New England Highway Singleton Bypass Options Assessment

Preferred Option Report

December 2016

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Executive summary

Introduction

Roads and Maritime Services is planning for a future New England Highway bypass at Singleton.

The New England Highway passes through Singleton and forms the main road access through the town and to the town centre. More than 25,000 vehicles use the highway through Singleton and across the Hunter River, with around 3750 of these being heavy vehicles.

Traffic volumes are predicted to increase as a result of population growth, future land developments in Singleton, and regional freight movement traffic growth.

In November 2014, Roads and Maritime started a route options assessment to identify a preferred corridor for the future bypass and secure the corridor in Singleton Council's Local Environmental Plan (LEP).

The assessment identified options based on planning, environmental, engineering, socio-economic and existing infrastructure constraints in and around the town.

Three shortlisted options were placed on display for community feedback in late 2015.

This feedback, along with technical investigations and a value management workshop has been used to select the preferred bypass route. Technical investigations included flood modelling to help understand the potential flooding impact of each option.

The NSW Government has committed $92 million towards the project under Rebuilding NSW.

Timing for construction of the bypass has not been confirmed and would be subject to approval and funding availability.

Project objectives

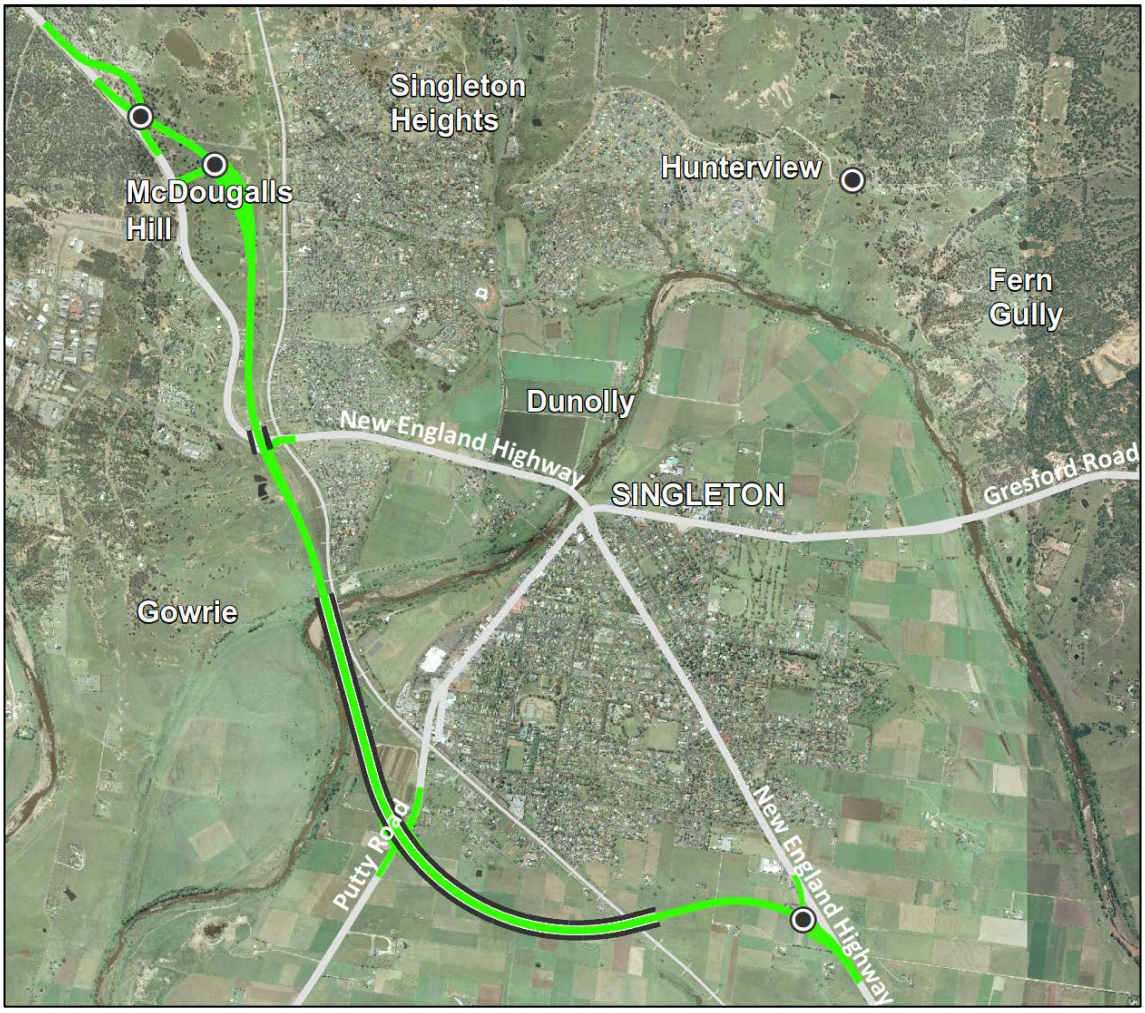
The key objectives of the project are to:

- Improve travel reliability on the New England Highway through Singleton, particularly for road freight supporting the Upper Hunter and the North West New England region
- Improve the town centre by removing freight traffic
- Improve road safety for through and local traffic in Singleton
- Provide best value for money
- Provide clarity for Singleton Council by including the corridor in the LEP
- Potentially provide improved flood amenity and/or evacuation routes for Singleton.

Preferred option

The preferred route involves building a new 8.9 kilometre long section of highway bypassing Singleton to the west as shown in **Figure (i)**.

Figure (i) Singleton bypass preferred option



The proposed bypass departs the New England Highway near Newington Lane, heads west over the Main Northern Railway line and then across the floodplain, over Putty Road. It continues over the Hunter River, west of the town, before crossing the New England Highway west of Gowrie Gates and rejoining the highway north of McDougalls Hill. This route was referred to as Option B in the 2015 route option display and throughout this report.

The proposed bypass would include:

- Nine kilometres of new highway with a single lane in each direction and the possibility to upgrade to dual carriageway in the future
- A 3.1 kilometre bridge over the Main Northern Railway, Doughboy Hollow and Hunter River floodplains
- Highway exit ramps at both the northern and southern ends of Singleton to provide access to the town centre
- A full interchange at Putty Road including access to and from the town centre via John Street
- A full interchange at Magpie Street including access to the industrial area
- A potential southbound entry ramp to the bypass at Gowrie Gates
- Minimum flood immunity along the new highway for a one in 20 year flood event.

Key benefits of the preferred option

The preferred option:

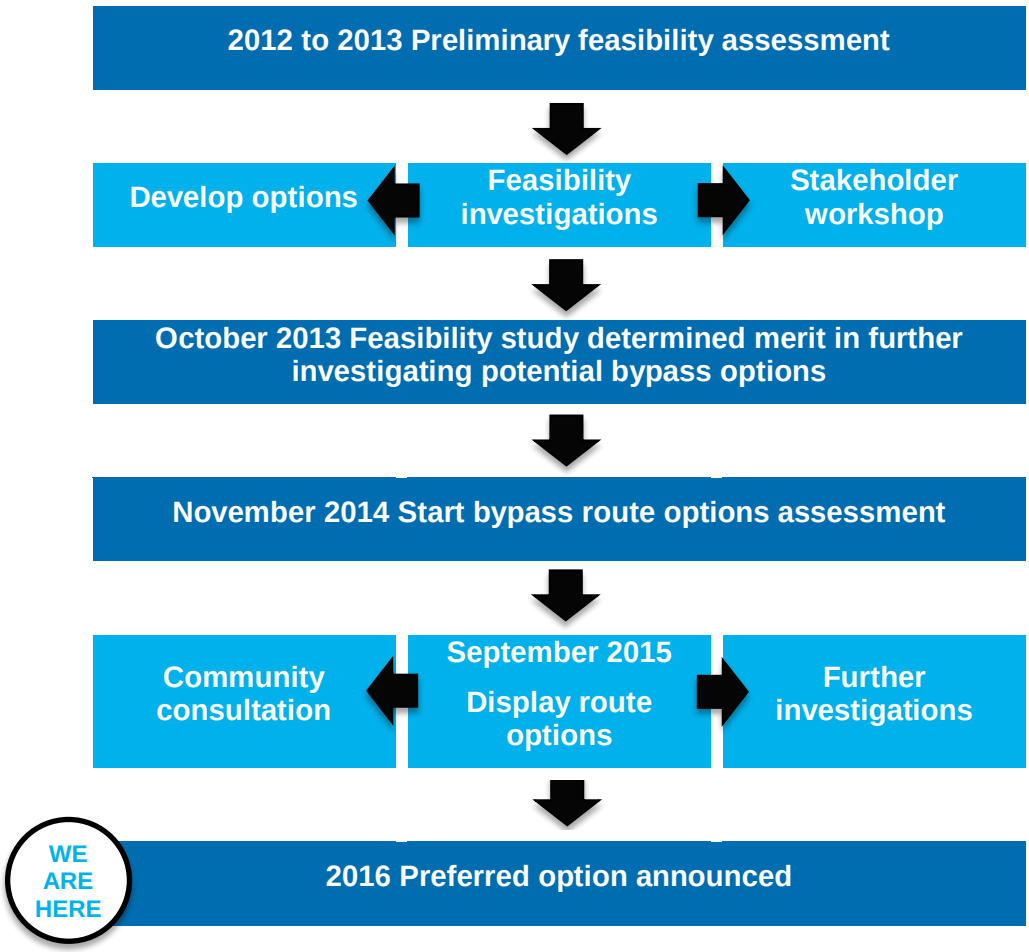
- Reduces travel times and congestion
- Has the least environmental impact
- Provides the greatest connection to existing roads and routes
- Has the least impact on property and local access
- Has the least impact on high quality agricultural land
- Has the least impact on future residential growth precincts in Singleton
- Meets a range of other benefits such as potential flood evacuation routes, better access to the town centre and provides a heavy vehicle bypass between the north and west
- Is economically viable.

Options development and assessment

An options assessment process started in November 2014 to identify a preferred bypass and route.

This was a continuation of broader development process, shown in **Figure (ii)**

Figure (ii) Development process



Assessing the values of each option

Values important to the project were identified through desktop investigations, during collaborative workshops and at meetings with key stakeholders. These values informed the assessment criteria which were used to identify a preferred option.

A value management workshop was held in March 2016 and included representatives from the local community, local public transport operators, Singleton Council, Roads and Maritime and AECOM.

Technical/functional, socio-economic, and environmental categories were used to compare and assess each of the three shortlisted options.

Community consultation

The three shortlisted options were displayed for community and stakeholder feedback between 28 September and 23 October 2015 and 168 submissions were received. The most commonly raised issues included:

- Changes to hydrology and potential local flooding (13%)
- Property acquisition/compensation (12%)
- Traffic forecasts, use of local routes and travel times (9%)
- Isolation or fragmentation of agricultural land (8%)
- Impact on business/trade loss (6%)
- Property value (5%).

Traffic

The operation of the road network in the study area is predicted to gradually worsen if no bypass is built. Average travel times along the New England Highway between Belford and Rixs Creek are forecast to increase. Without the bypass, significant traffic congestion along the New England Highway could also prevent traffic from efficiently accessing Singleton town centre.

A bypass would have the following benefits:

- Time spent travelling in the study network could be reduced during peak periods
- Average heavy vehicle volumes along the existing New England Highway through Singleton could be reduced
- The preferred option would reduce the total weekday traffic on John Street (Singleton town centre).

A bypass would improve overall network performance, reduce freight traffic through the town centre and potentially improve access to Singleton.

Flooding

A preliminary flood impact assessment was carried out to understand how a bypass would affect flooding in and around Singleton. The assessment considered mainstream flooding of the Hunter River and Doughboy Hollow Creek.

The impact a bypass would have on flooding is influenced by the length of the proposed bridges and the location of interchanges. Longer bridge lengths would minimise the impact on flooding.

In general, the assessment showed changes in floodwater levels would be relatively localised for all three shortlisted options.

The preferred option crosses the Doughboy Hollow floodplain, which is relatively wide and has a complex system of flood flow paths. The proposed bridge across the floodplain would reduce the impact the bypass would have on these flows. The proposed Putty Road interchange is also located in this floodplain however the impact would be minor and flooding would be localised.

Of the three options, the preferred option provides the best evacuation access for Singleton. Access to and from the town centre would be via the southern interchange for up to a one in 20 year event. Evacuation access is also possible via Putty Road in a one in 10 year event.

Next steps

The NSW government has committed $92 million towards the bypass under Rebuilding NSW, with $1.5 million in 2016-17 to progress planning.

The preferred route corridor will be included in Singleton Council's LEP, reserving the land for the bypass.

Roads and Maritime will carry out further consultation with affected landowners and key stakeholders, including Singleton Council. Subject to approval, the project would move to the concept design and environmental assessment stage.

Timing for construction of the bypass has not been confirmed and would be subject to approval and funding availability.

Contents

Figures

Tables

1. Introduction

1.1. Project overview

Roads and Maritime has been investigating the New England Highway bypass of Singleton since 2012. The New England Highway forms part of the National Land Transport Network and is a major freight and commuter route.

The highway passes through Singleton and forms the main road access through the town and to the town centre. More than 25,000 vehicles use the highway through Singleton and across the Hunter River, with around 3750 of these being heavy vehicles.

Traffic volumes are predicted to increase as a result of population growth, future land developments in Singleton, and an increase in regional freight movement traffic growth.

In 2013 Roads and Maritime completed a preliminary feasibility study which determined there is merit in carrying out further investigations and planning for a bypass of Singleton.

In November 2014 Roads and Maritime started a route options assessment to identify a preferred corridor for the future bypass and secure the corridor in Singleton Council's LEP. The development and assessment of various route options and investigations focused on identifying options based on planning, environmental, engineering, socio-economic and existing infrastructure constraints in and around the town.

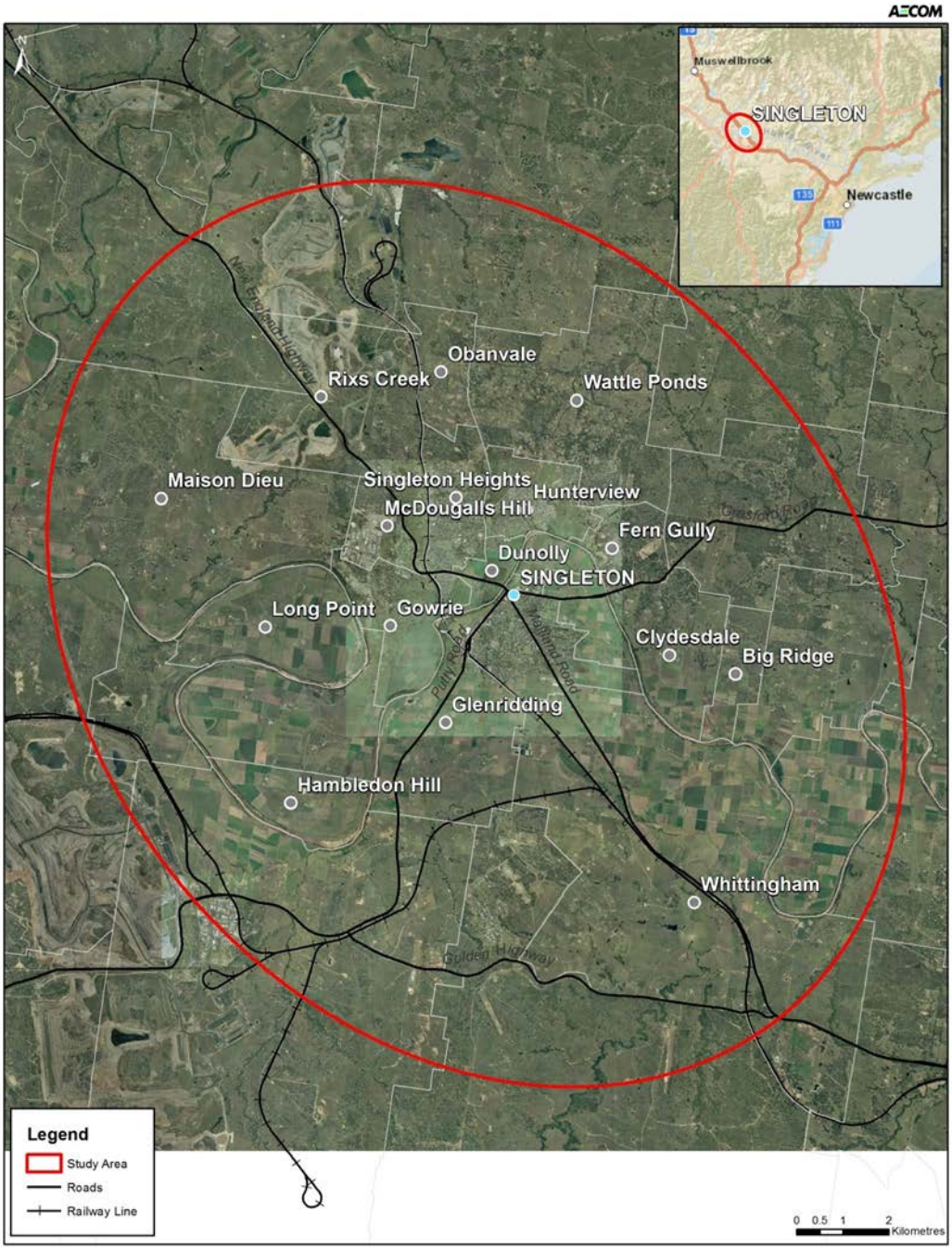
The NSW Government has committed $92 million for the project under Rebuilding NSW.

