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Western Sydney Airport
Aviation Fuel Supply Corridor Options Report

Prepared for the Department of Infrastructure, Regional Development and Cities

This Report is prepared by Deloitte Financial Advisory Pty Limited for the Commonwealth of Australia through the Department of Infrastructure, Regional Development and Cities.

Contents

Tables

Figures

Acronyms and abbreviations

Acronym	Full name
AFS	Airport Fuel Services
ALC	Airport Lessee Company
ALC	Australian Logistics Council
ATM	Air traffic movements per year
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BL	Billion litres
DG	Dangerous goods
DGHV	Dangerous goods heavy vehicle
EIS	Environmental Impact Statement
GTK	Gross tonne kilometres
JUHI	Joint User Hydrant Installation
KT	Kilotonnes, one thousand tonnes
KSA	Sydney (Kingsford Smith) Airport
MAP	Million annual passengers
ML	Million litres
SMP	Sydney Metropolitan Pipeline
TKM	Tonne kilometres
VKT	Vehicle kilometres travelled
WSA	Western Sydney Airport
WSA Co	WSA Co Limited — WSA lessee company

Glossary

Term	Explanation
Aviation fuel	Aviation fuel is the general term used to describe fuel used in aircraft of all sizes. Aviation fuel includes aviation gasoline (Avgas) and aviation turbine fuel (Jet A1).
B-double	An articulated truck configuration where a prime mover tows two semi-trailers. The first semi-trailer connects to the prime mover by means of a turntable coupling and the second semi-trailer connects to the first semi-trailer by a turntable coupling. For the purpose of this report, a B-double is assumed to have a jet fuel load capacity of 54,000 litres.
Bridging	An unloading or loading facility for the receipt or dispatch of jet fuel from a truck to a storage facility or vice versa.
Central Sydney terminal	A terminal located in the central region of Sydney, in the vicinity of Parramatta, including the Clyde (owned and operated by Viva Energy Australia) and Silverwater (joint venture between Caltex and Exxon Mobil) storage terminals. This locality aligns with the region known as Greater Parramatta outlined in the draft Greater Sydney Region Plan prepared by the Greater Sydney Commission, October 2017.
Corridor (pipeline)	A pipeline pathway, defined by rights-of-way and easements, in which the pipelines and facilities of a hazardous liquid or gas transmission pipeline operator are located, including rights-of-way and easements over and through public or private property.
Demurrage	A separate charge, in addition to ordinary transport costs, which is imposed according to the terms of a carriage contract upon the person responsible for unreasonable delays in loading or unloading cargo.
Diversity of supply	Multiple points and/or modes of jet fuel supply. This could include any or all of the following: • multiple supply ports • multiple and large-scale seaboard terminals • multiple pipelines located in separated easements with different routes depending on the supply point • road transport, including varied route options and on-site capacity for deliveries.
Easement	An easement is a section of land registered on a property title, which provides a party with the right to use the land for a specific purpose even though they are not the landowner. Statutory easements like power lines, telephone lines or drainage easements may not always be registered on a title, especially in cases where a utility is located on Crown land.
Eastern Sydney terminal	Storage terminals located in the eastern region of Sydney and in the vicinity of the Sydney CBD, including Port Botany, Banksmeadow and Kurnell (Botany Bay) and Gore Bay (Sydney Harbour).
Fuel interface	Batches of different refined products and grades are pumped back-to-back in a multi-product pipeline, usually without any devices separating them. Some mixing of products occurs at the interface of two adjacent batches. The interface material resulting from the pumping of batches of different products, like gasoline and jet fuel, produces an unusable mixture, which requires reprocessing at a refinery or special purpose-built terminal.
Jet fuel	Aviation turbine fuel (Jet A1).
Local differential	The price premium paid by airlines, above the Singapore Benchmark Price (as published by Platts, the energy and commodity information provider) for supply of jet fuel on an into-plane basis. The local differential is used by airlines as a benchmark or measure of the relative jet fuel price competitiveness of different international airports.
Multi-user pipeline	A pipeline that multiple parties can access to transport jet fuel from a refinery or seaboard terminal to on-airport jet fuel storage.

Multi-product pipeline	A pipeline that allows multiple products (e.g. jet fuel, diesel or gasoline) to be transported. These products may be from one or more users. Multi-product pipelines generate product interfaces which need to be managed (see fuel interface).
Multi-product corridor	Multiple pipelines that transfer separate products and use the same corridor.
National Operating Committee	The Australian Government established the National Operating Committee (NOC) on Jet Fuel Supply Assurance to minimise the risks around jet fuel supply disruption at major Australian international airports (Sydney, Melbourne, Brisbane, Perth, Adelaide, Darwin, Hobart and Cairns), in addition to three overseas airports (Auckland, Christchurch and Nadi). The NOC relies on information provided by the relevant Joint User Hydrant Installation (JUHI) managers at each airport. A Jet Fuel Summary Report on potential supply disruptions (traffic light report) for a six-week forecast period is issued by the NOC. A Black traffic light on a given day indicates the requirement for jet fuel suppliers to ration jet fuel supplies, requiring airlines to tanker in jet fuel to the airport. A Red traffic light on a given day indicates that jet fuel suppliers have no capacity to recover should there be a problem with planned production or supply of jet fuel.
Open access	Where all jet fuel suppliers have equal rights to access jet fuel supply infrastructure (e.g. key seaboard terminal storage facilities, pipelines, on-airport storage and/or into-plane services) through a fee-based, non-discriminatory pricing agreement with the owners/operators of the infrastructure.
Tankering	The process whereby an aircraft carries sufficient jet fuel to allow it to return to its port of origin or proceed to an onward destination, without the need to refuel at a transit port. Tankering usually occurs when jet fuel is more expensive at the intermediary port than at the aircraft's port of origin or its onward destination.
Western Sydney depot	A potential jet fuel storage depot in the western region of Sydney, for example, Plumpton.

Executive summary

Background

In April 2014, the Australian Government announced Badgerys Creek as the site of a new Western Sydney Airport (WSA) (Figure 1). As Western Sydney's population grows (it is expected to reach three million in the 2030s), WSA will deliver much-needed aviation services to residents of Western Sydney.[1] WSA will also help to meet Sydney's growing population and aviation demand as well as deliver economic and social benefits to the Western Sydney, Sydney, NSW and national economies. WSA will create jobs, encourage investment and be a source of economic growth for many years to come.

In May 2017, the Australian Government announced that WSA would be constructed by a Commonwealth-owned company (WSA Co) and committed up to $5.3 billion to build the airport. Operations are planned to commence in 2026. Stage 1 of the airport development will comprise a single runway and facilities to cater for up to 10 million annual passengers (MAP), the expected demand after five years of operation. The airport will grow over time and a second parallel runway is expected to be required by around 2050.

Figure 1: Western Sydney Airport, Badgerys Creek

Source: WSA Airport Plan

The Australian Government, through the Department of Infrastructure, Regional Development and Cities, has prepared preliminary planning, design and approval documents.

The Australian Government prepared the following key documents to support the development of WSA (among others):

- WSA Environmental Impact Statement (WSA EIS)[2] — finalised in September 2016
- WSA Business Case[3] — summary released in November 2016
- WSA Airport Plan[4] — determined in December 2016.

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[1] A blueprint of the Western Sydney Airport, Prime Minister of Australia, media release, 12 December 2016. https://www.pm.gov.au/media/blueprint-western-sydney-airport
[2] WSA EIS http://westernsydneyairport.gov.au/media-resources/resources/environmental-assessment
[3] WSA Business Case summary http://westernsydneyairport.gov.au/files/WSA_Business_Case_summary.pdf
[4] WSA Airport Plan http://westernsydneyairport.gov.au/files/Western_Sydney_Airport_Plan.pdf

One of the WSA Airport Plan requirements, Condition 26, states:

> 'By 31 December 2017, the Infrastructure Department must, in consultation with any NSW Government agencies specified by the NSW Department of Premier and Cabinet and any other relevant stakeholders, consider, analyse and report on options for a corridor for a pipeline to supply aviation fuel to the Airport Site.'

This report has been developed to satisfy this condition and also present the answers to two key questions:

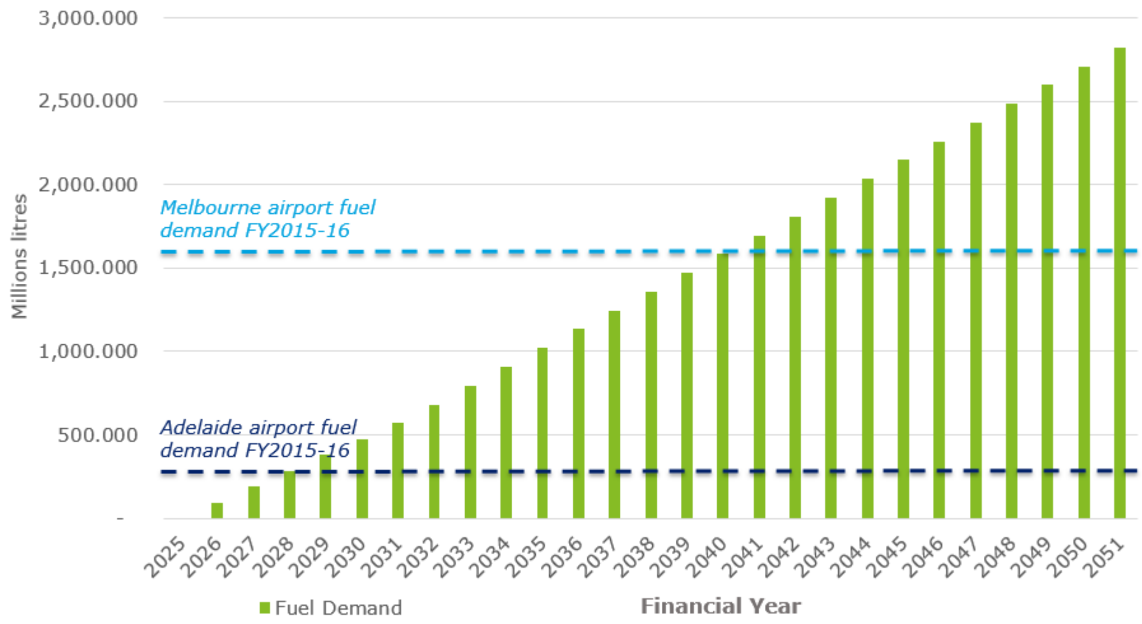
- What is the most cost-efficient way to deliver jet fuel to WSA?
- When will a jet fuel pipeline be a viable option to service WSA?

Australia's aviation fuel industry

Pipelines and trucks are both important modes of jet fuel supply and are needed to support an airport's growth at different developmental stages. Multiple supply modes from multiple seaboard terminals also make sure that there is supply diversity. This strengthens the resilience of the jet fuel supply chain and minimises the risk to security of supply.

Airports are often supplied with jet fuel by road until the demand reaches a level to support the large capital investment associated with jet fuel pipelines. The forecast jet fuel demand for WSA is 570ML per annum in 2031 and 2.82BL per annum in 2051 (Figure 2). This assessment of jet fuel demand was undertaken prior to WSA Co having an opportunity to undertake its own assessment. The closest jet fuel storage infrastructure with jet fuel capability is located at Clyde (near Parramatta) in the Sydney basin. Terminals at Clyde and Port Botany import jet fuel from large-scale export refineries in northern Asia through port facilities located at Gore Bay (Sydney Harbour), Port Botany and Kurnell (Figure 3).

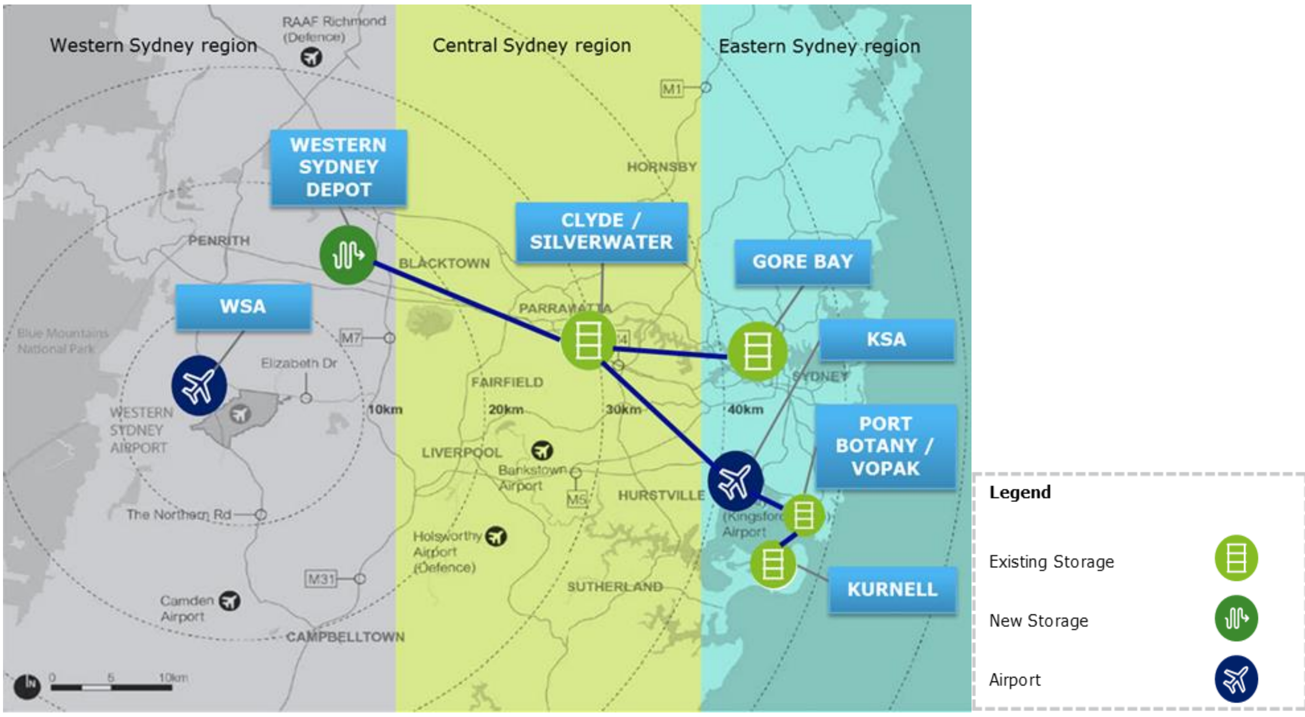
Figure 2: WSA jet fuel demand (litres per annum), with jet fuel demand at Melbourne and Adelaide Airports, in 2015/16 shown for the purposes of comparison[5]



Source: Deloitte analysis 2017

[5] Melbourne Airport is supplied through both a jet fuel pipeline and via road tanker, while Adelaide Airport relies solely on road tankers to meet daily demand.

Figure 3: Geographic locations of existing terminals in the greater metropolitan region of Sydney



Source: Deloitte 2017 and Greater Sydney Commission 2017

The planning, approval and construction process for a jet fuel pipeline could take between three and five years but it is highly dependent on a number of variables.

In 2016 the NSW Government, which is responsible for critical corridor preservation in NSW, nominated the WSA jet fuel pipeline as a priority to be included in Infrastructure Australia's *Infrastructure Priority List 2017*.

During 2017, Transport for NSW (TfNSW) commenced preliminary work to identify route options for a jet fuel pipeline corridor to WSA and surrounds. This included commissioning research to determine the most effective and sustainable jet fuel pipeline options while minimising the impact of construction on the community and the environment. This work is still underway and was therefore not able to be included in this report.

Consultations and case studies

More than 30 stakeholder organisations were consulted (Appendix B) as part of this report to help determine the most cost-efficient way to deliver jet fuel to WSA. Case studies of four Australian airports (Canberra, Gold Coast, Adelaide and Melbourne) were also undertaken to assess how WSA could be supplied with jet fuel at different air traffic levels.

Three main themes were identified across the consultations and case study research.

- A general recommendation for the early preservation of at least one pipeline corridor to service WSA. Corridor preservation should start well before the pipeline will be required (based on economic grounds) to service WSA. Pipeline planning, approval, development and construction time should be taken into account when timing corridor preservation.
- Jet fuel costs at WSA, including jet fuel related fees and charges, should be comparable to KSA jet fuel costs. This would provide an added incentive for airlines to use WSA, as an alternative to, or in conjunction with, KSA.
- Investment in jet fuel infrastructure needs to occur before it is needed, to ensure it is in place once demand requires it.

Other key findings that came from these consultations and case studies are outlined below.

- A pipeline would not be required at the start of services at WSA in 2026, based on the anticipated jet fuel volumes required in its early stages of operation.

- There are no current plans to close or relocate the existing Sydney basin delivery points at Gore Bay, Port Botany and Kurnell, and terminals at Clyde and Silverwater in the short to medium term. It should be assumed that the status quo will remain when planning a WSA pipeline.
- Any jet fuel delivery system, both to and at WSA, needs to be designed specifically for jet fuel.
- There was a strong preference to use the existing infrastructure and easements wherever possible. The existing terminal infrastructure in western Sydney should be used in order to minimise the distance required for a pipeline/corridor. This view was expressed by a range of stakeholders beyond those that currently owned or operated parts of the existing infrastructure.
- On-site storage at the airport is essential (Joint User Hydrant Installation (JUHI) or similar) to allow a better response to any problems associated with supply to the airport.

Western Sydney Airport pipeline options

Three pipeline options were developed as a result of the stakeholder engagement and research into fuel supply arrangements at a number of Australian airports. Other pipeline options may exist, but the below options were the ones the stakeholders were willing to present during this consultation process.

- **PP1** — an existing pipeline from a port in eastern Sydney to a central Sydney terminal where jet fuel is treated and stored, and then a new pipeline (40km) to WSA.
- **PP2** — an existing pipeline from a port in eastern Sydney to a western Sydney depot, where a new intermediate storage facility would be constructed to pump jet fuel via a new pipeline (25km) to WSA.
- **P1** — a new pipeline (60km) from the Botany Bay terminal to WSA and a new pumping facility.

The pipeline options all included dedicated jet fuel pipelines, rather than multi-product pipelines[6], and were designed within the context of the current operating and industry environment in Sydney. This includes the network of jet fuel pipelines and storage terminals that already enable the safe, reliable and efficient supply of jet fuel to KSA.

Jet fuel delivery by road transport was also considered, as both trucks and pipelines are important supply modes. Three 'base case' options with a mix of road transport routes were developed:

- **T1** — road transport from an eastern Sydney seaboard port to WSA.
- **TP1** — an existing pipeline from a port to a central Sydney terminal where jet fuel is treated and stored, then road transport from a central Sydney terminal to WSA.
- **TP2** — an existing pipeline from a port to a western Sydney depot, then road transport from a western Sydney depot to WSA.

Economic analysis

The pipeline options were considered alongside the road transport routes (base case) to inform the economics and to understand when jet fuel demand would warrant a pipeline to WSA. A 'least cost' analysis, also known as a cost-efficiency analysis, was used to determine the most feasible and economically viable jet fuel delivery option. The analysis estimated and compared the costs incurred for each delivery option, including pipeline operating costs, capital costs, travel time and vehicle operation, environmental externalities and the impacts associated with potential road accidents.[7]

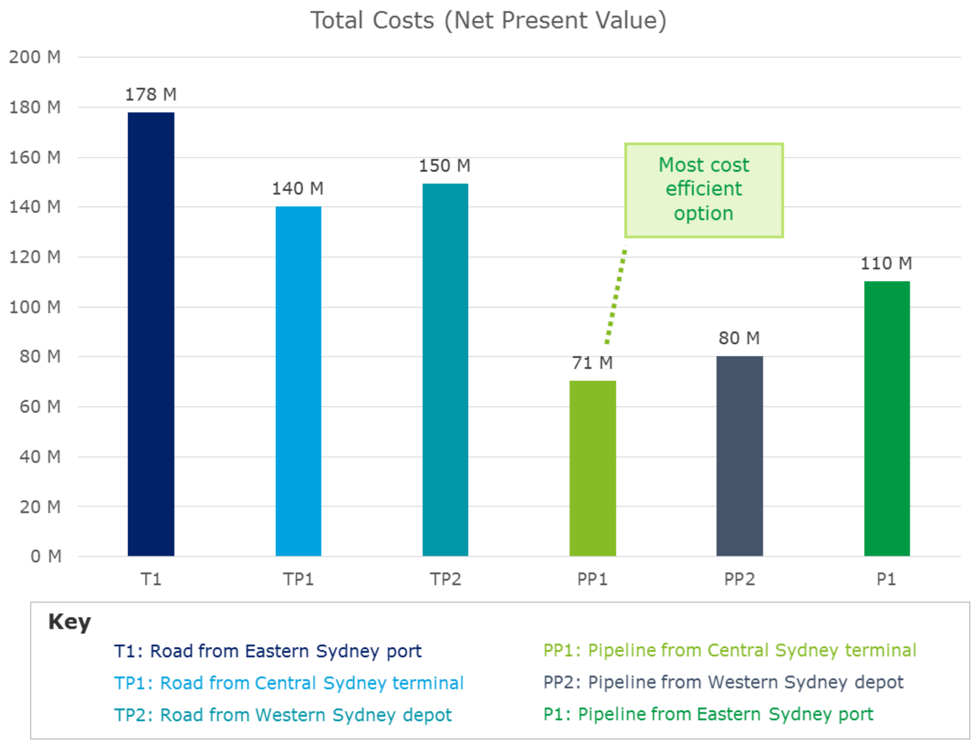
The economic analysis and comparison of pipeline corridor options and potential transport routes demonstrated that:

1. All pipeline options indicate that a pipeline will not be required on day one of WSA operations — there is insufficient jet fuel demand to justify the investment.
2. A new build pipeline's feasibility is driven predominately by jet fuel volume — the larger the volume, the higher the operating cost savings for piped options and the faster capital costs are recuperated.

[6] A pipeline that allows multiple products (for example jet fuel, diesel or gasoline) to be transported. These products may be from one or more users. Multi-product pipelines generate product interfaces, which need to be managed (see fuel interface definition in Glossary).
[7] No road toll costs have been included as no specific route is assumed.

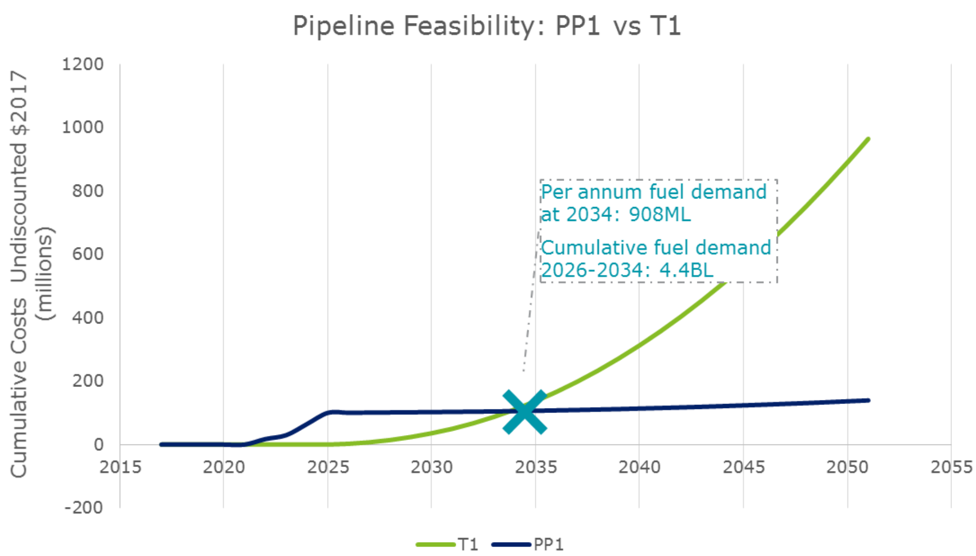
3. All of the pipeline options were found to be more cost-efficient in supplying jet fuel to WSA than road transportation options in the longer term.
4. PP1 was the most cost-efficient pipeline option (Figure 4). This option uses the existing pipeline network to the central Sydney terminals and connects a new 40km pipeline directly to WSA.
5. A jet fuel pipeline to WSA has been determined to be viable by 2034 (Source: Deloitte analysis, 2017, Figure 5). In 2034, it is expected that jet fuel demand for WSA could be 2.5ML per day, equivalent to 908ML per year.

Figure 4: Cost-efficient comparison of options over 25 years ($ millions, $2017)



Source: Deloitte analysis, 2017

Figure 5: Pipeline feasibility. PP1 (40km) is the most cost-efficient option



Source: Deloitte analysis, 2017

Based solely on the economic analysis, jet fuel will need to be delivered by truck to WSA until around 2034 and, based on WSA's passenger forecasting, approximately 41 B-double trucks will be required on a daily basis by 2033. This result is consistent with the WSA EIS modelling.

This report does not detail a specific pipeline corridor route. Although it has included a high-level assessment of safety and environmental impacts in the economic analysis of the options considered, these would need to be assessed in much greater detail in future detailed corridor route assessments. There have not been any specific consultations with local councils through which a pipeline may pass, nor with the community in the preparation of this report. The Commonwealth Government anticipates that as planning for a pipeline progresses, a more widespread consultation program, including a detailed analysis of safety and/or environmental impacts, can be expected. This would be undertaken by the NSW Government as part of its responsibility for critical corridor preservation in NSW.

Key findings and next steps

In summary:

- A pipeline is not expected to be required until demand reaches 908ML per annum at WSA. This is projected to occur in 2034.
- Industry has indicated that unless it is economically and financially viable, road transport will be the mode chosen to deliver jet fuel to WSA.
- A pipeline corridor/route must connect into multiple ports, have open access, multiple storage terminals and/or be able to connect in with multiple transport routes to ensure diversity of supply and enhance the reliability of jet fuel supply.
- It is expected that affected stakeholders, including infrastructure and fuel industry representatives, community, and local councils will be consulted in the final determination of defining a pipeline route prior to development.

Based on the findings of this report, the following next steps have been recommended for the development of WSA and the planning of the supply of aviation fuel to WSA.

- **Condition 26 of the WSA Airport Plan**
    - A copy of this report will be provided to the nominated regulatory delegate for the WSA Airport Plan in the Department of Infrastructure, Regional Development and Cities as evidence of satisfying Condition 26 of the Airport Plan.
- **Corridor planning**
    - Infrastructure Australia could consider the findings of this report in its future development of the Infrastructure Priority List.
    - The NSW Government could consider the findings of this report in its future planning for fuel corridors and infrastructure for western Sydney and regional NSW.
    - Although only three high-level pipeline options resulted from this study, future corridor planning should include further engagement with industry to ensure other viable options are not overlooked. This will be important for encouraging open access and diversity of supply.
    - Given the report identifies a jet fuel pipeline could be feasible as early as 2034, and the lead time for planning and developing a jet fuel pipeline corridor is between three and five years, WSA Co should undertake a detailed assessment of its jet fuel demand for WSA at an appropriate stage, once it has reviewed aircraft movement demand forecasts. If its demand is found to be significantly higher for the first stage of WSA's operation than that calculated in this report, it should begin engagement with the NSW Government on corridor preservation as early as possible.
    - The Australian and NSW governments could consider co-locating a jet fuel pipeline within the rail, road, water or other pipeline corridors it is planning for western Sydney. This would be particularly beneficial if planning is required for other corridors to WSA from either Parramatta or St Marys (near the western Sydney fuel depot) because these generic routes were found to be the most cost-efficient routes for supplying jet fuel to WSA by pipeline in the longer term.

- **Planning and development of WSA**
    - The WSA developer, WSA Co, should consider the findings of this report:
        - in its development of Stage 1 of WSA
        - when it undertakes its next master plan for WSA
        - in complying with Condition 28 of the WSA Airport Plan. Condition 28 states that WSA Co must, within two years of the grant of an Airport Lease, and at least once every five years thereafter, prepare and publish a review of aviation fuel supply options comparing the social, economic and environmental costs, savings and benefits of jet fuel supplied to the Airport by road with other alternatives including a jet fuel pipeline.
- **Operational planning for WSA**
    - WSA Co could use this report in developing its concept of operations for the safe, efficient and reliable supply of jet fuel to WSA, and in planning the procurement of associated supply agreements.
    - In accordance with Condition 27 of the WSA Airport Plan, WSA Co must ensure that contracts that it enters into in relation to the supply, transport, storage or disposal of aviation fuels for the Stage 1 Development of the Airport include provisions requiring compliance with all applicable Commonwealth, state and local laws relating to the protection of the environment.

About this report

The purpose of the report

This report has been prepared to satisfy the requirements of Condition 26 of the WSA Airport Plan, which states that:

> 'By 31 December 2017, the Infrastructure Department must, in consultation with any NSW Government agencies specified by the NSW Department of Premier and Cabinet and any other relevant stakeholders, consider, analyse and report on options for a corridor for a pipeline to supply aviation fuel to the Airport Site.'

This report presents strategic level corridor options for a jet fuel pipeline to supply WSA. These corridor options are based on the opinions and expertise of a range of stakeholders likely to have an interest in supplying jet fuel to WSA. To inform the development of these options, the project undertook an extensive stakeholder engagement program and analysis to answer two key questions:

- What is the most cost-efficient way to deliver jet fuel to WSA?
- When will a jet fuel pipeline be a viable option to service WSA?

The report's structure

This report has been prepared in three parts:

Part 1: Project overview — outlines WSA's history, including the WSA Airport Plan and current legislative requirements (Section 1) as well as the national jet fuel industry and supply chain (Section 2). A series of stakeholder consultations and case studies place WSA in a national context and begin to outline the main jet fuel delivery considerations (Section 3) to help identify WSA's pipeline options (Section 4).

Part 2: Economic analysis — focusses on the economic analysis of the pipeline options, outlining the analytical methods, data sources and pipeline costs used in the analysis (Section 5). The pipeline options are compared to assess their overall cost-efficiency, feasibility and optimal time of delivery (Section 6).

Part 3: Summary — outlines the key project findings and next steps towards providing safe, reliable, efficient and low-cost jet fuel to WSA (Section 7).

