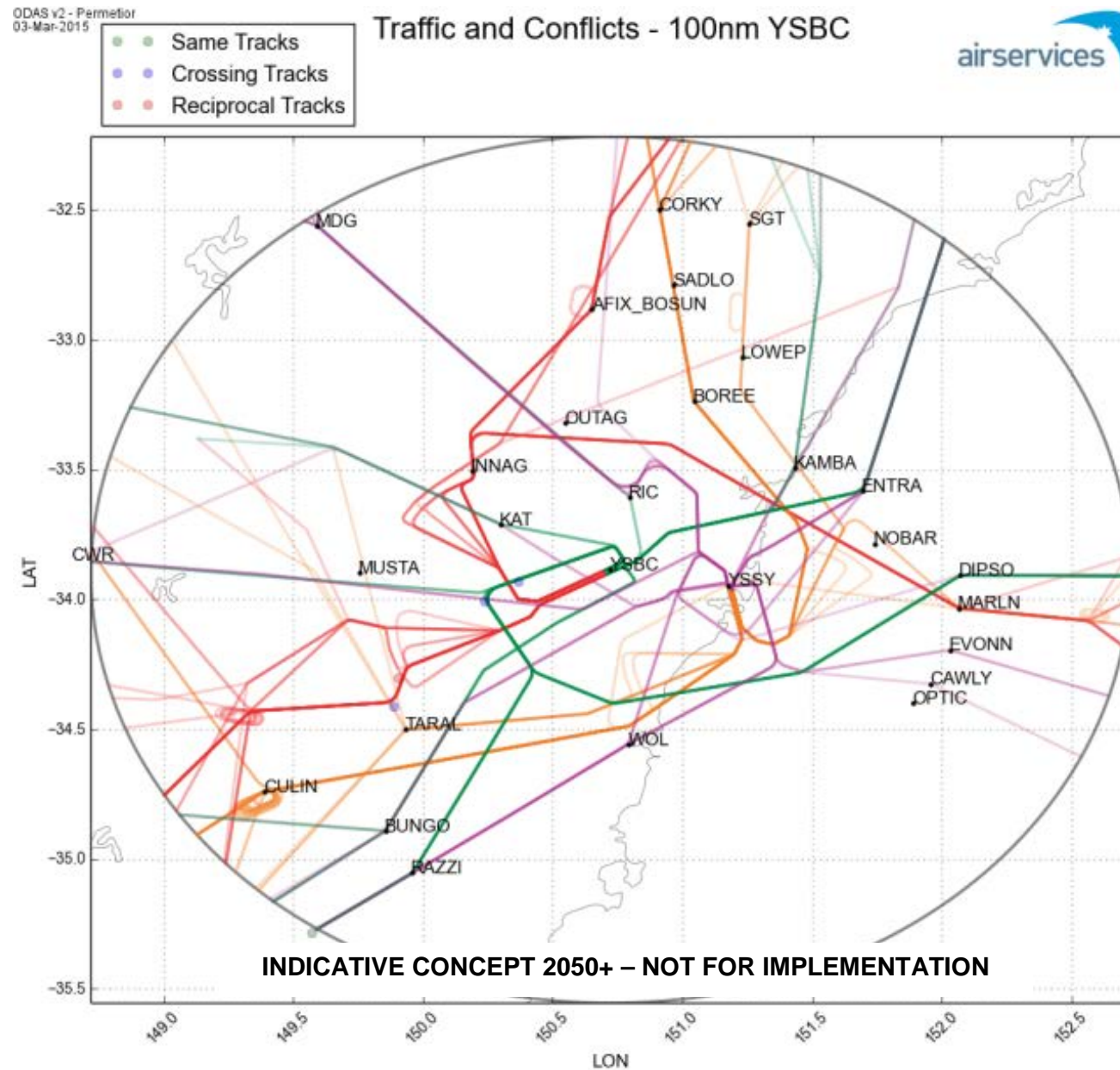
ODAS v2 - Permetior
03-Mar-2015