Timing for construction of the bypass has not been confirmed and would be subject to approval and funding availability.

1.2. Study area for the proposal

The assessment considered multiple corridor and route options across Singleton and the surrounding suburbs to the east and west, including Gowrie, Singleton Heights, Glenridding, Whittingham, Hunterview and Darlington. The study area is shown in **Figure 1**.

Figure 1 Diagram of study area



Singleton local government area (LGA) has a population of about 24,000 and is located in the Upper Hunter region, 80 kilometres north-west of Newcastle and 47 kilometres south-east of Muswellbrook. Landmarks include the Singleton Military Area, 14 kilometres south of Singleton, the Hunter coalfields to the south-west, Mount Thorley to the west, and Warkworth and Rixs Creek to the north-west. Singleton is located at the geographic heart of the Hunter Valley and major industries in the district include coal mining, power generation, light industry, vineyards, horse breeding and cattle production.

The town of Singleton is situated on relatively flat land while steeper topography lies to the north. The Hunter River divides the town and its floodplains encompass the town centre, constraining development in the area. Flooding south-west of Singleton from Doughboy Hollow Creek also

forms a constraint. Singleton is subject to periodic flooding from the Hunter River, with significant flooding events in 1955 and 2007. Between 1964 and 1984 a flood levee was built to protect the town against future flooding.

1.3. Project objectives

The key objectives of the project are to:

- Improve travel reliability on the New England Highway through Singleton, particularly for road freight supporting the Upper Hunter and the North West New England region
- Improve the town centre by removing freight traffic
- Improve road safety for through and local traffic in Singleton
- Provide best value for money
- Provide clarity for Singleton Council by including the corridor in the LEP
- Potentially provide improved flood amenity and/or evacuation routes for Singleton.

2. Strategic context

The New England Highway forms part of the inland Sydney-Brisbane Corridor of the National Land Transport Network (NLTN). This transport network is funded by the Australian, State and Territory governments and is recognised for its strategic importance to national and regional economic growth, development and connectivity. The objectives to be addressed by the project include both Australian and State government priorities.

The New England Highway is recognised as a major freight and commuter route with about 15 per cent of all traffic movements being heavy vehicles. The route allows for the transport of goods to domestic and international markets via Newcastle and Sydney. Due to mining activities in the region, the route also accommodates the transport of mining equipment and vehicles, which are often oversize and/or over-mass vehicles.

Traffic flow along this route is currently impeded by heavy vehicle traffic. The capacity and amenity of the route is expected to be put under further pressure as regional growth continues.

The project is consistent with the following strategic plans:

- ***NSW Long Term Transport Master Plan*** (NSW Government, 2012)*:* The project would support this plan as the proposed bypass of Singleton would enhance the connectivity of communities and industries. The New England Highway is the main transport route connecting the Upper Hunter and North West New England to Newcastle and Sydney.
- ***NSW Government State Infrastructure Strategy*** (NSW Government, 2012): This strategy includes a commitment to improve local transport for regional communities including Singleton
- ***Hunter Strategic 2013 Infrastructure Plan*** (NSW Government, 2014): This plan aims to provide a strategic infrastructure framework to inform future urban growth within the Hunter Metropolitan Area. This plan identifies the need to continue planning for the future bypass of Singleton.
- ***Rebuilding NSW State Infrastructure Strategy 2014*** (NSW Government, 2014): This strategy notes transport freight is critical to the NSW economy and the *Rebuilding Regional NSW* plan identifies the need to develop the corridor strategy for the New England Highway. In March 2015, as part of the *Rebuilding NSW Infrastructure* strategy, the State Government announced a $92M commitment for a bypass of the New England Highway at Singleton to address a well-known traffic pinch point on the New England Highway.
- ***Australian Infrastructure Plan*** (Australian Government, 2016): This plan highlights the need to reduce the impact of freight movements on regional centres and includes a bypass of Singleton in the medium term of 5-10 years.
- ***NSW State Plan 2021*** (NSW Government, 2011)*:* By reducing travel times on the New England Highway, the bypass would improve the efficiency of the National Land Transport Network. This a contributing factor to driving economic growth in regional NSW as it improves the productivity of freight movements for businesses located in the Upper Hunter and North West New England.
- ***Sydney to Brisbane Corridor Strategy 2007*** (Australian Government, 2007): The bypass is consistent with this strategy as it will improve road safety through Singleton where there are high volumes of freight and passenger vehicles. The bypass would manage congestion within a major regional centre, improve amenity of the town and help plan for corridor reservation to meet future requirements.
- ***Upper Hunter Strategic Regional Land Use Plan*** (NSW Government, 2012): This strategy includes a commitment to proceed with planning for improved traffic management through Singleton.
- ***Singleton Council Land Use Strategy*** (Singleton Council, 2008)*:* This strategy identifies that increasing traffic on the New England Highway will affect the adequacy and safety of existing

traffic arrangements within Singleton. The strategy notes selecting a bypass route would help future planning.

A number of road projects are proposed, underway or have recently been completed to improve the future performance of the Sydney-Brisbane Corridor. A bypass of Singleton would contribute to the objectives of current and future proposed works by improving road safety and increasing capacity of existing road infrastructure along the inland route.

A bypass of Singleton would help reduce current levels of traffic congestion and potential crashes associated with heavy vehicles travelling through the Singleton town centre and the nearby Gowrie Gates rail underpass. Identifying a preferred bypass route would reserve the land in the LEP to allow future construction to take place.

3. Existing road conditions

3.1. Existing road network

The New England Highway forms the main road access through Singleton and to the town centre. Access to the town from the south-west is provided by Putty Road and the Golden Highway, which is the main inland route between Newcastle and Central West NSW. Gresford Road to the east provides access to smaller communities in the Upper Hunter.

The New England Highway connects Singleton with Muswellbrook to the north and Maitland to the south. The Main Northern Railway also provides access to Singleton, which runs along the town's western boundary. The New England Highway passes under the railway via a narrow rail underpass on the north side of Singleton, known as the Gowrie Gates.

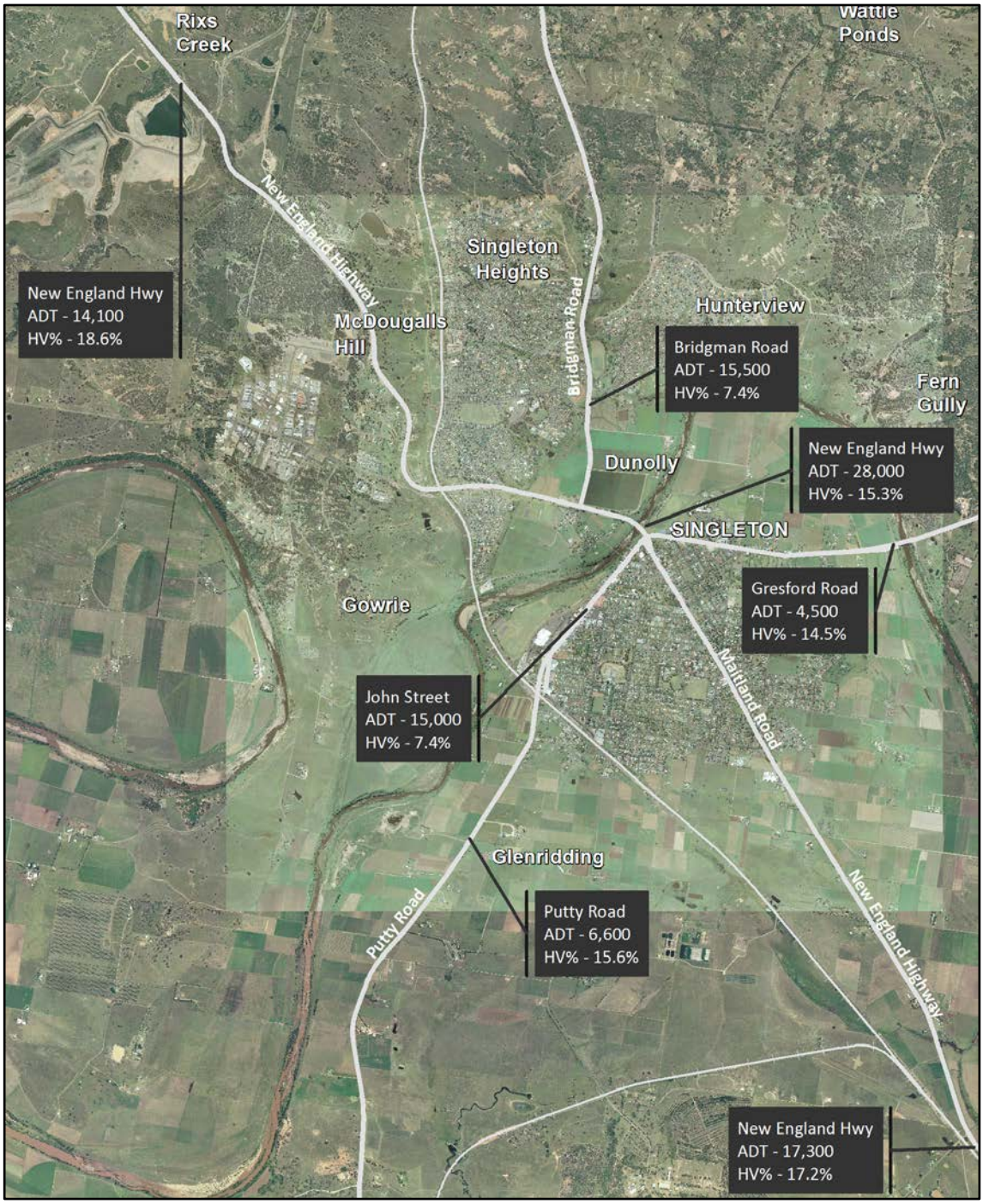
Between 18,000 and 28,000 vehicles per day use the highway through Singleton. Around 15 per cent of these are heavy vehicles. Key road users include:

- Town centre shoppers and workers
- Singleton and Singleton Heights residents
- Mining workers driving to mines around Singleton
- Freight and construction vehicles servicing mines around Singleton
- Commercial and general motorists travelling between the Upper Hunter and North West New England to Newcastle and Sydney.

A brief description of key corridors in and around Singleton is provided below and illustrated in **Figure 2**.

- **The New England Highway** is a major north-south route passing through the Singleton town centre. It provides access to Singleton, Singleton Heights, and trips to the coalfields and rural properties in the area. The highway carries the highest amount of traffic and heavy vehicle movements in the area. Outside Singleton, the highway is generally a regional highway with an undivided carriageway providing one to two traffic lanes in each direction. The speed limit of the New England Highway through Singleton town centre is 50km/h.
- **Putty Road** is a rural arterial road used by about 6000 vehicles per day and connects the Golden Highway to John Street, Singleton.
- **Bridgman Road** is a rural sub-arterial road used by about 15,500 vehicles per day connecting Singleton Heights and Hunterview to the New England Highway.
- **John Street** continues from Putty Road to Queen Street and Gresford Road to the east. John Street covers the length of the town centre and is bound by retail and commercial land. John Street is used by about 15,000 vehicles per day.
- **Gresford Road** is an east-west rural road connecting traffic from areas east of Singleton to the town centre. The road is used by about 4500 vehicles per day.

Figure 2 Average daily traffic (ADT) in 2014 including percentage of heavy vehicles (HV%)



3.2. Existing traffic conditions

Current traffic conditions have been assessed through collection and analysis of traffic data. The date has been collected via:

- Permanent traffic count stations
- Automated traffic counts completed for this study
- Manual classified counts

- Origin-destination surveys
- Travel time surveys
- Site visits.

Permanent traffic count stations

Permanent count data was collected from stations located at:

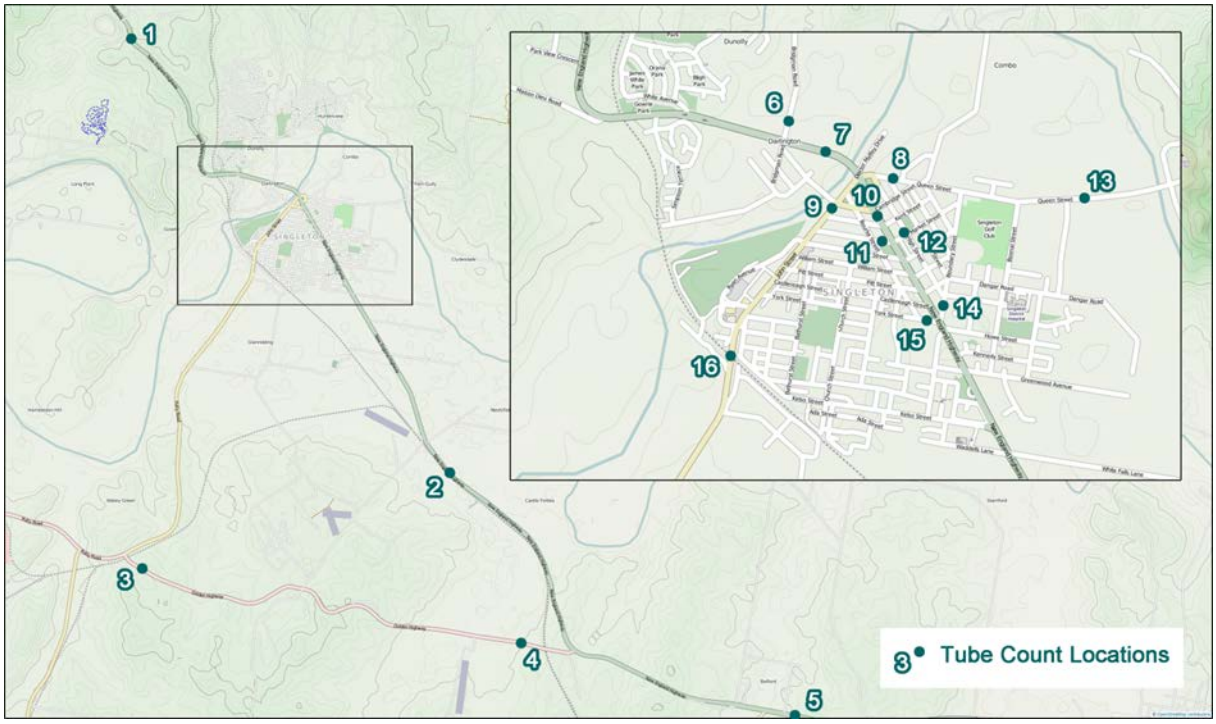
- New England Highway south of Muswellbrook
- New England Highway at Foy Brook
- New England Highway north of Airport
- New England Highway at Belford
- New England Highway at Black Creek
- Putty Road south of Broke Road.