Part 1: Project overview

1 Western Sydney Airport

Key points

- In April 2014, the Australian Government announced Badgerys Creek as the Western Sydney Airport (WSA) site. In 2017, the Australian Government committed up to $5.3 billion to build WSA to meet Sydney's growing population and aviation demand.
- The Australian Government, through the Department of Infrastructure, Regional Development and Cities, has undertaken preliminary planning, design and approval processes. This included developing the WSA Environmental Impact Statement (EIS) and the WSA Airport Plan and Business Case to support WSA's construction and operation.
- In December 2016, the Minister for Urban Infrastructure determined the WSA Airport Plan which authorised Stage 1 of the airport (building a single runway facility capable of handling up to 10 MAP).
- This report builds on the work of the Australian Government and NSW Government in relation to the planning and construction of WSA and delivery of related projects near the airport site.
- In 2016 the NSW Government, which is responsible for critical corridor preservation in NSW, nominated the WSA fuel pipeline as a priority to be included in Infrastructure Australia's *Infrastructure Priority List 2017*.
- During 2017, Transport for NSW (TfNSW) commenced preliminary work to identify route options for a fuel pipeline corridor to WSA and surrounds. This included commissioning research to determine the most effective and sustainable fuel pipeline options while minimising the impact of construction on the community and the environment. This work is still underway and was therefore not able to be included in this report.
- This report was informed by a review of the existing fuel supply arrangements at other Australian airports and an extensive program of stakeholder consultation and engagement.

1.1 Western Sydney Airport

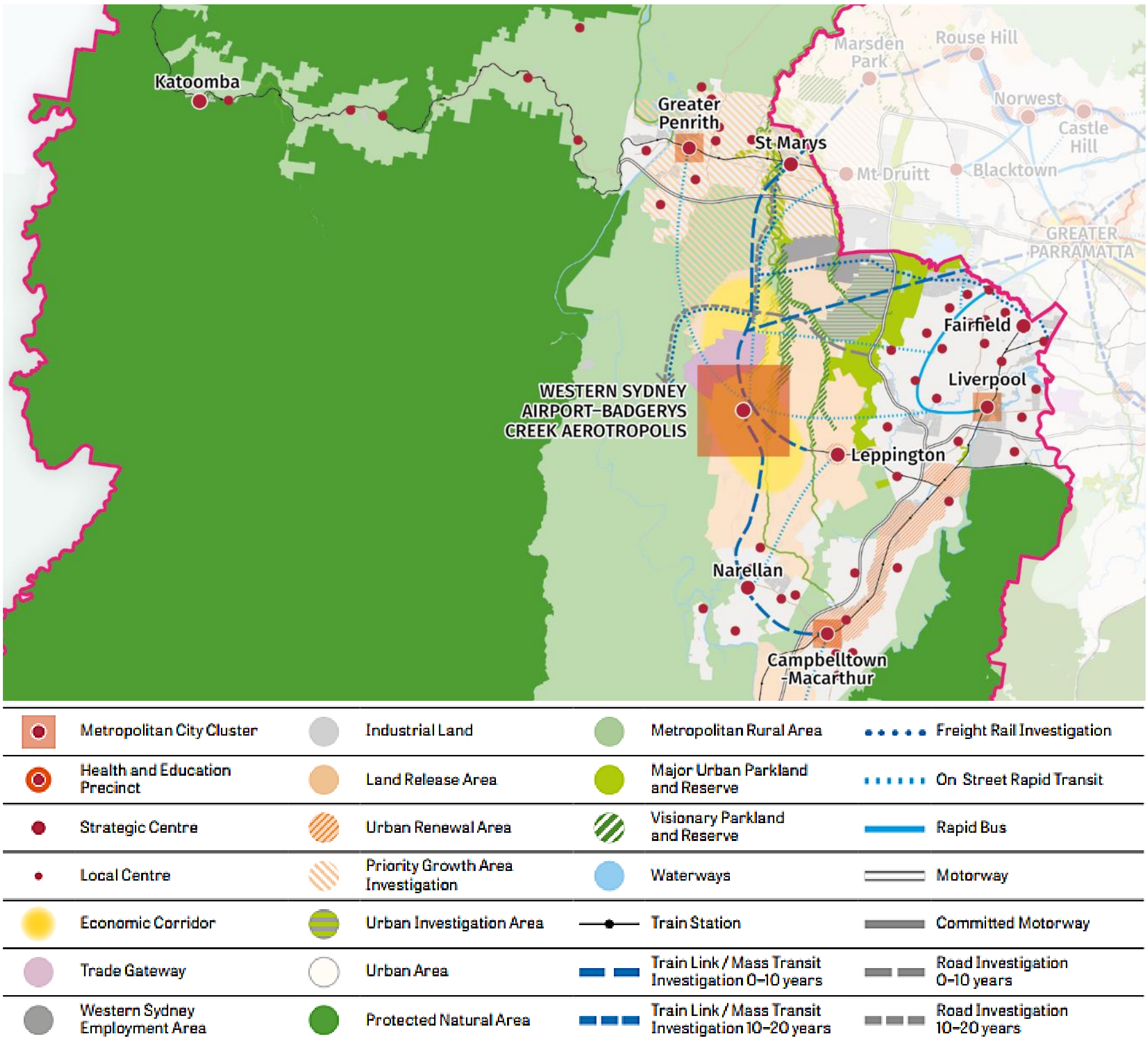
In 2014, the Australian Government announced that Badgerys Creek would be the site for Sydney's second major airport. This was a major government commitment to transport infrastructure for Sydney and NSW. Western Sydney Airport (WSA) is located in the emerging Western City or 'aerotropolis', approximately 50km west of Sydney's central business district (CBD) (Figure 6).

In late 2016, the Australian Government finalised the WSA EIS and the Minister for Urban Infrastructure determined the Airport Plan, which authorised Stage 1 of the airport (a single runway airport facility expected to commence operations in 2026).

In August 2017, the Australian Government established WSA Co, a Government-owned company, to deliver Western Sydney Airport.[8]

[8] Establishing WSA Co Limited, Minister for Urban Infrastructure, media release, 7 August 2017. http://minister.infrastructure.gov.au/pf/releases/2017/August/pf034_2017.aspx

Figure 6: Western City District Structure Plan 2036



Source: Draft Western City District Plan, Greater Sydney Commission, 2017

1.1.1 WSA Environmental Impact Statement

The WSA EIS, finalised in September 2016, stated that jet fuel[9] would initially be supplied by road tanker to the Stage 1 Development and this was 'anticipated to be sourced from either the Clyde or Banksmeadow Port Botany jet fuel terminals'.[10] The WSA EIS stated that future delivery may be via a dedicated pipeline as the airport grows in response to demand beyond Stage 1.[11]

Transport modelling conducted for the WSA EIS estimated that approximately 43 B-double trucks would be required by 2031 to meet the anticipated Stage 1 daily jet fuel demand when passenger numbers reach 10 MAP.[12] Initial estimates of WSA passenger numbers in its first few years after opening (in 2026) are similar to those at Canberra Airport today (3 MAP). There are approximately 12 trucks per week delivering jet fuel to the fuel farm at Canberra Airport.[13]

[9] Aviation fuel is the general term used to describe fuel used in aircraft of all sizes. Aviation fuel includes aviation gasoline (Avgas) and aviation turbine fuel (Jet A1). WSA's aviation fuel requirements will be for jet fuel (Jet A1), and therefore this report focuses on the supply of jet fuel to WSA.
[10] WSA EIS, Volume 1, Chapter 5, page 182.
[11] WSA EIS, Volume 1, Chapter 5, page 182.
[12] WSA EIS, Volume 2, Chapter 15, page 236.
[13] Fueltrac, Import Parity Indicator Price (IPIP) Reports, 2015/16.

This anticipated demand was based on WSA flight schedule assumptions, including the assumption that all aircraft would refuel at WSA, which may not be the case.[14] This report has used updated numbers and assumptions, including an analysis of likely refuelling patterns based on aircraft and points of origin/onward points of destination, to inform the estimated jet fuel demand for WSA from 2026 and beyond.[15]

The WSA EIS acknowledges that it is important to preserve a corridor for future jet fuel pipeline development and that this needs to be investigated. The Department has provided additional information within this report to support further consideration and planning for a pipeline corridor.

1.1.2 WSA Airport Plan

The WSA Airport Plan sets out the vision for WSA's development and operation at Badgerys Creek and authorises the development of Stage 1.

Domestic, international and freight carriers, which operate out of WSA during Stage 1, with an anticipated operational capacity of 10 MAP in addition to freight aircraft movement.

This report has been informed by Airport Plan assumptions that relate to WSA jet fuel supply. These include:

- 24-hour airport operation
- on-site storage that can hold three days' worth of jet fuel
- jet fuel is transported by road until demand justifies investment in a dedicated jet fuel pipeline
- growth during the first five years of operation, with passenger numbers expected to reach 10 MAP in 2031
- a fuel farm near the north-western boundary of WSA off Anton Road
- jet fuel deliveries to the WSA fuel farm are from the primary access point on Anton Road via Adams Road
- a minimum of two, and up to five, B-double tankers can be unloaded at any one time at the WSA fuel farm.

In addition to Condition 26, the Airport Plan sets out two other conditions in relation to supplying WSA with aviation fuel:

- Condition 27 — Statutory compliance — aviation fuels

  (1) The Site Occupier must ensure that contracts which it enters into in relation to the supply, transport, storage or disposal of aviation fuels for the Stage 1 Development of the airport include provisions requiring compliance with all applicable Commonwealth, state and local laws relating to the protection of the environment.
  (2) This condition ceases to have effect if and when a contract has been entered into for the construction of a fuel supply pipeline.

- Condition 28 — Aviation fuel supply periodic cost benefit reviews

  (1) The ALC must, within two years of the grant of an Airport Lease, and at least once every five years thereafter, prepare and publish a review of aviation fuel supply options comparing the social, economic and environmental costs, savings and benefits of fuel supplied to the Airport by road with other alternatives including a fuel pipeline. The reviews must be undertaken in consultation with any New South Wales Government agencies specified by the New South Wales Department of Premier and Cabinet.
  (2) This condition ceases to have effect if and when a contract has been entered into for the construction of a fuel supply pipeline.

This report will provide a baseline for the airport lessee (WSA Co) to address these conditions in the future.

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[14] For the purposes of this report, and to estimate jet fuel demand at WSA, we have assumed that all aircraft will refuel at WSA. This may not be the case. Airlines carrying domestic passengers may refuel at airports with cheaper jet fuel if it is safe to do so. Aircraft can 'tanker' additional jet fuel to reduce the amount of jet fuel required at destination airports. Sensitivity tests (Section 6.4) informed jet fuel demand scenarios.
[15] This is outlined in Section 4 of this report.

1.2 Previous government consultation and planning

This report has considered the work of the Australian Government and NSW Government in relation to WSA's planning and construction, and delivery of related projects near to the airport site.

The NSW Government, through Transport for NSW (TfNSW), has also investigated potential corridor routes for WSA jet fuel delivery by road transport and pipeline infrastructure. This has been undertaken since the WSA pipeline corridor was listed as a priority item on Infrastructure Australia's *Infrastructure Priority List 2017*.[16]

1.2.1 Corridor preservation

The NSW Government is responsible for critical corridor preservation in NSW, and in 2016 nominated the WSA fuel pipeline as a high priority initiative in the long-term infrastructure plan, Infrastructure Australia's *Infrastructure Priority List 2017*.[17] During 2017, TfNSW commenced preliminary work to identify potential routes for a fuel pipeline corridor to WSA and surrounds. This included commissioning research to determine the most effective and sustainable fuel pipeline approach, while minimising the impact of construction on the community and the environment.[18] This work was still underway and was therefore not able to be included in this report.

The protection and early acquisition of corridors provides for more efficient future land use. This statement was supported by stakeholders during the engagement process. The protection and early acquisition of corridors enhances the ability to deliver infrastructure that secures the best value and outcomes for taxpayers; lowers social disruption; and minimises the cost of building new infrastructure in the future. Corridor preservation will also lead to forward planning and certainty for industry and WSA.

The NSW Government is focusing on corridor preservation as NSW's population and urban density impacts on land use planning and urban infrastructure planning. This is consistent with the feedback received during stakeholder consultations.

1.2.2 Alignment with NSW road projects

To connect WSA with Sydney's road network and capitalise on the economic benefits of the airport, the Australian Government and NSW Government have partnered to invest in and deliver new roads and existing road upgrades in western Sydney. This will provide efficient and safe access for freight and passengers using WSA.

The Western Sydney Infrastructure Plan (WSIP) is a 10-year, $3.6 billion road investment program funded by the Australian Government and NSW Government. It supports an integrated transport solution for the region. The WSIP program will construct new and upgrade existing roads ahead of WSA's commencement to accommodate the increase in local and freight traffic. In addition, the work will provide direct access to the WSA site and support future development in the area.

[16] Infrastructure Priority List, November 2017, http://infrastructureaustralia.gov.au/projects/infrastructure-priority-list.aspx
[17] ibid
[18] See http://www.freight.transport.nsw.gov.au/strategy/projects/western-sydney-fuel-pipeline

WSIP projects

The Northern Road: This project will upgrade approximately 35km of the Northern Road and is being delivered in six stages. Construction commenced in January 2016 and is expected to be completed in 2020.

Bringelly Road: This project will upgrade approximately 10km of Bringelly Road, between Camden Valley Way and the Northern Road. The project is being delivered in two stages. Construction commenced in January 2015 and is expected to be completed in 2020.

M12 Motorway: This project will provide an east-west link between the M7 Motorway and the Northern Road, and provide the main access road to WSA. The project is in the planning stage, with construction expected to commence in 2020 and be completed prior to WSA's opening in 2026.

Werrington Arterial Road: This project upgraded the Werrington arterial road, which included road widening, new entry and exit ramps, and intersection upgrades. Construction commenced in March 2015 and was opened to traffic in May 2017. This was the first major WSIP project to be completed.

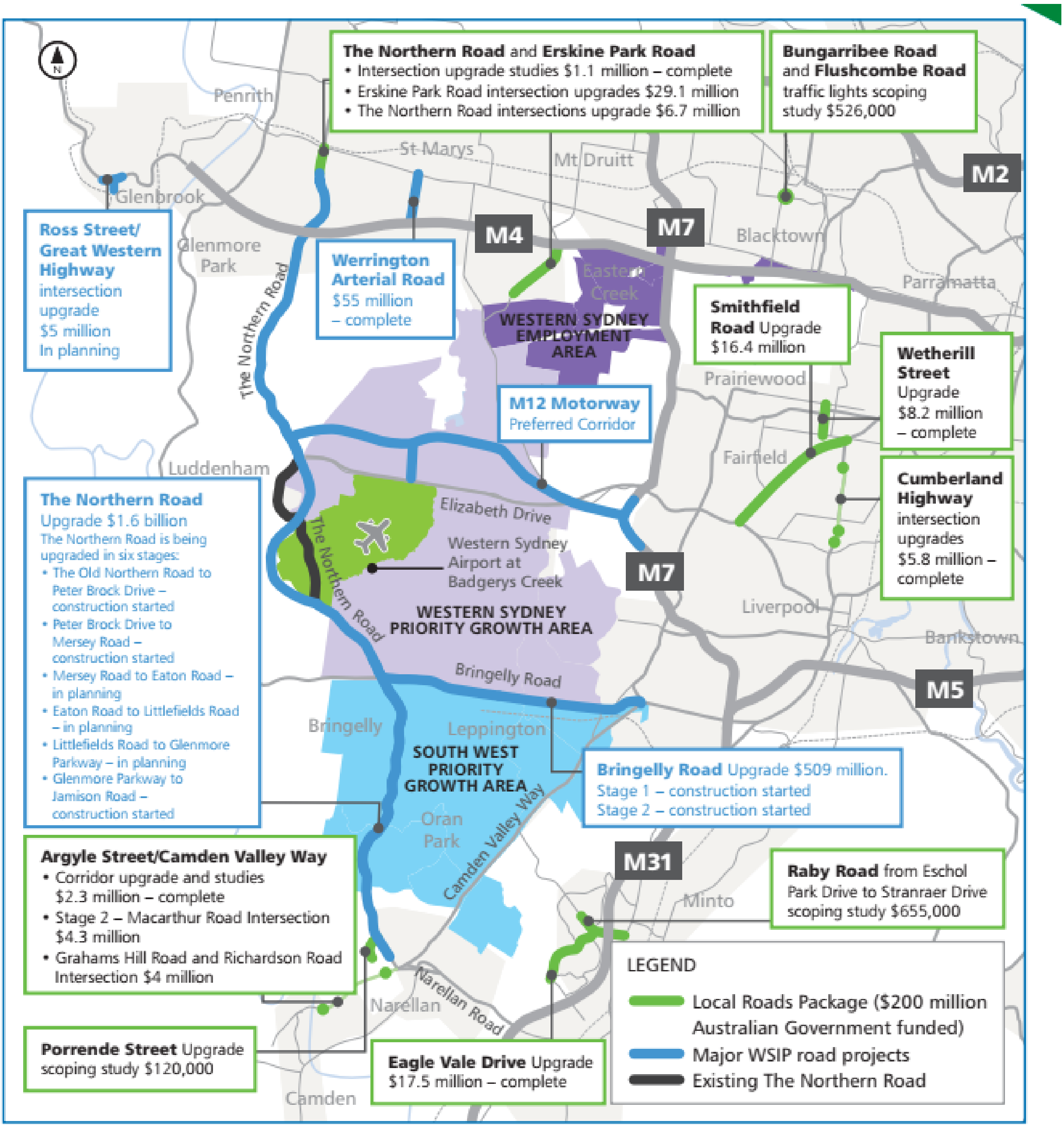
Glenbrook Intersection at Ross Street: This upgrade will occur at the Great Western Highway and Ross Street intersection at Glenbrook. It will be a gateway to Glenbrook Village and provide safe access. The project is currently in the planning stages, with construction expected to commence early in 2018 and be completed in late 2018.

Local Roads Package (LRP): The LRP is a competitive rounds-based program, which is enabling a range of Western Sydney councils to complete for minor road improvement works. All Round 1 projects are complete, with Round 2 projects underway or in the planning stages.

Source: Department of Infrastructure, Regional Development and Cities, Western Sydney Infrastructure Plan

Jet fuel is most likely to be transported to WSA by road in the early stages of operations and so the movement and connectivity of the road network around WSA will be critical to ensure its safe and efficient supply and meet growing passenger demand. Roads and motorways included within the WSIP are likely to be an integral part of this road network (Figure 7). The proposed road corridors could also hold a fuel pipeline, although this would depend on its detailed design and alignment with construction timeframes.

Figure 7: The Western Sydney Infrastructure Plan, including outline of projects



Source: Western Sydney Infrastructure Plan, Roads and Maritime Services, June 2017

The current economic outlook for transporting jet fuel by road to WSA has been considered in the economic analysis of this report (Section 5). The analysis considers the increasing costs, due to increasing travel times, likely to affect travel between existing fuel terminals within the Sydney basin and WSA.

1.3 Legislative requirements

The legislative requirements associated with road transport, pipelines and the environment across potential routes has an impact upon the decisions made by investors, industry and government. They also add to the costs associated with the construction and operation of new infrastructure. Regulatory costs are shared amongst the recipients of the jet fuel supply service, and these include the investor, industry, airports, airlines and the end user (subject to commercial arrangements). The costs of legislative compliance for the WSA operational environment have been considered at a high-level and these are outlined in Section 5.

A list of legislative requirements reviewed for this document are outlined below:

Relevant pipeline legislation:

- Pipelines Regulations 2013, NSW
- Environmental Planning and Assessment Act 1979, NSW
- Pipelines Act 1967 No. 90, NSW

Relevant road transport

- Dangerous Goods (Road and Rail Transport) Act 2008, NSW
- Dangerous Goods (Road and Rail Transport) Regulation 2014, NSW
- Heavy Vehicle (adoption of National Law) Act 2013 No 42, NSW
- Road Transport (Vehicle Registration) Regulation 2007, NSW
- Heavy Vehicle (Mass, Dimension and Loading) National Regulation 2013, NSW
- Australian Code for the Transport of Dangerous Goods by Road and Rail 2008, Commonwealth
- Road and Rail Transport (Dangerous Goods) Act 2008 No 95, NSW
- Dangerous Goods (General) Regulation 1999, NSW
- Airports Environmental Protection Regulations 1997, Commonwealth

Storage of Dangerous Goods

- Aviation Transport Security Regulations 2005, Commonwealth
- National Code of Practice for the Storage and Handling of workplace dangerous goods (general) regulation 1999, NSW
- Airports Environmental Protection Regulations 1997, Commonwealth

1.4 Planning and approval process for a jet fuel pipeline

1.4.1 NSW Government processes

The planning, approval and construction process for a jet fuel pipeline could take between three and five years but it is dependent on a number of variables.

Major pipeline developments in NSW are currently deemed to be State Significant Infrastructure (SSI),[19] or State Significant Developments (SSD)[20] under the State and Regional Development SEPP[21]. This is because they are viewed as having wider significance and impact than on just the local area. As a result, the planning and construction of a jet fuel pipeline for WSA would be reviewed by the NSW Department of Planning and Environment, and approved by the Minister for Planning. A flowchart explaining the process for approval through the NSW Department of Planning and the Environment is outlined in Appendix A.

The Environmental Planning and Assessment Regulation 2000 (NSW) outlines that all key issues must be identified and assessed by the Director General in collaboration with the relevant local council and the Office of Environment and Heritage.

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[19] State Significant Infrastructure, Department of Planning and Environment http://www.planning.nsw.gov.au/Assess-and-Regulate/Development-Assessment/Systems/State-Significant-Infrastructure.

[20] SSD are declared by the SEPP or the Planning Minister whilst SSI are generally carried out by a public authority. Proposals that meet both SSD and SSI criteria will usually default to SSD assessment to ensure that the SSI process is restricted to public authorities undertaking infrastructure projects.

[21] State Environmental Planning Policies (State and Regional Development) 2001.

The project must then undertake the following steps to complete the planning and approval process in accordance with the Secretary's Environmental Assessment Requirements (SEARs). These steps include (but may not be limited to):

- developing an environmental impact statement (EIS)
- public exhibition of the EIS
- reviewing public submissions to EIS (may be asked to respond to the EIS submissions)
- consulting with landowners, corridor/easement owners and local communities.

A pipeline licence will be granted if the application for a pipeline to SSI is approved.[22]

The timing for the planning and approval process to be completed will be dependent on a number of variables, which include:

- the route selected, ownership of the land (publically or privately owned) and the number of easements required
- the number of SEARs that need to be addressed by the proponent
- the complexity and level of information available to prepare the EIS
- the potential interaction or conflicts with any other major infrastructure, environmentally sensitive areas or sensitive urban areas
- the exhibition period prescribed by the NSW Department of Planning and Environment
- the level of consultation required
- the number and nature of objections that are raised
- the time taken to address the public submissions and the review process.

The timeframe is likely to change if the project is deemed to be critical state significant infrastructure.

A possible timeframe is provided below for guidance, taking into account NSW Government legislation and requirements.

Task	**Timeframe**
Consultation with landowners and local communities	6 to 12 months (additional time may be required if the pipeline is located on privately owned land)
EIS development	6 to 12 months
EIS public exhibition	Minimum of 30 days
Responses/submissions to EIS may be passed along to the proponent and other government agencies	Minimum of 30 days (dependent on number of responses and action decided by the Director-General)
Judicial review heard by the Land and Environment Court	3 months from the date of the public notice of original decision.

Once these approvals have been completed, the corridor land can be acquired and the pipeline can be constructed. These steps would account for the majority of the three to five-year lead time for developing a new pipeline.

[22] EDO NSW, State Significant Development and State Significant Infrastructure, July 2015 www.edonsw.org.au/state_significant_development_and_state_significant_infrastructure.

1.4.2 Commonwealth Government processes

Development on the airport site is controlled by the Airports Act (1996) and the EPBC Act (1999). The Airport Plan is an instrument of the Airports Act that provides authority for the development of Stage 1 of the airport. The current Airport Plan is not likely to provide sufficient authority for the development of a jet fuel pipeline across the site. The authority to develop a jet fuel pipeline on the site would most likely be obtained through the approval of a variation to the Airport Plan or a major development plan submission; this would need to be confirmed once further details were available about a proposed development.

There may be scope to combine the on-site and off-site environmental assessments for a jet fuel pipeline.

Irrespective of the pathway required to obtain the planning and environmental approval for a jet fuel pipeline on the airport site, a building permit will be required. This permit would be required from the Airport Building Controller (ABC) prior to construction starting. A certificate of compliance would then be required from the ABC once construction had been completed.

2 Australia's aviation fuel industry

Key points

- Four Australian international airports have all or part of their jet fuel supplied by pipeline. The minimum average daily pipeline volume transported to a major Australian airport is approximately 2.8ML (Perth International Airport). This equates to 1BL per annum.
- Pipelines and trucks are both important modes of jet fuel supply and they are required to support an airport's growth at different stages of its development. Multiple supply modes from multiple seaboard terminals make sure that there is supply diversity. This strengthens the resilience of the jet fuel supply chain and minimises the risk to security of supply.
- It is common for airports to be supplied with jet fuel only by road until the demand reaches a level that supports the large capital investment required to build a jet fuel pipeline.
- The forecast jet fuel demand for WSA is 570ML per annum in 2031 and 2.82BL per annum in 2051. This assessment of jet fuel demand was undertaken prior to WSA Co having an opportunity to undertake its own assessment.
- The Sydney basin terminals at Port Botany and Clyde import jet fuel from large-scale export refineries in northern Asia through port facilities located at Gore Bay (Sydney Harbour), Port Botany and Kurnell. Jet fuel supplied to WSA from these terminals will need to be cost-effective to capitalise on supply chain efficiency — this includes cost-effective and appropriately sized on-airport fuel storage and delivery infrastructure (storage and hydrant systems).
- There is no fuel infrastructure near WSA. The closest fuel storage infrastructure with jet fuel capability is located at Clyde (near Parramatta).
- A range of factors influence the jet fuel market and jet fuel costs. These include:
    - distances from fuel infrastructure
    - accessibility to fuel infrastructure
    - industry factors, such as the actions of larger airline fleets (e.g. decisions on where aircraft are refuelled)
    - volumes into WSA and KSA
    - several supply chain factors.

2.1 Australian international airports

The current jet fuel supply operating environment of the larger Australian airports has been assessed to better understand the requirements and likely supply chain issues that could affect WSA.

Nine major Australian airports are categorised as large because of their number of aircraft movements, passengers and jet fuel volume (Table 1). Four of these airports receive jet fuel into on-airport storage by pipeline — KSA, Melbourne (Tullamarine), Perth and Brisbane. Seven of these airports are supplied with jet fuel by road transport, including two of the airports that primarily receive jet fuel by pipeline.

There are six jet fuel pipelines in Australia that supply the four largest Australian airports (Table 2). Brisbane and KSA are both supplied by two pipelines, while Melbourne and Perth are each supplied by one pipeline. The inland airports of Melbourne and Perth are supplied with jet fuel by a 36km long pipeline and a >52km long pipeline, respectively.

Table 1: Current jet fuel delivery arrangements at large Australian airports

Airport	State	Total aircraft movements FY 2015–16 (BITRE)	Total passengers FY 2015–16 (BITRE)	Jet fuel volume FY 2015–16 (MLpa)[23]	Pipelines (number)	Estimated average daily pipeline volume (ML/day) (Fueltrac)	Average fuel truck movements per day (Fueltrac)
KSA	NSW	314,352	41,090,678	3285	2	8.8	8
Melbourne	Vic	234,789	33,704,854	1785	1	3.8	21
Brisbane	Qld	192,917	22,320,178	1106	2	3.0	0
Perth	WA	94,747	12,558,276	1030	1	2.8	0
Adelaide	SA	78,695	7,777,747	320	0	0	17
Gold Coast	Qld	41,370	6,273,682	220	0	0	12
Canberra	ACT	37,147	2,814,717	22	0	0	1
Darwin	NT	27,129	2,041,309	150	0	0	5
Townsville	Qld	25,255	1,530,381	45	0	0	2

Source: Jet fuel at selected Commonwealth leased airports, Fueltrac, 2017

Table 2: Current jet fuel pipelines supplying Australian airports

Airport	Pipeline owner	Start	Finish	Products	Distance to seaboard terminal (km)
Sydney	Caltex	Kurnell	Sydney Airport	Dedicated jet fuel pipeline drawing from Kurnell and Port Botany terminals	17
Sydney	Viva Energy	Clyde	Sydney Airport	Dedicated jet fuel pipeline drawing from Viva Energy terminal at Clyde	25
Melbourne	Viva Energy/ Exxon Mobil/BP	Somerton	Melbourne Airport	Dedicated jet fuel pipeline drawing from Somerton terminal. The Somerton terminal is supplied by pipeline from seaboard terminals in the Port of Melbourne and the Port of Geelong	36
Brisbane	Caltex/Viva Energy	Pinkenba	Brisbane Airport	Dedicated jet fuel pipeline supplied either by the Caltex Lytton refinery or imports	8
Brisbane	BP	Bulwer Island	Brisbane Airport	Dedicated jet fuel pipeline supplied by imports from North Asia	4
Perth	BP	Kewdale	Perth Airport	Dedicated jet fuel pipeline drawing from the Kewdale terminal. The Kewdale terminal is supplied by pipeline from the Kwinana Refinery	52

Source: Jet fuel at Commonwealth leased airports, Fueltrac, 2017

[23] Fueltrac, Import Parity Indicator Price (IPIP) Reports, 2015/16.

Multiple modes of jet fuel supply from multiple seaboard terminals adds supply diversity and strengthens the resilience of the supply chain. Reliance on a single transport mode or single terminal adds supply chain risk and weakens supply chain resilience.

Rail is not considered to be a cost-effective supply option for jet fuel to Australian international airports as there are no rail-head facilities at any major Australian seaboard fuel terminals or on-airport storage facilities. Rail is also likely to be a high fixed-cost operation with little opportunity to achieve a cost-competitive solution in the foreseeable future, because of the relatively short distance between the port facilities in the Sydney region and the WSA site; the need to extend the rail network and dedicated terminal infrastructure at both ends; and the need for a dedicated fleet on the route.

As a result, truck and pipeline supply are likely to remain the two most cost-effective supply modes for jet fuel to Australian airports.

Pipeline and road transport have both proven to be safe, efficient and low-cost methods of jet fuel supply in Australia. They are important to securing jet fuel supply at any international airport. This is particularly the case at airports that refuel medium and long haul international aircraft, which cannot tanker enough jet fuel to forgo refuelling at their initial destination.