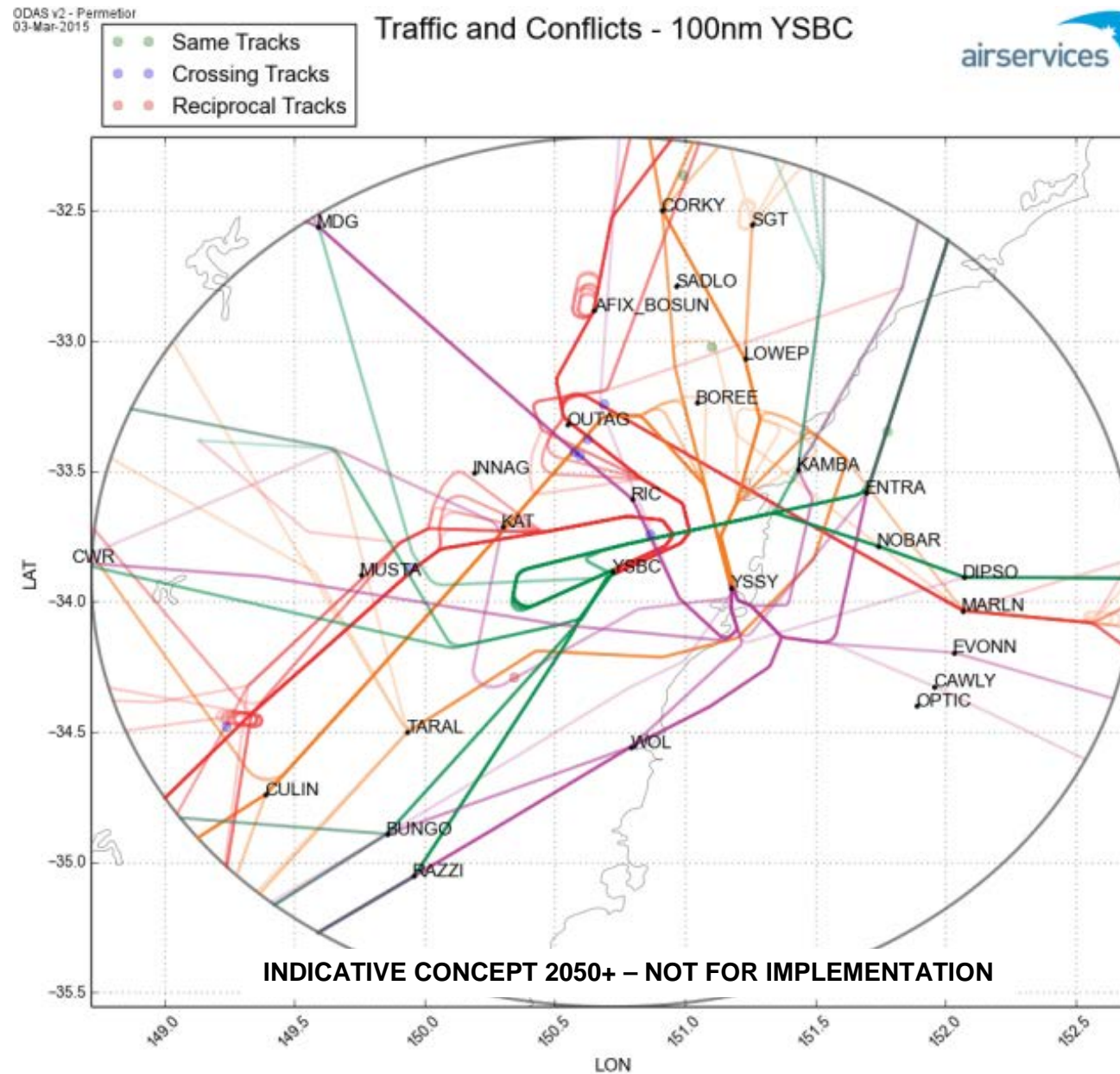
- Same Tracks
- Crossing Tracks
- Reciprocal Tracks