The data broadly indicates a median growth rate of two per cent each year, which is in line with the longer term historical trends for the last 20 years.

Automatic traffic counts

Seven day automatic traffic counts were collected in the Singleton area from June to August 2014 at the locations shown in **Figure 3**. Data from the automatic traffic counts was used to provide average daily traffic (ADT) volumes and the percentage of heavy vehicles (HV%) used in **Figure 2**.

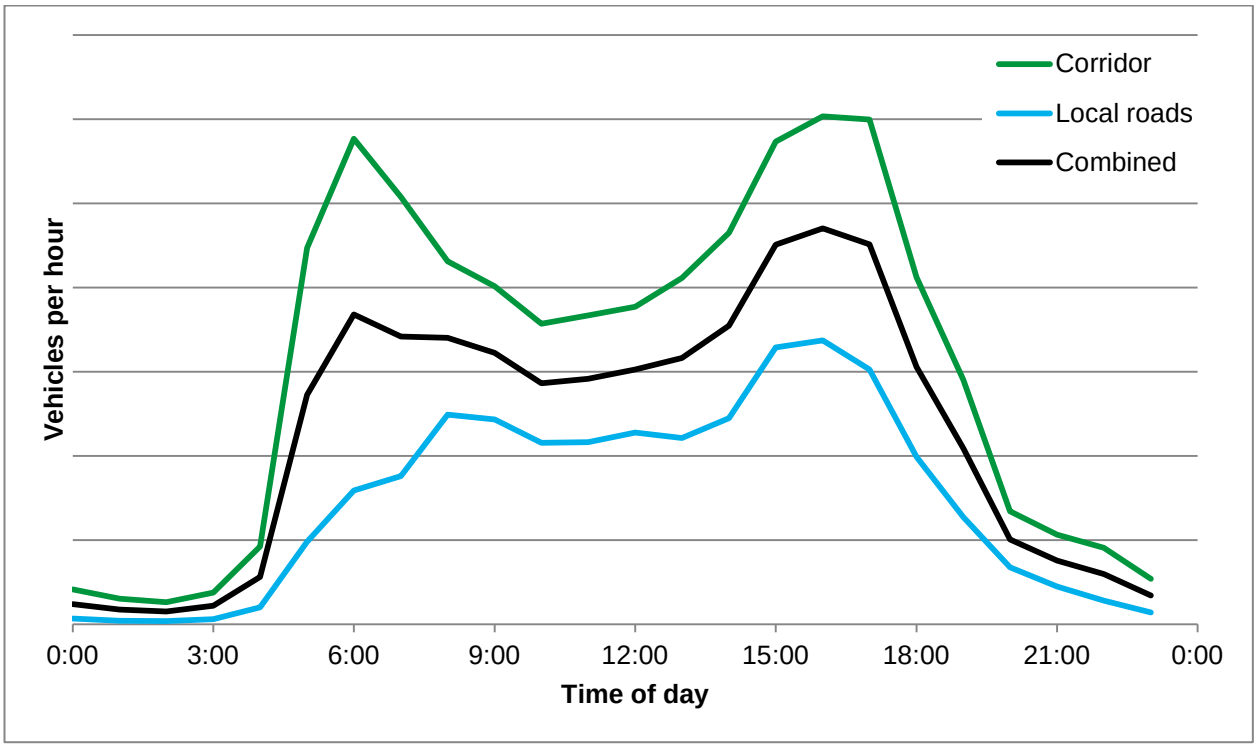
Figure 3 2014 Automatic traffic count locations



The distribution of daily traffic along road corridors in the study area shown in **Figure 4** shows a distinct early morning peak between 6am and 7am, which is associated with the ‘mining peak’.

Overall traffic demands appear to decrease slightly between 7am and 8am and peak again between 8am and 9am as a result of work and school trips.

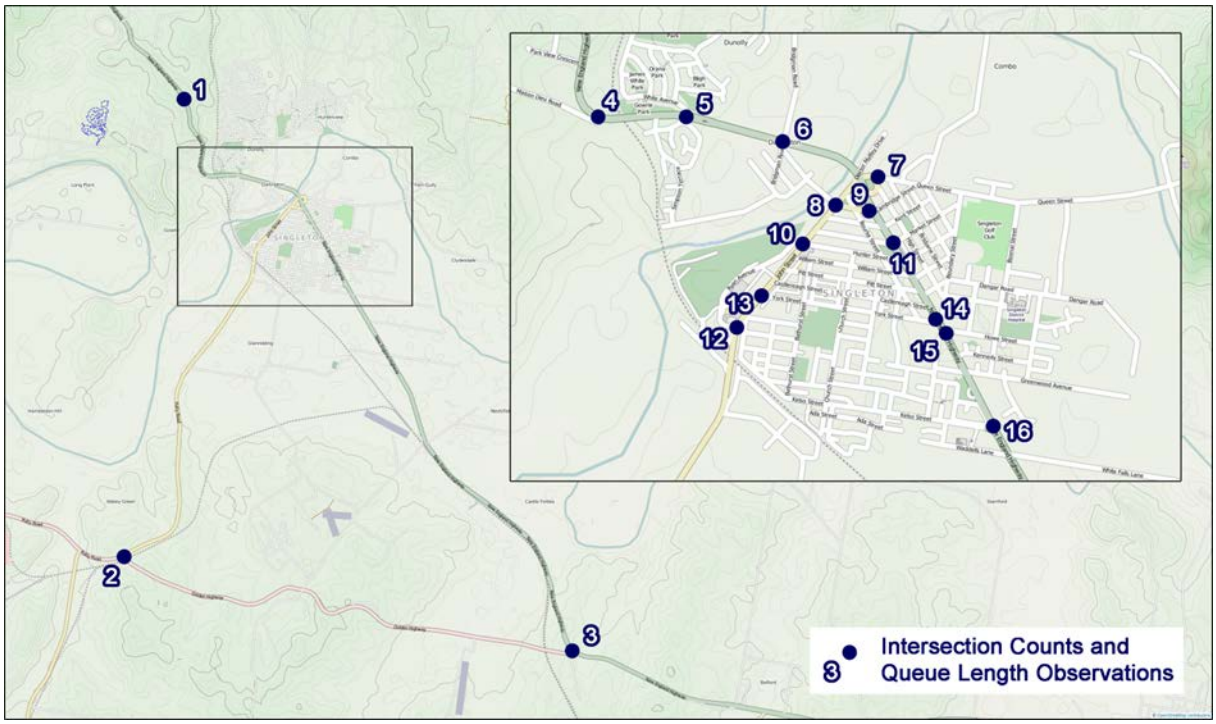
Figure 4 Average traffic volumes at key corridors and local roads



Intersection turning count and queue length surveys

Intersection turning count and queue length survey data was collected in June 2014. The data was used to estimate the existing traffic demands in the study area.

Figure 5 Intersection count and queue length survey locations



The 2014 intersection count data suggests up to 200 heavy vehicles travel along the New England Highway each hour, which is about 14 per cent of the peak hour traffic. The number of heavy vehicles in the morning peak between 6am and 9am is relatively consistent. The overall traffic demands are relatively consistent between 3pm and 6pm, with the highest heavy vehicle demands recorded between 3pm and 4pm.

Origin-destination survey

Vehicle origin-destination (OD) surveys were completed in June 2014. The OD surveys recorded the percentage of vehicles between one survey station and another. Survey stations were located at:

- The New England Highway, north of Rixs Creek Lane
- Putty Road, north of the Golden Highway
- The Golden Highway, west of Putty Road
- The New England Highway, east of Golden Highway
- Gresford Road at Redbournberry Bridge
- Bridgman Road, north of the New England Highway
- The New England Highway between Bridgman Road and the Hunter River Bridge
- John Street, south of Campbell Street
- Queen Street, west of Civic Avenue.

The OD survey quantified the number of trips at these locations in the Singleton area.

Site visits

Site visits were carried out between January and February 2015. Observation of traffic conditions suggest most intersections in the study area operate at a satisfactory level without major traffic issues. The evening peak is more congested than the morning peak, with southbound traffic queues observed at Bridgman Road and Elizabeth Street.

The New England Highway through Singleton carries the highest amount of traffic and heavy vehicle movements in the study area. The evening peak is slightly more congested than the morning peak with traffic queues observed along the New England Highway southbound at Bridgman Road and Elizabeth Street. Visual observation of traffic conditions together with traffic modelling suggest most intersections in the study area are currently operating at a satisfactory level without major congestion issues.

There are however merging locations at each end of the Hunter River Bridge, which cause delays to road users during peak periods.

3.3. Historical crash data analysis

Historical crash data for the five years to 2013 shows there were a total of 205 crashes, including one fatality and 78 injury crashes on the following roads in the study area:

- New England Highway
- Putty Road
- Bridgman Road
- Queen Street.

Table 1 shows a breakdown of the crashes by road section and severity.

Table 1 Location and severity of crashes

Road	Section	Fatal	Injury	Non-casualty (tow away)	Total
Bridgman Road	New England Highway to Retreat Road	0	12	16	28
New England Highway	Rixs Creek to Bridgman Road	1	16	20	37
New England Highway	Bridgman Road to Waddells Lane	0	35	63	98
New England Highway	Waddells Lane to Haggartys Lane	0	0	4	4
New England Highway	Haggartys Lane to Range Road	0	0	3	3
Putty Road	Queen Street to Carrington Street	0	8	12	20
Putty Road	Carrington Street to Heuston Lane	0	0	0	0
Putty Road	Heuston Lane to 0.95 kilometres north of Golden Highway	0	3	5	8

Road	Section	Fatal	Injury	Non-casualty (tow away)	Total
Queen Street	New England Highway to Dyrring Road	0	4	3	7
Total study area		**1**	**78**	**126**	**205**

Singleton town centre has the highest number of crashes, with 98 crashes occurring between Bridgman Road and Waddells Lane. One fatal crash was recorded between Rixs Creek and Bridgman Road. No fatal crashes were recorded for Singleton town centre.

To compare crash severity against the state average, the crash severity index was calculated for all sections in the study area, as detailed in **Table 2**.

Table 2 Location and crash severity index

Road	Section	Crash severity index
Bridgman Road	New England Highway to Retreat Road	1.21
New England Highway	Rixs Creek to Bridgman Road	1.27
New England Highway	Bridgman Road to Waddells Lane	1.18
New England Highway	Waddells Lane to Haggartys Lane	1.00
New England Highway	Haggartys Lane to Range Road	1.00
Putty Road	Queen Street to Carrington Street	1.20
Putty Road	Carrington Street to Heuston Lane	-
Putty Road	Heuston Lane to 0.95 kilometres north of Golden Highway	1.19
Putty Road	0.95km north of Golden Highway to Golden Highway	1.00
Queen Street	New England Highway to Dyrring Road	1.29
Total Study Area		**1.20**
New South Wales (1 Jan 2008 to 31 Dec 2012)		**1.24**

Source: AECOM, based on Roads and Maritime Hunter Region Crash Data, Transport for New South Wales Centre for Road Safety Data, and Australian Bureau of Statistics Survey of Motor Vehicle Use (SMVU) data.

The total crash severity for the study area is 1.20 which is slightly below the 2008 to 2012 NSW average of 1.24. However the section from Rixs Creek to Bridgman Road has a crash severity index of 1.27, which is higher than the NSW state average. The section of Queen Street joining to New England Highway also has an above average index of 1.29.

Crash data showed:

- The majority of crashes occurred in fine weather conditions, with only a few occurring during rain or overcast conditions.
- The greatest number of crashes occurred during daylight with 125 crashes out of the total 205. The second highest proportion of crashes occurred at night.

- Most crashes occurred between 5am and 7am and 3pm and 6pm. The crash profile is consistent with the early morning peak, or 'mining peak', which occurs before the traditional morning peak between 8am and 9am.

Crash rates per 100 million vehicle kilometres travelled (100MVKM) are shown in **Table 3**. These crash rates are calculated using the volume of traffic and distance travelled along a route, providing a measure of risk per kilometre travelled.

Table 3 Crash rate per 100MVKM (2009-2013)

Road	Section	Length (km)	Annual average daily traffic	Fatal	Injury	Non-casualty (tow away)	Total crashes per 100MVKM
Bridgman Road	New England Highway to Retreat Road	4.6	15,538	0.0	9.3	12.3	21.6
New England Highway	Rixs Creek to Bridgman Road	4.2	28,027	0.5	7.5	9.4	17.4
New England Highway	Bridgman Road to Waddells Lane	2.9	21,994	0.0	30.2	54.3	84.5
New England Highway	Waddells Lane to Haggartys Lane	1.6	21,994	0.0	0.0	6.4	6.4
New England Highway	Haggartys Lane to Range Road	3.5	21,994	0.0	0.0	2.1	2.1
Putty Road	Queen Street to Carrington Street	2.0	16,466	0.0	13.0	19.5	32.6
Putty Road	Carrington Street to Heuston Lane	2.2	16,466	0.0	0.0	0.0	0.0
Putty Road	Heuston Lane to 0.95 kilometres north of Golden Highway	3.6	16,466	0.0	2.8	4.6	7.3
Queen Street	New England Highway to Dyrring Road	3.7	7,300	0.0	8.1	6.1	14.2
New South Wales (1 Jan 2013 to 31 Dec 2013)				**0.5**	**28**	**-**	**-**

Source: AECOM, based on Roads and Maritime Hunter Region Crash Data, Transport for New South Wales Centre for Road Safety Data, and Australian Bureau of Statistics Survey of Motor Vehicle Use (SMVU) data.

The crash rate per 100MVKM indicates the section of New England Highway in Singleton has a higher number of injury crashes per 100MVKM than the NSW average. The sections of New England Highway from Rixs Creek to Bridgman Road have a higher rate of fatal crashes (0.5) than the NSW average, but a lower number of injury crashes than the NSW average (7.5). This is consistent with the higher than average crash severity observed in the area.

4. Environmental constraints

Provided below is a summary of key environmental constraints which were considered during the assessment. Due to the large area covered by the shortlisted options and the number of private properties involved, this environmental investigation was carried out through a desktop study.