No Australian airport with a jet fuel demand of less than 2.8ML per day, equivalent to 1BL per annum, receives jet fuel into on-airport storage via a jet fuel pipeline.[24]

It is common for airports to receive jet fuel by road until demand reaches a level that supports the large capital investment in a pipeline. Adelaide Airport has nearly eight million passengers per year, the equivalent to WSA's projected service in 2030. It is investigating the pipeline supply of jet fuel to account for expected passenger increases and increases in jet fuel demand but this decision is reportedly still some years away.

Even with a dedicated jet fuel pipeline, the supply of jet fuel by road is needed to diversify supply methods, as is the case at KSA and Melbourne Airport. Diversity of supply is critical as it:

- mitigates the risk of jet fuel supply disruption caused by a single point failure in the pipeline (e.g. Auckland Airport (Figure 8) or an unplanned maintenance event
- provides a low-cost option of supplementing demand that cannot be met by a pipeline (e.g. Melbourne Airport) without the need for further capital investment in a new and or larger pipeline.

Figure 8: Pipeline disruptions impacting airport operations

Auckland Airport

This example shows that relying solely on piped jet fuel may not be suitable.

Auckland Airport receives jet fuel via a 168km pipeline from New Zealand's sole refinery at Marsden Point. On Thursday 14 September 2017, New Zealand's jet fuel pipeline was ruptured causing major issues for the Auckland Airport and motorists. Excavation machinery struck the pipe and created a 20cm tear that caused the rupture.

The flow from the refinery was shut off within 15 minutes but even after interim pipeline repairs were carried out, jet fuel flow had reduced by 30 per cent. Consequently, many airlines operating out of Auckland were forced to postpone or cancel their scheduled flights. Auckland Airport relies on its pipeline for all jet fuel deliveries as it does not have the facilities to accept jet fuel supply by road.

Approximately 27 domestic and international flights were cancelled over the weekend and a number of others were redirected to other airports to refuel. Auckland Airport cancelled more than 100 flights during this period.

Source: Newshub, 2017; Sydney Morning Herald

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[24] Fueltrac, Import Parity Indicator Price (IPIP) Reports, 2015/16.

2.2 Sydney basin demand

When the Shell Clyde and Caltex Kurnell refineries were closed and converted into large-scale, efficient import terminals, jet fuel became a fully imported product into the Sydney basin terminals.

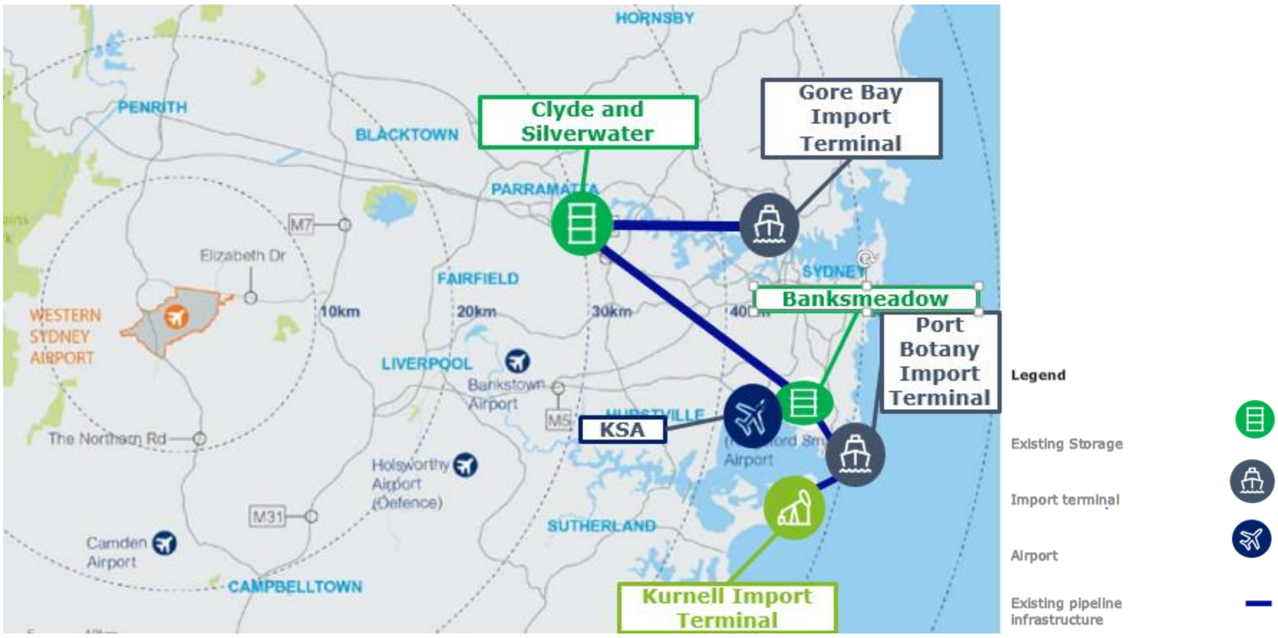
It came through port handling facilities at:

- Caltex — Kurnell
- Vopak — Port Botany
- Viva Energy — Gore Bay, Sydney Harbour (for pipeline transfer to Clyde).

KSA is the primary source of demand for jet fuel imported through the Sydney basin terminals (Figure 9). Approximately 3.55BL of jet fuel was imported through the Sydney basin terminals during 2015 to 2016, according to petroleum statistics. About 3.3BL of the total volume was consumed by aircraft using KSA.[25] International airlines accounted for 2.3BL, or approximately 70 per cent, of KSA jet fuel demand.[26]

Other airports that drew more than 0.01BL per annum demand from Sydney basin terminals at Port Botany (Caltex at Banksmeadow and Vopak at Port Botany) and Clyde (Viva Energy) were RAAF Williamtown, Canberra Airport and RAAF Richmond[27]. The jet fuel demand of other individual general aviation or RAAF airports in NSW, supplied from Sydney basin fuel terminals, is understood to be less than 0.01BL per annum per airport.

Figure 9: KSA jet fuel supply chain



Source: Deloitte, Fueltrac, 2017

Jet fuel is transferred from the Sydney basin terminals at Clyde, Kurnell and Port Botany to KSA by pipeline and road. Road transport movements constitute an estimated 3 per cent of total supply volumes (equivalent to approximately 100ML per annum) due to the capacity of the on-airport storage facility at KSA to receive jet fuel by truck. The remaining 97 per cent of KSA's jet fuel supply occurs via one of two pipelines — the Viva Energy pipeline from Clyde (approximately 25km) and the Caltex pipeline from Kurnell (approximately 17km) and Port Botany (approximately 10km). The Viva Energy Clyde pipeline pumps approximately 5ML per day, while the Caltex pipeline pumps approximately 9.6ML per day at Kurnell or 8ML per day via Vopak, Port Botany.[28]

Jet fuel from large-scale export refineries in north Asia can be efficiently imported into the Sydney basin terminals at Clyde, Kurnell and Port Botany. This is possible because of their large size and ability to exploit deep-water draft benefits to receive long range (LR) product tankers. Jet fuel can then be distributed from

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[25] Fueltrac, Import Parity Indicator Price (IPIP) Reports, 2015/16.
[26] Information sourced from the Department of Environment & Energy at http://www.environment.gov.au/energy/petroleum-statistics.
[27] Source: RFT FSB DFS 001 – 2015 sourced via Austender at www.austender.gov.au.
[28] National Competition Council consideration of the declaration of the Caltex jet fuel pipeline 2011/12 accessed at www.ncc.gov.au.

Sydney basin terminals at a lower cost than is possible at most other Australian ports (Figure 11) contributing towards a lower overall fuel cost than at other airports.

In the context of WSA, there is potential for lowering fuel delivery costs by joining existing infrastructure and/or easements servicing KSA to any new (but separate) jet fuel pipelines and/or spurs to WSA. This has the potential to ensure WSA is able to derive some cost savings at the port importation point despite it being some distance from the seaboard port terminals receiving fuel imports.

A safe, efficient and low-cost method of transporting jet fuel from these terminals into on–airport storage will be needed to capitalise on the efficiency of the existing supply chain and ensure a competitive and reliable supply. A pipeline will be needed to achieve low costs at WSA, assuming that jet fuel demand grows in line with the forecasts outlined in the WSA EIS, Airport Plan and modelling undertaken for this report. The pipeline options analysed in this report take this supply chain into consideration.

Operational life of existing pipeline network

Fuel industry representatives indicated that the existing network is regularly maintained and has no longevity issues. Regulatory requirements ensure that each pipeline is reviewed every five years. It is anticipated, based on regular monitoring and maintenance, that the existing network will have at least 40 more years of operational life before new and greater investments are needed. From industry's point of view, all pipelines across Sydney should be in a similar state as they are bound by the same testing regimes.

2.3 Current network of fuel pipelines and terminals in Sydney

In addition to large-scale efficient import terminals at Clyde, Port Botany and Kurnell, the Sydney basin also has a network of fuel pipelines extending from Port Botany, Kurnell and Gore Bay in the east to the Clyde and Silverwater terminals in central Sydney.

The Kurnell import terminal and Banksmeadow terminal connect to Silverwater terminal storage tanks via the Sydney Metropolitan Pipeline (SMP). The Vopak, Port Botany terminal is also connected into the SMP via a short interconnecting pipeline. The SMP transfers gasoline and diesel from seaboard terminals at Port Botany to the Silverwater terminal in western Sydney.

The Sydney Newcastle Pipeline (SNP) travels west from Silverwater to the Plumpton pumping station before heading north to Newcastle. This pipeline transports gasoline and diesel to Newcastle (Figure 10).

The forecast decline in gasoline demand due to changes in the passenger car fleet over time (such as the increase in hybrid and fuel cell vehicles, and improved fuel efficiency across the fleet) could lead to more capacity on the existing SMP and SNP pipelines, which could be used to supply jet fuel to western Sydney.

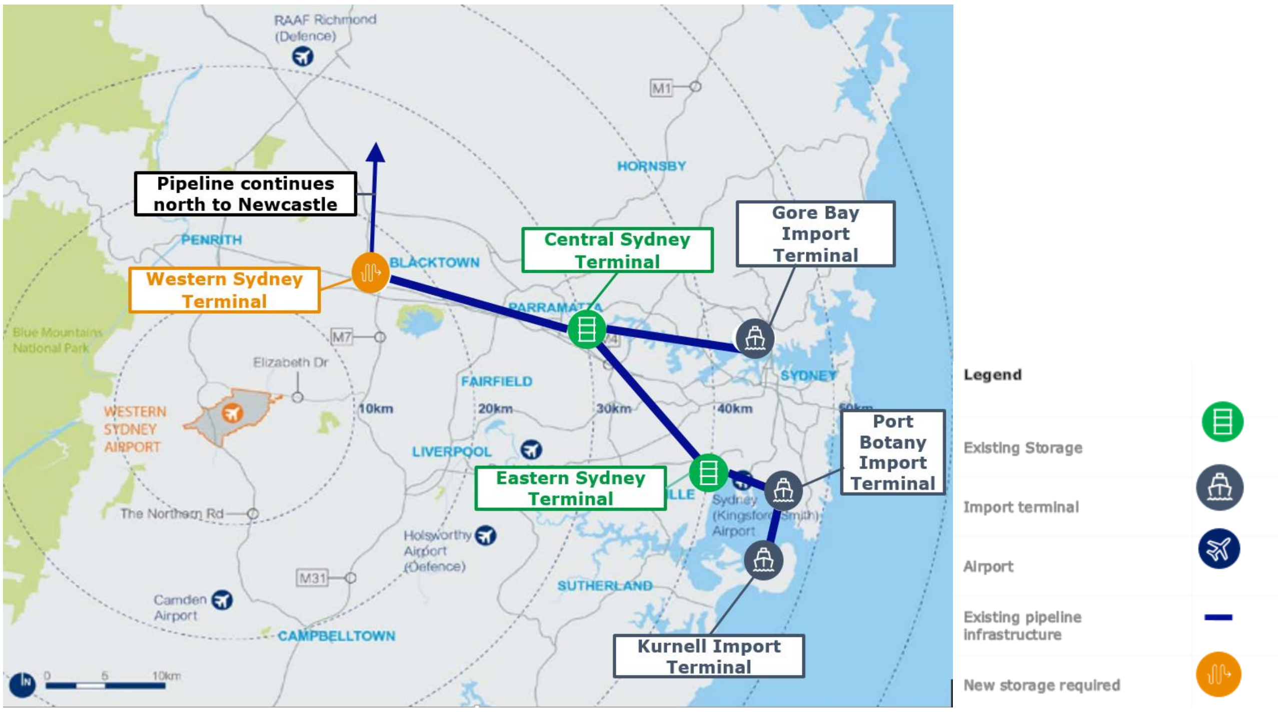
Adaptability of existing pipeline network

Stakeholder representatives identified that the existing network could adapt to ensure appropriate jet fuel storage for KSA and WSA, when WSA becomes operational in 2026. The existing pipeline network, including multi-product and dedicated jet fuel pipelines, could adapt to the new industry environment, depending on the demand for fuel (of all types) if there are changes in the licensing conditions and a full safety review is undertaken.

As both the SMP and SNP are multi-product pipelines, they will not be able to supply WSA directly. Instead, an intermediate storage depot would need to be constructed along the SNP to manage product interfaces and recertify and store jet fuel before it is transferred to a WSA dedicated jet fuel pipeline.

This option is evaluated within this report along with alternate options, such as the construction of a dedicated pipeline from the Clyde and Silverwater terminals and a dedicated jet fuel pipeline connection from Port Botany terminals to on-airport storage at WSA.

Figure 10: Existing network of fuel pipelines and terminals across Sydney



Source: Deloitte, Fueltrac, 2017

2.3.1 Off-airport jet fuel storage

It is operationally and financially preferable for on-airport storage and hydrant lines to supply jet fuel to WSA aircraft, because of WSA's geographic location relative to the seaboard terminals. In international case studies where aircraft are directly supplied by off-airport storage, the seaboard terminals are adjacent to the airport and generally closer to the aircraft than an alternative on-airport storage facility.

The stakeholder consultations confirmed that development of an off-site jet fuel storage facility, or development of a new fuel terminal was not the industry's preference. The existing large storage terminals, which have undergone or are undergoing major refurbishment, already exist in western Sydney negating the need for additional and specific investment. Industry confirmed that the existing infrastructure has some capacity to expand and account for WSA's additional jet fuel requirements. New storage infrastructure investment costs would be significant and a new off-airport storage facility is likely to be uneconomic, compared to on-airport storage, because of WSA's distance from seaboard terminal storage sites.

2.4 Competitive costs of jet fuel

The Board of Airline Representatives of Australia (BARA) describes three objectives to deliver a competitive jet fuel supply at Australia's major international airports. On behalf of their members, BARA stated that airports should provide:

- open and competitively priced off-airport storage facilities
- open access to existing jet fuel pipelines or, where necessary, new independently owned pipelines
- on-airport storage and distribution facilities that enable a competitive and reliable jet fuel supply[29].

2.5 Infrastructure charges likely to impact airports in Sydney

The infrastructure charges for jet fuel from an export refiner in north Asia delivered into on-airport storage at KSA, Melbourne Airport and WSA (if it were operational in the 2015 to 2016 financial year) have been modelled (Figure 11).

[29] BARA, 2017 https://bara.org.au/publications/.

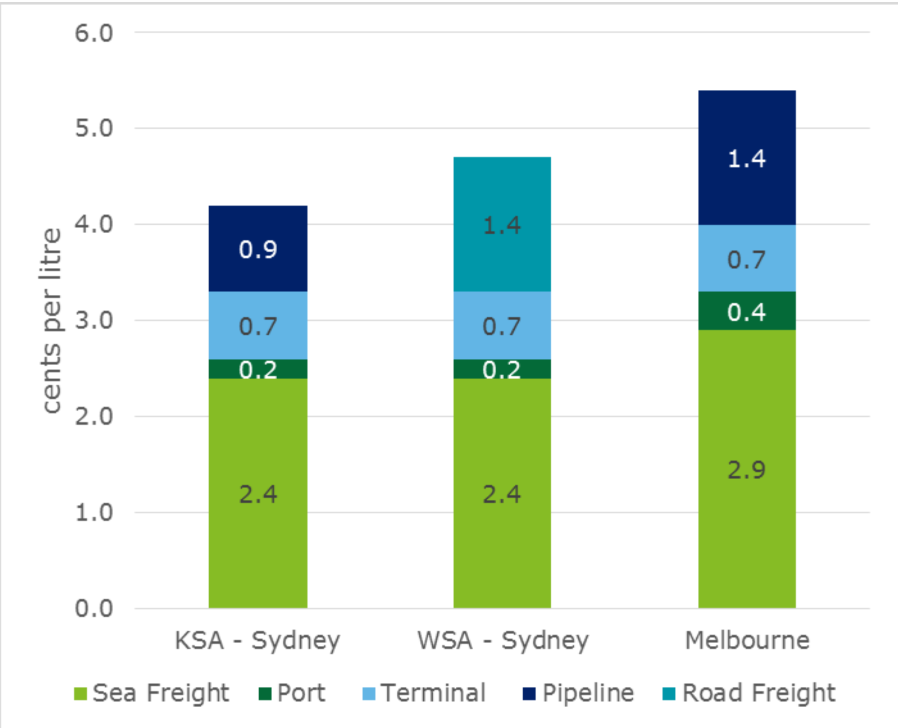
The comparisons are made on a cent per litre basis and include the:

- costs of shipping jet fuel in 80,000 tonne long range vessels into Sydney basin terminal storage and shipping jet fuel in 35,000 tonne medium range vessels into Port of Melbourne terminal storage[30]
- port charges (from the 2015 to 2016 financial year) for bulk liquids in Sydney and Melbourne ports
- benchmark terminal cost for an efficient large-scale terminal receiving regular jet fuel imports by product tanker across its berths[31]
- benchmark pipeline costs for transporting jet fuel from Sydney basin terminals to KSA jet fuel storage (which is based on the marginal litre rate for trucking jet fuel between Port Botany terminals and KSA)
- benchmark pipeline cost for transporting jet fuel from the Port of Melbourne terminals via the Somerton and Tullamarine pipelines to Melbourne Airport jet fuel storage
- benchmark road freight charges for transporting jet fuel from Port Botany terminals to the proposed WSA site using the current road network.

The following were excluded from the analysis:

- The ex-refinery north Asian price of jet fuel (equivalent to the locations modelled)
- Insurance/loss and cost of credit (equivalent to the locations modelled)
- On-airport storage and distribution costs via the hydrant network
- Airport levies, throughput fees, excises and GST.

Figure 11: Infrastructure charges for jet fuel delivered into on-airport storage (for the 2015 to 2016 financial year)



Source: Fueltrac Import Party Indicator Price (IPIP) Reports 2015/16

If road freight transport is used during Stage 1 of the WSA development, then the infrastructure cost for delivery into on-airport storage at WSA will be approximately 0.5 cents per litre (cpl) above KSA but

[30] Fueltrac, Import Parity Indicator Price (IPIP) Reports, 2015/16.
[31] Fueltrac, Import Parity Indicator Price (IPIP) Reports, 2015/16.

approximately 0.7cpl below Melbourne Airport (Figure 11) based on the marginal litre rate from Port Botany to WSA rate.

The airport operator will need to make sure that on-airport storage and distribution costs via the hydrant network are comparable to those at KSA and Melbourne Airport to maintain this comparative position for delivery of jet fuel into-plane.

The geographic distance between WSA and the Sydney basin supply terminals relative to KSA, will place WSA at a theoretical 0.5cpl jet fuel price premium (Figure 11) when compared to KSA (although KSA currently charges airlines an airport fuel levy which effectively reduces the theoretical premium).

2.6 Jet fuel supply for WSA

In WSA's initial operational phase, supplying jet fuel by road is likely to be more efficient. Indicative WSA flight schedules forecast that by 2031 there will be approximately:

- 72,700 aircraft movements per annum
- 10 MAP
- 570ML of jet fuel demand per annum (Figure 2)[32].

In this case WSA would have slightly higher passenger numbers and jet fuel demand than Adelaide airport currently and slightly lower numbers than Perth airport today.

By 2051, the synthetic flight schedule forecast is for approximately:

- 216,810 aircraft movements per annum
- 37 MAP
- 2820ML of jet fuel demand per annum (Figure 2).

This would give WSA slightly higher passenger numbers and jet fuel demand than at Melbourne airport currently and slightly smaller numbers than KSA today.

2.7 Timing of a jet fuel pipeline for WSA

If a pipeline was built too early in WSA's development, or the pipeline was monopolised and not open access, then transportation costs to WSA by pipeline would likely be higher than the marginal per litre road transport rate from Port Botany to WSA. This has the potential to discourage Sydney basin terminals from using the pipeline and encourage them to use trucks. In the event that supply by road transport was restricted in favour of pipeline supply and/or the pipeline rate becomes the marginal litre rate, then the:

- cost of supply from Sydney basin terminals would increase
- local infrastructure charges (Figure 11) for WSA would increase
- price competitiveness of WSA relative to KSA and Melbourne Airport would diminish.

Consequently, fuel costs could reduce the number of international flights using WSA and increase the level of fuel tankering that occurs on shorter haul domestic flights.

[32] Details of how the annual fuel demand profile was estimated for WSA is contained in Section 4.

3 Consultations and case studies

Key points

- More than 30 organisations across a range of industry sectors were consulted along with representatives from the NSW Department of Premier and Cabinet and other key NSW Government agencies specified by the NSW Department of Premier and Cabinet.
- Case studies of four Australian airports (Canberra, Gold Coast, Adelaide and Melbourne) were undertaken to assess how WSA could be supplied with jet fuel at different Stage 1 operational levels.
- Three main themes were identified across the consultations and case study research.
    - A general recommendation for the early preservation of at least one pipeline corridor to service WSA. Corridor preservation should start well before the pipeline will be required (based on economic grounds) to service WSA. Pipeline planning, approval, development and construction time should be taken into account when timing corridor preservation.
    - Jet fuel costs at WSA, including jet fuel related fees and charges, should be comparable to KSA jet fuel costs. This would provide an added incentive for airlines to use WSA, as an alternative to, or in conjunction with, KSA.
    - Investment in jet fuel infrastructure needs to occur before it is needed, to cater for future growth of the airport and the region.
- Other key findings that came from these consultations and case studies.
    - A pipeline would not be required at the start of services at WSA in 2026, based on the anticipated jet fuel volumes required in its early stages of operation.
    - There are no current plans to close or relocate the existing Sydney basin delivery points at Gore Bay, Port Botany and Kurnell, and terminals at Clyde and Silverwater in the short to medium term. It should be assumed that the status quo will remain when planning a WSA pipeline.
    - Any fuel delivery system, both to and at WSA, needs to be designed specifically for jet fuel.
    - There was a strong preference to use the existing infrastructure and easements wherever possible. The existing terminal infrastructure in western Sydney should be used in order to minimise the distance required for a pipeline/corridor. This view was expressed by a range of stakeholders beyond those that currently owned or operated parts of the existing infrastructure.
    - On-site storage at the airport is essential (JUHI or similar) to allow a better response to any problems associated with supply to the airport.

3.1 Consultation with WSA fuel supply stakeholders

3.1.1 Overview of consultation process

Over 30 organisations across a range of sectors, who have an interest in fuel supply or associated issues at WSA or at airports generally, were consulted. These included fuel companies, airlines, airports, truck and logistics related industry groups, infrastructure owner-operators and relevant Commonwealth and NSW government agencies (Appendix B). These consultations were undertaken to understand stakeholder perspectives, industry operating environments and also, where possible, substantiate existing assumptions about WSA fuel supply. Owing to the commercial sensitivity of much of the information provided by stakeholders, information has been consolidated on an industry and/or sector basis where required.

Consistent views and themes were put forward by the diverse range of stakeholders. This enabled this report to capture the generally held views when identifying fuel corridor options to support WSA jet fuel delivery. Specifically, the information received during these consultations was used to:

- conduct a stocktake on the industry and arrangements at Australia's major airports, including Sydney's supply chain
- identify corridor options
- identify what is required to ensure jet fuel supply diversity
- consider corridor size, location and environment
- determine when a pipeline will be needed to replace the bulk of road transport deliveries
- assess the options, economically and financially.

3.1.2 Consultation methodology

A set of common questions (Appendix C) were developed to ensure a consistent approach with all industry respondents and tailored questions to each category of stakeholder (e.g. airlines, airports, fuel companies and industry associations). Stakeholders that would be directly or indirectly impacted were asked to provide comments and advice on the delivery of jet fuel to WSA. Stakeholders from government agencies were also consulted to provide advice on planning and approval processes and considerations. This included working in collaboration with TfNSW and the Department of Premier and Cabinet to satisfy Condition 26 of the WSA Airport Plan.

Phase one of the consultation involved a series of one-on-one meetings with key industry stakeholders. Follow up questions were supplied to representatives from these organisations to maintain ongoing dialogue and encourage the sharing of information and feedback beyond the consultation sessions.

Phase two of the consultation involved providing each stakeholder an opportunity to discuss their feedback further and provide advice on information to be used in the report. The Department sought stakeholder approval prior to using the information supplied in this report.

3.1.3 Common themes and key messages

Stakeholders suggested that infrastructure (both on-site and off-site) should be built to meet WSA's future growth and extended to consider fuel supply requirements in western Sydney generally. Preserving a corridor for a dedicated jet fuel pipeline (even though it may be a future investment) was viewed as a priority. This would ensure the pipeline corridor is available when jet fuel demand reaches the level that would justify investment in a WSA pipeline by commercial interests.

Fuel company representatives noted that industry investment in pipeline infrastructure would only occur when it becomes more economical to transport fuel via pipeline than via truck (when critical mass volumes are attained to justify significant capital expenditure). However, they all agreed that a pipeline corridor and proposed route should be discussed by the relevant key interest stakeholders (fuel sector, infrastructure owner/operators, Commonwealth Government and NSW Government) in the short term as a matter of priority. This would allow sufficient time for planning controls and regulatory requirements.

Key messages from stakeholder groups included:

- They preferred open access to fuel infrastructure for all industry participants. This would encourage equal access rights and costs to pipeline infrastructure and enable increased jet fuel price competition across the sector.
- A designated pipeline to WSA will not be used unless the overall costs for using the pipeline is comparable to, or more competitive than, trucking costs.
- Connect a designated pipeline to WSA into the existing fuel supply infrastructure, such as easements, pipelines and terminals, where possible. This would minimise the distance required for a pipeline and therefore capital investment costs. This is particularly important in the Sydney context where the supply chain exists in eastern Sydney and services KSA. Investment in the pipeline would be commercially viable sooner if less capital expenditure is required. This view was expressed by a range of stakeholders beyond those that currently owned or operated parts of the existing infrastructure.

- Any pipeline to WSA must be designed and constructed as a dedicated jet fuel pipeline to: avoid the risk of jet fuel contamination; minimise jet fuel waste (and subsequent transportation and re-refining costs); and ensure priority access for jet fuel supply. However, it was agreed that a dedicated jet fuel pipeline could be located within a multi-product pipeline corridor.
- WSA jet fuel costs, including jet fuel-related fees and charges, should be the same or cheaper than those at KSA: this would provide an added incentive for airlines to use WSA, either as an alternative to, or in conjunction with, KSA.
- Diversity in WSA jet fuel delivery is critical to ensure the minimum risk to supply in the event of a supply chain disruption and to handle fluctuations in jet fuel demand.

The fuel industry sector generally agreed that a pipeline should:

- provide open access for all suppliers
- be built a time when it can introduce costs that are equivalent to, or less than, road transport costs
- leverage the existing jet fuel infrastructure network (pipelines, easements and delivery terminals) and supply chains that currently service KSA. This will minimise capital costs for new infrastructure but could also enable earlier investment in a pipeline to WSA and lower jet fuel prices earlier in WSA's operational life
- ensure diversity of supply for WSA.

Airline and airport organisations noted that jet fuel infrastructure planning should consider:

- long-term development plans for jet fuel related infrastructure (pipelines, storage facilities, hydrant systems etc.) at WSA. These should consider and meet, where possible, anticipated aviation demand/growth and short term requirements
- reserving a pipeline corridor as a matter of priority. This will enable future development of pipeline infrastructure at an appropriate time when a critical mass for jet fuel demand is reached. At this time a reduced reliance on road transport will be justified and a guaranteed return on investment can be achieved.

Government organisations suggested considering the following:

- preservation of the corridor(s) and the timing for its identification and reservation
- open access to the infrastructure for all fuel suppliers
- diversity of supply to ensure a reliable supply of jet fuel to WSA.

A summary of the key themes and frequency of topics discussed during consultation can be found in Table 3.

Table 3: Main themes from WSA consultation

Main themes	Topic covered in discussions (Total number of times)
Preserve the corridor	8
Open access	9
On-airport infrastructure to be owned by the airport and independently operated	5
Costs of pipeline need to be competitive with trucking	4
Build airport infrastructure to meet future growth	7
Connect WSA pipeline into existing infrastructure	6
Dedicated jet fuel pipeline to WSA	6
WSA fees/charges must be less than or equal to KSA fees and charges	3
Diversity of supply	7
Planning times for pipeline and upgrades are excessive	8
Very few (or no) specific complaints have been received relating to fuel trucks delivering fuel to airports (airports, fuel companies etc.)	5
Consider wider uses for pipeline prior to being dedicated jet fuel line (i.e. diesel)	4
Industry need security if they are to invest in infrastructure	5
Congestion issues of trucking	5

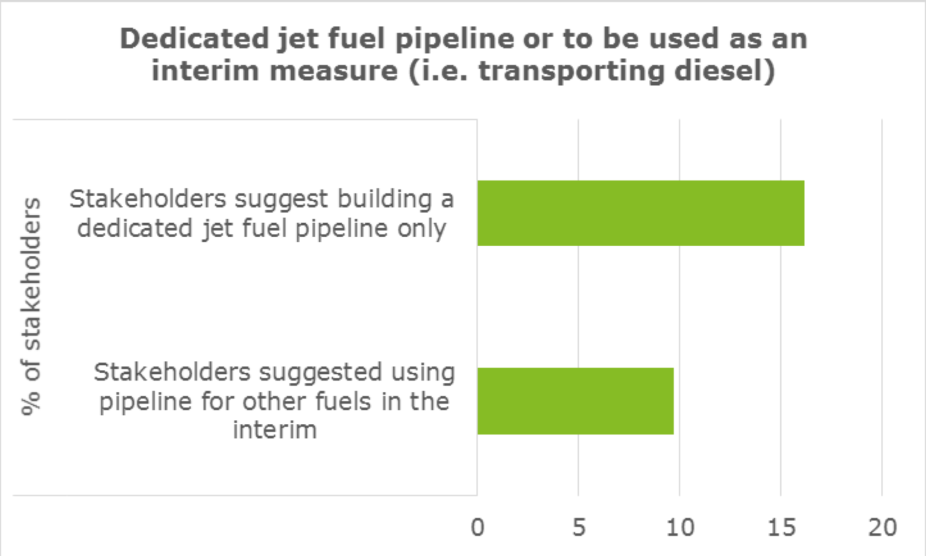
Source: Deloitte analysis

Some industry stakeholders from various sectors suggested building a pipeline that could be used for other fuel product transportation in the short term. It could then be converted to a dedicated jet fuel pipeline when operations begin at WSA or when jet fuel demand reaches the level where the construction and operation costs could provide a return on capital investment. This was not a widely held view (Figure 12). Other stakeholder groups noted the operational and supply risks associated with a pipeline designed for one purpose and used for another in the interim, including the specific design elements of a jet fuel supply system compared to a ground fuel (gasoline, diesel, etc.) based pipeline system.