Traffic and Conflicts - 100nm YSBC



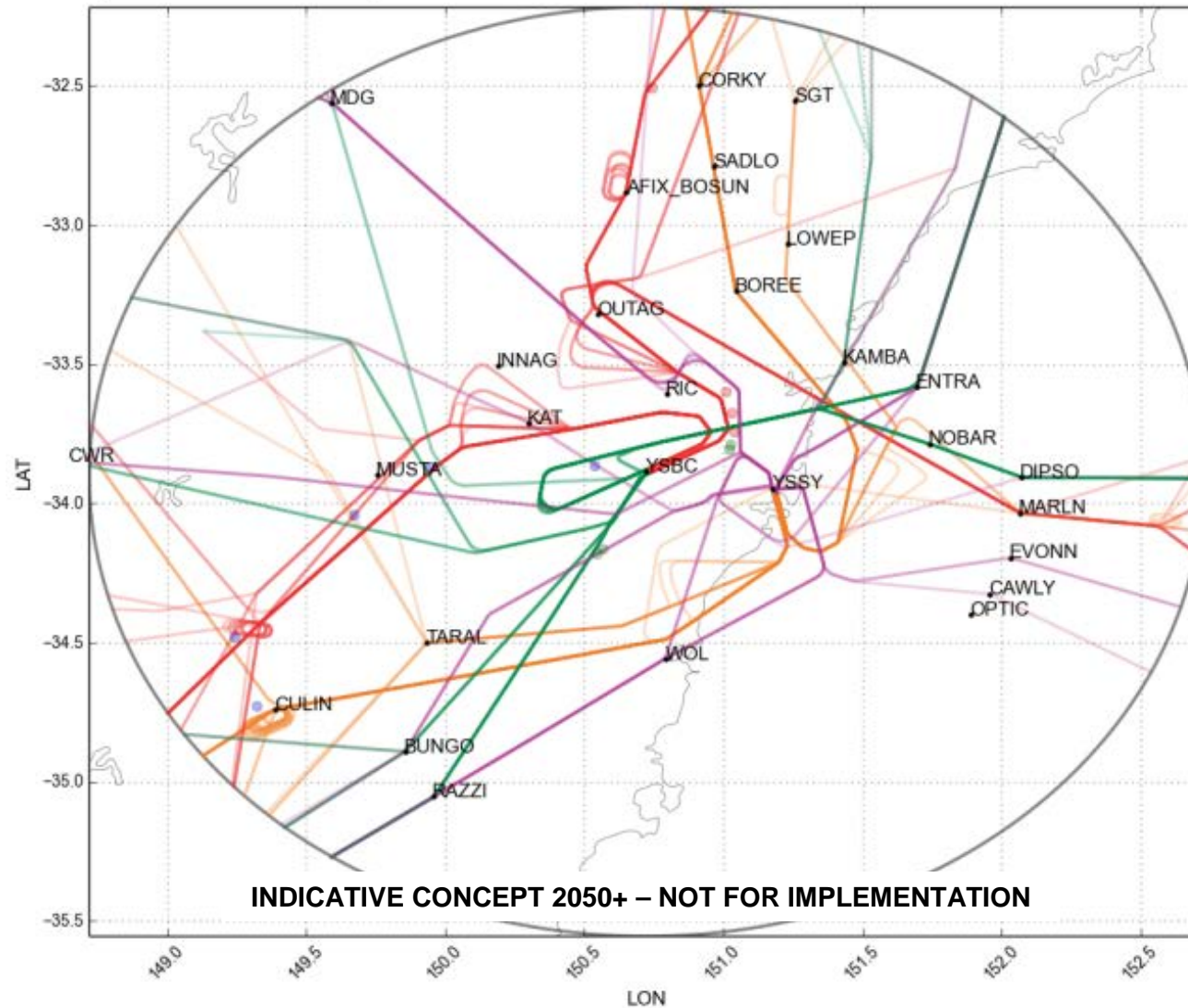
Appendix W - Model 3 WSA RWY05R/KSA RWY34R