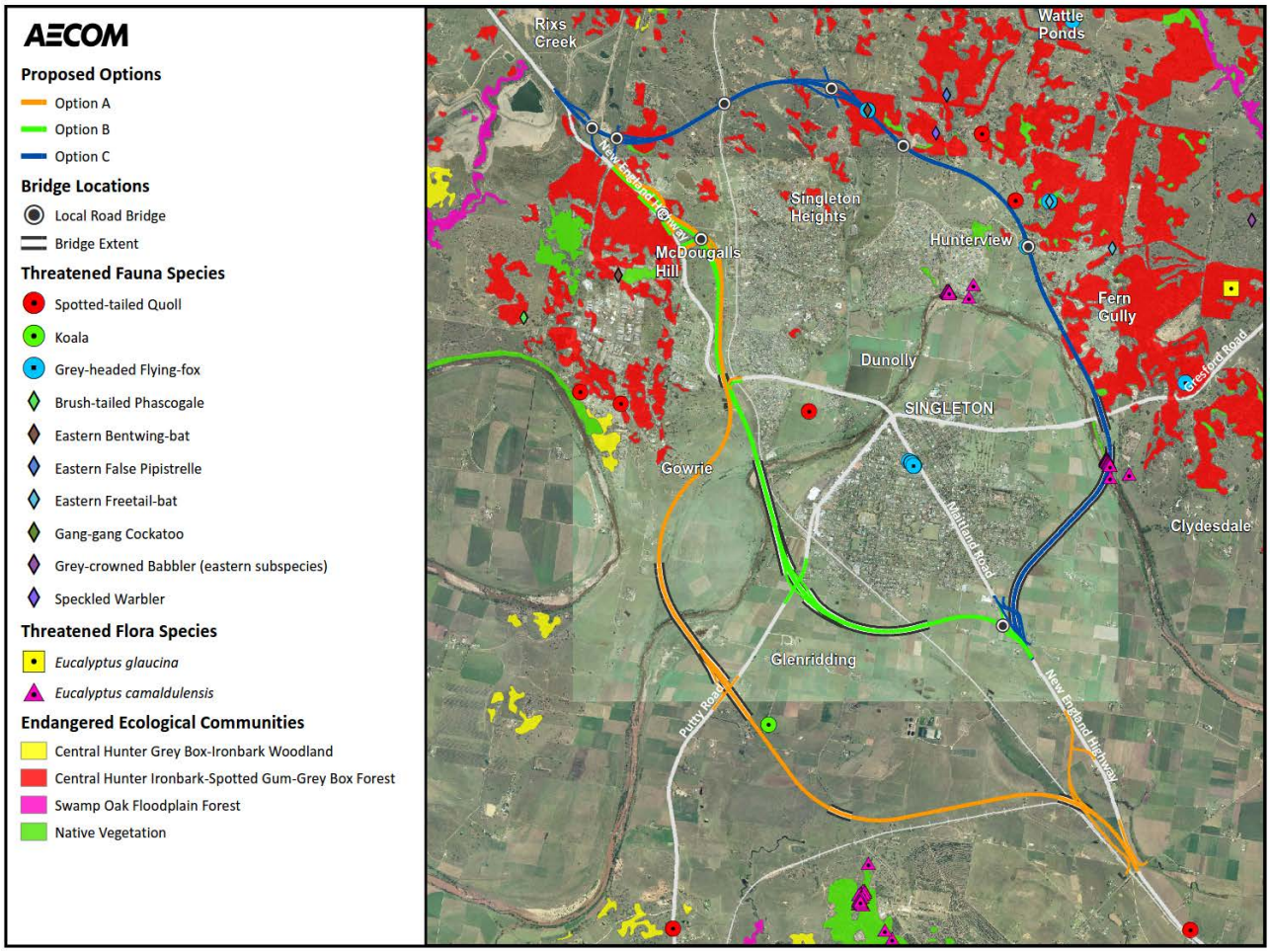
4.1. Biodiversity

Local ecology is a potential constraint to the shortlisted corridors. **Figure 6** provides a map of the known constraints.

The study area is characterised by large areas of floodplain bordering the Hunter River and surrounding the town of Singleton. These floodplains have been cleared to a large extent for agricultural purposes. Remaining bushland is generally located in areas of undeveloped steeper terrain. The Singleton Council vegetation map identifies three Endangered Ecological Communities (EECs) in the study area. Other non-EEC vegetation communities form a small proportion of overall vegetation in the study area.

Of the three vegetation communities, Central Hunter Ironbark-Spotted Gum-Grey Box Forest accounts for the most of the vegetation and dominates large areas of land to the north-east (**Figure 6**). It is typically limited to the steeper elevated areas beyond the floodplain. Smaller isolated stands of Central Hunter Grey Box-Ironbark Woodland and Swamp Oak Floodplain Forest are present in areas surrounding Singleton. Their distribution is irregular although the presence of Swamp Oak Floodplain Forest is generally confined to existing creeks and minor watercourses.

Figure 6 Overview of Fauna, Flora and Endangered Ecological Communities



A search of the NSW Office and Environment and Heritage (OEH) Wildlife Database was carried out to identify previously recorded sightings of threatened species in the study area. The OEH wildlife database search identified a number of threatened flora and fauna species. These results have been mapped to more accurately show the location and distribution of species listed as vulnerable or endangered.

Threatened species sightings in the study area are generally located outside of the Hunter River floodplains in EECs or remnant vegetation. This may be attributed to historical and contemporary agricultural land use and the absence of suitable habitat in the floodplains. Endangered River Red Gums (*Eucalyptus camaldulensis*) were recorded on the northern bank of the Hunter River, east and north of the Singleton town centre and within Commonwealth owned Department of Defence land to the south of Singleton.

A single Koala sighting was recorded in 2006 at Glenridding, south of Singleton, in an isolated stand of trees. It is unlikely this stand of trees would meet the definition of core koala habitat under State Environmental Planning Policy No 44 (SEPP 44). However potential koala habitat may be present in the broader study area based on the likely presence of feed trees associated with vegetation communities recorded in the study area. Of these, two EECs (Central Hunter Ironbark-Spotted Gum-Grey Box Forest and Central Hunter Grey Box-Ironbark Woodland) account for a substantial proportion of vegetation in the study area and may provide potential koala habitat.

While this search indicates the potential presence of threatened species and communities in the study area, accurate locations cannot be determined without more detailed investigation.

EECs and threatened species known in the area are generally located in steeper topography outside of Singleton itself and beyond the Hunter River floodplains. This distribution is related to past development activities and agricultural land use, which have been concentrated in the town of Singleton and Hunter River floodplains.

Any bypass option would need to cross the Hunter River, which is identified as key fish habitat. Any modification or obstruction to river flows resulting from construction of a bridge would have a potential environmental impact and require further assessment.

4.2. Aboriginal heritage

The study area is in the Wanaruah Local Aboriginal Land Council (LALC) boundary and contains more than 900 sites of Aboriginal heritage significance according to the Aboriginal Heritage Information Management System (AHIMS) searches. A map of known sites is presented in **Figure 7**, which shows sites are concentrated to the north of Singleton and along the banks of the Hunter River.

The majority of records are identified as scattered artefacts. Two scarred trees are located in the study area, south of Rixs Creek and south-east of Wattle Ponds. While other records identify the presence of Aboriginal art, burials and waterholes in the broader study area, these are not within the shortlisted corridors assessed as part of this study.

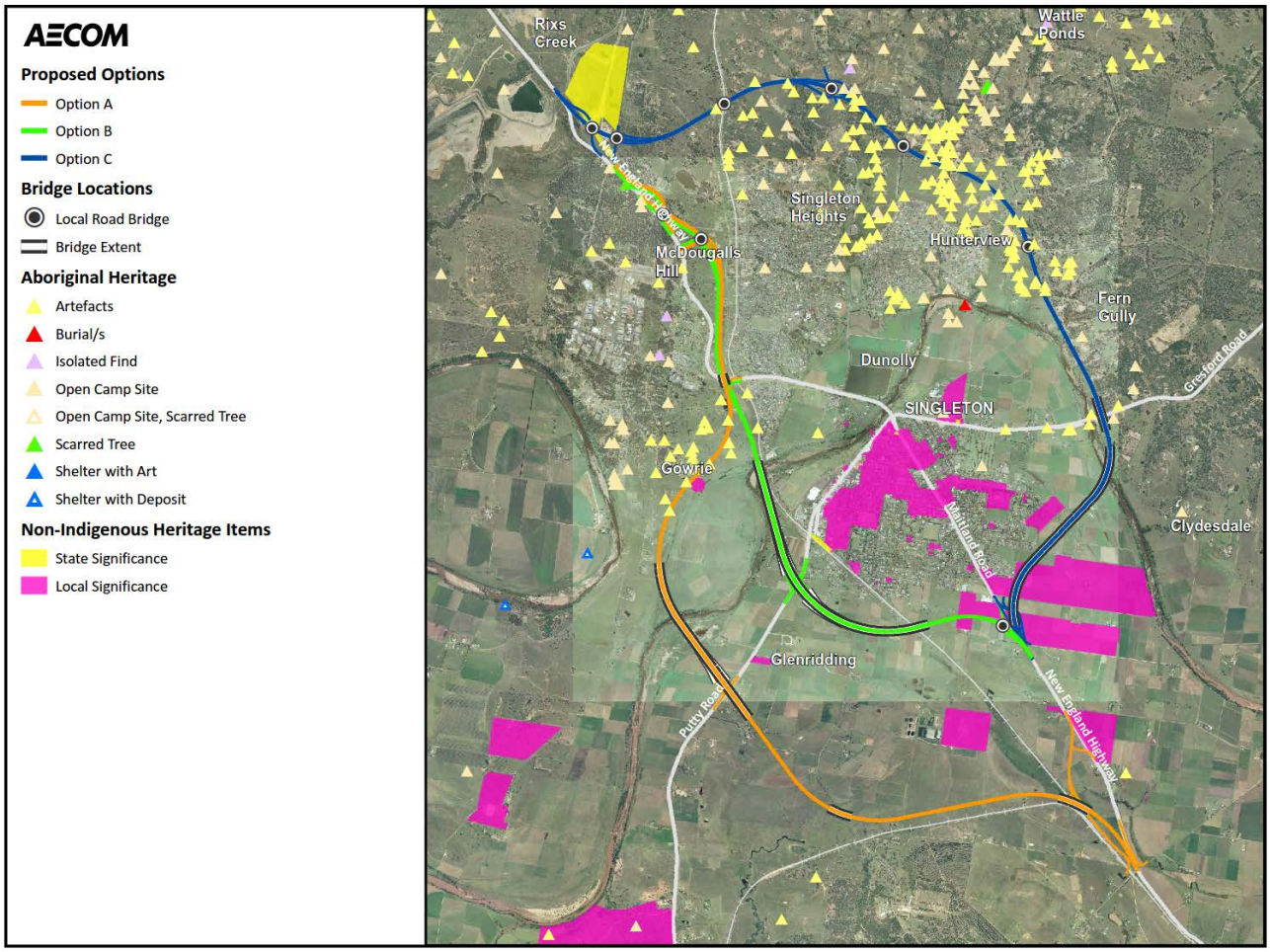
Aboriginal heritage sites generally overlap with ecological constraints identified for the study area and share a similar relationship with past development activities and agricultural land use. It is recognised the AHIMS register does not provide an exclusive listing of all Aboriginal heritage located in the study area.

Land along the banks of the Hunter River and steeper, densely vegetated topography to the north is considered to have a greater likelihood of Aboriginal use in the past. There is potential for additional items of Aboriginal heritage to be located within these areas and elsewhere in the study area.

A search of spatial data held by the National Native Title Tribunal identified no native title in the study area. A single native title claim is registered for the study area on behalf of the Plains Clans of the Wonnarua People.

To the north of the Hunter River there is a concentration of identified Aboriginal heritage items including open camp sites and sites where Aboriginal artefacts have been identified. The presence of similar Aboriginal heritage items has also been identified in the Gowrie area.

Figure 7 Overview of heritage constraints



4.3. Non-Aboriginal heritage

Heritage listings for historic (non-Aboriginal) heritage items were identified in the study area on both the State Heritage Register of NSW and under Schedule 5 of the Singleton LEP 2013. A map of known sites is shown in **Figure 7**. Sites are generally in the Singleton town centre and along major roads leading into Singleton, including the New England Highway.

The mapping highlights the potentially affected property boundary as a whole, rather than the actual heritage item. This is because the surrounding land will often be listed as part of the item and still requires an assessment.

About 115 historic heritage items were identified in the study area. Of these items, eight fall in the three shortlisted corridors. These are presented in **Table 4**.

Table 4 Historic (non-Aboriginal) heritage items listed in Schedule 5 of Singleton LEP 2013

Suburb	Item name	Address	Property	Significance	Item no.
Rixs Creek	Coke ovens	New England Highway	Lot 2, DP 598097; Lot 4, DP 1123099	State	I45
Singleton	Ardersier	48 Maitland Road	Lot 323, DP 818758	Local	I118
Whittingham	Former gates and gate lodge (Neotsfield)	4244 New England Highway	Lot 1, Section A, DP 10096	Local	I152
Glenridding	Former pumping station	55 Waterworks Lane		Local	I21
Whittingham	Former Lairmont Hotel	4253 New England Highway	Lot 1, DP 399230	Local	I153
Gowrie	Gowrie Private Cemetery	3 Hambledon Hill Road	Part Lot 4, DP 873262	Local	I22
Whittingham	The Woolpack Inn	3 Newington Lane	Lot 1, DP 1122748	Local	I151
Singleton	Bebeah	New England Highway	Lot 101, DP 1048703	Local	I120

4.4. Topography, geology and soils

Limited information is available on soils in the area. The route options are constrained by hilly regions in the north of the study area, increasing the overall footprint of the earthworks. Soils and geology may be a constraint in the study area where bypass options cross the floodplain. Deep piling for bridge structures and building embankments could be required for construction.

4.5. Surface water and groundwater resources

The Hunter River and a series of tributary creeks including Doughboy Hollow Creek cross the study area. Any bypass option would need to cross the Hunter River.

The Hunter River is a permanently flowing waterway managed as part of the south-east Coast Drainage Division in central NSW. The waters of the Hunter River are managed in accordance with the Water Sharing Plan for the Hunter Regulated River Water Source. Surface waters outside the

Hunter Regulated River Water Source are managed in accordance with the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources. Both plans are legal instruments under the Water Management Act 2000.

Groundwater in the study area is considered part of the Hunter River Alluvium groundwater management unit. Groundwater is located in restricted sub-surface areas as identified under Section117A of the Water Act. A review of publically accessible borehole data indicated groundwater is typically present at depths greater than nine metres below the surface of the bore.

Construction activities involving excavations, cut and fill or driving piers have the potential to interact with groundwater in the study area. Groundwater drawdown or other forms of water take would require further assessment to determine significance of impact.

4.6. Noise and vibration

Existing land form and terrain, as well as existing land use and services, have been assessed to understand potential noise and vibration impacts of the route options.

Sensitive receivers (properties potentially impacted by noise and vibration) in the study area include homes in Singleton and its surrounding suburbs, as well as homesteads in rural areas. The Singleton town centre and immediately surrounding area contains a large number of sensitive receivers. Singleton town centre is separated from the newer residential area of Singleton Heights and light industrial areas of Maison Dieu by the Hunter River and its floodplain.

Existing road and rail traffic is likely to have a considerable impact in these areas. Mining operations to the north-west of Singleton also contribute to background noise levels. To the south-west of the study area, the Mount Thorley light industrial area and the eastern edge of the Mount Thorley Warkworth and Bulga Complex mining operations influence noise and vibration levels.

The potential impacts of the bypass would be related to:

- Noise and vibration generating construction activities such as land clearing, bulk and civil earthworks, and road construction
- The relocation of traffic to the bypass route and introducing noise and vibration to currently unaffected areas.

Opportunities exist to reduce noise and vibration in Singleton by reducing traffic in the town centre. However any bypass option would introduce new or additional noise and vibration impacts in currently unaffected areas. Further opportunities to minimise noise and vibration impacts the may be identified through further assessment and the inclusion of noise management measures in design.

4.7. Air quality

Potential air quality impacts of the bypass include:

- Dust and emissions generated during construction of the bypass
- Emissions generated during operation of the bypass as a result of vehicle traffic.

Given traffic currently passes through Singleton, any bypass could potentially improve the air quality along this section of the New England Highway by reducing traffic. However any option has the potential to introduce new or additional air quality impacts in currently unaffected areas.

An air quality study would be carried out as part of the environmental assessment.

4.8. Contamination

A search of the Contaminated Land Public Record and Record of Notices identified eight records in the Singleton LGA. Of these, none are recorded within the three shortlisted corridors. The

potential for contamination in these corridor options would not be ruled out based on previous land use in the area, including agriculture.

4.9. Visual and landscape character

The visual and landscape characteristics of the study area have been assessed through a review of existing land form and terrain as well as existing land use and services. Existing land use was determined by the Singleton LEP 2013 which governs permitted land use in the study area.