Other reasons for a dedicated jet fuel pipeline included the:

- additional costs associated with converting the delivery system
- potential risks to jet fuel quality
- potential for increased waste during periods of product changeover and subsequent quality verification and recertification costs.

Figure 12: Dedicated jet fuel pipeline vs. multi-product pipeline



Source: Deloitte analysis

3.2 Case studies — Australian airports

Following the stakeholder consultations and an assessment of WSA's expected size in the early stages of its operation, the project team selected a number of airports to compare aircraft movements and jet fuel demand. These airports included:

- Canberra Airport
- Gold Coast Airport
- Adelaide Airport
- Melbourne Airport

These airports represent the potential different development phases of WSA over time and their key parameters are listed in Table 4.

Table 4: Comparisons between Canberra, Gold Coast, Adelaide and Melbourne airports

Parameter	Canberra	Gold Coast	Adelaide	Melbourne
Aircraft movements (FY 2015–16)	37,147	41,370	78,695	234,789
Passenger numbers (FY 2015–16)	2,814,717	6,273,682	7,777,747	33,704,854
Jet fuel demand ML (FY 2015–16)	22	220	320	1785
Supply terminals (number)	3	2	2	3
Jet fuel local differential (cpl)	20	8	7.6	6.9
Supply mode	Truck	Truck	Truck	Truck/pipeline
Average trucks/day (FY 2015–16)	1	12	17	21
Pipeline model	Nil	Nil	Nil	Oil Company JV
Distance from supply terminal (km)	280	113	15 to 20	45
On-airport storage volume (ML)	0.7	3.8	7	6.8
On-airport days cover	11.6	6.3	8.0	1.4
Fuel infrastructure fees	Recovered by airport levy in fuel price	Recovered by supplier in fuel price	Recovered by airport in aeronautical charges	Recovered by airport levy and supplier in fuel price
Hydrant model	Nil	Oil Company JV	Airport Owned	Oil Company JV

Source: BITRE and Fueltrac

Canberra Airport and Gold Coast Airport are unlikely to be supplied by pipeline. This is because of their distance from the nearest seaboard supply terminal and the prohibitive cost of constructing pipelines of over 100km for airports of this size.

Adelaide Airport is close to seaboard terminal storage and is currently investigating pipeline supply.

Melbourne Airport is supplied by pipeline and road transport — it relies on road transport to supply up to 40 per cent total jet fuel demand.

The following case studies provide additional context on the challenges associated with both on-airport and off-airport jet fuel demand and infrastructure.

3.2.1 Canberra Airport

Canberra Airport's jet fuel demand was approximately 22ML per annum in the 2015 to 2016 financial year. Canberra Airport provides services for predominantly short haul domestic flights to and from Sydney, Adelaide, Melbourne and Brisbane but some longer haul domestic routes also use the airport. Typically, short haul flights tanker jet fuel to avoid paying the higher jet fuel prices at Canberra Airport. Since 2016, Canberra has secured international flights that transit via Canberra enroute to Wellington and Singapore. An additional international service to Qatar (via Sydney) will commence in February 2018. Long haul flights are supplied with jet fuel from Canberra's on-site fuel farm to enable them to safely reach their forward destination. The jet fuel is supplied using on-site refuelling trucks rather than a hydrant system.

Canberra Airport invested in the on-airport storage facilities so they could manage jet fuel infrastructure upgrades to meet aviation demand, rather than rely on oil companies to determine when the investment met their internal hurdle rates. While Canberra Airport owns the infrastructure, they have appointed an experienced oil industry player to operate and maintain it in accordance with best industry practice. Caltex is the current operator of the on-airport storage and into plane facilities at the airport.

Jet fuel is currently supplied by road from either the Banksmeadow (Caltex) or Clyde (Viva Energy) terminals in Sydney.

Fuel Infrastructure Fees at Canberra Airport are recovered through an airport levy or throughput fee which is added to the price of jet fuel.

3.2.2 Gold Coast Airport

Gold Coast Airport (GCA) is the sixth-busiest airport in terms of passenger numbers in Australia. The airport's jet fuel demand was approximately 220ML per annum during the 2015 to 2016 financial year. The airport attracts domestic short haul, international short haul (i.e. to New Zealand) and international long haul (i.e. to Asia) services. More passengers have been attracted to GCA since low-cost long haul carriers began operating and flying into the airport.

GCA currently receives all of its jet fuel by road. Jet is supplied from fuel terminals at the Port of Brisbane from either Caltex, at the Lytton Terminal, or BP, at the Bulwer Island Terminal. Approximately 12 B-double trucks deliver jet fuel to the airport on an average day. The airport is approximately 113km from Brisbane.

Jet fuel is not supplied by pipeline because the annual jet fuel volume does not justify investing in a pipeline of over 100km. The airport has appointed Caltex as Joint User Hydrant Operator (JUHI) and BP is the other member. Fuel infrastructure fees are recovered through the price of jet fuel.

3.2.3 Adelaide Airport

Adelaide Airport's jet fuel demand was approximately 320ML per annum during the 2015 to 2016 financial year. Adelaide Airport is Australia's fifth-busiest airport for domestic services and sixth largest for international services — it is growing steadily.

Adelaide Airport has expressed an interest in constructing a pipeline to transport jet fuel approximately 15 to 20km to the airport from the Port of Adelaide fuel terminals. Current jet fuel volumes are inadequate to justify the required investment. If international passenger[33] numbers continue to grow and flights increase then the resulting increases in jet fuel demand could support pipeline construction in the mid-term.

Jet fuel is currently imported into two seaboard terminals at Birkenhead and Largs North. On average, 17 B-double jet fuel deliveries are made each day from the two terminals to Adelaide Airport's on-airport storage. Adelaide Airport only has two jet fuel storage tanks. This creates supply risk when the storage tanks need to be taken offline for cleaning or other maintenance work. Jet fuel is transported from the on-airport storage to aircraft by either the airport-owned hydrant lines or tanker truck.

Adelaide Airport has appointed Mobil as the on-airport storage and fuel delivery operator. The airport recovers fuel infrastructure fees via aeronautical charges applied to all Adelaide Airport flights rather than through the price of jet fuel.

3.2.4 Melbourne Airport

Melbourne Airport consumed more than 1.7BL of jet fuel in the 2015 to 2016 financial year. Melbourne Airport currently has 6.8ML of on-airport jet fuel storage. Additional on-airport storage is forecast for installation and commissioning in 2019.

There are two refineries operating in Victoria — Exxon Mobil in Altona and Viva Energy in Geelong (formerly Shell).

- The Viva Energy refinery is connected to the multi-product Viva Energy pipeline which is used to transport finished jet fuel from Geelong (both imported and locally refined product). The Viva Energy pipeline takes the fuel to Viva's terminal facilities in Newport. The Viva Energy terminal facilities are connected to the Somerton JV pipeline. Viva also uses trucking from Newport to Melbourne Airport.
- The Exxon Mobil Altona refinery is connected into the Somerton JV Pipeline. A planned 2.7km pipeline connection from the Mobil Yarraville terminal to the Somerton JV Pipeline has been announced.[34]

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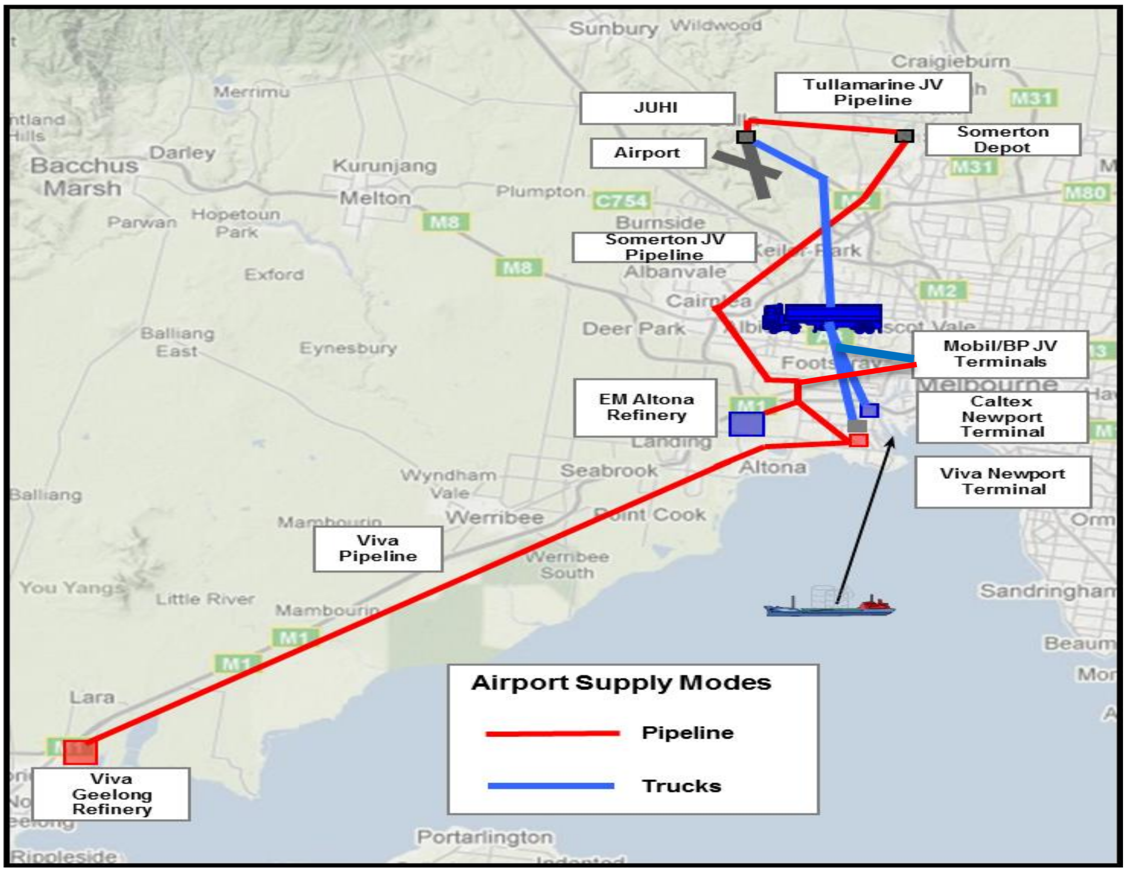
[33] Between 2009 and 2013, passenger flight demand at Adelaide Airport grew 29 per cent. Source: Adelaide Airport Master Plan 2015.
[34] Information accessed at http://www.exxonmobil.com.au/en-au/company/news-and-updates/news-releases-and-alerts/mobil-to-construct-pipeline-to-improve-jet-fuel-supply-for-melbourne-airport.

- The Somerton Pipeline has a capacity of approximately 11ML per day. This pipeline is reported to be owned by an unincorporated JV between Exxon Mobil (37.5 per cent), Shell (18.75 per cent), BP (18.75 per cent) and Colonial (25 per cent).
- The Somerton Depot is located to the east of the airport and was originally designed as a multi-product storage facility, however it is now solely used as intermediate storage for jet fuel. The Somerton Depot is reported to be owned by another unincorporated JV between Exxon Mobil (50 per cent), Shell (25 per cent) and BP (25 per cent). Jet fuel is transferred from the depot to the Tullamarine Pipeline which is owned by the same parties.
- The Tullamarine Pipeline has a theoretical maximum capacity of approximately 4.5ML per day[35], although the current nominal operating capacity is believed to be around approximately 3.8ML per day (Table 1).
- In addition to the two refineries which transport jet fuel to the airport by the pipelines, imported jet fuel is held in tank farms at terminals in Yarraville and Newport. Viva Energy, Mobil and Caltex each have terminal facilities and can truck jet fuel to the airport. The capacity to receive jet fuel by truck at the airport is reportedly being upgraded to a theoretical maximum capacity of approximately 3ML per day.

There are two additional import terminals in Victoria at Geelong and Hastings. Terminals Pty Ltd at Geelong has planning permission for incremental storage. Hastings is owned by United Petroleum (Figure 13).

Figure 13: Jet fuel supply modes to Melbourne Airport (includes truck supply)



Source: Deloitte analysis

3.2.4.1 Previous jet fuel supply issues

The increasing trend of red and black traffic lights at Melbourne Airport, as reported to the Commonwealth by the National Operating Committee (NOC), during the period from the 2012 to 2013 financial year to the 2016 to 2017 financial year highlights that investment in key jet fuel supply chain infrastructure in Victoria was lagging the growth in demand for jet fuel at Melbourne Airport.

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[35] Melbourne Airport Jet Fuel Demand Study for the Period to 2028; Melbourne Jet Fuel Demand Study Group.

3.2.4.2 Planned investment in key jet fuel infrastructure

Based on known planned investments in on-airport storage at Melbourne Airport, an upgrade to the bridger facility at the airport and planned investment in seaboard terminal infrastructure for jet fuel in Port of Melbourne and Port of Geelong terminals, there is forecast to be a marked improvement in the resilience of the Melbourne Airport jet fuel supply chain post the commissioning of the new infrastructure. However, jet fuel supply to Melbourne Airport remains at risk until all planned infrastructure upgrades are completed.

In addition, the upgrade to the bridger facility at the airport is a medium term supply chain solution. Based on forecast demand for jet fuel, either the bridger facilities or pipeline will need investment within five to ten years to ensure the supply issues of the past five years are not repeated.

3.3 Main findings from consultations and case studies

Three main themes were identified across the consultations and case study research.

- A general recommendation for the early preservation of at least one pipeline corridor to service WSA. Corridor preservation should start well before the pipeline will be required (based on economic grounds) to service WSA. Pipeline planning, approval, development and construction time should be taken into account when timing corridor preservation.
- Jet fuel costs at WSA, including jet fuel related fees and charges, should be comparable to KSA jet fuel costs. This would provide an added incentive for airlines to use WSA, as an alternative to, or in conjunction with, KSA.
- Investment in jet fuel infrastructure needs to occur before it is needed, to cater for future growth of the airport and the region.

Other key findings that came from these consultations and case studies.

- Stakeholders that reviewed the WSA EIS and Airport Plan confirmed that the anticipated jet fuel demand and growth at WSA is on par with the documented growth experienced at other airports around Australia.
- A pipeline would not be required at the start of services at WSA in 2026. This conclusion is based on anticipated volumes in WSA's early stages and was supported by stakeholder feedback.
- A pipeline corridor should be considered in the short term. Corridor preservation should proceed before pipeline development and construction. A dedicated jet fuel pipeline could then be constructed close to the time when the appropriate level of jet fuel demand is expected.
- Certainty (of contracts, supply, revenue and return) is required to enable investment. This applies at any point along the supply chain (fuel sector).
- Jet fuel delivery by road can adapt to demand requirements. Its use or number of trucks on the road (and potential conflicting land-uses such as fuel terminals in urban areas) will be determined by clear government policy and not commercial goodwill. On that basis it is unlikely that the existing delivery points (Gore Bay/Port Botany) and terminals (Clyde/Silverwater) will be relocated or shutdown in the foreseeable future.
- Any fuel delivery system, both to and at WSA, needs to be jet fuel specific in its design (fuel companies, airlines, airport case studies). It is less preferable (and costlier) to retrofit pipelines.
- Existing infrastructure and/or easements must be used wherever possible. The existing terminal infrastructure in western Sydney should be used to minimise the distance required for a pipeline/corridor. This could also take into account infrastructure with a high potential for redundancy in the future through changing fuel type preferences and requirements (decline in the use of gasoline).
- On-site storage of jet fuel at WSA is essential to an efficient, low-cost supply that can meet the airline demand.
- Industry representatives suggest building infrastructure that will meet WSA's expected future demand.

4 Western Sydney Airport pipeline options

Key points

- A specific pipeline route from the supply point to WSA has not been considered. This would be undertaken as part of a corridor selection process.
- The corridor options assessed, consider the current operating and industry environment in Sydney, including the network of jet fuel pipelines and storage terminals that enables the safe, reliable and efficient supply of jet fuel to KSA.
- The options presented are unlikely to be mutually exclusive due to WSA's geographic position. A pipeline option is likely to be supplemented with road transport to ensure supply diversity.
- The pipeline options considered were:
  - **PP1** — includes an existing pipeline from a port in eastern Sydney to a central Sydney terminal where fuel is treated and stored, and then a new pipeline (40km) to WSA
  - **PP2** — includes an existing pipeline from a port in eastern Sydney to a western Sydney depot, where a new intermediate storage facility would be constructed to pump jet fuel via a new pipeline (25km) to WSA
  - **P1** — includes a new pipeline (60km) from the Botany Bay terminal to WSA and a new pumping facility.
- The options were informed by the stakeholder consultation process. This process was a substantial component of this report's development, which satisfies Condition 26 of the WSA Airport Plan.
- Other pipeline options may exist, but the above options were the ones the stakeholders were willing to present during this consultation process.
- The pipeline options all include dedicated jet fuel pipelines. While multiple users (jet fuel suppliers) would be able to use the pipeline infrastructure, multi-product pipelines were not considered at this stage. The additional cost of multi-product pipelines would outweigh the financial benefits gained by using the pipeline for other fuels in the short-term.
- While these options consider the existing Sydney pipeline network, these options:
  - are not mutually exclusive (and therefore it is possible a combination of the options are pursued to service WSA)
  - are agnostic to fuel supplier arrangements
  - do not consider existing commercial arrangements or future market structures.

4.1 Identifying WSA pipeline options

The WSA pipeline options were developed in the context of Sydney's industry supply chain, while acknowledging the feedback and comments shared during stakeholder consultations. Stakeholders thought that the pipeline should connect to the existing infrastructure, to lower capital costs and enhance connection with KSA and WSA. This would increase jet fuel demand across the network and lower the cost of jet fuel to WSA.

Pipeline options were considered to provide a low-cost, safe and reliable supply of jet fuel to WSA. All three pipeline options support a pipeline mode of supply when demand is economically sufficient to support investment. A road transport base case has been used to identify when the point at which a pipeline supply becomes economically feasible.

4.2 Staged jet fuel requirements for WSA

WSA Stage 1: WSA is expected to have an operational capacity of approximately 10 million regional, domestic and international passengers per year (10 MAP) along with freight traffic by 2031, five years after operations commence. It is anticipated that three jet fuel storage tanks (approximately 9ML in total) will be available to receive jet fuel on the airport site. The final layout, capacity and location of on-airport storage will be subject to detailed design and is not addressed in this report.

WSA future growth: WSA will grow in response to increased passenger demand. The ultimate airport design includes an expanded terminal and facilities, including a second parallel runway (expected around 2050) to support the expected increase in passenger demand. In the long term (beyond 2060), the airport will cater for more than 80 MAP. Jet fuel storage on-airport will be increased to ensure a minimum of three days on airport storage is maintained throughout the development of the airport.

4.3 Annual jet fuel demand estimates

The economic analysis performed as part of this report required the development of a forecast of annual jet fuel demand for WSA over the 25-year appraisal period, from 2026 to 2051. The 25-year forecast was developed by calculating the jet fuel demand at two points in the life of the airport and drawing a straight line between them to provide an annual demand profile.

This is a fairly conservative method for estimating jet fuel demand across each of the years between the two points, but given a range of factors (haulage distances, aircraft jet fuel efficiency, market dynamics and the likely aircraft types to be used) cannot be determined with certainty for 2026 and beyond, this method is a valid and robust approach. Moreover, the results are tested for sensitivity later in this report, to ensure they remain valid and robust.

The two points that were initially calculated for annual jet fuel demand were 2031 and 2052. These were chosen because there was already detailed passenger and aircraft movement forecasts, including synthetic flight schedules, available for these years from earlier work undertaken by LEK for the WSA Airport Plan and Business Case. This information was then converted to an equivalent jet fuel demand. This was done by calculating the aircraft type and destination of each aircraft movement to produce an estimate of the total jet fuel demand for these particular years (i.e. 2031 and 2052). Table 5 provides a summary of the aircraft, passenger and jet fuel demand for these two points.

A straight line was then drawn between these two points to produce the annual jet fuel demand profile for WSA (Figure 14). This profile has been extrapolated from 2031 to provide annual estimates for the earlier years from 2026 to 2030. The profile has then been truncated to remove the year 2052 because it falls outside of the 25-year economic appraisal period from 2026 to 2051. The assumptions relating to these jet fuel demand calculations can be found in Appendix D.

Table 5: Point estimate forecasts of annual aircraft movements and jet fuel demand at WSA for selected years

	2031	2052	Average growth p.a. 2031 to 2052	Average % growth 2031 to 2052
Aircraft movement (annual) [36]	72,270	216,810	7227	5%
Jet fuel demand (annual, million litres)	570	2937	112	8%
Jet fuel demand (daily, million litres)	1.56	8.05	0.31	-
Equivalent number of trucks to meet demand (trucks per day)	29	149	-	-

Source: FuelTrac and Deloitte analysis.

[36] LEK analysis.

Aircraft movements are expected to reach 72,270 per year and passenger movements are expected to reach 10.3 million per year by 2031, about five years after WSA commences operation.[37] Passenger demand outlined in this report differs slightly from the WSA business case, which predicts 9.7MAP by 2031. This difference has arisen through this report's use of updated flight schedule forecasts.

Adelaide Airport had 78,695 aircraft movements with 320ML of jet fuel consumed in the 2015 to 2016 financial year. This is similar to the projected aircraft movements for WSA's Stage 1 in 2031. At Melbourne airport, there were 234,789 aircraft movements in the 2015 to 2016 financial year with 1785ML of jet fuel consumed. This is the approximate level that WSA is expected to reach in 2052.[38]

Although WSA's projected aircraft movements are similar to Adelaide Airport in 2031 and Melbourne Airport in 2052, its jet fuel demand is expected to be higher in the respective years.[39] It was assumed that WSA would attract more international long haul flights and these require significantly more jet fuel than domestic flights, due to aircraft weight, number of passengers, regulated safety requirements and the distance to final destination.[40] The jet fuel demand modelling also assumes that all domestic flights will refuel at WSA.[41]

Figure 14: Annual jet fuel demand forecast

Source: Deloitte analysis

The WSA business case and WSA EIS also include assumptions relating to WSA's anticipated jet fuel use and supply. Jet fuel demand was driven by WSA flight schedule assumptions, including an assumption that all aircraft would refuel at WSA. Furthermore, updated aviation schedules reflect WSA's significance as an international airport with a substantial demand from international long haul aircraft. This report uses updated numbers and assumptions to estimate WSA's jet fuel demand for the period 2026 to 2051. This assessment of jet fuel demand was undertaken prior to WSA Co having an opportunity to undertake its own assessment.

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[37] Fueltrac and Deloitte analysis.
[38] Fueltrac and Deloitte analysis.
[39] LEK analysis shows that 22 per cent of 2031 and 37 per cent of 2052 flights are forecast to be international flights at WSA.
[40] Ibid
[41] Domestic refuelling has been tested in the sensitivity test (Section 6.4).

The WSA EIS estimated that approximately 43 B-double trucks would be required to service WSA by 2031 to meet Stage 1 operational requirements.[42] The WSA EIS has higher road transport movements for a lower jet fuel demand profile compared to the analysis in this report (Section 2).

4.4 Shortlisted options — Condition 26

The shortlisted corridor options were assessed in the context of the current operating and industry environment in Sydney. This includes the network of jet fuel pipelines and storage terminals that enables the safe, reliable and efficient supply of jet fuel to KSA.

As explained in Section 2, the current pipeline network in metropolitan Sydney transports fuel from the ports of Gore Bay, Kurnell and Port Botany to the inner, north and western suburbs of Sydney and to NSW more broadly. The furthest west a jet fuel pipeline travels is to the Clyde/Silverwater area in Sydney's western suburbs, 40km from WSA. It is connected by approximately 15km of pipeline from the port facility at Gore Bay or approximately 35km of pipeline from Port Botany terminals. These options are unlikely to be mutually exclusive due to WSA's geographic position. A pipeline option is likely to be supplemented with road transport to ensure supply diversity.

The pipeline options considered in this report are summarised below and explained in more detail in Table 6 and the illustrations in Figures 15 to 17:

- **PP1** — includes an existing pipeline from a port in eastern Sydney to a central Sydney terminal where jet fuel is treated and stored, and then a new pipeline (40km) to WSA
- **PP2** — includes an existing pipeline from a port in eastern Sydney to a western Sydney depot, where a new intermediate storage facility would be constructed to pump jet fuel via a new pipeline (25km) to WSA
- **P1** — includes a new pipeline (60km) from the Botany Bay terminal to WSA and a new pumping facility.

The options were informed by the stakeholder consultation process. This process was a substantial component of this report's development, which satisfies Condition 26 of the WSA Airport Plan.

Other pipeline options may exist, but the above options were the ones the stakeholders were willing to present during this consultation process.

These options:

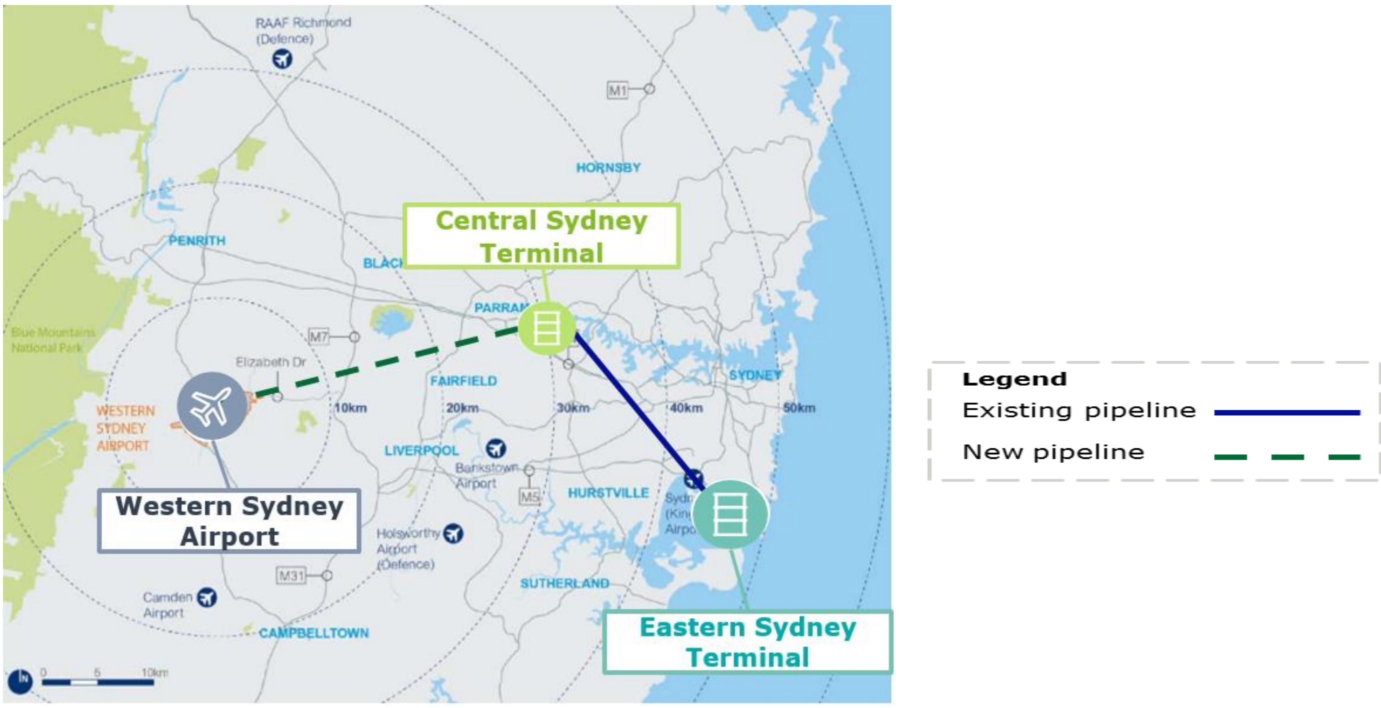
- are not mutually exclusive (and therefore it is possible a combination of the options are pursued to service WSA)
- are agnostic to jet fuel supplier arrangements
- do not consider existing commercial arrangements in place, or future market structures.

[42] WSA EIS, Volume 2, Chapter 15, page 236.