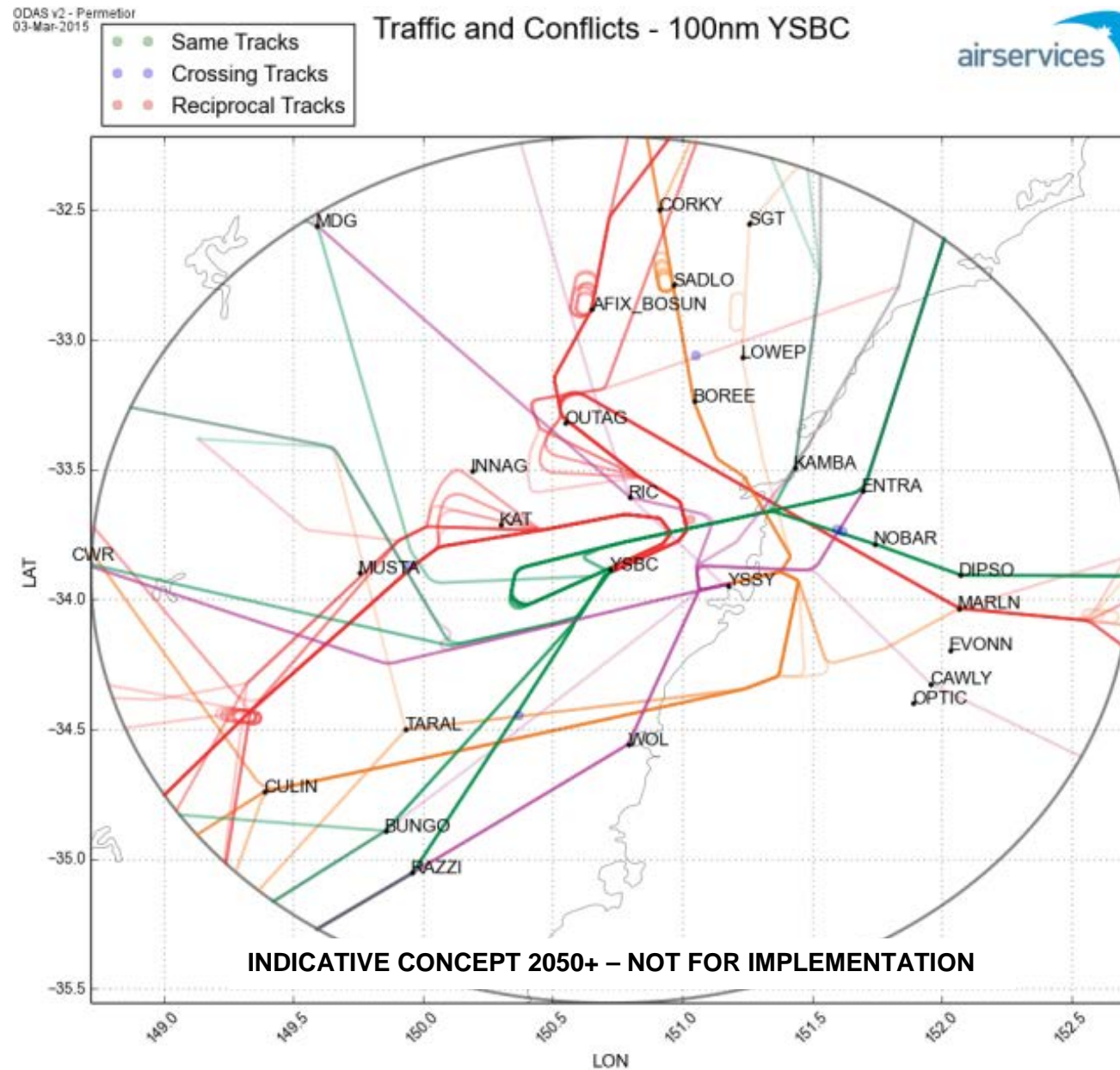


Appendix X - Model 3 WSA RWY23R/KSA RWY16R

Appendix Y - Model 3 WSA RWY23R/KSA RWY34RODAS v2 - Permetior
03-Mar-2015

- Same Tracks
- Crossing Tracks
- Reciprocal Tracks

Traffic and Conflicts - 100nm YSBC

Appendix Z - Model 3 WSA RWY23R/KSA RWY25R

Appendix AA – KSA Traffic Profile (parallel runways in use) 40 arrival and 40 departures for Models 1-3.