The landscape character and visual setting is strongly influenced by the Hunter River and its floodplain. The floodplain is characterised by open, low-lying farmland and a network of drainage lines. The dominant rural activity in the region is agricultural grazing. Open cut mining activities are also a consistent visual element in the landscape in the northern and western extents of the study area. The study area is generally flat in areas of floodplain but bounded by steeper terrain to the north and south.

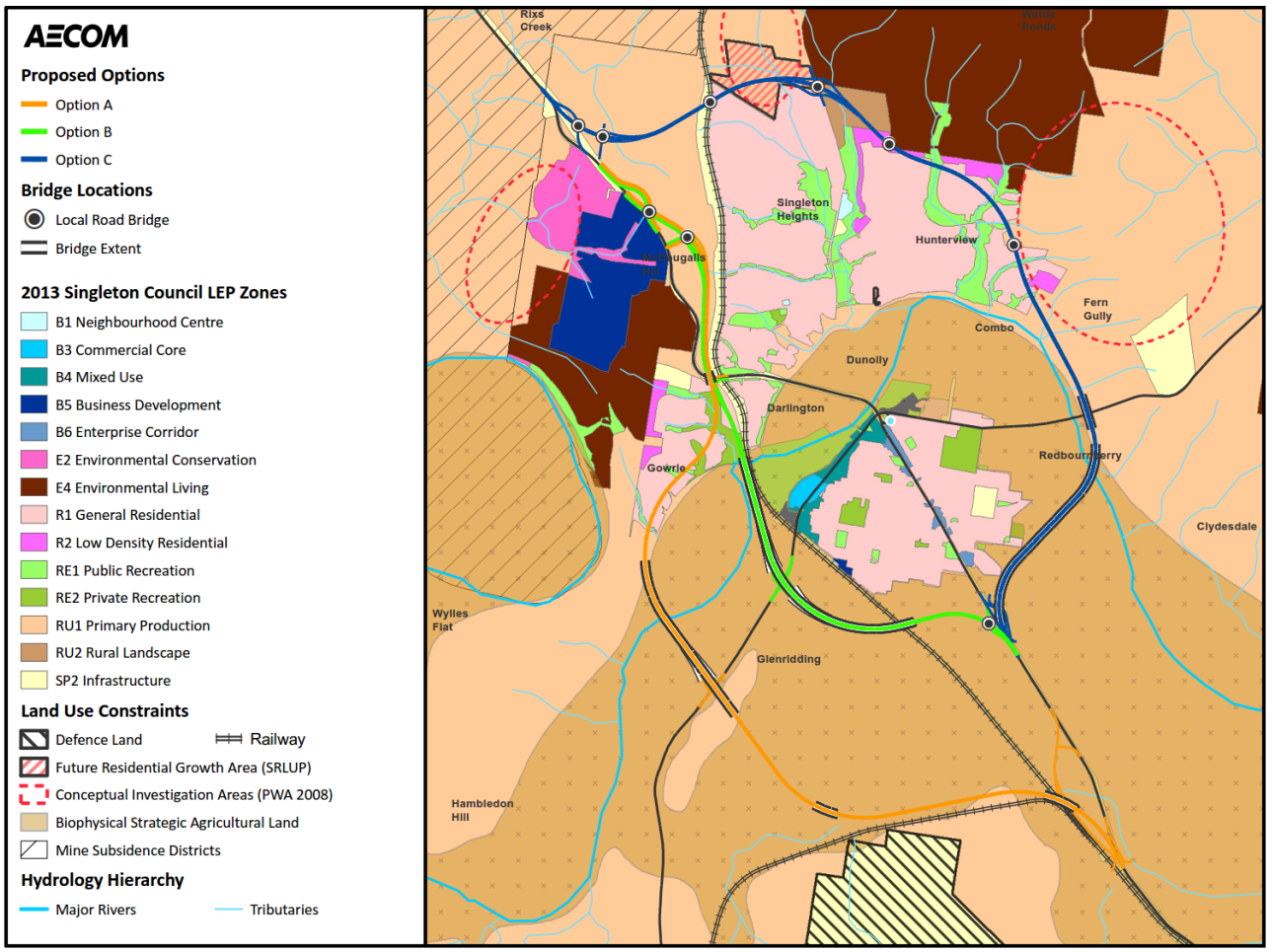
The existing New England Highway and Main Northern Railway are generally visible depending on proximity and available sight lines. There are a number of existing bridges crossing the Hunter River both in Singleton and Redbournberry. A number of other roads, minor access tracks and utilities cross the rural landscape. Tree lines and scattered vegetation are also present in the floodplain, contributing to the local landscape character.

Lookouts in the study area include Heuston Lookout (also referred to as Apex Lookout) on Lookout Road at Gowrie and Hunterview Lookout at John Street, Singleton. Heuston Lookout provides a panoramic view to the east, south and west overlooking the Hunter River and floodplains. Hunterview Lookout is relatively constrained by the immediately surrounding landscape due to its closeness to the banks of the Hunter River.

4.10. Land use

A map of the 2013 LEP zones is shown in **Figure 8**.

Figure 8 Overview of 2013 Local Environmental Plans zones



Any bypass option would cross areas of strategic agricultural land and primary production zones.

Interactions with future development in the study area are a potential constraint to the bypass either through conflicting land use or potential delays during the approval stage. Project approval depends on the timing of relevant planning applications. Relatively new expansions in Singleton Heights and the surrounding area may also be a potential constraint.

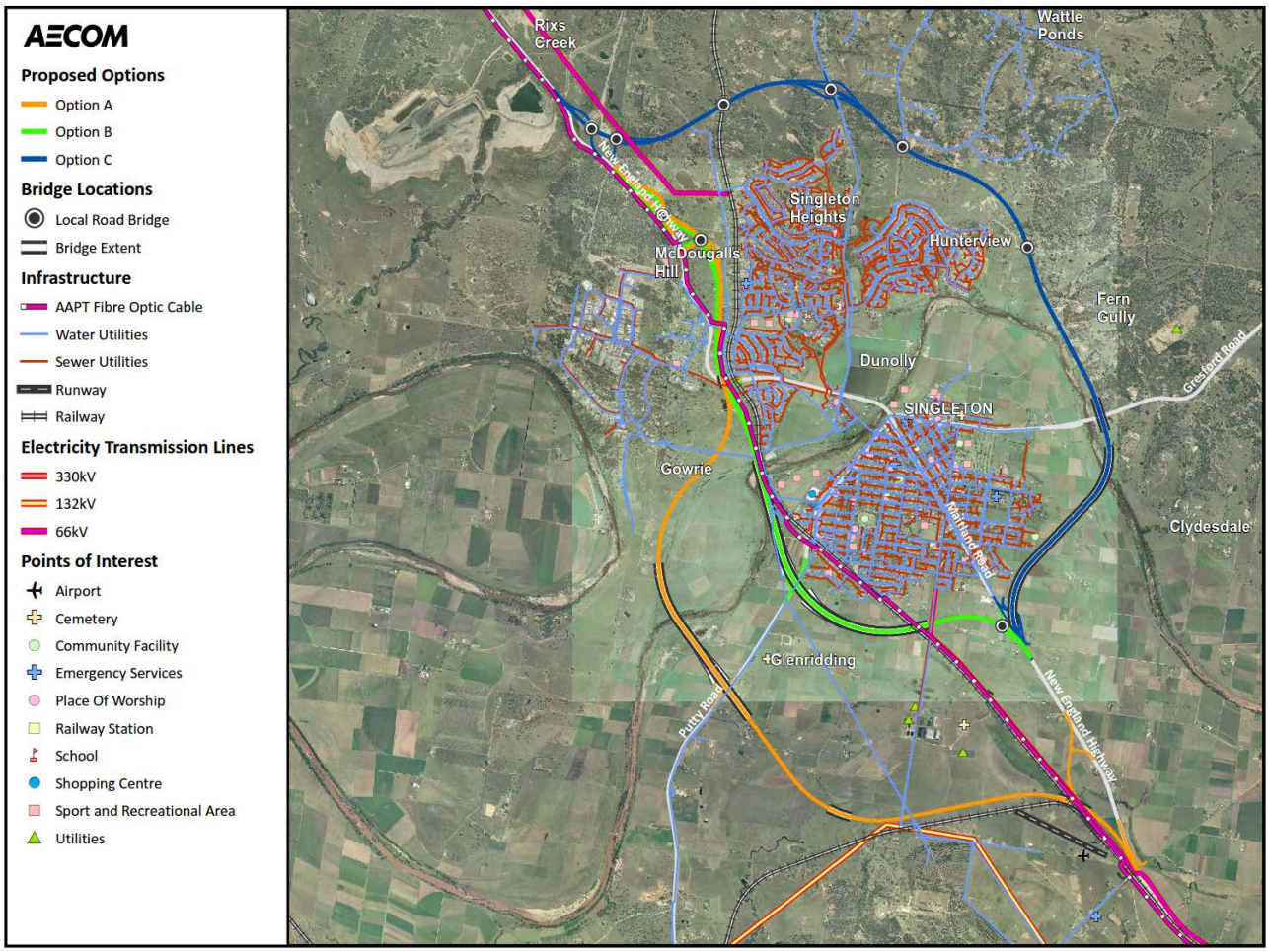
4.11. Major infrastructure

Utilities and infrastructure have been identified by reviewing spatial datasets provided by Singleton Council and a variety of datasets sourced from third party data providers including NSW Land and Property Information, StreetPro and Geoscience Australia.

A map of the major infrastructure assets in the study area is shown in **Figure 9**. This map is an overview and not a complete account of all utilities and infrastructure present.

Of these assets, a few major infrastructure assets interact with the bypass options. An AAPT fibre optic cable is located in the existing rail corridor however is not expected to cause a significant constraint to the design.

Figure 9 Overview of infrastructure and land use



4.12. Rail operations

Singleton is serviced by the Main Northern Railway which runs along the western side of town as shown in **Figure 9**. The rail line currently supports eight scheduled passenger trains on weekdays, as well as freight and coal train movements. It is estimated there are 88 coal train round trips per day at Singleton (Australian Rail Track Corporation, 2014).

Maintaining rail operations during construction and operation of the bypass is essential and must be considered as a constraint. Any bypass option would cross the Main Northern Railway.

4.13. Local airports

Singleton Airport is located immediately north-west of the intersection between the New England Highway and Range Road, as shown in **Figure 9**. The airport is used by training aircraft, charter planes and for skydiving.

The Obstacle Limitation Surfaces (OLS) as defined by the *Civil Aviation Safety Authority Manual of Standards Part 139—Aerodromes* may present a potential constraint to the bypass.

4.14. Surface water and flooding

Flooding is a significant issue for Singleton and is an important constraint on each of the bypass options. A modelled flood flow distribution indicating major flood features is shown in **Figure 23**.

Managing the impact a bypass may have on flooding has been a key consideration during the preferred route assessment. The impact of flooding has been a major factor in changes to route alignments. Special attention has been given to flooding in Doughboy Hollow which, if obstructed, would force additional flows around the north and east of Singleton and increase the risk of flooding in residential areas.

Issues relating to surface water and flooding were identified by reviewing available information from government and Singleton Council sources, aerial photographs and topographical information. Documents include:

- *Singleton Flood Study* (WBM, June 2007)
- *Singleton Floodplain Risk Management Study* (Paterson Consultants, Sep 2011)
- *Singleton Route Bypass Route Options Flood Assessment* (BMT WBM, Dec 2014).

A flood study was carried out as part of this project and findings are presented in **Section 8** of this report.

5. Design criteria

Road geometry for the development of the preferred option has been designed in accordance with Austroads Guide to Road Design (2010) and, where applicable, Road and Maritime supplements.

The design criteria adopted for the bypass are summarised in **Table 5**.

Table 5 Design criteria - Strategic design/preferred option

Design element	Design criteria
Design speed	110km/h horizontal and vertical
Posted speed limit	100km/h
Number of lanes	Two lanes with provision for a future upgrade to four lanes
Traffic lane width	3.5 metres
Shoulder widths	3 metres(outside shoulder) 2.5 metres (outside shoulder on viaduct) 1 metre (inside shoulder)
Median width	1 metre generally without barrier
Minimum horizontal radius	750 metres minimum
Maximum vertical grade	Eight per cent maximum
Vertical clearance to overhead bridge	6.5 metres for bypass 5.3 metres for local roads
Design vehicle	19.5 metre semi-trailer 26 metre B-double

The typical cross sections are shown in **Figure 10** and **Figure 11**.

Figure 10 Typical road section

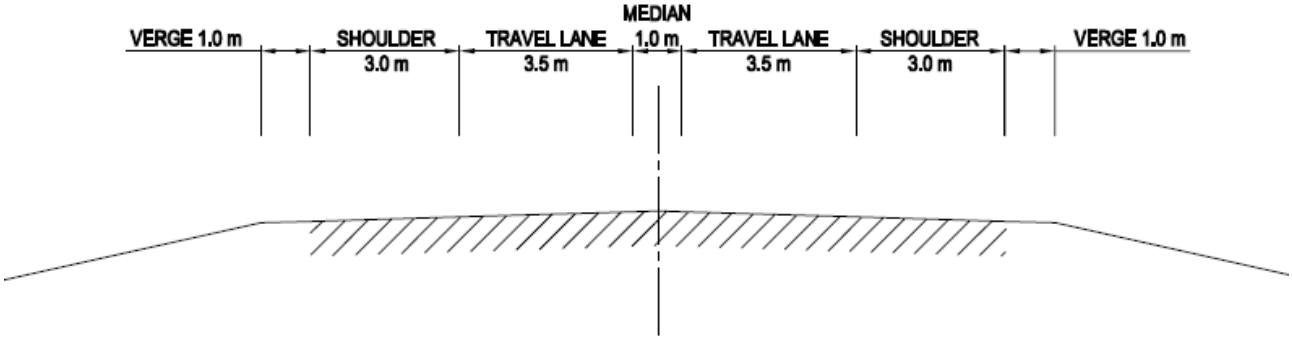
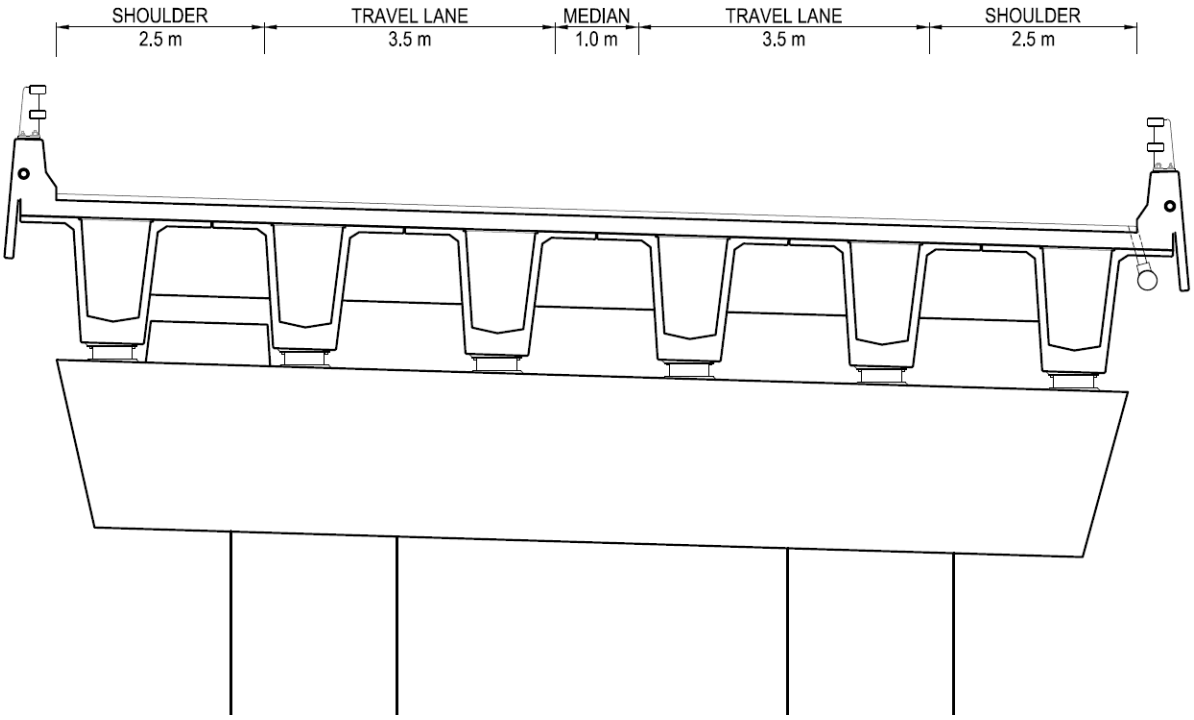