Table 6: A summary of pipeline infrastructure shortlisted options

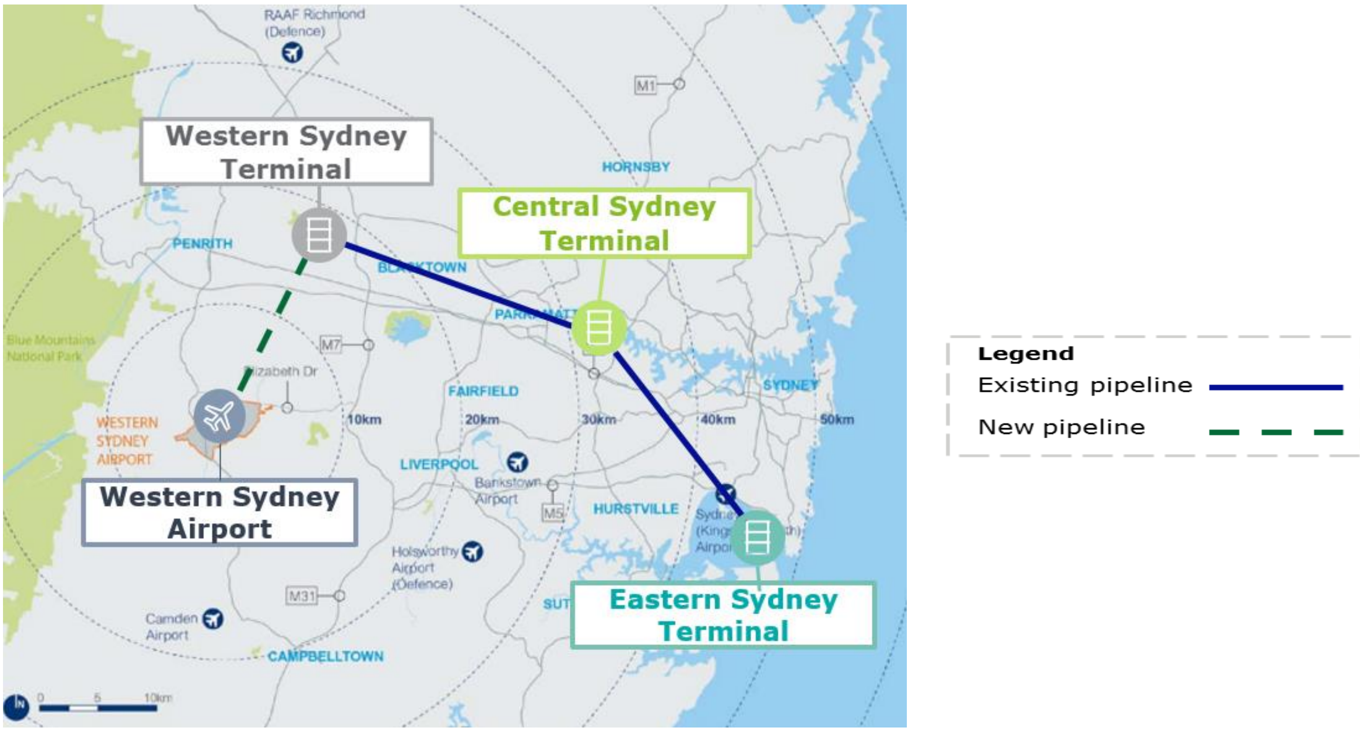
	PP1	PP2	P1
Existing pipeline infrastructure	Yes	Yes	No
Origin	Eastern Sydney terminals	Eastern Sydney terminals	Not applicable
Destination	Central Sydney terminals	Western Sydney depot	Not applicable
Requires use of new pipeline corridors	Yes	Yes	Yes
Distance	40km	25km	60km
Origin	Central Sydney terminals	Western Sydney depot	Botany Bay terminals
Destination	WSA	WSA	WSA
Pumps required	No	No	Yes
Intermediate storage to be built	No	Yes	No

Figure 15: Option PP1 includes an existing pipeline from a port in eastern Sydney to a central Sydney terminal and then a new pipeline (40km) to WSA



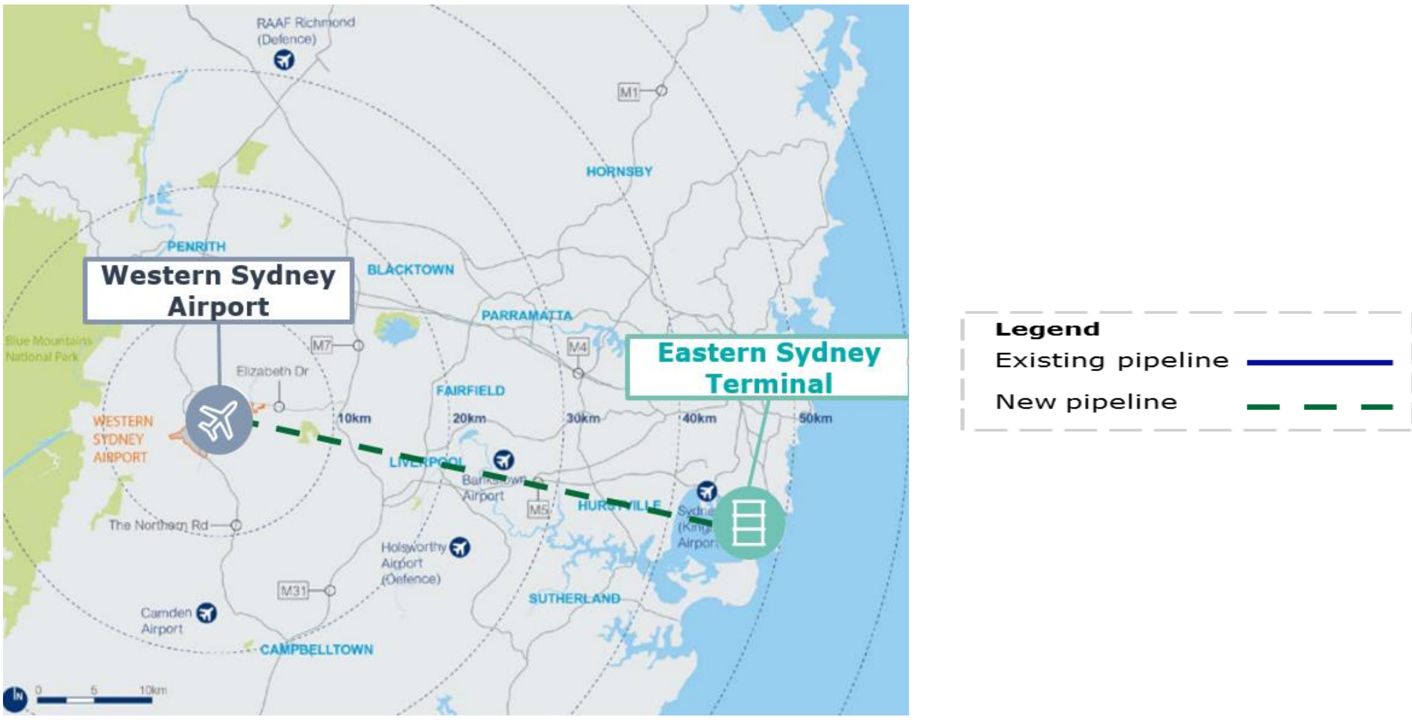
Source: Deloitte

Figure 16: Option PP2 includes an existing pipeline from a port in eastern Sydney to a western Sydney depot, where a new intermediate storage facility would be constructed to pump jet fuel via a new pipeline (25km) to WSA



Source: Deloitte

Figure 17: Option P1 includes a new pipeline (60km) from the Botany Bay terminal to WSA



Source: Deloitte

4.5 Impacts of a multi-product pipeline

Only dedicated jet fuel pipelines were considered. On-airport jet fuel storage facilities are not designed to handle multi-product interfaces or handle off-specification fuels. Jet fuel pipelines directly feeding on-airport storage facilities are recommended to be dedicated to jet fuel. The recent international examples at Manchester Airport[43] and Surabaya[44] illustrate the risk of jet fuel contamination from jet fuel pipelines and hydrant systems.

Some stakeholders suggested that constructing a multi-product pipeline would have additional benefits to the community if different types of fuel, including diesel and gasoline, were transported to western Sydney and into NSW. However, the additional costs and storage requirements associated with multi-product pipelines would reduce the financial benefits generated by using the pipeline for other fuels in the short-term.[45] Pumping multi-product liquid down the pipeline may provide the required demand to warrant pipeline infrastructure investment in the short term; however, the quality risk and costs likely to be incurred later on (through recertification of the fuel, storage requirements, and later recertification of the pipeline when it becomes a dedicated jet fuel pipeline to meet demand) would be too large. The commercial risks to the airport (as well as fuel companies and airlines) associated with this option were considered and it was decided not to consider multi-product pipelines. This view was supported by oil participant and airline stakeholder feedback during the engagement process.

Industry strongly recommends a dedicated jet fuel pipeline

Industry representatives stated that jet fuel stewardship requirements make it necessary to use a dedicated jet fuel pipeline to supply jet fuel to dedicated on-airport storage facilities.

[43] http://www.independent.co.uk/news/uk/home-news/fuel-supply-problems-threaten-flight-chaos-at-manchester-airport-7820809.html

[44] https://aviation-safety.net/database/record.php?id=20100413-2

[45] A multi-product pipeline would require an intermediate storage tank, outside the WSA site, to allow for recertification of jet fuel before it reaches WSA.

Part 2: Economic analysis

5 Economic methods and analysis

Key points

- A least cost analysis, also known as a cost-efficiency analysis, was used to determine the most feasible and economically viable option to deliver fuel to WSA. The least cost analysis considers all costs as standalone to determine the least cost option. This was used in preference to a cost benefit analysis, which considers the difference in costs relative to business as usual.
- The three pipeline options were considered alongside three road transport routes (base case) to inform the economics and to understand when jet fuel demand would warrant a pipeline to WSA.
- The economic analysis was also undertaken to answer two questions:
    - **Cost-efficiency** — which supply option (pipeline option or road transfer route) provides the most cost-efficient method of delivering jet fuel to WSA?
    - **Pipeline feasibility** — what is the point in time when a jet fuel pipeline will become economically and commercially feasible, compared to road transportation and, therefore, when is the most optimal time for potential investment in a pipeline, including the volume of required fuel demand?
- An appraisal period of 25 years was selected that extended from 2026 (the first year of operation of WSA) to 2051.
- The analysis considered the economic and financial impacts of each option. The economic analysis estimated and compared the costs incurred for each delivery option, including pipeline operating costs, capital costs, travel time and vehicle operation, environmental externalities and the impacts associated with potential road accidents.
- An overview of the six options used is included below:
    - Base case – a mix of road transport routes including likely deliveries of jet fuel to WSA from eastern, central and western Sydney jet fuel storage terminals:
        - **T1** — road transport from eastern Sydney seaboard port to WSA
        - **TP1** — existing pipeline from a port to a central Sydney terminal where fuel is treated and stored, then road transport from central Sydney terminal to WSA
        - **TP2** — existing pipeline from a port to a western Sydney depot, then road transport from a western Sydney depot to WSA. Note the existing pipeline route will need to go through an intermediate storage terminal in central Sydney in order to get to western Sydney.
    - **PP1** — includes an existing pipeline from a port in eastern Sydney to a central Sydney terminal where fuel is treated and stored, and then a new pipeline (40km) to WSA
    - **PP2** — includes an existing pipeline from a port in eastern Sydney to a western Sydney depot, where a new intermediate storage facility would be constructed to pump jet fuel via a new pipeline (25km) to WSA
    - **P1** — includes a new pipeline (60km) from the Botany Bay terminal to WSA and a new pumping facility.

5.1 Context

The WSA EIS and the Airport Plan estimated jet fuel demand and delivery options, while economic modelling relating to the expected airport demand was also conducted to prepare the business case for Government.

These estimated that truck movements of 43 B-doubles a day, equivalent to approximately 2.7ML per day, would be required to meet the jet fuel demands of Stage 1. Furthermore, the WSA EIS and the WSA Business Case did not provide cost-efficiency analysis for building pipelines to supply WSA from various points within central or western Sydney.

An updated aircraft movement analysis[46] was used to inform the jet fuel demand forecasts in this report.

The economic analysis was undertaken to answer two key questions:

- What is the most cost-efficient way of delivering jet fuel (considering both pipeline and base case road options)?
- When will a jet fuel pipeline be a viable option to service WSA?

All options were assessed over a 25-year period to provide a long-term horizon. Discounting was included in the analysis, as different options entail a different cost profile. Some options (those including a new pipeline for instance) involve significant upfront pipeline construction costs, followed by low operational costs. By contrast, the upfront costs of other options (existing pipeline and road transport) are minimal, but the operating costs and external costs relating to the increased use of road transport options are relatively high. When the options with discounting were assessed, costs in present value terms could be compared.

5.2 Economic methodology overview

5.2.1 Economic data sources

Data used in the economic analysis was sourced from documented and formal sources, including the Australian Transport Assessment and Planning (ATAP) Guidelines (2016) and Principles and Guidelines for Economic Appraisals for Transport for NSW (2012) as well as stakeholder consultations with the jet fuel and infrastructure investment sectors, airlines and several airports. Any inconclusive evidence gathered through the consultation process was accommodated using a scenario/sensitivity analysis in the economic assessment.

5.2.2 Economic modelling approach

A least cost analysis, also known as a cost-efficiency analysis, was used to determine the most feasible and economically viable option to deliver jet fuel to WSA. This approach identifies the option that can meet the anticipated future demand at the least cost to society.

A least cost analysis compares the costs incurred for each delivery option, including pipeline operating costs, capital costs, travel times and vehicle operations, environmental externalities and the impacts associated with potential road accidents. It takes an economic view of costs, rather than only considering the financial implications.

A least cost approach was adopted because WSA's jet fuel demand can be met by road transport, pipeline, or a combination of both. Other economic approaches, including a cost benefit analysis (CBA), were considered but the least cost approach was found to be superior. This method does not use a hypothetical 'business as usual' scenario as with a CBA. A CBA compares the costs and benefits of one option to a business as usual option. Rather than taking a hypothetical position that road transport is the business as usual option, the least cost approach treats the merits of each alternative delivery option in a standalone manner. There are many options that could be used as the business as usual scenario, including pipeline and road combinations, so the selection of only one business as usual option could be criticised.

5.2.3 Discounting future values

By discounting the costs and benefits that will arise in the future, options can be directly compared by representing the costs of options that accrue at different times. Discounting converts future values from different time periods to an equivalent amount in today's dollars (present values). It is a common approach in economic modelling when comparing various options that have costs and benefits.

[46] Deloitte and Fueltrac analysis.

There are two primary reasons for discounting, to reflect that:

- the equivalent funds could earn an economic return if they were not invested in the nominated project
- costs or benefits occurring later are worth less than the same costs occurring earlier in the project.

Both are significant when considering the timing for investing in a pipeline to provide jet fuel to WSA where the time profile and magnitude of initial capital investment required to meet WSA's jet fuel demand is different depending on the alternative road and pipeline delivery options.

A discount rate of 7 per cent has been used on future values within this report. This is in line with the discount rate range of 4 per cent to 7 per cent recommended by ATAP Guidelines for projects within the Department of Infrastructure, Regional Development and Cities. Future values are discounted to present day values to enable comparison. An industry rate-of-return on investments was not used as an economic analysis was conducted and not a financial analysis.

5.2.4 Appraisal period

An appraisal period of 25 years was selected for this analysis, extending from 2026 (the first year of operation of the proposed new airport) to 2051.

In line with TfNSW and ATAP guidance, the analysis considered a long-term evaluation horizon to account for the pipeline's long life. However, the environmental implications of maintaining and operating a pipeline over the long run are not well understood and there was a lack of evidence in the public domain and from stakeholder consultations to suggest or monitor the effects. In light of this, it was not possible to appropriately determine these costs beyond a 25-year time horizon.

The pipeline becomes feasible much earlier (between 2030 and 2040, depending on the option, see Section 6) than WSA's 25th year of operation. So, the length of the evaluation period would not change the options' ranking.

A residual value calculation for the pipeline asset has not been included in the last year of the appraisal period, as most options involving pipelines are likely to make use of existing infrastructure and not new infrastructure. It is expected that the existing pipeline will operate for 40 years after construction before any investment in material upgrades is needed.[47]

5.2.5 Options

Three pipeline options (Section 4) were considered alongside three road freight/transport routes (base cases) to inform the economics and to understand when jet fuel demand would warrant a pipeline to WSA.

Six options to transport jet fuel to WSA were individually analysed:

- **T1** — road transport from the eastern Sydney seaboard port
- **TP1** — an existing pipeline from a port to a central Sydney terminal, where jet fuel is treated and stored, then road transport from the central Sydney terminal
- **TP2** — an existing pipeline from a port to a western Sydney depot, then road transport to WSA. The existing pipeline route would pass through an intermediate storage terminal in central Sydney to get to western Sydney[48]
- **PP1** — an existing pipeline from a port in eastern Sydney to a central Sydney terminal, where jet fuel is treated and stored, and then a new pipeline to WSA
- **PP2** — includes an existing pipeline from a port in eastern Sydney to a western Sydney depot, where a new intermediate storage facility would be constructed to pump jet fuel via a new pipeline (25km) to WSA
- **P1** — a new pipeline from an eastern Sydney seaboard port.

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[47] As indicated by the fuel industry during stakeholder consultations.
[48] It is noted that existing pipelines between central Sydney and western Sydney depots are currently owned and operated by one fuel company. This option assumes the pipeline infrastructure for the options TP2 and PP2 will have an independent ownership structure and there will be open access to all fuel companies.

5.3 Pipeline costs overview

The following financial and economic costs were factored into the analysis of jet fuel delivery by pipeline:

- corridor protection and acquisition costs
- pipeline construction capital costs
- pipeline operating costs
- depot storage fee (including pump costs)
- depot variable throughput fee
- booster pumps (when the pipe is longer than 40km)
- re-certification costs that arise when jet fuel moves from one container to another.

These costs and the information they are based on is outlined further in Appendix D. Scenario-based modelling was used where reliable point estimates were not available for selective variables. Lower and upper bound estimates are shown for such variables.

5.3.1 Pipeline capital costs

A summary of the capital costs for each option is provided in Table 7.

5.3.1.1 Pipeline construction capital costs

Pipeline costs are based on pipeline length and so longer pipelines are a greater capital cost expense. It was estimated, in consultation with stakeholders and fuel industry experts, that new pipeline construction will cost approximately $2.5 million per kilometre (+/-20 per cent margin) in 2017 price terms.

5.3.1.2 Other capital costs

Options TP2 and PP2 include storage facilities at a western Sydney depot, but these will need to be constructed. The storage facility is expected to cost approximately $20 million, based on information provided by fuel industry experts.

Stakeholder consultations indicated that incremental pumping stations or booster pumps are likely to be required for pipelines over approximately 60km long to retain adequate flow for jet fuel. Fuel industry experts estimate pumping facility capital costs at $13.5 million. This facility will only be required for Option P1 as all other piped options are less than 60km long.

Table 7: Capital costs for each option ($ millions, $2017)[49]

	Pipeline	Storage	Additional pump	Total
T1	-	-	-	**-**
TP1	-	-	-	-
TP2	-	20	-	20
PP1	100	-	-	100
PP2	63	20	-	83
P1	150	-	14	164

Source: Deloitte analysis, 2017

5.3.2 Pipeline operating costs

The operating cost breakdown (Table 8) considers additional operating costs per litre of jet fuel for TP2 and PP2. These costs were informed by stakeholder consultation and advice from fuel industry experts.

[49] Capital costs have been tested in a sensitivity analysis in Section 6.4 to account for 20 per cent variances in costs.

5.3.2.1 General operating costs for PP2

Fuel industry stakeholders suggested that if piped infrastructure carries more than 700ML of jet fuel per day then the unit cost of pipeline operations are in the order of magnitude of $0.001 (i.e. $0.1) per litre of jet fuel handled.

If the volume of jet fuel handled is lower than this threshold, then a fixed cost component of $350,000 per annum and a variable cost component of $0.0005 per litre form the unit cost of operation.

5.3.2.2 Additional operating costs for TP2 and PP2

Industry experts indicated that PP2 would incur additional operating costs. TP2 and PP2 involve pipelines from an eastern seaboard terminal to a western Sydney depot that will go through an existing pipeline in the central Sydney terminal before going up to a western Sydney depot. This will result in an additional operating cost of $0.1 cents per litre of jet fuel transported, which has been factored into the modelling.

In order to get jet fuel from the eastern Sydney terminal to a western Sydney depot, the jet fuel must go through an additional handling process in Silverwater. This adds another cost to PP2 and TP2, which use multi-product pipes to a western Sydney depot, that is not borne by the other pipeline options. The incremental operating expenses of intermediate storage have been factored into the analysis.

5.3.2.3 Additional fixed cost for P1

P1's pipeline is 60km long and will incur additional property rents for the required pumping facility. This was included in the analysis and it was assumed that property rents for a pumping facility would equate to 0.36 per cent per annum of the capital costs of building the pumping facility ($13.5 million). This amounts to $48,600 per annum in 2017 values. Capital cost profiles are outlined in Section 6.

Table 8: Pipeline operating costs for each option, ($ per litre, $2017)

	Pipeline operating costs	Additional depot throughput cost	Total
T1	-	-	-
TP1	0.001	-	0.001
TP2	0.002	0.002	0.004
PP1	0.001	-	0.001
PP2	0.002	0.002	0.004
P1	0.001	-	0.001

Source: Deloitte analysis, 2017

5.4 Road transport costs overview

It is pivotal to understand the differences in cost drivers for road and pipeline delivery in order to understand the feasibility point of pipeline versus road transport for delivering jet fuel to WSA. To inform the economic analysis, road transport costs considered the current operating environment in Sydney, including any network capacity (e.g. traffic congestion) issues surrounding local ports and storage facilities, and how such costs can influence road transport effectiveness. This report considers the financial costs for road transport operators, including regulatory requirements.

The following financial and economic costs will arise when jet fuel is delivered to WSA by road:

- Financial (and direct) costs of transportation
  - travel time costs of road transport operators
  - loading and unloading time costs
  - vehicle operating costs

- Economic costs on the broader community, otherwise known as road external costs. This includes:
  - travel time costs of freight journeys
  - external effects on the environment due to road transportation. This includes the effects of air pollution, greenhouse gases, noise, water, nature and landscape, urban separation[50], and associated upstream and downstream costs
  - road damage costs from road transportation
  - accident costs imposed due to road transportation.

Table 9 provides a summary of these road operating costs for each option. Further details can be found in Appendix D.

Table 9: Road operating costs for each option ($ per litre, $2017)[51]

	Road operating costs[52]	**Road external costs**[53]
T1 (119km return)	0.0135	0.0069
TP1 (81km return)	0.0096	0.0054
TP2 (48km return)	0.0072	0.0047
PP1	-	-
PP2	-	-
P1	-	-

Source: Deloitte analysis, 2017

5.5 Cost exclusions

5.5.1 General cost exclusions

The following costs were excluded from the analysis:

- refinery costs
- shipping costs
- port charges
- airport storage costs, including the cost of constructing and operating airport storage
- aircraft refuelling costs
- airport levies
- cost of credit
- financing costs
- storage costs
- depreciation costs.

Details on the rationale behind the cost exclusions listed above can be found in Appendix D.

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[50] Urban separation results from three primary elements: time loss due to separation for pedestrians, lack of non-motorised transport provision and visual intrusion.
[51] Road operating costs and external costs summary assumes fuel is only transported by B-doubles.
[52] Road operating costs have been tested in the sensitivity analysis (Section 6) based on different factors applied to ATAP vehicle operating costs.
[53] External costs for road have been tested in sensitivity analysis (Section 6) to reflect scenarios in which external costs are not accounted.

5.5.2 Pipeline cost exclusions

The analysis was intended to be conducted using lifecycle costs. However, the lifecycle costs of pipelines are not well established, or at the least, not publicly known due to their commercial sensitivity. These costs include:

- environmental contingencies
- large-scale capital works or irregular maintenance costs including pigging[54]
- other site specific costs associated with storing large quantities of jet fuel in an urban area.

Excluding these costs does not bias the results significantly. This is because the mode of jet fuel delivery to WSA involves the use of existing pipeline infrastructure to a certain point in the supply chain and these costs would have arisen regardless of whether there was a need to deliver jet fuel to WSA or not.

Given that this is a least cost analysis, a residual value calculation for the pipeline asset has not been included in the last year of the appraisal period. This is because most of the options involving pipelines are likely to make use of existing infrastructure and not new infrastructure.

5.6 Cost summary

The operating cost for each option varies with the mix of road and pipeline transport, road trip length and any additional operating costs. Similarly, capital costs will also vary depending on the option, pipe length and any additional capital costs. A high-level cost comparison between the pipeline options and the base case road routes has been provided at Table 10 and 11. Pipeline operating costs are calculated differently depending on whether the volume of jet fuel passing through is greater or lower than 700ML per annum. This is factored into the modelling and the calculation methodology is outlined in Section 5.3.2.

Table 10: Operating costs for each option, ($ per litre, $2017)[55]

	Road operating costs[56]	Road external costs[57]	Pipeline operating costs[58]	Additional depot throughput cost	Total
T1	0.0135	0.0069	-	-	0.0204
TP1	0.0096	0.0054	0.001	-	0.0149
TP2	0.0072	0.0047	0.002	0.002	0.0139
PP1	-	-	0.001	-	0.0010
PP2	-	-	0.002	0.002	0.0040
P1	-	-	0.001	-	0.0010

Source: Deloitte analysis, 2017

[54] Pipeline pigging is a statutory requirement to ensure the integrity of the pipeline is maintained. Pigging refers to the practice of using devices known as 'pigs' to perform various maintenance operations. This is done without stopping the flow of the product in the pipeline.
[55] Road operating costs and external costs summary assumes that fuel is only transported by B-doubles.
[56] Road operating costs have been tested in a sensitivity analysis (Section 6.4) based on different factors applied to ATAP vehicle operating costs.
[57] External costs for road have been tested in a sensitivity analysis (Section 6.4) to reflect scenarios in which external costs have not been accounted.

Table 11: Capital costs for each option ($ millions, $2017)

	Pipeline	Storage	Additional pump	Total
T1	-	-	-	**-**
TP1	-	-	-	-
TP2	-	20	-	20
PP1	100	-	-	100
PP2	63	20	-	83
P1	150	-	14	164

Source: Deloitte analysis, 2017

5.7 Key assumptions

Several key assumptions were used to complete the economic modelling:

- Labour costs were escalated in real terms to account for real wage growth in the future. Future real wage growth was estimated using the wage price index (WPI) that was adjusted for inflation using expected changes in the consumer price index (CPI).
- No other cost items were escalated.
- B-double vehicles carry a load of 54,000L per trip.
- Road transportation costs were obtained as a dollar value per kilometre travelled (vkt). However, in order to compare costs to pipeline costs, these dollar values were converted to dollar per litre using the formula:

$$\$\,per\ litre\ = \$\,per\ Vkt\ \times \frac{VKT\ per\ return\ trip}{Vehicle\ Capacity\ per\ return\ trip\ (L)}$$

- Key inputs into the economic model are detailed in Appendix D.
- Both direct and external costs are included and modelled to examine results in options involving road transport. Costs were modelled in a manner such that:
    - options involving new pipelines (PP1, PP2 and P1) did not have any road transport costs factored in. All jet fuel was assumed to be supplied by pipeline, regardless of whether the pipeline feasibility threshold i.e. minimum commercially viable quantity had been reached.
    - four years lead time was assumed for corridor planning approvals to be confirmed, to allow enough time prior to requirement of the jet fuel pipeline.

6 Economic analysis results

Key points

- **Cost-efficiency** — based on an economic analysis and comparison of pipeline corridor options and potential transport routes:
  - all of the pipeline options were found to be more cost-efficient in supplying jet fuel to WSA than road transportation options in the longer term
  - the most cost-efficient pipeline option, even under sensitivity analysis, was PP1. This option uses the existing pipeline network to the central Sydney terminals and connects a new 40km pipeline directly to WSA (see Figure 4, page 17).
- **Pipeline feasibility** — based on an economic analysis and comparison of pipeline corridor options and potential transport routes:
  - a new build pipeline's feasibility is driven predominately by jet fuel volume — the larger the volume, the higher the operating cost savings for piped options and the faster capital costs are recuperated
  - all pipeline options indicate that a pipeline will not be required on day one of WSA operations — there is insufficient jet fuel demand to justify the investment
  - a jet fuel pipeline to WSA has been determined to be viable by 2034. In 2034, it is expected that jet fuel demand for WSA could grow to 2.5ML per day, equivalent to 908ML per year (see Figure 5, page 17)
  - jet fuel will be required to be delivered by truck to WSA until around 2034. Based on updated passenger forecasting for WSA, approximately 41 B-double trucks will be required on a daily basis by 2033. This is consistent with modelling for the WSA EIS.

6.1 Options overview

The findings in this section can be used to inform all stakeholders with an interest in the supply of jet fuel to WSA, including WSA Co, the NSW Government, fuel and investment companies, and the general public. In this chapter the likely required timing, identification, preservation and ultimate construction of jet fuel pipeline to service WSA is identified.

The pipeline options were analysed against delivering jet fuel to WSA by road. This economic approach uses a least cost approach (or a monetised cost-effectiveness analysis) to inform when it may be more economically and financially viable to transport jet fuel by pipeline rather than road.

The economic analysis addresses the following:

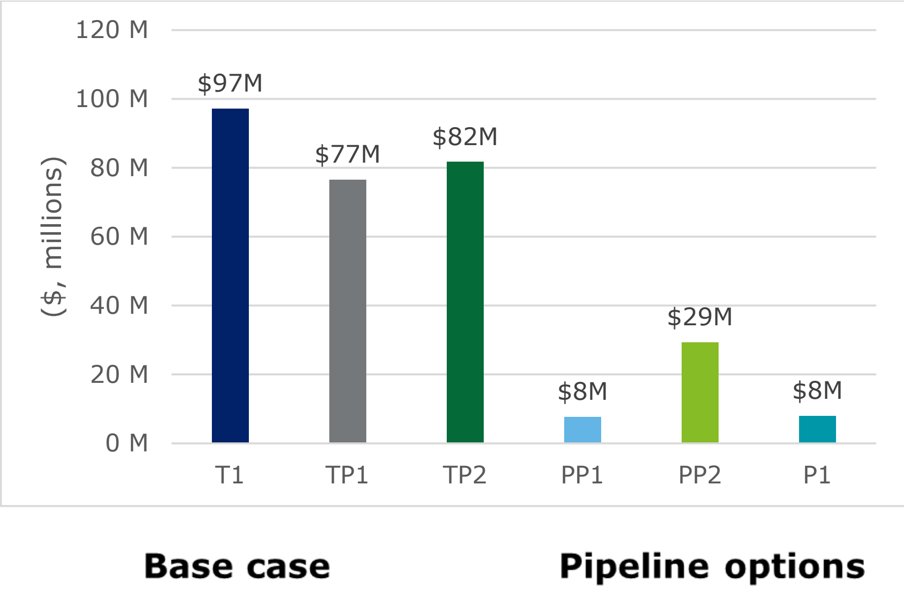
- cost-efficiency — which method of supply (pipeline or road) is the most cost-efficient method to deliver jet fuel to WSA?
- pipeline feasibility — when will a designated jet fuel pipeline to WSA be economically and financially feasible?

A pipeline's cost-efficiency and feasibility depends on a number of factors, including the pipeline's length, jet fuel demand and inclusion or exclusion of external costs.