	Departures										Arrivals				
	CAWLEY	CORDO	DIPSO	ENTRA	EVONN	KATOOMB A	KAMBA	RICMON D	SOFA L	WOLLONGON G	BORE E	CALAG A	MARL N	ODAL E	RIVE T
A320	1	0	0	2	1	1	0	1	0	2	3	0	1	0	3
A321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A330	0	0	0	0	0	1	0	2	0	0	1	0	0	0	2
A340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AT76	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
B350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B460	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B712	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B737	0	0	0	4	1	2	0	1	0	4	5	0	1	0	6
B744	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1
B763	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1
B777	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1
B788	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CL60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DH8D	0	2	0	0	0	0	2	0	1	0	0	2	0	2	0
E190	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1
JS41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MD11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SF34	0	1	0	0	0	1	1	0	1	0	0	1	0	3	0

Appendix BB – KSA Traffic Profile (runway 25 in use) 24 arrivals and 24 departures models 1-3

	Departures										Arrivals				
	CAWLEY	CORDO	DIPSO	ENTRA	EVONN	KATOOMB A	KAMBA	RICHMOND	SOFA L	WOLLONGONG	BORE E	CALAG A	MARL N	ODAL E	RIVET
A320	1	0	0	2	0	1	0	1	0	1	2	0	1	0	3
A321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A330	0	0	0	0	0	1	0	1	0	0	1	0	0	0	1
A340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A388	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AT76	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
B350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B460	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B712	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B737	0	0	0	2	0	2	0	1	0	4	3	0	1	0	3
B744	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1
B763	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
B777	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B788	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CL60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DH8D	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0
E190	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
JS41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MD11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SF34	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0

Appendix CC – WSA Traffic Profile Model 1&2 (RWY05L) – 25 arrivals and 25 departures

	Departures										Arrivals				
	CAWLEY	CWR	DIPSO	ENTRA	EXETA	BTH	KAMBA	RICHMOND	SOFAL	RAZZI	BOSUN	MUSTA	MARLN	HOGAN	RIVET
A320	0	0	2	2		0	0	0	0	2	2	2	2	0	0
A321	0	0		0		0	0	0	0	0	0	0	0	0	0
A330	0	1		0		0	0	0	0	0	0	1	0	0	0
A340	0	0		0		0	0	0	0	0	0	0	0	0	0
A388	0	0		0		0	0	0	0	0	0	0	0	0	0
AT76	0	0		0	1	0	0	0	0	0	0	0	0	1	0
B350	0	0		0		0	0	0	0	0	0	0	0	0	0
B460	0	0		0		0	0	0	0	0	0	0	0	0	0
B712	0	0		0		0	0	0	0	0	0	0	0	0	0
B737	0	1	2	3		0	0	1	0	2	3	4	2	0	0
B744	0	0		0		0	0	0	0	0	0	0	0	0	0
B763	0	0		0		0	0	0	0	1	0	1	0	0	0
B777	0	0	1	0		0	0	0	0	0	0	0	1	0	0
B788	0	0		0		0	0	0	0	0	0	0	0	0	0
BE20	0	0		0		0	0	0	0	0	0	0	0	0	0
CL60	0	0		0		0	0	0	0	0	0	0	0	0	0
DH8D	0	0		0	1	0	1	0	0	0	1	0	0	1	0
E190	0	0		1		0	0	0	0	0	0	1	0	0	0
JS41	0	0		0		0	0	0	0	0	0	0	0	0	0
SF34	0	0		0	1	1	1	0	0	0	1	0	0	2	0

Appendix DD – WSA Traffic Profile Model 1&2 (RWY23R) – 21 arrivals and 21 departures

	Departures										Arrivals				
	CAWLEY	CWR	DIPSO	ENTRA	EXETA	BTH	KAMBA	RICHMOND	SOFAL	RAZZI	BOSUN	MUSTA	MARLN	HOGAN	RIVET
A320	0	0	2	2		0	0	0	0	2	2	1	2	0	0
A321	0	0		0		0	0	0	0	0	0	0	0	0	0
A330	0	1		0		0	0	0	0	0	0	0	0	0	0
A340	0	0		0		0	0	0	0	0	0	0	0	0	0
A388	0	0		0		0	0	0	0	0	0	0	0	0	0
AT76	0	0		0	1	0	0	0	0	0	0	0	0	0	0
B350	0	0		0		0	0	0	0	0	0	0	0	0	0
B460	0	0		0		0	0	0	0	0	0	0	0	0	0
B712	0	0		0		0	0	0	0	0	0	0	0	0	0
B737	0	1	2	3		0	0	1	0	2	2	3	1	0	0
B744	0	0		0		0	0	0	0	0	0	0	0	0	0
B763	0	0		0		0	0	0	0	1	0	1	0	0	0
B777	0	0	1	0		0	0	0	0	0	0	0	1	0	0
B788	0	0		0		0	0	0	0	0	0	0	0	0	0
BE20	0	0		0		0	0	0	0	0	0	0	0	0	0
CL60	0	0		0		0	0	0	0	0	0	0	0	0	0
DH8D	0	0		0	1	0	1	0	0	0	1	0	0	0	0
E190	0	0		1		0	0	0	0	0	0	1	0	0	0
JS41	0	0		0		0	0	0	0	0	0	0	0	0	0
SF34	0	0		0	1	1	1	0	0	0	1	0	0	1	0