Figure 11 Typical bridge section



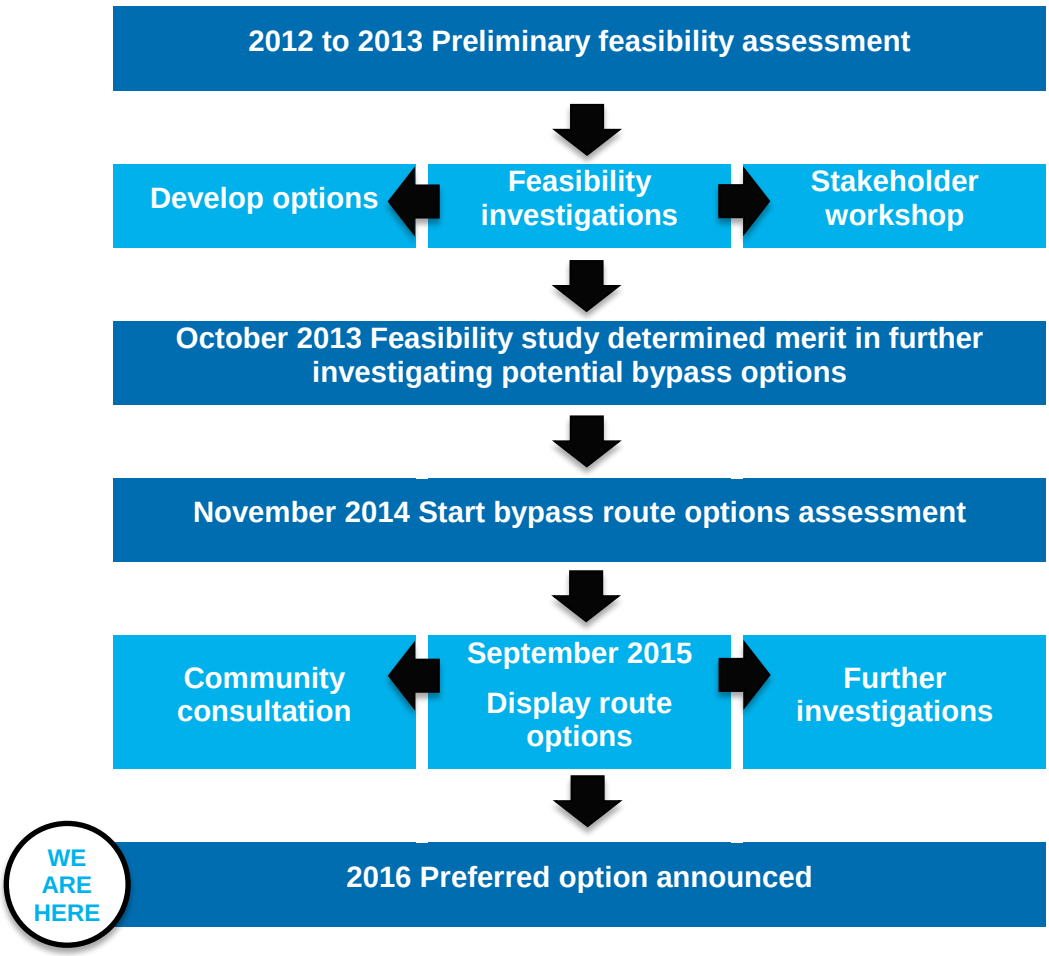
6. Options development and assessment

6.1. Overview

To identify a preferred corridor, Roads and Maritime sought to meet the project objectives and address environmental, social and technical constraints.

The process followed is shown in **Figure 12**.

Figure 12 Development process



6.2. Preliminary feasibility study

Roads and Maritime completed the preliminary feasibility study in 2013. The purpose of the study was to consider possible route options and investigate the feasibility of the New England Highway bypass of Singleton. The study included traffic assessments, constraints mapping, options identification, engineering design and economic analysis.

The feasibility study determined there was merit in carrying out further investigations and planning for the Singleton bypass. It was recognised further detailed investigations were required to determine whether the options considered or other alternatives would be the best outcome for a bypass.

The study was presented to the community for comment in June 2013. The key issue raised during this consultation was the impact of flooding through Singleton.

6.3. Bypass route options assessment

In November 2014 Roads and Maritime started the route options assessment of the New England Highway bypass of Singleton to identify a preferred option and to secure a route corridor in Singleton Council's LEP.

The development and assessment of route options focused on identifying planning, environmental, physical, socio-economic and existing infrastructure constraints in and around the town.

At the start of the assessment, a review of the 2013 preliminary feasibility assessment report was carried out alongside new and updated information. This information included:

- Updated aerial maps and property boundaries
- Results of flood modelling on the four options identified in the preliminary feasibility assessment (BMT WBM, 2014)
- Updated design requirements.

As described in the *Singleton Bypass - Route Options Identification Report* (Roads and Maritime Services September 2015), 12 options were identified and assessed at a Multi Criteria Analysis (MCA) workshop held in February 2015. The workshop was attended by representatives from Singleton Council, Roads and Maritime, and consultants BMT WBM and AECOM. As part of the workshop each of the 12 options were assessed against the certain criteria. These criteria are listed in **Figure 10**.

Table 6 Multi criteria analysis workshop assessment criteria

Assessment criteria	Sub-criteria
Travel time/attraction to freight traffic	Is the route attractive to freight?
	Is the route longer in distance compared to the existing?
	Is the route longer in travel time compared to the existing?
Improvement to traffic within town/accessibility within town	Could the route improve travel for local traffic travelling beyond Singleton?
	Will the route provide opportunities for improved access to the town centre?
	Will the route provide road safety improvements for through traffic?
Environmental impact - heritage	Is there potential impact on Aboriginal heritage?
	Is there potential impact on European heritage?
Environment impact - flooding	Will the route significantly impact flooding in the area?
	What is the flood immunity of the route?
	Does the route improve flood evacuation to Singleton?
Impact on environmentally sensitive communities	Does the route impact environmentally sensitive communities? (flora & fauna)
Social and amenity	Will the proposed route affect noise sensitive receivers?
	Will the proposed route affect sensitive local areas of interest?
	Will the proposed route cause significant visual impact?

Land use and ownership	Are there land uses (current or future) that may affect the feasibility of the route?
	Does the route impact future growth areas in Singleton?
Engineering constraints	Is the topography causing significant issues for the route?
	What is the probable extent of soft soils along the route?
	Are there significant work health and safety issues with the route?
	What is the extent and complexity of structures along the route?

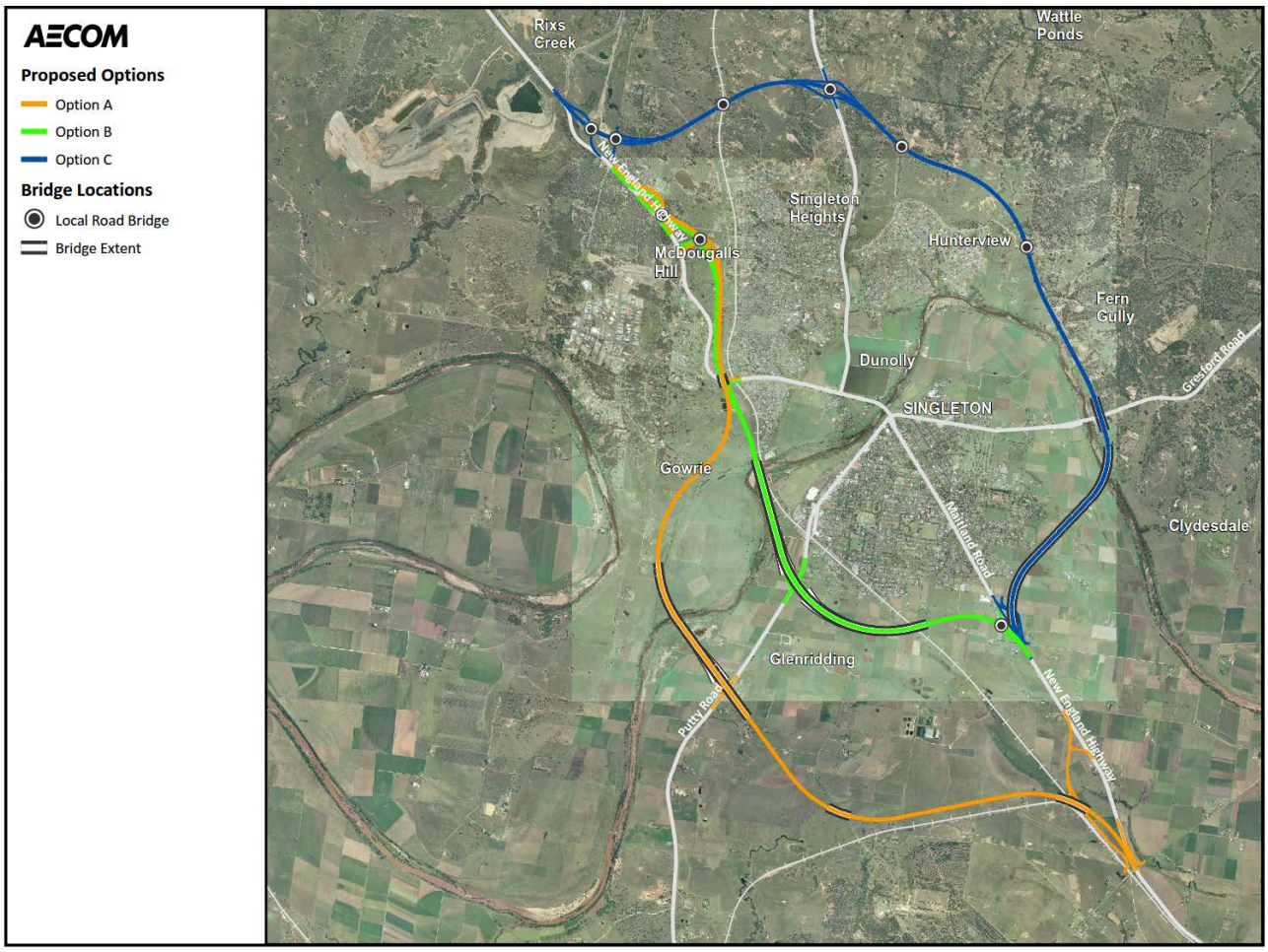
The workshop reduced the 12 options to five. Further development of the five options included detailed traffic investigations, environmental and flooding evaluations, strategic designs, cost estimates and economic analysis. Each option was assessed against a range of factors including ease of construction, social and environmental factors and how well the road would function.

Three options were then shortlisted and placed on display for community and stakeholder feedback in September 2015. The key features of each of the three shortlisted options are listed in **Table 7**. The shortlisted options are shown in **Figure 13**.

Table 7 Summary of the three shortlisted options

Route option	Length	Bridge Summary
Option A	13 kilometres	Seven bridges (including a 2 kilometre long viaduct)
Option B	8.9 kilometres	Six bridges (including a 3.1 kilometre long viaduct)
Option C	11.9 kilometres	Eight bridges (including a 2.3 kilometre long viaduct)

Figure 13 Singleton bypass shortlisted options



6.4. Description of shortlisted options

6.4.1. Option A

Option A is about 13 kilometres long and bypasses Singleton to the west. This option starts south of Singleton departing from the existing New England Highway at Range Road.

A half interchange is provided at the southern end with a northbound off ramp and southbound on ramp. The northbound off ramp passes underneath the bypass immediately before the bypass crosses the Main Northern Railway. The bridge structure spans both the ramp and the rail line. The ramp connects back to the New England Highway north of where the bypass departs from the highway and the southbound on ramp reuses the existing New England Highway.

After crossing the railway, the bypass continues in a westerly direction before curving to the north-west. Near the mid-point of the curve the bypass passes over Army Camp Road.

The bypass continues on an embankment to the north-west until the edge of the Hunter River floodplain. A bridge will be used to cross the river and connect to the northern side of the Hunter River floodplain. The bridge structure has been designed to be of sufficient height to allow local road and farm traffic to pass underneath and minimise severance of properties. While on the bridge the bypass crosses Putty Road where a half interchange is located. This interchange will have both a northbound on ramp and a southbound off ramp, and the height of the ramp embankments has been minimised to limit impact on floodwaters.

After crossing the Hunter River the bypass curves towards the north-east and then back to the north before crossing the New England Highway immediately west of the existing Gowrie Gates rail overbridge. A potential southbound on ramp connects the bypass to the New England Highway at this point. From here, the alignment continues in a northerly direction, and is located between the Main Northern Railway to the east and the New England Highway to the west.

A full interchange is located before the northern connection of the bypass to the New England Highway. The interchange has a northbound off ramp and southbound on ramp located at the extension of Magpie Street which will maintain connection with the McDougalls Hill industrial area. The northbound on ramp is provided by reusing the section of the New England Highway between Magpie Street and the bypass, and the southbound off ramp requires a bridge to pass over the bypass and connect to the New England Highway immediately north of Magpie Street.

6.4.2. Option B

Option B is about 8.9 kilometres long and bypasses Singleton to the west. This option starts south of Singleton departing from the existing New England Highway south of Newington Lane and initially heads west. The connection to the New England Highway is located within the Doughboy Hollow floodplain.

A half interchange is provided at the southern end with a northbound off ramp and southbound on ramp. The northbound off ramp passes over the bypass before connecting back to the New England Highway slightly north of where the bypass departs from the highway. The southbound on ramp reuses the existing New England Highway.

The main alignment continues west and crosses over the Main Northern Railway line then curves back to head north along the western side of Singleton. About two kilometres of this route is located in the Doughboy Hollow floodplain and is on bridge to minimise the impact on floodwater. The structure has been designed with sufficient height clearance to allow local road and farm traffic to pass underneath and minimise severance of properties. While on the bridge structure, the bypass crosses Putty Road where a full interchange will be located. This interchange includes a northbound on ramp and off ramp, and southbound on ramp and off ramp. The height and footprint of the ramp embankments have been minimised to limit the impact on floodwater.

After crossing the Hunter River floodplain the bypass curves towards the north-east and then back to the north before crossing the New England Highway immediately west of the existing Gowrie Gates rail overbridge. A potential southbound on ramp connects the New England Highway to the bypass at this point. From here, the alignment continues in a northerly direction, and is positioned between the railway on its east and the New England Highway on its west.

A full interchange is located before the northern connection of the bypass to the New England Highway. The interchange has a northbound off ramp and southbound on ramp located at the extension of Magpie Street, which will maintain connection with the McDougalls Hill industrial area. The northbound on ramp is provided by reusing the section of the New England Highway between Magpie Street and the bypass, and the southbound off ramp requires a bridge to pass over the bypass and connect to the New England Highway immediately north of Magpie Street.

6.4.3. Option C

Option C is about 11.9 kilometres long and bypasses Singleton to the east. This option starts south of Singleton departing from the existing New England Highway south of Newington Lane and heads north-east. The connection to the New England Highway is located within the Doughboy Hollow floodplain, which would be bridged.