6.2 Cost-efficiency

The operating costs of transporting jet fuel to WSA over 25 years through a pipeline are lower than road transport (Figure 18). Road transport options (base cases T1, TP1 and TP2) have higher operating costs compared to the new build pipeline options.

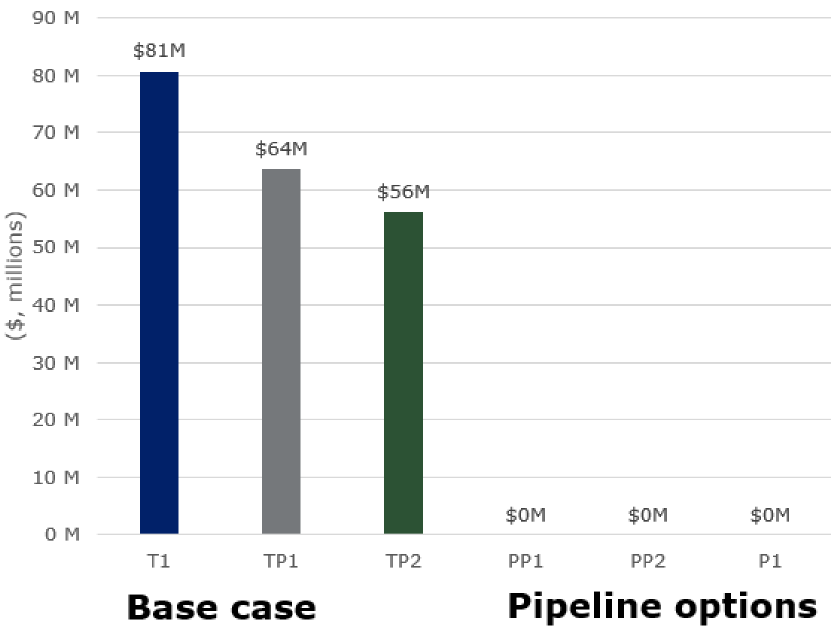
Figure 18: Discounted operating costs for each option ($2017)



Source: Deloitte analysis, 2017

The analysis also accounted for other external costs incurred during road transportation (Figure 19). Road transport has significant costs to the broader community that are not factored into the vehicle's financial operating costs. These include environmental, road damage, road accident and travel time costs. External costs for road options make up between 38 per cent to 45 per cent of total costs and substantially increase road operating costs (Figure 21).[59] [60]

Figure 19: Discounted other external costs for each option ($2017)



Source: Deloitte analysis, 2017

Although the operating and external costs for road transport are significantly higher than pipelines, pipelines incur large capital costs (Figure 20).

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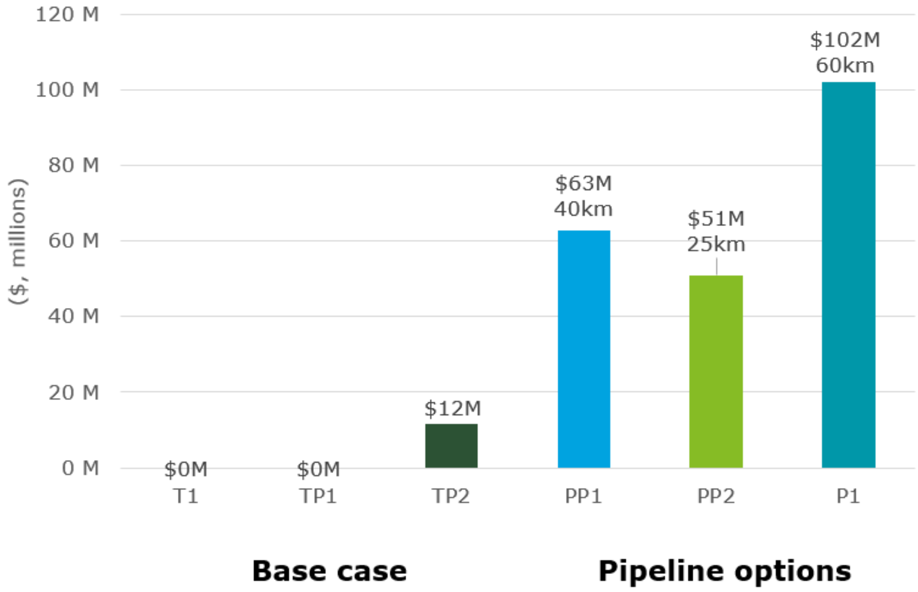
[59] Refer to Appendix D. Environmental externalities refers to air pollution, noise pollution, water pollution, greenhouse gas emissions, impacts on nature and landscapes, urban separation, upstream and downstream costs.
[60] Refer to Appendix D for method of calculating parameter values for external costs.

Figure 20: Discounted capital costs for each option ($2017)



Source: Deloitte analysis, 2017

Jet fuel demand must reach a critical volume to justify the capital costs of a pipeline. The capital costs must also be offset by a pipeline's lower operating costs and external costs when compared to road transport costs.

If the timing of the cost is not factored in (costs are undiscounted) then the pipeline infrastructure is significantly less costly over the evaluation period compared to the base cases (road transport). This is because the pipeline operating cost savings far outweigh the pipeline's large capital costs. Similarly, factoring in the timing of the costs (discounted costs) makes pipeline transport more attractive than road transport (Table 12 and Figure 20).

Table 12: Undiscounted and discounted costs of shortlisted options, aggregated from 2026 to 2051 ($2017)

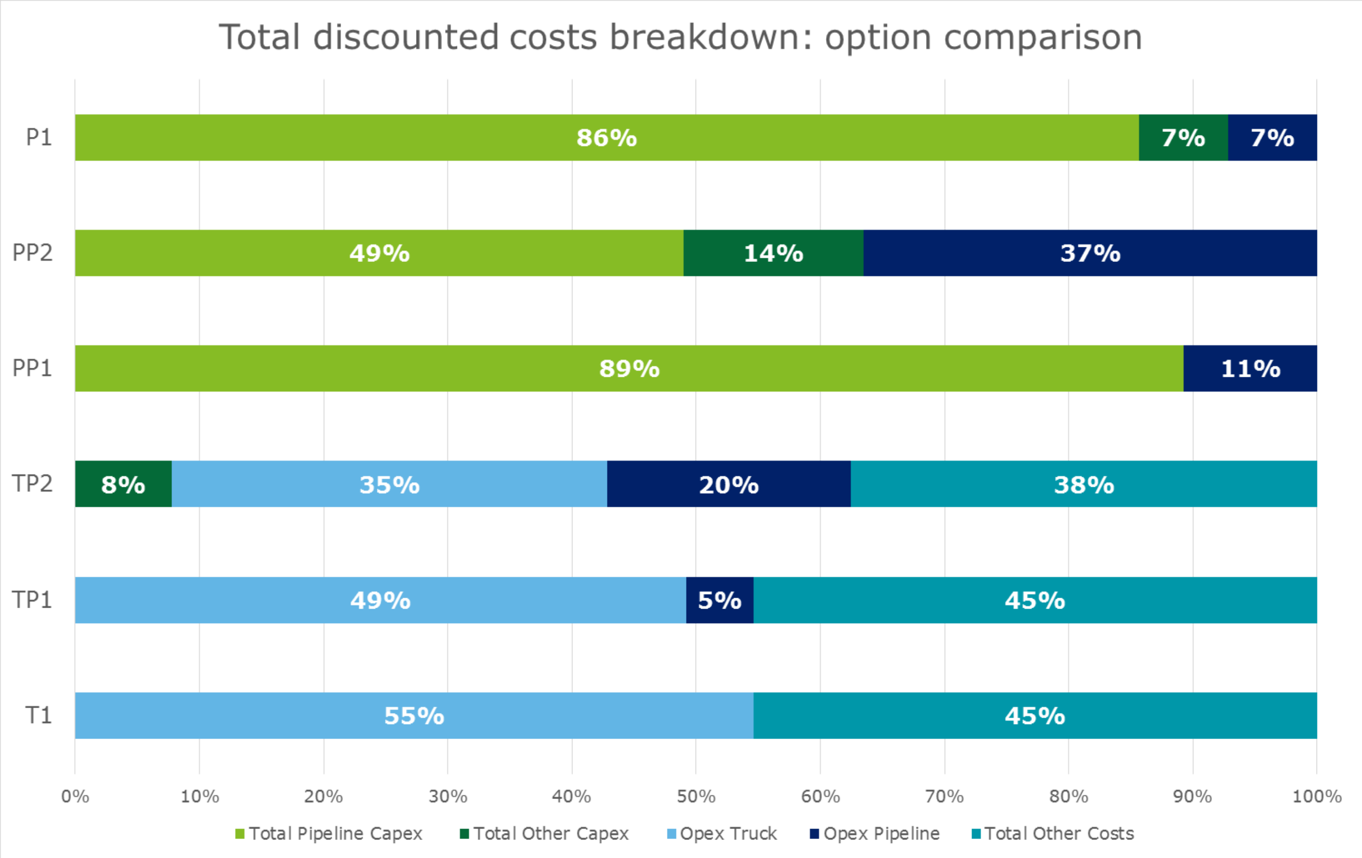
Delivery options	Total undiscounted costs ($M)	Total discounted costs ($M)	Rank based on discounted costs
T1	934.7	177.9	6
TP1	735.2	140.3	5
TP2	740.9	149.5	4
PP1	138.2	70.6	1
PP2	233.0	80.3	2
P1	202.9	110.2	3

Source: Deloitte Analysis, 2017

Option PP1 is the most cost-efficient option with lower discounted and undiscounted costs. Although the 25km pipeline option (PP2) is the shortest build option, it requires additional capital costs as an intermediate storage depot is required to process interfaces and recertify jet fuel for quality and compliance. PP2 also has higher operating costs compared to the other pipelines due to higher throughput fees and the extra pipe the jet fuel has to travel through to reach a western Sydney depot.

It seems logical from the analysis that PP1, which provides a pipeline from a central Sydney terminal(s), is the most cost-efficient option. See Appendix D for a breakdown of the capital costs.

Figure 21: Total discounted cost breakdown for each option, (% of total discounted costs, $2017)



Source: Deloitte Analysis

The cost drivers of each option (Figure 21) were analysed as follows:

- **T1 (road transport from an eastern Sydney terminal to WSA):** Costs for T1 are driven by road transport operating costs, which make up 55 per cent of the total discounted costs. The other 45 per cent are externality costs arising from vehicle operations. This is the only option that doesn't use pipelines and so its operating costs are substantially higher than all of the other options. The discounted operating costs for the evaluation period are between 4 to 12 times higher than the piped options.
- **TP1 (use existing infrastructure and road transport from a central Sydney terminal to WSA):** This option uses existing pipelines from an eastern Sydney terminal to a central Sydney terminal which reduces its operating costs compared to T1. However, TP1 still involves 40km of road transport per trip and so road transport operating costs make up 49 per cent of the total costs. Externalities make up 45 per cent of the costs and 5 per cent of costs are attributed to pipeline operating expenditure. However, this option is the cheapest option without capital expenditure.
- **TP2 (use existing infrastructure and road transport from a western Sydney depot to WSA):** TP2 incurs a small capital cost of $20 million in 2025 in order to build jet fuel storage. TP2 will also incur an extra $0.002 per litre depot throughput fee and $0.001 per litre for pipeline operations from the central Sydney terminal to a western Sydney depot. However, as demand grows, the cost of road transport from a western Sydney depot will be lower than transport from the central Sydney terminal or an eastern Sydney terminal because of the shorter haulage distance. Hence, TP2 has marginally lower costs compared to TP1 and T1, but significantly higher costs compared to the piped options.

- **PP1 (use existing infrastructure and pipeline from a central Sydney Terminal to WSA):** Piping from a central Sydney terminal generates the lowest discounted total costs of all the options. PP1 costs are mostly related to the capital costs (89 per cent) of building the new pipeline from a central Sydney terminal to WSA. Despite a higher capital cost relative to having a new pipeline built from a western Sydney depot to WSA, central Sydney terminals operating costs are lower compared to the option involving a western Sydney depot. Unlike PP2, PP1 does not include an additional storage facility or require jet fuel to be recertified through an intermediate terminal. This makes PP1's discounted operating costs approximately four times lower than PP2.
- **PP2 (use existing infrastructure and pipeline from a western Sydney depot to WSA):** This is the second most cost-efficient option. Capital costs only make up 63 per cent of its total costs, while pipeline operating costs make up 37 per cent. Although PP2 has lower capital costs compared to P1 (pipeline from a central Sydney terminal), this option incurs an additional depot throughput fee of $0.002/L and an additional operating fee of $0.001 per litre. This is because the option involves jet fuel going through the central Sydney terminal before reaching a western Sydney depot. Over time, the additional operating costs are greater than the capital savings made from building a shorter pipeline.
- **P1 (pipeline from Botany Bay terminals to WSA):** This is the most expensive of all the new build pipeline options. P1's longer pipeline (60km) has significantly higher costs than PP1's (40km) and PP2's (25km). The pipeline also generates additional capital costs for a pumping facility, as the pipeline is longer than 60km.

Fuel industry supports use of existing infrastructure

During stakeholder consultation, fuel industry experts advocated the use of the existing pipeline infrastructure to reduce capital costs. This is in line with the economic results and aligns with the general view held by the fuel sector. Where possible, connecting a designated pipeline to WSA into the existing fuel supply infrastructure (such as easements, pipelines and terminals) would minimise the new pipeline's length and capital investment costs. If less capital expenditure is needed, then pipeline investment could more quickly become commercially viable.

6.3 Pipeline feasibility

6.3.1 Overview of assessing feasibility

The cost-efficiency analysis reveals that pipeline options are more attractive than road transport in the long term. The data was further analysed to determine the best time to invest in a new build pipeline — a feasibility point. The feasibility point is when the cost to transport jet fuel via pipeline is more attractive than transporting via alternate modes (i.e. the jet fuel demand to WSA is sufficient enough to warrant a pipeline and costs per litre are similar to costs per litre for jet fuel delivery by road transport).

Pipeline feasibility depends on a number of factors, including pipeline length, jet fuel demand, and inclusion or exclusion of external costs. The feasibility point differs across the new build pipeline options (PP1, PP2 and P1) because of their differences in pipeline length. The results indicate that none of the new build pipeline options will be required to deliver jet fuel to WSA when airport operations begin in 2026. According to the modelling, annual jet fuel demand will be 95ML in 2026 and this is not high enough to justify investment in a pipeline.

The most cost-efficient option (PP1) indicates that B-double trucks should deliver jet fuel until 2034 when jet fuel demand will be 908ML per annum.

From a commercial perspective, if a pipeline was built too early in WSA's development (i.e. there was insufficient demand for jet fuel at WSA to provide savings in operating costs to cover sufficient pipeline capital costs[61]) or if the pipeline was not on open access, then pipeline use would be discouraged at Sydney basin terminals and truck use would be encouraged. If road supply was restricted in favour of pipeline supply, then:

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[61] It is understood that various industry groups compare the marginal litre rate of road freight against the operating costs and return on investments of a pipeline to calculate commercial viability. However, this report is an economic analysis and capital costs are incurred prior to the project, so a comparison of total costs has been used for the feasibility analysis.

- the cost of supply from Sydney basin terminals would increase
- the local infrastructure charges (Section 2.5) for WSA would increase
- the price competitiveness of WSA relative to KSA and Melbourne Airport would diminish.

This would reduce WSA's attractiveness to international airlines wishing to fly to Sydney.

When they considered pipeline investment timing, the fuel industry confirmed that private investment would not be possible unless jet fuel demand was high enough to ensure that operating cost savings could cover capital costs and provide a reasonable rate-of-return over the investment horizon. If demand is below this threshold, then the investor will not generate adequate returns. Jet fuel volume is the predominant driver of a new pipeline's feasibility. The larger the volume, the higher the operating cost savings for piped options and the faster capital costs are recuperated. Similarly, as capital costs grow, the jet fuel volume needed to recover capital costs increases.

6.3.2 Simple scenario explanation of pipeline feasibility

Before assessing the feasibility point of the specific pipeline options in this report, it is worth explaining the assessment process using a simple scenario and basic assumptions.

If we compare road transport with pipeline costs (excluding external costs such as environmental externalities, road accidents and road damage), a longer pipeline (e.g. 60km) would need a higher jet fuel demand to warrant investment in the pipeline as opposed to 20km or 40km pipeline.

We understand that investment in a pipeline, of any length, requires a certain level of jet fuel demand (the 'threshold volume') to surpass road transport as the more cost-effective mode of transport.

If aggregated jet fuel demand over time were to rise above these estimated threshold volumes, the costs of supplying jet fuel using road transport would be higher compared to a pipeline option.

To supply jet fuel via a 20km pipeline for the same cost as supplying it by road, the total cumulative fuel demand would need to be 2.6BL (see Appendix D for detailed calculation). This is the threshold volume for a 20km pipeline. Similarly, the threshold volume for a 60km pipeline was found to be 7.9BL.

This scenario considers the variances between the options. In particular, it does not account for the intricacies of capital and operating costs of pipeline or road transport. However, it puts into perspective the threshold volumes of jet fuel that are needed to make a pipeline feasible over road transport alone.

Pipeline feasibility occurs at a significantly lower jet fuel demand when external costs, like environmental externalities, road damage and road accidents, are taken into account as these increase road transport costs.

Pipeline feasibility should be determined after taking into account both the direct and external costs of road transport, as when road transport is used the external costs are generally borne by the wider society.

6.3.3 Feasibility of pipeline options considered

The feasibility of the pipeline options detailed in this report, when calculated with external costs, is similar to the simple scenario outlined above. Our analysis compared the cumulative nominal costs to deliver each option and determined the point at which the total cumulative costs for each new pipeline option were the same as the road option T1.

All piped option analysis indicated that a pipeline would not be required at the start of services at WSA in 2026 (Table 13). According to the results, annual jet fuel demand will only be 95ML in 2026 and therefore too low to justify investment in a pipeline.

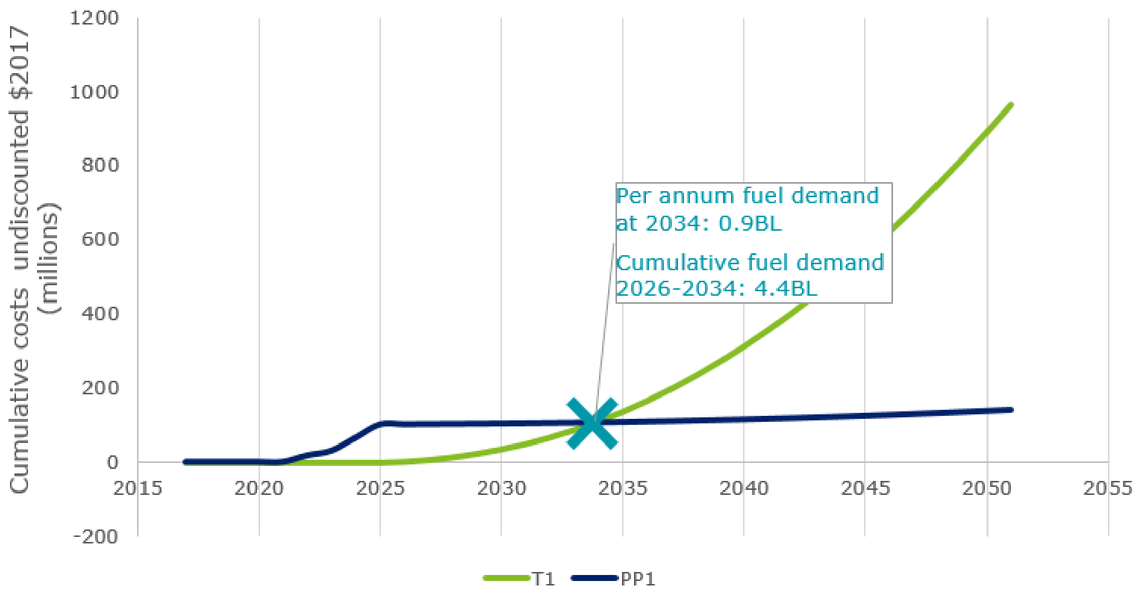
Table 13: Pipeline feasibility summary (with external costs)

	PP2	PP1	P1
Feasibility year	2034	2034	2037
Cumulative jet fuel volume between 2026 and feasibility year (billion litres)	4.4	4.4	7.8
Per annum jet fuel volume in feasibility year (billion litres)	0.9	0.9	1.2

Source: Deloitte Analysis

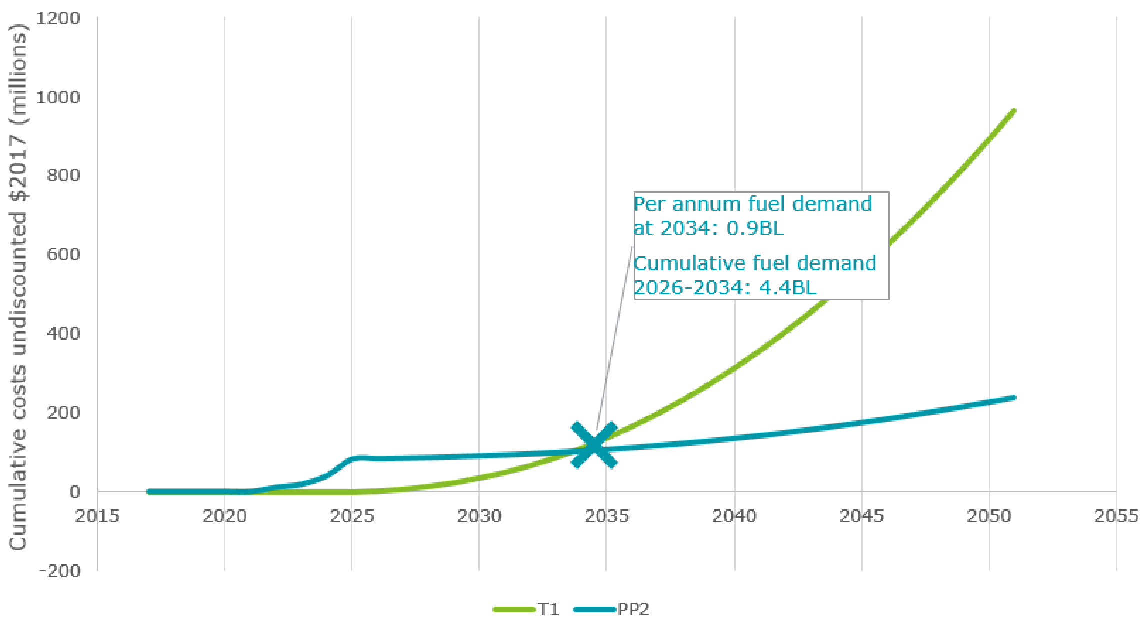
Due to lower capital costs, PP1 and PP2 reach this point by 2034. The piped options PP1 and PP2 become feasible when the total jet fuel volume over the eight-year period (aggregated from 2026 to 2034) is 4.4BL and annual jet fuel demand at 2034 is 0.9BL. The feasibility point for each pipeline option (PP1, PP2 and P1) is illustrated in further detail in Figures 22 to 24.

Figure 22: Breakeven point for Option PP1 (40km new build, includes external costs) (2017)



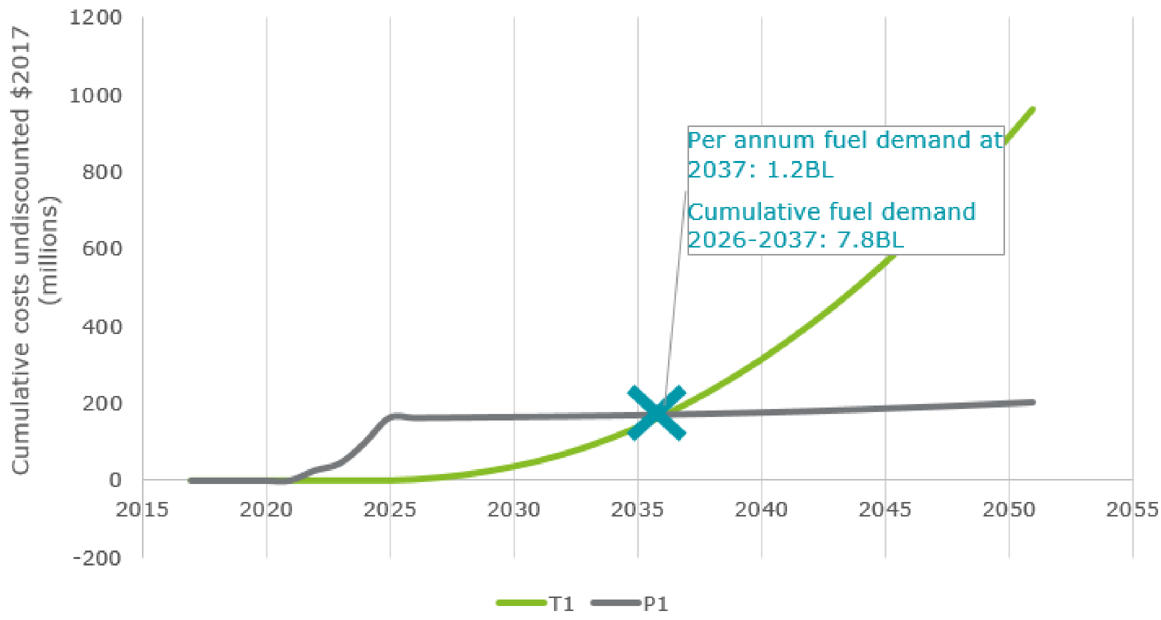
Source: Deloitte Analysis, 2017

Figure 23: Breakeven point including external costs for Option PP2 (25km new build option)



Source: Deloitte Analysis, 2017

Figure 24: Breakeven point including external costs (millions) for Option P1 (60km new build option)



Source: Deloitte Analysis, 2017

It would cost the same to service 7.8BL of jet fuel over an aggregated period of time when building and operating a 60km pipeline (P1) as it would to supply the jet fuel by road (T1) (Figure 24). WSA is expected to consume approximately 7.8BL in aggregate over the 11-year period from 2026 through to 2037.

In the most cost-efficient option PP1, B-doubles are expected to be used for jet fuel deliveries up until 2034. Assuming that B-doubles have a tank capacity of 54,000 litres, then WSA will require five B-doubles per day in 2026 and 41 B-doubles per day in 2033 to satisfy jet fuel demand.

6.4 Sensitivity tests

6.4.1 Cost-efficiency sensitivity

The economic assessment in this report used project forecasts for WSA aviation travel and jet fuel use. As a result, a series of scenarios and sensitivity tests were undertaken to determine the cost of each option using different input values to those used in the core scenario of the more extensive assessment above (Table 14).

Table 14: Sensitivity summary

Impact	**Scenario**
Discount rate	Discount rate used increased by 4%
Discount rate	Discount rate used increased by 10%
Pipeline operating costs	Total pipeline operating costs increased by 10%
Pipeline operating costs	Total pipeline operating costs decreased by 10%
Capital expenditure	Total capital expenditure increased by 20%
Jet fuel demand	50% reduction in jet fuel demand
Jet fuel demand	Reduce jet fuel demand so that only 50% of domestic flights refuel
External/other costs	External costs are not accounted for
Road direct costs	Time delays and associated costs (including demurrage and congestion) increases by 50%[62]
Road direct costs	A-double to B-double ratio increases to 50% from 2036-2051
Road direct costs	Total road operating costs are calculated using ATAP parameter values.
Road direct costs	Total road operating costs reduced down from 175% to 125% of ATAP values[63]

Source: Deloitte Analysis

Ranking the options shows that using the existing infrastructure with a new build pipeline provides the least cost delivery method (Table 15). In all scenarios, PP1 and PP2 are more cost-efficient than the road transport options (T1, TP1 and TP2). Between PP1 and PP2, PP1 is consistently more cost-efficient, except where there is a substantial (50 per cent) reduction in jet fuel demand. This is a result of central Sydney's higher capital costs and hence the need for more jet fuel flow to recuperate the capital costs. The net present value of total costs in each scenario is detailed in Appendix D.

[62] Demurrage costs refers to the costs associated with delays to loading or unloading product (in this case jet fuel). This sensitivity allows for increases in loading times or waiting times at storage terminal or WSA jet fuel tanks. This sensitivity also considers increases in costs associated with congestion for road transport and the impact this may have on jet fuel delivery to WSA by road transport.
[63] Refer to road transport costings outlined in Appendix D. No road toll costs have been included as no specific route is assumed.

The ranking of the new build 60km option (P1) varies significantly in ranking under sensitivity testing. When parameters such as low jet fuel demand, low road operating costs, no external costs (as outlined in Table 15) are in place, P1 becomes less attractive than road transport options (T1, TP1 and TP2).[64] This is because P1 has significantly higher capital costs compared to all other options.

Table 15: Sensitivity analysis — option ranking

	T1	TP1	TP2	PP1	PP2	P1
Core scenario[65]	6	4	5	1	2	3
Discount rate used increased by 4%	6	4	5	1	2	3
Discount rate used increased by 10%	6	3	4	1	2	5
Total pipeline operating costs increased by 10%	6	4	5	1	2	3
Total pipeline operating costs decreased by 10%	6	4	5	1	2	3
Total capital costs increased by 20%	6	4	5	1	2	3
Total capital costs decreased by 20%	6	4	5	1	2	3
50% reduction in jet fuel demand	5	3	4	2	1	6
Reduce jet fuel demand so that only 50% of domestic flights refuel	6	4	5	1	2	3
External costs are not accounted for	5	2	4	1	2	6
Wait time increases by 50%	6	5	4	1	2	3
A-double to B-double ratio increases to 50% from 2036-2051	6	4	5	1	2	3

[64] No road toll costs have been included as no specific route is assumed
[65] Core scenario based on a discount rate of seven per cent.

	T1	TP1	TP2	PP1	PP2	P1
Total road costs are calculated using ATAP parameter values.	5	3	4	1	2	6
Total road costs decreased to 125% of ATAP values	6	3	5	1	2	4

Legend: 1=preferred option, 6=least preferred option. Source: Deloitte Analysis

6.4.2 Feasibility sensitivity

Sensitivity tests and analysis have been undertaken to understand the changes in the feasibility point in relation to jet fuel demand (Table 16). It was noted during consultations that some domestic flights may not refuel at WSA, but tanker in fuel if the price of the jet fuel is too high. Therefore, the impact of fewer domestic flights refuelling was assessed to determine its impact on investment timing. As expected, when a larger percentage of domestic flights refuel then the pipeline feasibility point is earlier.