Appendix EE – WSA Traffic Profile Model 3 – 50 arrivals and 50 departures

	Departures									Arrivals						
	BUNG O	CW R	DIPS O	ENTR A	EVON N	KATOOMB A	KAMB A	RICHMON D	RAZZ I	BOSU N	MEHA N	MARL N	NONU P	05ROUTA G /23ROUTA G	05RINNA G /23RINNA G	05LOUTAG / 23LOUTAT P
A320	0	0	2	4	2	0	0	0	4	4	0	4	2	0	2	0
A321	0	0		0		0	0	0	0	0	0	0	0	0	0	0
A330	0	1		0		1	0	0	0	0	0	0	1	0	1	0
A340	0	0		0		0	0	0	0	0	0	0	0	0	0	0
A388	0	0		0		0	0	0	0	0	0	0	0	0	0	0
AT76	2	0		0	-	0	0	0	0	0	0	0	0	2	0	0
B350	0	0		0		0	0	0	0	0	0	0	0	0	0	0
B460	0	0		0		0	0	0	0	0	0	0	0	0	0	0
B712	0	0		0		0	0	0	0	0	0	0	0	0	0	0
B737	0	1	1	6	3	1	0	2	4	6	0	4	7	0	1	0
B744	0	0		0		0	0	0	0	0	0	0	0	0	0	0
B763	0	0		0		0	0	0	2	0	0	0	0	0	0	0
B777	0	0	-	0	2	0	0	0	0	0	0	2	2	0	0	0
B788	0	0		0		0	0	0	0	0	0	0	0	0	0	0
BE20	0	0		0		0	0	0	0	0	0	0	0	0	0	0
CL60	0	0		0		0	0	0	0	0	0	0	0	0	0	0
DH8 D	2	0		0	-	0	2	0	0	0	2	0	0	2	0	0
E190	0	0		2		0	0	0	0	0	0	0	1	0	1	0
JS41	0	0		0		0	0	0	0	0	0	0	0	0	0	0
SF34	0	2		0	-	2	2	0	0	0	1	0	0	4	0	1

Appendix FF – WSA Traffic Profile Model 3 – 50 arrivals and 50 departures

- **KSA RWY16R**
 - Predominantly southern arrivals from Canberra and Melbourne
 - STARs
 - ODALE FIVE – expect radar vectors to final after MITSA (20NM SW)
 - RIVET TWO
 - Radar vector at 7-17NM SW KSA to a 12-15NM downwind
 - 5-7NM base leg with a 30% intercept to a 7-12NM final
- **KSA RWY16L**
 - Predominantly northern and eastern arrivals for a straight in approach
 - STARs:
 - MARLN ONE
 - CALGA ONE
 - BOREE SIX
 - Southern arrivals - radar vector at 5-8NM SE KSA to a 12-15NM downwind
 - 5NM base leg with a 30% intercept to a 6-12NM final
- **KSA RWY34L**
 - Predominantly southern arrivals from Canberra and Melbourne
 - STARs
 - ODALE FIVE – expect radar vectors to final after MITSA (20NM SW)
 - RIVET TWO
 - Radar vector at 10NM SW KSA to a 12-16NM downwind
 - 5NM base leg with a 30% intercept to a 6-14NM final
- **KSA RWY34R**
 - Predominantly northern eastern arrivals
 - STARs
 - MARLN ONE
 - CALGA ONE
 - BOREE SIX
 - Radar vector at 10NM SE KSA to a 12-16NM downwind
 - 5NM base leg with a 30% intercept to a 6-12NM final