A half interchange is provided at the southern end with a northbound off ramp and southbound on ramp. The southbound on ramp passes under the bypass using the floodplain bridge before connecting back to the New England Highway north of where the bypass departs from the

Highway. The ramp has been designed to minimise impact on floodwater. The northbound off ramp uses the existing New England Highway.

The main alignment heads north-west on a bridge across the Doughboy Hollow floodplain and the Hunter River floodplain. The structure has been designed with sufficient height to allow local road and farm traffic to pass underneath and minimise severance of properties. After crossing the Hunter River south of Gresford Road, the alignment is constrained by topography and curves towards the north through Clydesdale and Fern Gully, then runs next to the left bank of the Hunter River passing over Gresford Road.

The route remains constrained by topography and curves to the north-west to pass between Hunterview and Wattle Ponds, and then heads west passing to the north of Singleton Heights. At this location the bypass travels over Gresford Road, then under Pioneer Road, Wattle Ponds Road and Bridgman Road. A full interchange is located north of Singleton Heights at Bridgman Road, which consists of a northbound on ramp and off ramp, and southbound on ramp and off ramp.

North of Singleton Heights the bypass crosses over the Main Northern Railway before connecting with the New England Highway north of Rixs Creek Lane.

A full interchange is located before the northern connection of the bypass to the New England Highway. The interchange has a northbound off ramp and southbound on ramp located at Rixs Creek Lane, which will connect with the McDougalls Hill industrial area. The northbound on ramp is provided by reusing the existing section of the New England Highway, and the southbound off ramp will require a bridge to pass over the bypass and connect to the New England Highway north of Rixs Creek Lane.

7. Traffic modelling and analysis

For traffic modelling purposes the year of opening is assumed to be 2022, noting there is no approval or funding commitment for construction.

Traffic modelling was broadly carried out for two scenarios. These were without the project (Do Minimum) and with the project options. The Do Minimum scenario assumes there are no substantial changes to the road network in future years. This forms the basis for economic and traffic performance comparisons of the project options.

The Do Minimum model included traffic growth and potential road upgrades. These are described below.

New England Highway upgrade between Belford and the Golden Highway: This upgrade is being developed by Roads and Maritime as a separate project to the bypass. It provides two traffic lanes in each direction along the New England Highway between Belford and the Golden Highway. The right turn movement from the Golden Highway to the New England Highway would be replaced by a right turn flyover. The configuration of this proposed upgrade is shown in **Figure 14**.

Figure 14 Proposed design for the New England Highway upgrade between Belford and the Golden Highway

Upgrade of Bridgman Road and Wattle Ponds Road intersections: Potential upgrade of New England Highway intersections at Bridgman Road and Wattle Ponds Road to improve traffic flow.

No right turn on New England Highway at Elizabeth Street: Potential removal of right turn movements from the New England Highway into Elizabeth Street. This would reduce delays experienced by southbound traffic.

7.1.1. Future traffic conditions

Travel times were forecast along New England Highway between Rixs Creek and Bell Road for the Do Minimum scenario to represent the baseline future traffic conditions for years 2022, 2032 and 2042. Key performance metrics including Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) are summarised in **Table 8.**

Table 8 Do Minimum key performance summary

Performance Measures	Do Minimum									
	2022		**2032**		***Difference 2022-2032***		**2042**		***Difference 2032-2042***	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Vehicle Kilometres Travelled (VKT)	213,785	235,163	253,967	278,180	*40,182 +19%*	*43,017 +18%*	267,581	286,967	*13,613 +5%*	*8,786 +3%*
Vehicle Hours Travelled (VHT)	2964	3466	4519	4516	*1556 +52%*	*1050 +30%*	7411	6743	*2892 +64%*	*2228 +49%*
NEH Southbound Travel Time (mm:ss)	16:31	17:41	17:04	21:51	*00:33 +3%*	*04:10 +24%*	37:31	34:27	*20:26 +120%*	*12:36 +58%*
NEH Northbound Travel Time (mm:ss)	17:11	16:52	33:55	17:47	*16:44 +97%*	*00:55 +5%*	1:11:00	17:19	*37:05 +109%*	*-00:28 -3%*

Table 8 shows traffic congestion increases with the traffic growth. Average travel times along the New England Highway are forecast to increase by about 100 per cent in the northbound morning peak (7am to 8am) between 2022 and 2032. The northbound travel time is forecast to increase by over 53 minutes between 2022 and 2042, which suggests significant network congestion in 2042.

7.2. Traffic modelling results

7.2.1. New England Highway travel times

Travel time forecasts have been modelled between Bell Road and Rixs Creek Lane.

The average travel times in the morning (7am to 8am) and evening (4pm to 5pm) peak periods using the existing New England Highway are shown in **Figure 15** and **Figure 16**.

Figure 15 New England Highway travel times through Singleton - southbound

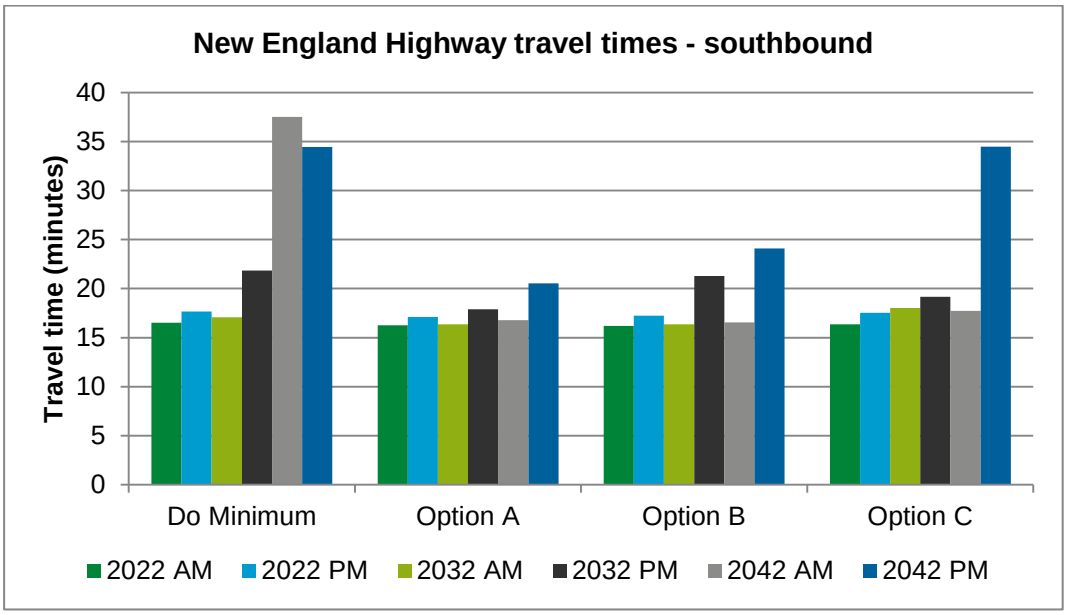
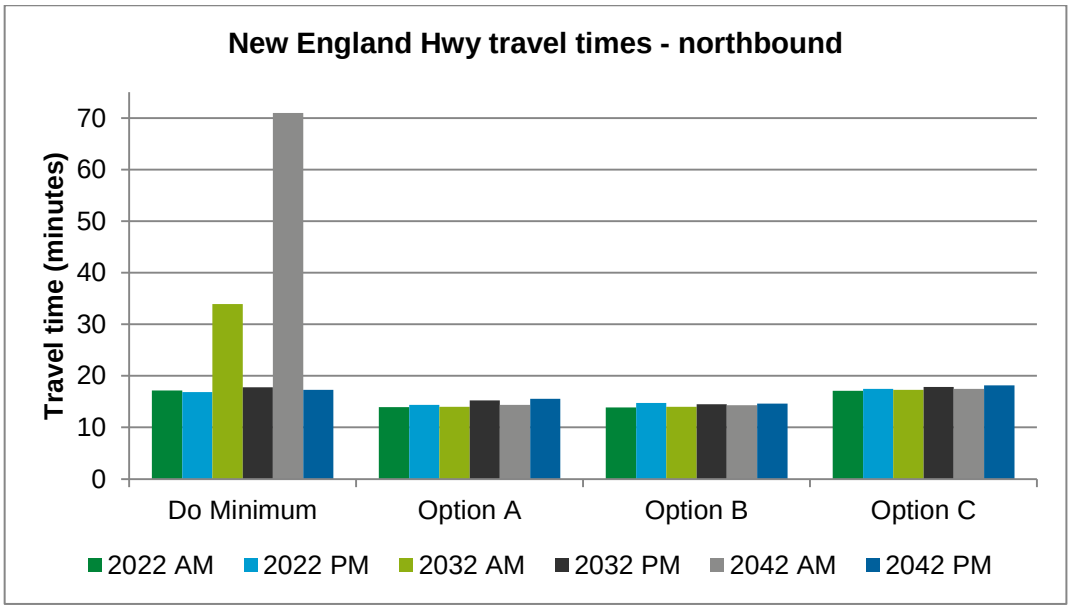


Figure 16 New England Highway travel times through Singleton - northbound



Findings from the New England Highway travel time forecasts are below.

- The Do Minimum northbound morning peak (7am to 8am) show travel times of about 34 minutes in 2032 and more than an hour in 2042. This is primarily due to increasing traffic along the highway through Singleton.
- Option A and Option B show the most consistent reduction of travel times along the New England Highway in all peak periods. The forecast saving in the northbound 2042 morning peak (7am to 8am) is about 55 minutes. These options are the most efficient of the assessment.
- In the southbound 2042 evening peak (4pm to 5pm), travel time along Option B and Option C would be marginally higher when compared with the Do Minimum scenario. This result is partly due to the traffic merging into a single lane at the southern connection. A separate project to duplicate the highway south of Singleton would improve this forecast travel time.
- In the southbound 2042 evening peak (4pm to 5pm) all of the options appear to have increased travel times for the New England Highway compared with the morning peak (7am to 8am). This result is partly due to the traffic merging at the southern connections, which causes enough additional delays to offset some of the expected savings from the bypass. A separate project to duplicate the highway south of Singleton would improve this forecast travel time.

7.2.2. Bypass travel times

The average bypass travel times in the morning (7am to 8am) and evening (4pm to 5pm) peak periods are shown in **Figure 17** and **Figure 18**.

Figure 17 Bypass travel times - southbound

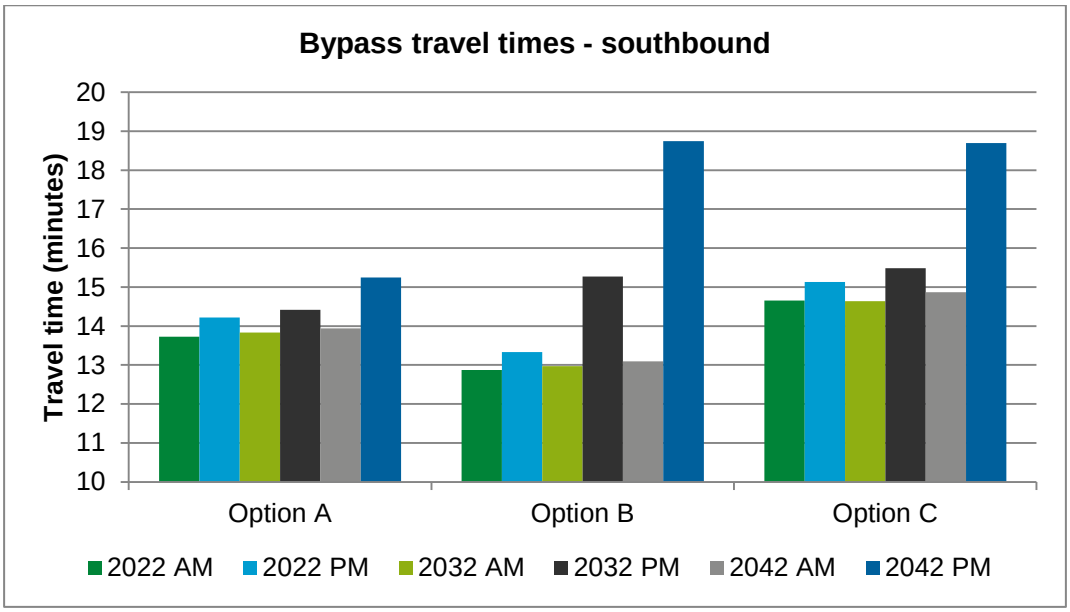
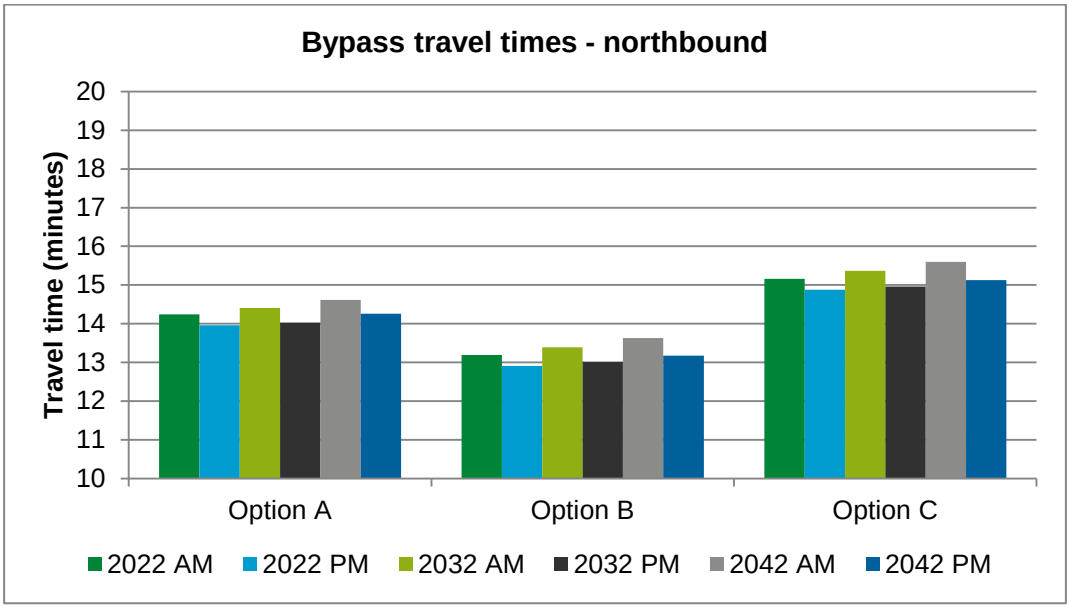


Figure 18 Bypass travel times - northbound



Findings from the bypass travel time forecasts are below.

- Option C has the highest travel times due to the longer distance between the timing points
- In the southbound 2042 evening peak (4pm to 5pm) higher relative travel times were recorded for Option B and Option C. This is due to merging of the bypass and New England Highway into a single lane at the southern connection. A separate project to duplicate the highway south of Singleton would improve this forecast.