Table 16: Feasibility timing based on jet fuel demand[66]

% of domestic flights refuelling	PP1 (year)	PP2 (year)	P1 (year)
25%	2036	2036	2039
50%	2035	2035	2038
75%	2035	2035	2037
100% (core scenario)	2034	2034	2037

Source: Deloitte analysis, 2017

It is expected that WSA's jet fuel demand will be predominantly driven by international flights (Section 4.3). Based on the aviation growth estimates, around 22 per cent of flights in 2031 are forecast to be international flights. In 2052, approximately 37 per cent are forecast to be international flights.[67] The major growth in jet fuel demand is in the international sector, particularly long haul international flights. This is driven by the increase in air travelled kilometres arising from higher passenger growth and demand in outbound passengers to the Middle East, China, Hong Kong, Singapore and other parts of South East Asia. Many passengers going to Europe will use these destinations as layovers. In the 2016 to 2017 financial year, international passenger traffic through KSA increased by 6.5 per cent from the previous year.[68] WSA jet fuel demand will therefore be largely driven by international aviation.

If demand is more conservative, when compared to the core scenario, the pipeline feasibility in all options would only increase by four years (Table 17). This extremely conservative scenario is defined as a scenario where total jet fuel demand (including domestic and international demand) is 50 per cent of the core scenario. Based on these conservative estimates, the timing of when pipeline option PP1 becomes feasible shifts from 2034 to 2038.

Table 17: Feasibility timing based on extremely conservative jet fuel demand

Total jet fuel demand reduction	PP1	PP2	P1
50%	2038	2038	2041

Source: Deloitte analysis, 2017

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[66] The year the pipeline is required changes based on WSA's jet fuel demand.
[67] L.E.K analysis, Deloitte analysis 2017.
[68] BITRE 2017 International airline activity August publication 2017.

Part 3: Summary

7 Key findings and next steps

7.1 Key findings

Australia's aviation fuel industry

- Four Australian international airports have all or part of their jet fuel supplied by pipeline. The minimum average daily pipeline volume transported to a major Australian airport is approximately 2.8ML (Perth International Airport). This equates to 1BL per annum.
- Pipelines and trucks are both important modes of jet fuel supply and they are required to support an airport's growth at different stages of its development. Multiple supply modes from multiple seaboard terminals make sure that there is supply diversity. This strengthens the resilience of the jet fuel supply chain and minimises the risk to security of supply.
- It is common for airports to be supplied with jet fuel only by road until the demand reaches a level that supports the large capital investment required to build a jet fuel pipeline.
- The forecast jet fuel demand for WSA is 570ML per annum in 2031 and 2.82BL per annum in 2051. This assessment of jet fuel demand was undertaken prior to WSA Co having an opportunity to undertake its own assessment.
- The Sydney basin terminals at Port Botany and Clyde import jet fuel from large-scale export refineries in northern Asia through port facilities located at Gore Bay (Sydney Harbour), Port Botany and Kurnell. Jet fuel supplied to WSA from these terminals will need to be cost-effective to capitalise on supply chain efficiency — this includes cost-effective and appropriately sized on-airport fuel storage and delivery infrastructure (storage and hydrant systems).
- There is no fuel infrastructure near WSA. The closest fuel storage infrastructure with jet fuel capability is located at Clyde (near Parramatta).
- A range of factors influence the jet fuel market and jet fuel costs. These include:
    - distances from fuel infrastructure
    - accessibility to fuel infrastructure
    - industry factors, such as the actions of larger airline fleets (e.g. decisions on where aircraft are refuelled)
    - volumes into WSA and KSA
    - several supply chain factors.

Consultations and case studies

- More than 30 organisations across a range of industry sectors were consulted along with representatives from the NSW Department of Premier and Cabinet and other key NSW Government agencies specified by the NSW Department of Premier and Cabinet.
- Case studies of four Australian airports (Canberra, Gold Coast, Adelaide and Melbourne) were undertaken to assess how WSA could be supplied with jet fuel at different Stage 1 operational levels.
- Three main themes were identified across the consultations and case study research.
    - A general recommendation for the early preservation of at least one pipeline corridor to service WSA. Corridor preservation should start well before the pipeline will be required (based on economic grounds) to service WSA. Pipeline planning, approval, development and construction time should be taken into account when timing corridor preservation.
    - Fuel costs at WSA, including fuel related fees and charges, should be comparable to KSA fuel costs. This would provide an added incentive for airlines to use WSA, as an alternative to, or in conjunction with, KSA.
    - Investment in fuel infrastructure needs to occur before it is needed, to cater for future growth of the airport and the region.
- Other key findings that came from these consultations and case studies.
    - A pipeline would not be required at the start of services at WSA in 2026, based on the anticipated jet fuel volumes required in its early stages of operation.
    - There are no current plans to close or relocate the existing Sydney basin delivery points at Gore Bay, Port Botany and Kurnell, and terminals at Clyde and Silverwater in the short to medium term. It should be assumed that the status quo will remain when planning a WSA pipeline.
    - Any fuel delivery system, both to and at WSA, needs to be designed specifically for jet fuel.
    - There was a strong preference to use the existing infrastructure and easements wherever possible. The existing terminal infrastructure in western Sydney should be used in order to minimise the distance required for a pipeline/corridor.
    - On-site storage at the airport is essential (JUHI or similar) to allow a better response to any problems associated with supply to the airport.

Western Sydney Airport pipeline options

- A specific pipeline route from the supply point to WSA has not been considered. This would be undertaken as part of a corridor selection process.
- The corridor options assessed consider the current operating and industry environment in Sydney, including the network of jet fuel pipelines and storage terminals that enables the safe, reliable and efficient supply of jet fuel to KSA.
- The options presented are unlikely to be mutually exclusive due to WSA's geographic position. A pipeline option is likely to be supplemented with road transport to ensure supply diversity.
- The pipeline options considered were:
  - **PP1** — includes an existing pipeline from a port in eastern Sydney to a central Sydney terminal where fuel is treated and stored, and then a new pipeline (40km) to WSA
  - **PP2** — includes an existing pipeline from a port in eastern Sydney to a western Sydney depot, where a new intermediate storage facility would be constructed to pump jet fuel via a new pipeline (25km) to WSA
  - **P1** — includes a new pipeline (60km) from the Botany Bay terminal to WSA and a new pumping facility.
- The options were informed by the stakeholder consultation process. This process was a substantial component of this report's development, which satisfies Condition 26 of the WSA Airport Plan.
- Other pipeline options may exist, but the above options were the ones the stakeholders were willing to present during this consultation process.
- The pipeline options all include dedicated jet fuel pipelines. While multiple users (jet fuel suppliers) would be able to use the pipeline infrastructure, multi-product pipelines were not considered at this stage. The additional cost of multi-product pipelines would outweigh the financial benefits gained by using the pipeline for other fuels in the short-term.
- While these options consider the existing Sydney pipeline network, these options:
  - are not mutually exclusive (and therefore it is possible a combination of the options are pursued to service WSA)
  - are agnostic to fuel supplier arrangements
  - do not consider existing commercial arrangements or future market structures.

Economic methods and analysis

- **Cost-efficiency** — based on an economic analysis and comparison of pipeline corridor options and potential transport routes:
  - all of the pipeline options were found to be more cost-efficient in supplying jet fuel to WSA than road transportation options in the longer term
  - the most cost-efficient pipeline option, even under sensitivity analysis, was PP1. This option uses the existing pipeline network to the central Sydney terminals and connects a new 40km pipeline directly to WSA.
- **Pipeline feasibility** — based on an economic analysis and comparison of pipeline corridor options and potential transport routes:
  - a new build pipeline's feasibility is driven predominately by jet fuel volume — the larger the volume, the higher the operating cost savings for piped options and the faster capital costs are recuperated
  - all pipeline options indicate that a pipeline will not be required on day one of WSA operations — there is insufficient jet fuel demand to justify the investment
  - a jet fuel pipeline to WSA has been determined to be viable by 2034. In 2034, it is expected that jet fuel demand for WSA could grow to 2.5ML per day, equivalent to 908ML per year
  - jet fuel will be required to be delivered by truck to WSA until around 2034. Based on updated passenger forecasting for WSA, approximately 41 B-double trucks will be required on a daily basis by 2033. This is consistent with modelling for the WSA EIS.

7.2 Next steps

Based on the findings of this report, the following next steps have been recommended for the development of WSA and the planning of the supply of aviation fuel to WSA.

Condition 26 of the WSA Airport Plan

- A copy of this report will be provided to the nominated regulatory delegate for the WSA Airport Plan in the Department of Infrastructure, Regional Development and Cities as evidence of satisfying Condition 26 of the Airport Plan.

Corridor planning

- Infrastructure Australia could consider the findings of this report in its future development of the Infrastructure Priority List.
- The NSW Government could consider the findings of this report in its future planning for fuel corridors and infrastructure for western Sydney and regional NSW.
- Although only three high-level pipeline options resulted from this study, future corridor planning should include further engagement with industry to ensure other viable options are not overlooked. This will be important for encouraging open access and diversity of supply.
- Given the report identifies a jet fuel pipeline could be feasible as early as 2034, and the lead time for planning and developing a jet fuel pipeline corridor is between three and five years, WSA Co should undertake a detailed assessment of its jet fuel demand for WSA at an appropriate stage, once it has reviewed aircraft movement demand forecasts. If its demand is found to be significantly higher for the first stage of WSA's operation than that calculated in this report, it should begin engagement with the NSW Government on corridor preservation as early as possible.

- The Australian and NSW governments could consider co-locating a jet fuel pipeline within the rail, road, water or other pipeline corridors it is planning for western Sydney. This would be particularly beneficial if planning is required for other corridors to WSA from either Parramatta or St Marys (near the western Sydney fuel depot) because these generic routes were found to be the most cost-efficient routes for supplying jet fuel to WSA by pipeline in the longer term.

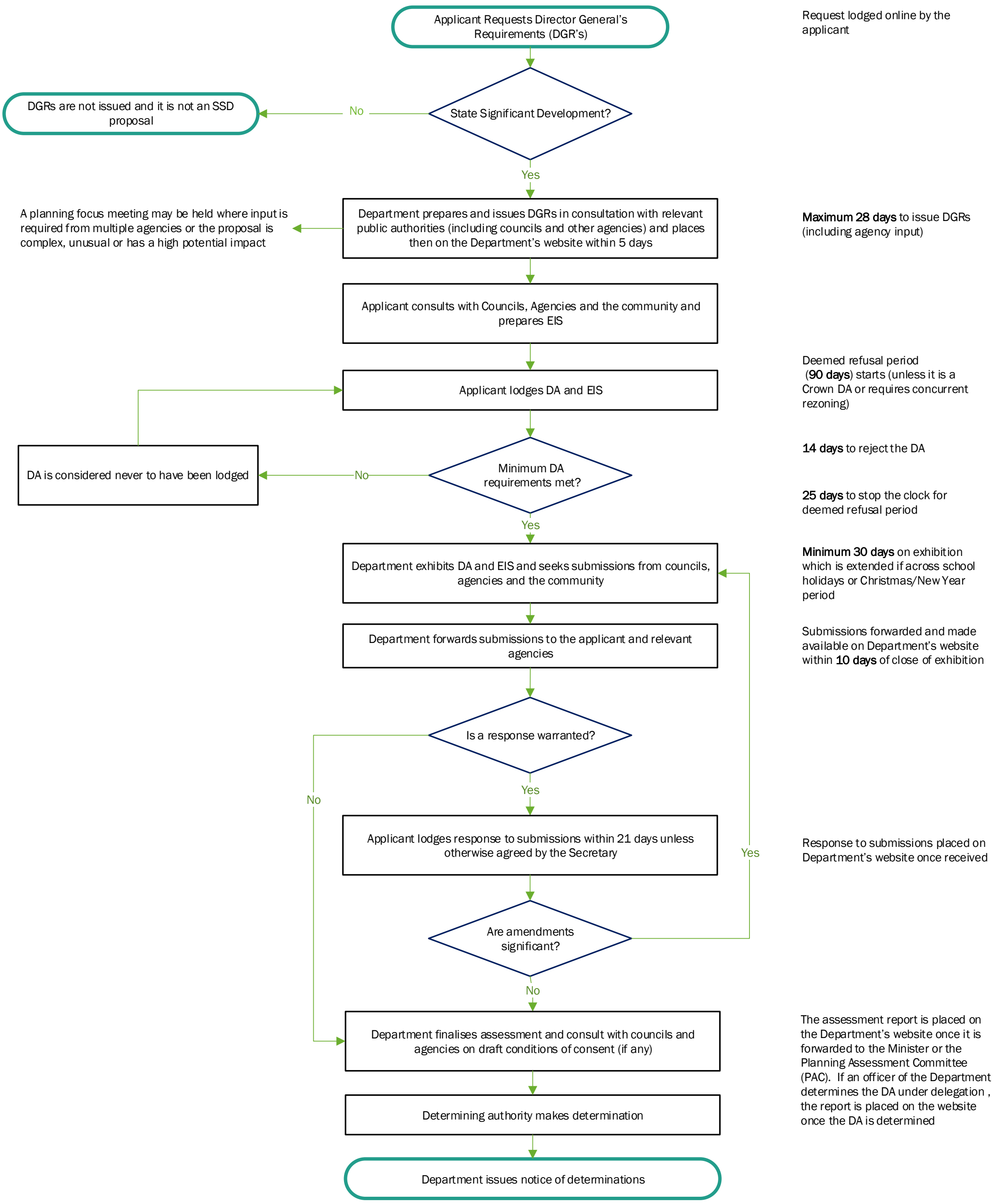
Planning and development of WSA

- The WSA developer, WSA Co, should consider the findings of this report:
    - in its development of Stage 1 of WSA
    - when it undertakes its next master plan for WSA
    - in complying with Condition 28 of the WSA Airport Plan. Condition 28 states that WSA Co must, within two years of the grant of an Airport Lease, and at least once every five years thereafter, prepare and publish a review of aviation fuel supply options comparing the social, economic and environmental costs, savings and benefits of jet fuel supplied to the Airport by road with other alternatives including a jet fuel pipeline.

Operational planning for WSA

- WSA Co could use this report in developing its concept of operations for the safe, efficient and reliable supply of jet fuel to WSA, and in planning the procurement of associated supply agreements.
- In accordance with Condition 27 of the WSA Airport Plan, WSA Co must ensure that contracts which it enters into in relation to the supply, transport, storage or disposal of aviation fuels for the Stage 1 Development of the Airport include provisions requiring compliance with all applicable Commonwealth, state and local laws relating to the protection of the environment.

Appendix A: State significant development flowchart



Adapted from

- " What is State signficant development and how are applications assessed and determined" NSW Department of Planning and Environment - http://www.planning.nsw.gov.au/Assess-and-Regulate/Development-Assessment/Systems/~/media/26E45F0B682A4D5C97DB547B92C7BC64.ashx (last accessed 1/12/17)

Appendix B: Stakeholder consultation list

The Department of Infrastructure, Regional Development and Cities, together with Transport for NSW, would like to thank the following stakeholders for their participation in the stakeholder engagement and consultation process:

- Adelaide Airport
- Australian Logistics Council
- Australian Pipelines and Gas Association
- Australian Trucking Association
- APA Group
- Board of Airline Representatives of Australia Inc.
- BP Australia (and Air BP a division of BP Australia)
- Caltex
- Canberra Airport
- Canberra Airport JUHI (through Caltex)
- Department of Defence (Cth)
- Department of Environment and Energy(Cth)
- Department of Industry (NSW)
- Department of Industry, Innovation and Science (Cth)
- Department of Infrastructure, Regional Development and Cities (Surface Transport and Aviation and Airports Divisions)
- Department of Planning and Environment (NSW)
- Department of Premier and Cabinet (NSW)
- Exxon Mobil
- Gold Coast Airport
- Gold Coast Airport JUHI (through Caltex)
- Greater Sydney Commission (GSC)
- Melbourne Airport
- National Road Transport Association
- NRMA
- Qantas
- Qube
- Regional Airlines Association of Australia (RAAA)
- Roads and Maritime Services
- Royal Vopak
- KSA JUHI (through Viva Energy)
- Transport for NSW
- Transport Management Centre
- Virgin Australia
- Viva Energy

Appendix C: Stakeholder consultation questions

The following is a list of questions used to guide the consultation process with each of the nominated stakeholders.

Questions for all stakeholders

1. Are you familiar with the current development plans/arrangements for WSA? (including the Airport Plan)
2. Do you have any concerns or comments regarding the Airport Plan?
3. Have you discussed options for providing jet fuel to the WSA?
4. What engagement, if any, have you had with the Commonwealth in relation to the airport?
5. What do you think will be the challenges to delivering jet fuel to WSA?

Airlines/BARA (on behalf of their members)

1. Has your organisation considered how it will run services to and from WSA?
2. Who do you think is best placed to construct, operate and manage the pipeline?
3. Who should construct, operate and manage the jet fuel storage site?
4. Are you aware of airlines that co-fund pipelines?
5. Would your organisation consider investing in a pipeline?
6. [above for Qantas and Virgin]
7. How much do you think a pipeline would cost?
8. Do you think a pipeline is a priority for sustainable delivery of jet fuel to the Western Sydney Airport?
9. When do you believe it should be constructed?
10. Would it be possible to commence construction for the pipeline after the airport commences operation or would this be less effective?
11. What is your tankering philosophy/policy – generally at each airport
12. What do you see as challenges to the delivery of jet fuel to WSA? (practicality, ownership, cost, other)
13. Would you expect to utilise other airports to refuel or would you envisage Western Sydney Airport becoming a refuelling site?
14. What are your assumptions about jet fuel use at WSA?

Airports

1. What have you learnt from your experience in jet fuel supply and storage to your airport?
2. Is there anything you wish you did better?
3. Is your current arrangement of jet fuel supply and storage meeting the current demand from airlines?
4. If you started with a clean slate, how would you design the delivery of jet fuel?
5. What type of ownership model do you favour?

6. In your experience, what are the pros and cons of a jet fuel pipeline?
7. In your experience, what are the pros and cons of providing jet fuel supply to an airport via trucks?
8. Are there any commercial restrictions in your current operating model?
9. Who do you think is best placed to own, operate and fund the infrastructure and/or pipeline?
10. Have you been required to fund additional requirements to support the existing jet fuel supply and storage facilities at your airport? (i.e. enhanced security, maintenance, contingency plans, etc.)
11. Who currently funds hydrant lines?
12. How much to build new hydrant lines?

Fuel Companies

1. Have you worked on the development of existing pipelines in NSW and Australia?
2. Do you have a forecast estimate of what a pipeline would cost?
3. What airports do you currently supply jet fuel to?
4. Would you alter any of the current jet fuel supply arrangements you are currently involved in to improve supply efficiency?
5. What type of pipeline do you think should be built for WSA?
6. What do you believe is the ideal solution/model for jet fuel supply to WSA?
7. Who do you think is best placed to build the pipeline?
8. Is existing infrastructure in Sydney and Western Sydney sufficient to cater for extra demand? Which infrastructure? Where?
9. Who do you think is best placed to fund the operation of a pipeline (either from the port or from an existing fuel supply hub)?
10. Who do you think is best placed to own and operate a pipeline to Western Sydney?
11. What level of volume would be required for you to consider building a pipeline for WSA?
12. Would you consider building a multi-product pipeline for WSA?
13. What type of return on investment would the infrastructure require?
14. What statistics/information do you use to forecast jet fuel growth?
15. Can we visit Gold Coast, Adelaide, Canberra, Melbourne and Sydney sites?
16. From a fuel company perspective, which airport (domestic and internationally) currently has an effective supply and storage facility for jet fuel?
17. Are the jet fuel storage facilities at existing airports (security, siting, design, etc.) adequate for current demand? Examples?

Industry associations on behalf of trucking companies

1. What are the current challenges to delivering jet fuel by road transport to WSA? (including regulatory and practical)
2. In your experience, are roads in this area becoming more congested?
3. Would anything on the current road network need to change to adequately support additional trucks delivering jet fuel to WSA?

4. What would be the most efficient route to transport jet fuel to WSA — Port Botany, Newcastle, Port Kembla — or from a pipeline at Clyde or Silverwater?
5. Are there any road restrictions near to Badgerys Creek that you are aware of?
6. What are the likely travel times between each of these ports?
7. Truck sizes, configurations, charge out rates, current road capacity?
8. Would additional security requirements be required?
9. What is the cost of a new truck (B-double) to buy, operate and maintain?
10. What is the time period for truck turnover? e.g. 10 years/20 years?
11. How long is required between ordering and receiving a supply truck ready for use?
12. Which airport currently sets the standards for safety and operational excellence both within Australia and internationally?
13. How do you plan for increased supply demands using truck deliveries?

Appendix D: Details of economic analysis

D.1 Jet fuel demand methodology

The economic analysis performed as part of this report required the development of a forecast of annual jet fuel demand for WSA over the 25-year appraisal period, from 2026 to 2051. The 25-year forecast was developed by calculating the jet fuel demand at two points in the life of the airport and drawing a straight line between them to provide an annual demand profile.

This is a fairly conservative method for estimating jet fuel demand across each of the years between the two points, but given a range of factors (haulage distances, aircraft fuel efficiency, market dynamics and the likely aircraft types to be used) this cannot be determined with certainty for 2026 and beyond, this method is a valid and robust approach. The results are tested for sensitivity later in Section D.13 to ensure they remain valid and robust.

The two points that were initially calculated for annual jet fuel demand were 2031 and 2052. These were chosen because there was already detailed passenger and aircraft movement forecasts, including synthetic flight schedules, available for these years from earlier work undertaken by LEK for the WSA Airport Plan and Business Case. This information was then converted to an equivalent jet fuel demand. This was done by calculating the aircraft type and destination of each aircraft movement to produce an estimate of the total jet fuel demand for these particular years (i.e. 2031 and 2052).

A straight line was then drawn between these two points to produce the annual jet fuel demand profile for WSA (Figure 16). This profile has been extrapolated from 2031 to provide annual estimates for the earlier years from 2026 to 2030. The profile has then been truncated to remove the year 2052 because it falls outside of the 25-year economic appraisal period from 2026 to 2051.

According to these forecasts (Table 18), jet fuel demand at WSA is expected to be 570ML per annum in 2031 and 2,937ML by 2052. Estimates of jet fuel demand were derived keeping in mind the aircraft type and distance to destination. These estimates were prepared on the basis that all flights arriving and departing from WSA will refuel at the airport, and that fuel efficiency of the aircraft will remain constant throughout the forecast period (in other words, a typical aircraft that is used today for domestic and international routes will remain in operation to 2051). A sensitivity analysis on aircraft refuelling at WSA was performed for this report (Section D.13) where it was assumed respectively that 25 per cent, 50 per cent and 75 per cent of domestic flights arriving at WSA are refuelled at the airport.

Table 18: Forecasts of annual aircraft movements, passenger movements and jet fuel demand at WSA for selective years

	2026	2031	2052	Average % growth p.a. 2031 to 2052
Aircraft movement (annual)	-	72,270	216,810	5%
Jet fuel demand (annual, million litres)	386	570	2,937	8%

Source: LEK analysis, Deloitte analysis.

D.2 Other inputs to economic modelling

Several data and information sources were used to prepare this economics report, as outlined below.

- Other than the jet fuel demand estimates for 2031 and 2052 as suggested above, fuel industry representatives (Fueltrac) prepared and provided:

- development costs of the new pipeline infrastructure, established through stakeholder consultations
- operating costs of the new and/or existing pipeline infrastructure, established through stakeholder consultations
- values that should be used to estimate the direct costs of road transport, such as time costs including wait time and loading/unloading time
- other capital costs including storage costs and additional pump and construction/materials, based on stakeholder consultations.

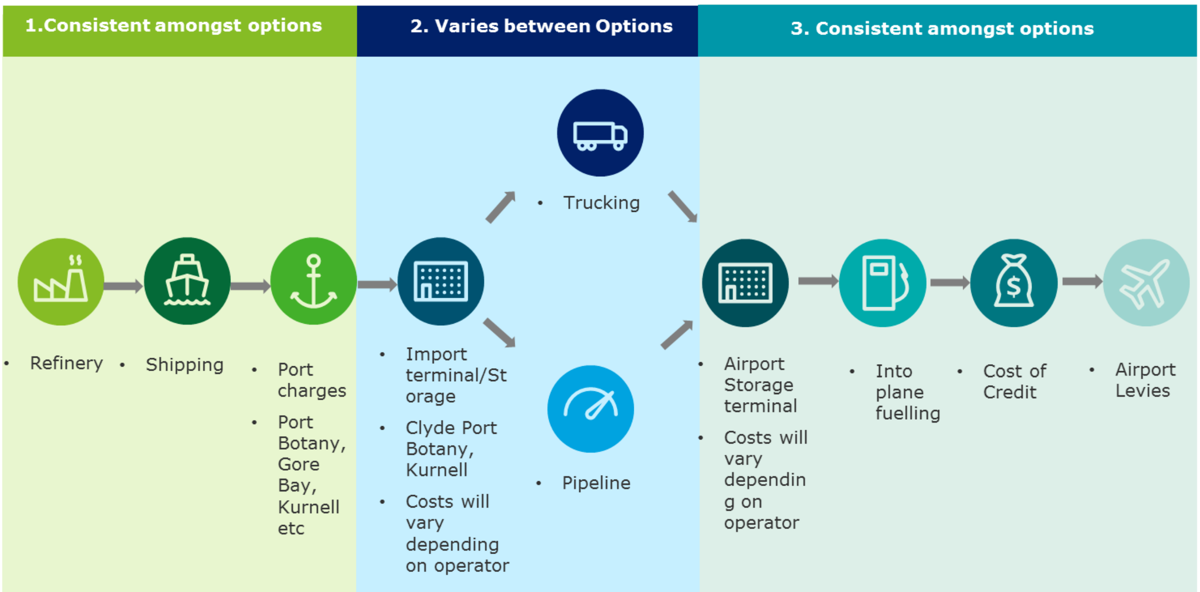
- Deloitte used parameter values from various government guidelines[69] on:
  - vehicle operating costs for road transport
  - indirect external costs of jet fuel movement by road that include the impact that vehicular flows have on the environment, road damage, and road user safety, as well as travel time saving for freight
  - indices to convert parameter values from dated guideline reports to 2017 price terms.

D.3 Cost exclusions

When distinguishing between the costs of the shortlisted options, this analysis has considered efficiency costs and not raw costs of each of the shortlisted options. This is because, the purpose of this analysis is to understand the least cost delivery option, and some cost elements in the supply chain of jet fuel from its origin to the proposed destination at WSA will be of the same magnitude across all shortlisted options, and therefore, will not contribute to the selection of the option with least cost.

Figure 25 provides a basic representation of the jet fuel supply chain from import terminals (i.e. origin) to the preferred destination (i.e. WSA).

Figure 25: Costs across the jet fuel supply chain (indicative and high-level)



Source: Fueltrac, Deloitte analysis 2017

In this supply chain, the costs pertaining to refinery, shipping and port charges will be the same across all of the six shortlisted delivery options and on this basis, have been excluded from the analysis. It was also ascertained by Deloitte that import terminal charges and storage fees would be consistent amongst delivery options, but delivery options pertaining to the Western Sydney depot will incur additional depot fees. Hence import terminal and storage fees have been excluded for all other options except for TP2 and PP2.

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[69] (i) Australian Transport Assessment and Planning (ATAP) Guidelines; (ii) Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives developed by Transport for NSW (TfNSW); (iii) Austroads (Road Safety Engineering Risk Assessment Part 7: Crash Rates Database). Several indices were used from the Australian Bureau of Statistics for converting dated values from guidelines to 2017 price terms.

Furthermore, the following cost categories are also not included in this analysis:

- The financing cost of servicing capital to build a new pipeline in some of the proposed options. Financing costs are not considered in an economic analysis, on the basis that capital costs of building the pipeline are included in full, and as upfront costs.
- Costs for converting or expanding storage facilities to cater for jet fuel has not been included in this analysis because it is treated as a commercial decision to be undertaken by the operator.
- Depreciation is not considered in this analysis as capital and operation costs are included separately, and unlike a financial analysis, an economic analysis does not consider depreciation. This is in alignment with NSW Treasury 'NSW Government Guide to Cost-Benefit Analysis', which states that depreciation should not be included in economic analysis as it double-counts the capital costs.

D.4 Road transport costs inputs

D.4.1 Direct costs

D.4.1.1 Time costs

The estimated time taken to complete a round trip to WSA in each of the road transport related options, and loading and unloading times are shown in Table 19.

The drive time (Table 19) is based on the estimated distance that vehicles will need to travel under the shortlisted options. This distance was estimated using routes identified with Google Maps that avoided tunnels (as dangerous goods, such as jet fuel, cannot travel in a tunnel).

Table 19: Travel time and loading/unloading time estimates

Delivery method	Drive time – round trip (hours) [70]	Load time (hours)	Average VKT (km) – round trip
T1	3.5	1.5	118.80
TP1	2.5	1.5	81.40
TP2	2.1	1.5	56.00

Source: Google maps

The parameter values used in the economic appraisal for the estimated values of travel time for vehicle occupants were sourced from the ATAP (2016) guidelines. These values were escalated to 2017 price terms using appropriate wage price indices using guidance from the ABS. The main parameter values are presented in Table 20.

Table 20: Vehicle occupant and urban freight travel time (2017 values)

Vehicle type	Value per occupant ($/person-hour)
B-double	27.5
A-double	28.3

Source: ATAP (2016) guidelines, and escalated to 2017 price terms using average wage price indices

[70] Travel time includes wait time. Wait time has been tested in the sensitivity analysis (Section 6.4) to account for the impact of increasing port congestion.

D.4.1.2 Vehicle operating costs

Vehicle operating costs are dependent on the type of vehicle, the distance travelled and/or load carried. In this instance, costs have been expressed as dollars per litre of jet fuel carried, to enable an easy comparison of these costs with pipeline operating costs that are shown in Section D.5 later in the report.

Costs are derived using ATAP guidance; these costs are derived assuming stop-start traffic conditions with average speeds under 60km/h. Deloitte estimated, using Google Maps data, that the average speed for the entire route in each of the three road transport related options would be under 60km/h and this warranted the use of the stop-start model (refer Table 21).[71]

Table 21: Average speed for road transport routes in 2017 (km/h)[72]

Delivery method	Average speed (km/h)
T1	43.2
TP1	46.5
TP2	41.5

Source: Google maps, Deloitte Analysis

ATAP further defines a series of parameters to generate per unit vehicle operating costs (in this case, converted to per litre costs). Values from Table 19, Table 20, and Table 21 were used to predict vehicle operating costs using the stop-start model guidance available from the ATAP (Table 22). Although A-doubles have higher vehicle operating costs per km travelled, they carry approximately 11,000 litres more per trip and therefore, costs for A-doubles and B-doubles were estimated to be the same per litre.

Table 22: Vehicle operating cost outputs for road transport ($ per litre, 2017)

Delivery method	B-double vehicle operating costs	A-double vehicle operating costs
T1	0.0052	0.0052
TP1	0.0034	0.0034
TP2	0.0025	0.0025

Source: Deloitte analysis

The total direct costs for road transport (Table 23 and Table 24) were sourced using government guidelines; data on the same was also available from fuel industry representatives (Fueltrac), which was based on commercial rates provided by industry and verified through stakeholder consultation. However, data provided by fuel industry representatives was higher than that suggested by the guidelines. Consequently, in the interests of consistency, the data sourced from the guidelines was used, however, it was escalated to be in line with industry representative estimates.

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[71] It should be noted that driving times appropriated from Google maps used in the speed calculation are time sensitive and thus vary by time of day. Times appropriated using Google maps are also based on travel by commuter car rather than heavy vehicle freight, however, it serves as a proxy in the analysis.

[72] Table speeds do not account for wait or loading time.

Sensitivity tests are completed (results shown in Section 6.4) to observe a change in results where estimates for road transport costs provided by fuel industry representations were used.

These outputs were estimated for the six delivery methods described in Section 5.2.5. The pipeline options that do not involve road transport were therefore excluded from the vehicle cost analysis. The final values are shown in Table 25 and Table 26.

Table 23: Total direct road costs B-double based on ATAP ($ per litre, 2017)

Delivery method	Vehicle operating costs	Labour costs	Total
T1	0.0052	0.0025	0.0077
TP1	0.0034	0.0020	0.0055
TP2	0.0025	0.0018	0.0043

Source: Deloitte analysis

Table 24: Total direct road costs A-double based on ATAP ($ per litre, 2017)

Delivery method	Vehicle operating costs	Labour costs	Total
T1	0.0052	0.0022	0.0073
TP1	0.0034	0.0017	0.0052
TP2	0.0025	0.0016	0.0040

Source: Deloitte analysis

Table 25: Total direct road costs escalated by 175% B-double ($2017, $ per litre)

Delivery method	Vehicle operating costs	Labour costs	Total[73]
T1	0.0090	0.0045	0.0135
TP1	0.0060	0.0036	0.0096
TP2	0.0043	0.0032	0.0076

Source: Deloitte analysis

[73] Total road operating costs for B-doubles have been tested in the sensitivity analysis (Section D.4) to account for variances in road operating costs.

Table 26: Total direct road costs escalated by 175% A-double ($2017, $ per litre)

Delivery method	Vehicle operating costs	Labour costs	Total[74]
T1	0.0090	0.0038	0.0128
TP1	0.0060	0.0030	0.0090
TP2	0.0043	0.0027	0.0071

Source: Deloitte analysis

D.4.2 Costs to the broader community[75]

D.4.2.1 Environmental costs

Similar to vehicle operating costs, environmental costs are also dependent on the vehicular distance travelled. The greater the distance travelled by vehicles on roads, the higher the running time of these vehicles and the greater the adverse environmental effects.

The following environmental costs are included in the economic analysis presented in this report, as per guidance from the ATAP:

- Air pollution and noise pollution.
- Water pollution that includes organic waste or persistent toxicants run-off from roads generated from vehicle use: engine oil leakage and disposal, road surface, particulate matter and other air pollutants from exhaust and tyre degradation.
- Nature and landscape impacts that are driven by habitat loss, loss of natural vegetation or reduction in visual amenity.
- Upstream and downstream costs that refer to the indirect costs of transport including energy generation, vehicle maintenance and infrastructure construction and maintenance.
- Urban separation, an urban impact that accounts for, among other things, visual intrusion and time loss imposed by vehicles for pedestrians. For example, when crossing a road, pedestrians have to wait at lights and therefore lose time which is a time cost.

Parameter values used in the appraisal of environmental costs were sourced from *Transport for NSW (TfNSW) Principles and Guidelines for Economic Appraisals 2016* and indexed by CPI to reflect 2017 price terms. The main environmental parameter values for freight vehicles are presented in Table 27. Value parameters are sourced from TfNSW rather than ATAP as environment values for ATAP have not been updated since 2012.

[74] Total road operating costs for A-doubles have been tested in the sensitivity analysis (Section D.13) to account for variances in road operating costs.
[75] Total externality costs have been tested in the sensitivity analysis (Section D.13) to account for scenarios with no external costs for road.

Table 27: Parameter values for environmental externalities (2017 values)

Environmental externalities	Heavy vehicles ($/1000 gross tkm[76])
Air pollution	27.0
Greenhouse gas emissions	6.0
Noise pollution	4.5
Water pollution	4.0
Nature and landscape	0.4
Urban separation	3.0
Upstream and downstream costs	24.0
Total	**69.0**

Source: TfNSW (2016), Guide to Project Evaluation, Part 4, Project Evaluation Data, Austroads, 2012.

D.4.2.2 Accident costs

Accident costs are also dependent on the distance travelled and account for the average cost of accidents by injury severity. Parameter values used in the appraisal of accident costs were sourced from ATAP (2016) guidelines and Austroads (2010) and indexed by CPI to reflect 2017 price terms (ABS 2016). The main parameter values are presented in Table 28 and Table 29. These parameters were used to calculate the final value for freight vehicle accident costs per litre that are presented in Table 30.

Table 28: Estimation of accident costs by injury severity, willingness to pay (2017 values)

Fatal crash ($)	Serious injury crash, per incident ($)	Other injury crash, per incident ($)
6,476,155	136,505	136,505

Source: ATAP (2016)

Table 29: Urban road accidents per 100 million vehicle kilometres (2017)

	Fatal	Injury
Urban	0.5	28.8

Source: Austroads (2010), AP-T152/10

[76] tkm refers to tonnes kilometres travelled.

Table 30: Freight vehicle accidents cost per litre (2017 values)

Delivery options	B-double ($/L)	A-double ($/L)
T1	0.00018	0.00015
TP1	0.00012	0.00010
TP2	0.000085	0.000071

Source: Deloitte Analysis

D.4.2.3 Road damage costs

Road damage costs account for damage caused to existing road infrastructure by vehicle operation. Heavier vehicles cause more damage.

Parameter values used in this report were sourced from TfNSW guidelines and indexed by CPI to reflect 2017 prices (ABS 2016). The main parameter values are presented in Table 31. No road damage costs are provided by these guidelines for A-doubles and hence B-double rates are used in the analysis as a proxy.

Table 31: Parameter values for road damage costs ($/vehicle km travelled, 2017 values)

Vehicle type	Value
B-double	0.26
A-double	Assumed to be same as those for B-double, as specific values for A-double vehicles were not available

Source: Transport for NSW (2016)

D.5 Pipeline cost inputs

D.5.1 Construction, planning and corridor reservation costs [77]

Pipeline construction cost estimates have been provided by fuel industry representatives through stakeholder consultations. It was estimated that construction of the new pipeline will cost approximately $2.5 million in 2017 price terms (+/-20 per cent margin) for each kilometre of pipeline infrastructure built. This estimate is inclusive of planning and approval costs, and corridor acquisition costs where relevant.

Information provided through the stakeholder consultation process, and validated by fuel industry representatives, indicated that the construction of a new pipeline could take between three and five years. This was inclusive of planning and approval time to secure corridor acquisition (up to two years at least) and the time to construct this infrastructure (up to two years).

The disaggregation of the unit costs reported above (i.e. $2.5 million per kilometre) over the various activities of planning and approval, corridor acquisition and actual build has been sourced from work previously completed by TfNSW on jet fuel delivery options to WSA. As a proportion of the total unit costs, planning and procurement costs represent 25 per cent, land acquisition costs represent 5 per cent and construction and material costs represent 70 per cent. It is noted that land acquisition costs are a low proportion of the total costs as consultation indicated that the majority of the pipeline corridors would likely use existing public land.

There were no capital costs assumed for options that use an existing pipeline infrastructure.

[77] Total pipeline capital costs have been tested in the sensitivity analysis (Section D.13) to account for variances in construction costs.

D.5.2 Other capital costs [78]

Additional storage Costs: Options TP2 and PP2 do not have existing storage facilities at the Western Sydney depot. Consequently, these will need to be constructed. Based on information provided by fuel industry representatives, the storage facility is expected to cost approximately $20 million.

Pumping facility capital costs: As advised during stakeholder consultations, incremental pumping stations or booster pumps are likely to be required for pipelines over approximately 60km in length in order to retain adequate jet fuel flow. Capital costs for the pumping facility were estimated by fuel industry representatives at $13.5 million. This facility will only be required for Option P1 as all other pipeline options are lower than 60km is length.

D.5.3 Operating costs[79]

When pipeline infrastructure carries more than 700ML of jet fuel per day, the unit cost of pipeline operations are in the order of magnitude of $0.001 (i.e. 0.1 Australian cents) per litre of jet fuel handled, as suggested by fuel industry representatives.

If the volume of jet fuel handled is lower than this threshold of 700ML per annum, the unit cost of operations comprise a fixed cost element of $350,000 per annum in addition to a variable cost component of $0.0005 per litre.

Additionally, it was confirmed by fuel industry representatives that operating costs for old and new pipeline infrastructure would be the same.

D.5.4 Additional pipeline operating costs for Western Sydney options

It was noted from industry experts that the operating costs in options TP2 and PP2 which involve pipelines from an eastern seaport to a western Sydney depot would go through two existing pipelines and therefore incur an additional operating cost of $0.01 per litre of jet fuel transported. This has been factored into Deloitte's modelling.

D.5.5 Additional depot operating costs (throughput fee)

If jet fuel is supplied via a multi-product pipeline from a seaboard terminal, an intermediate storage facility or depot will be required in the supply chain to:

- handle product interfaces
- recertify the jet fuel as on specification
- transfer recertified product along a dedicated jet fuel pipeline to dedicated on-airport storage.

In order to get jet fuel from the eastern Sydney terminal to the western Sydney depot, the jet fuel must go through an additional handling process in Silverwater. This is an added cost not incurred by the other pipeline options. It is noted that PP2 and TP2, which use multi-product pipes to the western Sydney depot, both require these additional depot costs. The incremental operating expenses of intermediate storage have been factored into these options.

D.5.6 P1 property rents

Additional property rents for the pumping facility of option P1 (60km) have been accounted for in these options. It has been assumed that property rents for a pumping facility would equate to 0.36per cent per annum of the capital costs of building the pumping facility ($13.5 million). This amounts to $48,600 per annum in 2017 values. Refer to D.6 for capital costs profiles.

D.6 Capital costs — pipeline

There is no capital outlay in options T1, TP1, TP2. The time profile of capital costs for the pipeline related options are shown in Table 32, Table 33, and Table 34.

[78] Ibid.

[79] Total pipeline operating costs have been tested in the sensitivity analysis (Section D.13) to account for variances in construction costs.

Table 32: PP1 – Pipeline capital costs ($millions, 2017)

Pipeline capital costs	**2022**	**2023**	**2024**	**2025**
Planning and procurement	12	12	-	-
Land acquisition	5	-	-	-
Construction/materials	-	-	35	35
Total capital expenditure	**17**	**12**	**35**	**35**

Source: Deloitte calculations using stakeholder analysis and fuel industry representatives

Table 33: PP2 – Pipeline capital costs ($millions, 2017)

Pipeline capital costs	**2022**	**2023**	**2024**	**2025**
Planning and procurement	8	8	-	-
Land acquisition	3	-	-	-
Construction/materials	-	-	22	22
Total capital expenditure	**11**	**8**	**22**	**22**

Source: Deloitte calculations using stakeholder analysis and fuel industry representatives

Table 34: P1 – Pipeline capital costs ($millions, 2017)

Pipeline capital costs	**2022**	**2023**	**2024**	**2025**
Planning and procurement	18	18	-	-
Land acquisition	8	-	-	-
Construction/materials	-	-	53	53
Total capital expenditure	**26**	**18**	**53**	**53**

Source: Deloitte calculations using stakeholder analysis, and fuel industry representatives

D.7 Capital costs — other

Other capital costs including storage costs, additional pump and construction/materials have been based on information gathered during stakeholder consultations.

No other capital costs have been included in options T1, TP1 and PP1. The options which have incurred pipeline capital costs are detailed in Table 35, Table 36, and Table 37.

Table 35: TP2 – Other capital costs ($millions, 2017) [80]

Other capital costs	**2022**	**2023**	**2024**	**2025**
Storage costs	-	-	-	20
Additional pump	-	-	-	-
Total other capital costs	**-**	**-**	**-**	**20**

Source: Stakeholder consultation

Table 36: PP2 – Other capital costs ($millions, 2017)

Other capital costs	**2022**	**2023**	**2024**	**2025**
Storage costs	-	-	-	20
Additional pump	-	-	-	-
Total other capital costs	**-**	**-**	**-**	**20**

Source: Stakeholder consultation

Table 37: P1 – Other capital costs ($millions, 2017)[81]

Other capital costs	**2022**	**2023**	**2024**	**2025**
Storage costs	-	-	-	-
Additional pump	-	-	-	13.5
Total other capital costs	**-**	**-**	**-**	**-**

Source: Stakeholder consultation

D.8 Results — capital costs discounted

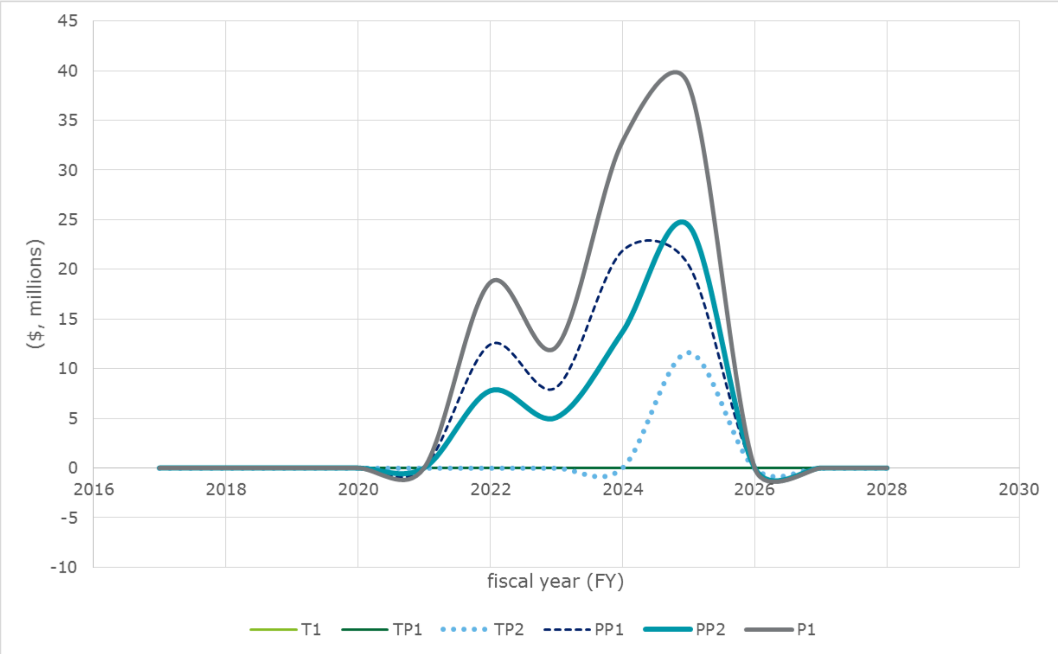
Discounted capital costs of various options are shown in Figure 26. A discount factor has been used to discount future values to present day values to enable an easy comparison between options.

The analysis shows that the 60km option (P1) has the highest capital costs compared to shorter build pipeline options PP1 and PP2.

[80] Estimate of $20 million to construct storage was sourced from fuel industry representatives.

[81] Estimate of $13.5 million to construct a pumping station was sourced from fuel industry representatives.

Figure 26: Option comparison – annual discounted capital costs ($ million, 2017)

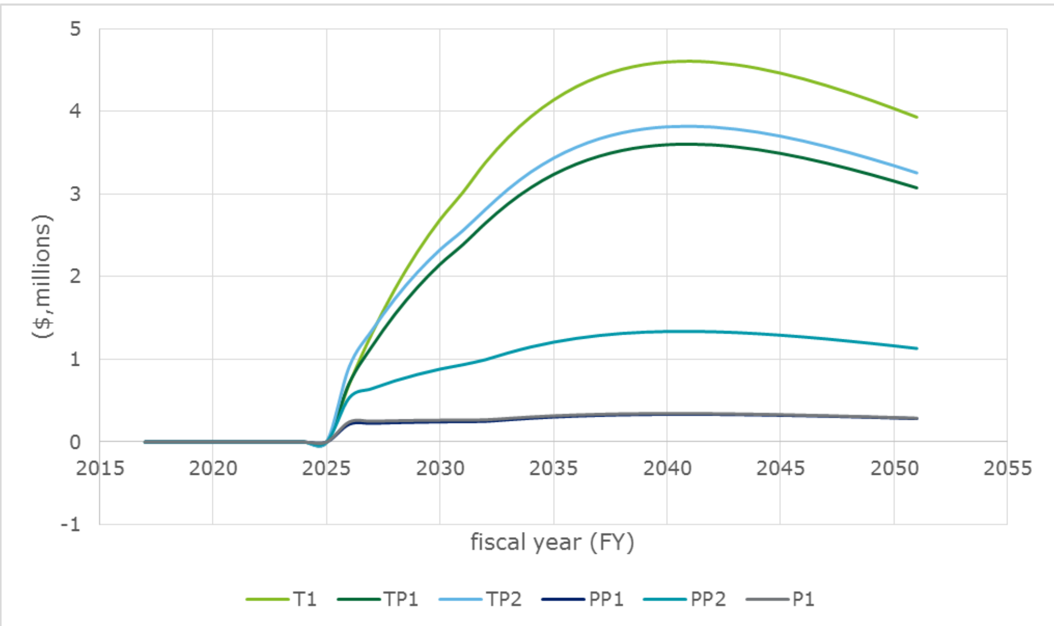


Source: Deloitte Analysis

D.9 Results — operating costs discounted

Figure 27 shows the discounted operating costs of the six shortlisted options. The operating costs shown for road related options are higher, on an annual basis, compared to delivery by pipeline.

Figure 27: Option comparison – annual discounted operating costs ($ millions, 2017)

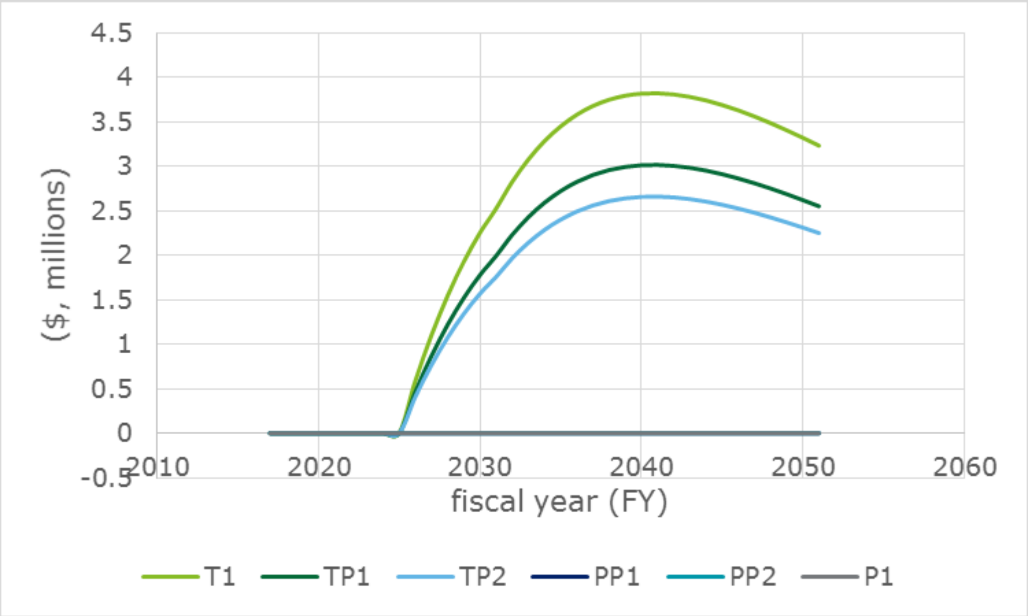


Source: Deloitte analysis

D.10 Results — other costs discounted

Road transport options have significantly higher ‘other costs’ as evidenced by Figure 28. Other costs refer to external costs imposed on the broader community and include environmental costs, accident costs and travel time costs.

Figure 28: Option Comparison – annual discounted other costs ($ millions, 2017)



Source: Deloitte analysis

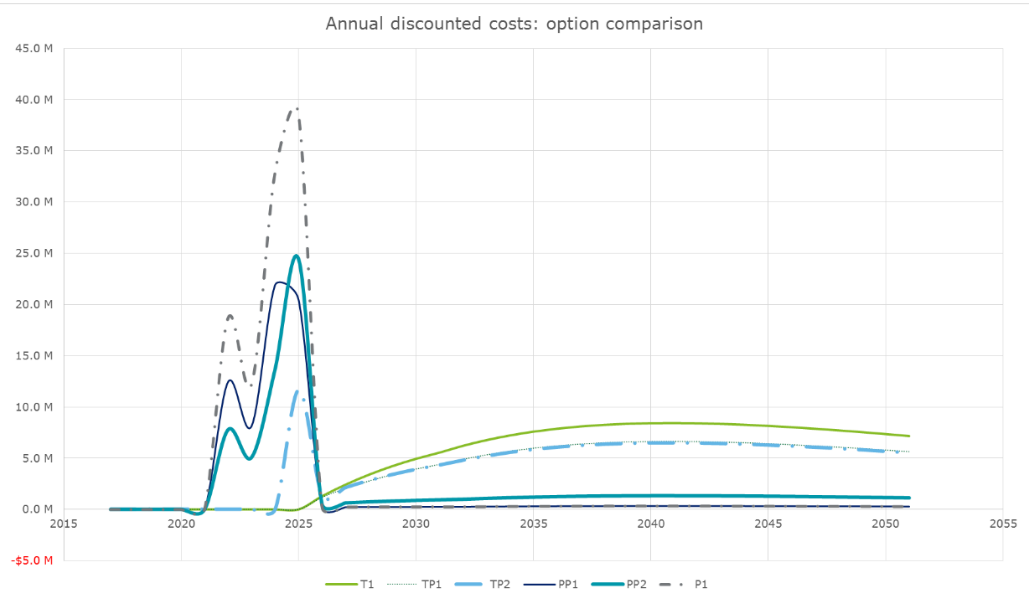
D.11 Results — cost-efficiency option comparison

We have costed the options on the basis that you should be able to deliver jet fuel by any of the options by 2026 when WSA becomes operational.

Modelling has been undertaken on the premise that each option should be able to deliver jet fuel to WSA in its first year of operations, 2026. This does not make a pipeline economically viable at this point. The relatively lower costs of pipelines compared to road transportation means that as jet fuel demand volumes grow, the cost savings of delivery by pipeline grow as well (until such time that the pipeline reaches capacity and additional investment is required).

Figure 29 illustrates the higher upfront capital costs involved in the pipeline options, but their relatively low long term operating costs, with significantly lower costs of operation after the pipeline construction has been completed. Figure 27 and Figure 29 show that road transport costs continue over time, while pipeline costs decrease over time.

Figure 29: Option comparison — annual discounted costs



Source: Deloitte analysis

It is important to note that road transport also contributes to the external costs, in particular road damage, crash costs and environmental externalities.

D.12 Results — feasibility calculations

The feasibility of the pipeline is dependent on a number of factors, including distance of the new pipeline, required jet fuel volumes, consideration of costs (direct costs only or both direct and external costs) and timing. If external costs imposed by vehicular traffic were excluded, Deloitte's analysis found that the feasibility point (i.e. when the cost of servicing aggregate jet fuel demand by truck equals that supplied by pipeline) for a 20km long pipeline is when the aggregate jet fuel demand is 4BL (Table 38).

If a 40km or a 60km pipeline is built and maintained, then a much larger volume of jet fuel will be required to be moved (8BL in case of a 40km pipeline and 12BL in case of a 60km pipeline) for the cost of supplying jet fuel to WSA by pipeline and road to be the same (Table 39 and Table 40).

If jet fuel demand were to rise above these estimated threshold volumes (and not necessarily in any given year, but aggregated over a number of years), then the cost of supplying jet fuel using road transport would be higher compared to a pipeline option.

Table 38: Pipeline scenario 20km — feasibility (no external costs)

Cost	Units ($)	Distance (km)	Litres (million)	Cost ($million)
Capital cost (pipeline)	$2,500,000	20	-	50
Operating cost (pipeline)	$0.001	-	4000	4
Operating cost (road)	$0.014	-	4000	54
Total cost (pipeline)	-	-	-	**54**
Total cost (road)	-	-	-	**54**

Source: Deloitte Analysis

Table 39: Pipeline scenario 40km — feasibility (no external costs)

Cost	Units ($)	Distance (km)	Litres (million)	Cost ($million)
Capital cost (pipe)	$2,500,000	40	-	100
Operating cost (pipe)	$0.001	-	8000	8
Operating cost (road)	$0.014		8000	108
Total cost (pipe)	-	-	-	**108**
Total cost (road)	**-**	**-**	**-**	**108**

Source: Deloitte Analysis

Table 40: Pipeline scenario 60km — feasibility (no external costs)

Cost	Units ($)	Distance (km)	Litres (million)	Cost ($million)
Capital cost (pipe)	$2,500,000	60	-	150
Operating cost (pipe)	$0.001	-	12,000	12
Operating cost (road)	$0.014	-	12,000	162
Total cost (pipe)	-	-	-	**162**
Total cost (road)	**-**	-	-	**162**

Source: Deloitte Analysis

When accounting for external costs, the pipeline feasibility tips in favour of a pipeline option at a significantly lower volume of jet fuel demand. As shown in Table 41, Table 42 and Table 43, servicing a 2.6BL jet fuel demand would cost the same using a 20km pipeline as supplying the jet fuel by road when external road use costs are considered. A higher volume of jet fuel demand (5.2BL) would be required for a 40km pipeline option to be feasible against road transport. Finally, for a 60km pipeline to be feasible, approximately 7.9BL of jet fuel would be required to be transported by pipeline, for the pipeline option to become more cost effective (Table 43).

Table 41: Pipeline scenario 20km — feasibility (includes external costs)

Cost	Units ($)	Distance (km)	Litres (million)	Cost ($million)
Capital cost (pipe)	$2,500,000	20	-	50
Operating cost (pipe)	$0.001	-	2632	3
Operating cost (road)	$0.020	-	2632	53
Total cost (pipe)	-	-	-	**53**
Total cost (road)	**-**	-	-	**53**

Source: Deloitte Analysis

Table 42: Pipeline scenario 40km — feasibility (includes external costs)

Cost	Units ($)	Distance (km)	Litres (million)	Cost ($million)
Capital cost (pipeline)	$2,500,000 per km	40	-	100
Operating cost (pipeline)	$0.001p.a.	-	5263	5
Operating cost (road)	$0.020p.a.	-	5263	105
Total cost (pipe)	-	-	-	**105**
Total cost (road)	**-**	-	-	**105**

Source: Deloitte Analysis

Table 43: Pipeline scenario 60km — feasibility (includes external costs)

Cost	Units ($)	Distance (km)	Litres (million)	Cost ($million)
Capital cost (pipeline)	$2,500,000 per km	60	-	150
Operating cost (pipeline)	$0.001p.a.	-	7895	8
Operating cost (road)	$0.020p.a.	-	7895	158
Total cost (pipe)	-	-	-	**158**
Total cost (road)	**-**	**-**	**-**	**158**

Source: Deloitte Analysis

This analysis is agnostic of the shortlisted options, but puts into perspective the threshold volumes of jet fuel beyond which pipeline options may be more feasible. These results also help benchmark the results of the feasibility analysis generated using the shortlisted options.

It is recommended that the feasibility of the pipeline option should be determined after taking into account both the direct and external costs of road transport, as the external costs will be borne by the wider society.

D.13 Results — sensitivity analysis

The economic assessment used project forecasts for WSA aviation travel and jet fuel use. As a result, a series of scenarios and sensitivity tests were undertaken to determine the cost of each option using different input values to those reported for the Core Scenario above. A cost-efficiency analysis was performed for each scenario with the Net Present Values shown in Table 44 below.

Table 44: Sensitivity analysis discounted costs ($ millions, 2017), over 25 years (2026-2051)

	T1	TP1	TP2	PP1	PP2	P1
Core scenario[82]	177.9	140.3	149.5	70.6	80.3	110.2
Discount rate used increased by 4%	349.1	274.9	284.5	91.0	119.2	139.6
Discount rate used increased by 10%	95.6	75.5	83.6	56.4	57.9	89.0
Total pipeline operating costs increased by 10%	177.9	141.0	152.4	71.3	83.2	111.0
Total pipeline operating costs decreased by 10%	177.9	139.5	146.6	69.8	77.4	109.5
Total capital expenditure increased by 20%	177.9	140.3	151.8	83.1	90.5	130.7
Total capital expenditure decreased by 20%	177.9	140.3	147.2	58.0	70.1	89.8
50% reduction in jet fuel demand	89.0	70.8	82.0	67.4	67.0	107.1
Reduce jet fuel demand so that only 50% of domestic flights refuel	145.2	114.7	124.6	69.4	75.3	109.0
External costs are not accounted for	97.2	76.6	93.3	70.6	80.3	110.2
Wait time increases by 50%	186.0	140.3	149.5	70.6	80.3	110.2
A-double to B-double ratio increases to 50% from 2036-2051	178.1	140.6	149.9	70.6	80.3	110.2
Total road costs are calculated using ATAP parameter values.	104.1	85.0	103.9	70.6	80.3	110.2
Total road costs decreased to 125% of ATAP values	128.7	103.4	119.1	70.6	80.3	110.2

Source: Deloitte Analysis

[82] Core scenario based on a discount rate of seven per cent.

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