7.2.3. Estimated average daily traffic

The existing and estimated average daily traffic (ADT) volumes in years 2022 and 2042 at a number of locations in the study area are shown in **Figure 19**, **Figure 20** and **Figure 21.**

Figure 19 Average daily traffic (ADT) in 2014 including percentage of heavy vehicles (HV%)

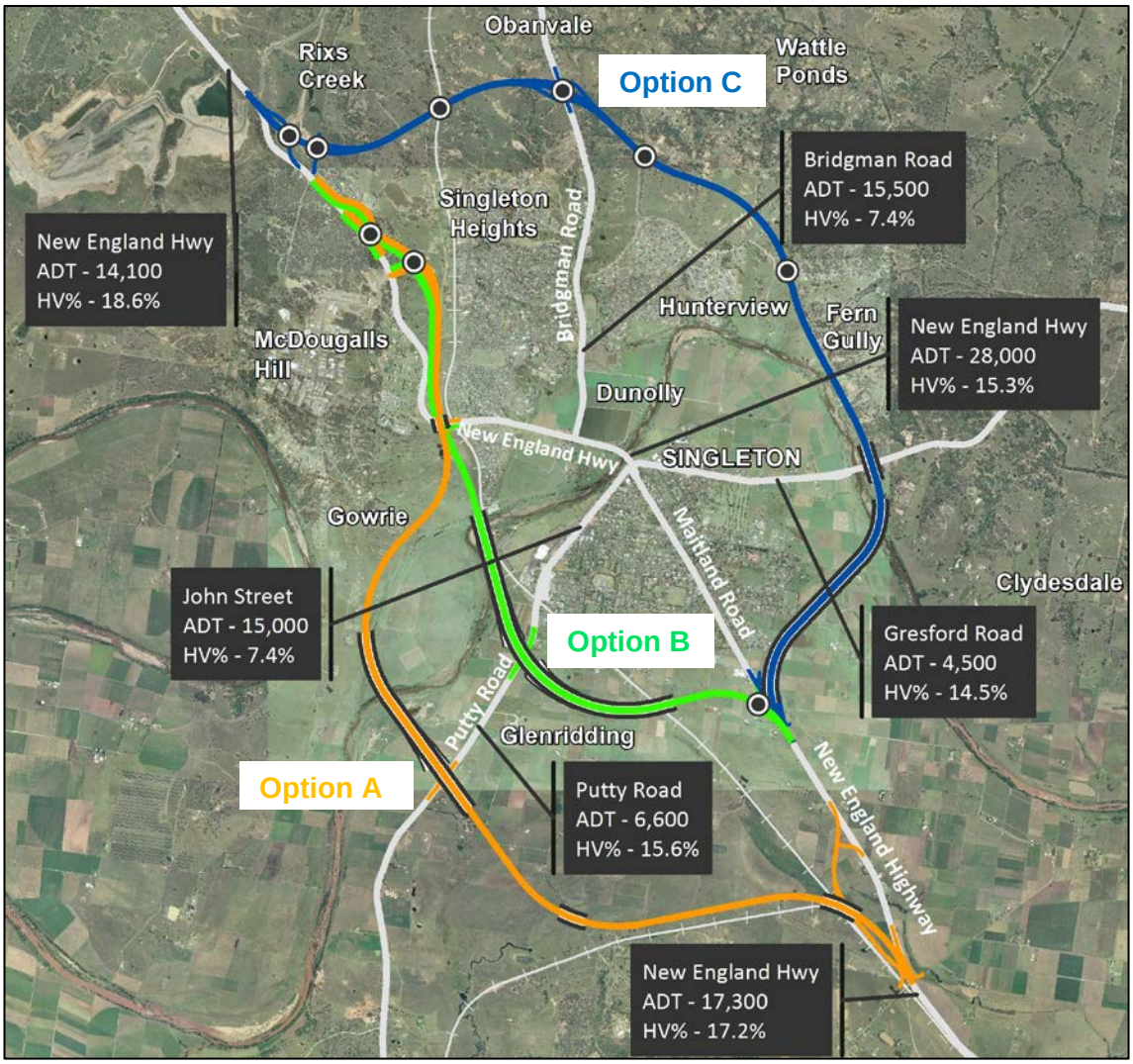
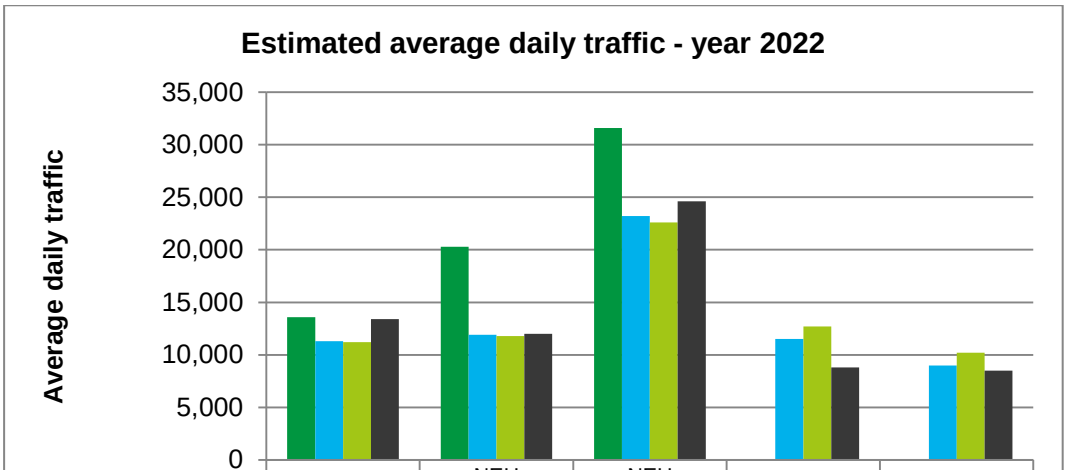
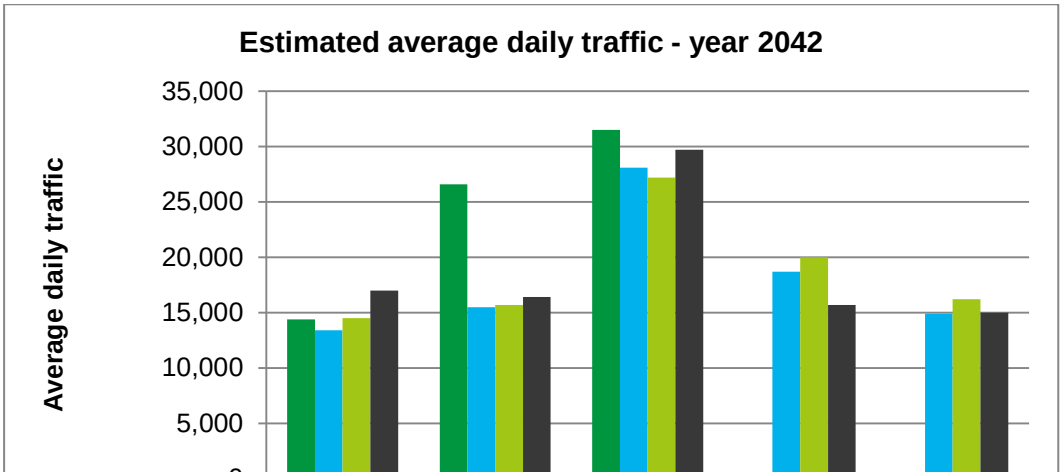


Figure 20 Estimated average daily traffic (ADT) in year 2022



	John St	NEH Sth of Magpie St	NEH Hunter River Bridge	Bypass - North	Bypass - South
Do Minimum (2022)	13,600	20,300	31,600	0	0
Option A (2022)	11,300	11,900	23,200	11,500	9,000
Option B (2022)	11,200	11,800	22,600	12,700	10,200
Option C (2022)	13,400	12,000	24,600	8,800	8,500

Figure 21 Estimated average daily traffic (ATD) in year 2042

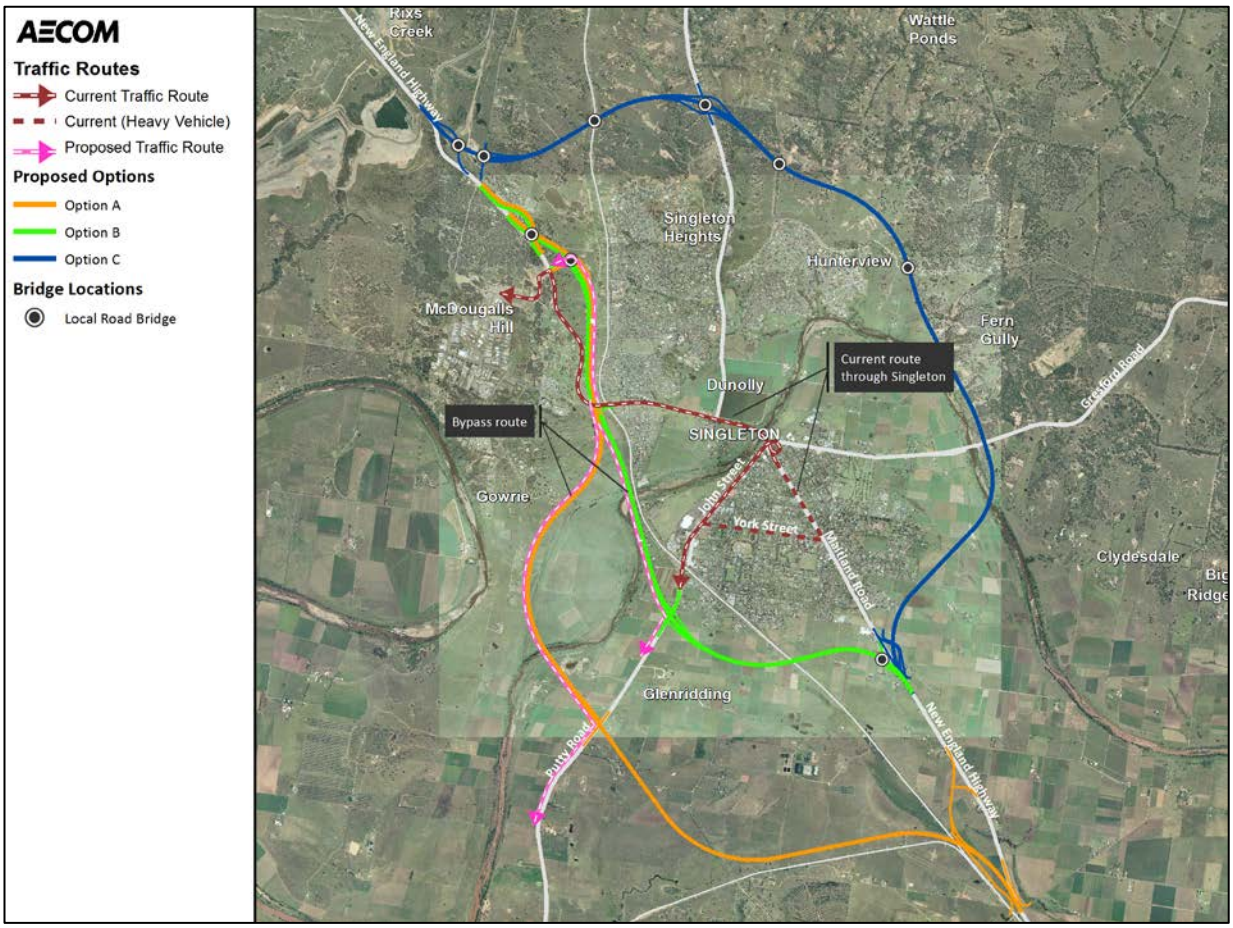


	John St	NEH Sth of Magpie St	NEH Hunter River Bridge	Bypass - North	Bypass - South
Do Minimum (2042)	14,400	26,600	31,500	0	0
Option A (2042)	13,400	15,500	28,100	18,700	14,900
Option B (2042)	14,500	15,700	27,200	20,000	16,200
Option C (2042)	17,000	16,400	29,700	15,700	15,000

Findings from the traffic volume estimates are below.

- By 2022 the forecast traffic volume on the New England Highway at the Hunter River Bridge (31,600) has reached theoretical road capacity which is also reflected in the 2042 forecast.
- The bypass connection between the north (including McDougalls Hill industrial area) and west (Putty Road) reduces the through traffic on John Street (Singleton town centre) by about 900 vehicles per day in 2022 for Options A and B (**Figure 22**)
- Option B would attract the highest traffic volumes on the bypass due to its close proximity to Singleton. The close proximity of the Putty Road interchange to the Singleton shopping and dining precinct would also attract more through traffic.
- Compared to the other options, Option C attracts less traffic because it is longer and provides less travel time saving. The distance between the Bridgman Road interchange and the Singleton shopping and dining precinct is also less attractive to traffic, so overall network improvements are less.
- In the hypothetical year of opening (2022) the volume of traffic on the New England Highway in Singleton is significantly reduced by between 7000 and 9000 vehicles per day at the Hunter River Bridge.

Figure 22 Illustration of connection between the north and west



7.3. Traffic results summary

Based on the traffic assessment, the operation of the road network in the study area is expected to gradually worsen due to traffic growth if no bypass is built. Average travel times along the New

England Highway between Belford and Rixs Creek, are forecast to increase from the existing 20 minutes during peak periods to more than 60 minutes in 2042. Without the bypass significant traffic congestion along the New England Highway could also prevent traffic from efficiently accessing Singleton.

A bypass would have the following benefits:

- Time spent travelling in the study network could be reduced by up to 44 per cent in 2042 during peak periods
- Average heavy vehicle volumes along the existing New England Highway near the Hunter River crossing could be reduced by up to 62 per cent in 2042
- The bypass connection between the north (including McDougalls Hill industrial area) and west (Putty Road) reduces the through traffic on John Street (Singleton town centre) by about 900 vehicles per day in 2022 for Options A and B.

A bypass would improve overall network performance, reduce freight traffic through the town centre and potentially improve access to Singleton, with bypass Options A and B would providing the most significant improvements.

8. Flooding

A preliminary flood impact assessment has been carried out to understand how a bypass would affect flooding in and around Singleton. The assessment considered mainstream flooding of the Hunter River and local catchment runoff from Doughboy Hollow Creek.

8.1. Flooding terminology

Predicted flood water levels are expressed based on their probability of occurring in any given year, and are mapped as areas of floodwater inundation. For example, the 10 year flood means there is a one in 10 chance that a flood of that size could occur in any one year. The term relates to the probability of that rainfall intensity and flood event occurring for the given location.

The term 10 year flood is interchangeable and means the same as the 1% AEP (Annual Exceedance Probability) flood, 10 Year ARI (Average Recurrence Interval) flood or one in 10 year flood. The 10 year flood doesn't mean that if it floods one year, it will definitely not flood for the next nine years. Nor does it mean that if no flooding has occurred for nine years that it will result in a flood the following year.

Flood levels recorded at Dunolly Bridge, Singleton have been referenced to describe flooding throughout this report. These levels are shown in **Table 9.**

Table 9 Comparison of modelling and historic flood levels – Hunter River at Dunolly Bridge

Flood description		Dunolly Bridge flood level (meters Australian Height Datum [AHD])	Dunolly Bridge gauge height (metres)
20% AEP	1-in-5 year flood	40.2	12.6
10% AEP	1-in-10 year flood	41.5	13.9
5% AEP	1-in-20 year flood	41.9	14.3
2007 event	*Historical event similar to 1-in-20 year flood*	*41.8*	*14.2*
2% AEP	1-in-50 year flood	42.2	14.6
1913 event	*Historical event similar to 1-in-50 year flood*	*41.8* (42.1)***	*14.3*
1% AEP	1-in-100 year flood	42.6	15.0
1955 event	*Historical event similar to 1-in-100 year flood*	*42.2* (42.7)***	*14.6*

Source: WBM 2016

* *The Singleton levee scheme was constructed after the 1955 event and the flood levels for a given flow at Dunolly Bridge have increased as a result.*

** *If the 1913 and 1955 floods occurred today, then they would likely result in peak flood levels of about 42.1 m AHD and 42.7m AHD, respectively.*

8.2. Flooding constraints

The Singleton catchment area is about 16,000 square kilometres. The original settlement of Singleton is on the floodplain of the Hunter River, with newer development located on flood free land north of the Hunter River floodplain.

The *Singleton Flood Study (WBM, 2003)* describes the flooding behaviour for the study area. Both the Main Northern Railway and New England Highway divide the natural path of major flood flows through Glenridding and Doughboy Hollow floodplains south of Singleton. The Singleton flood levee is located along the riverbank to the north-west of the Singleton town centre. The levee was constructed in 1963, extended in1982 and 1983 and again in 1987. The levee has been designed to withhold floods up to and including the one in 100 year event, similar to the one experienced in 1955.

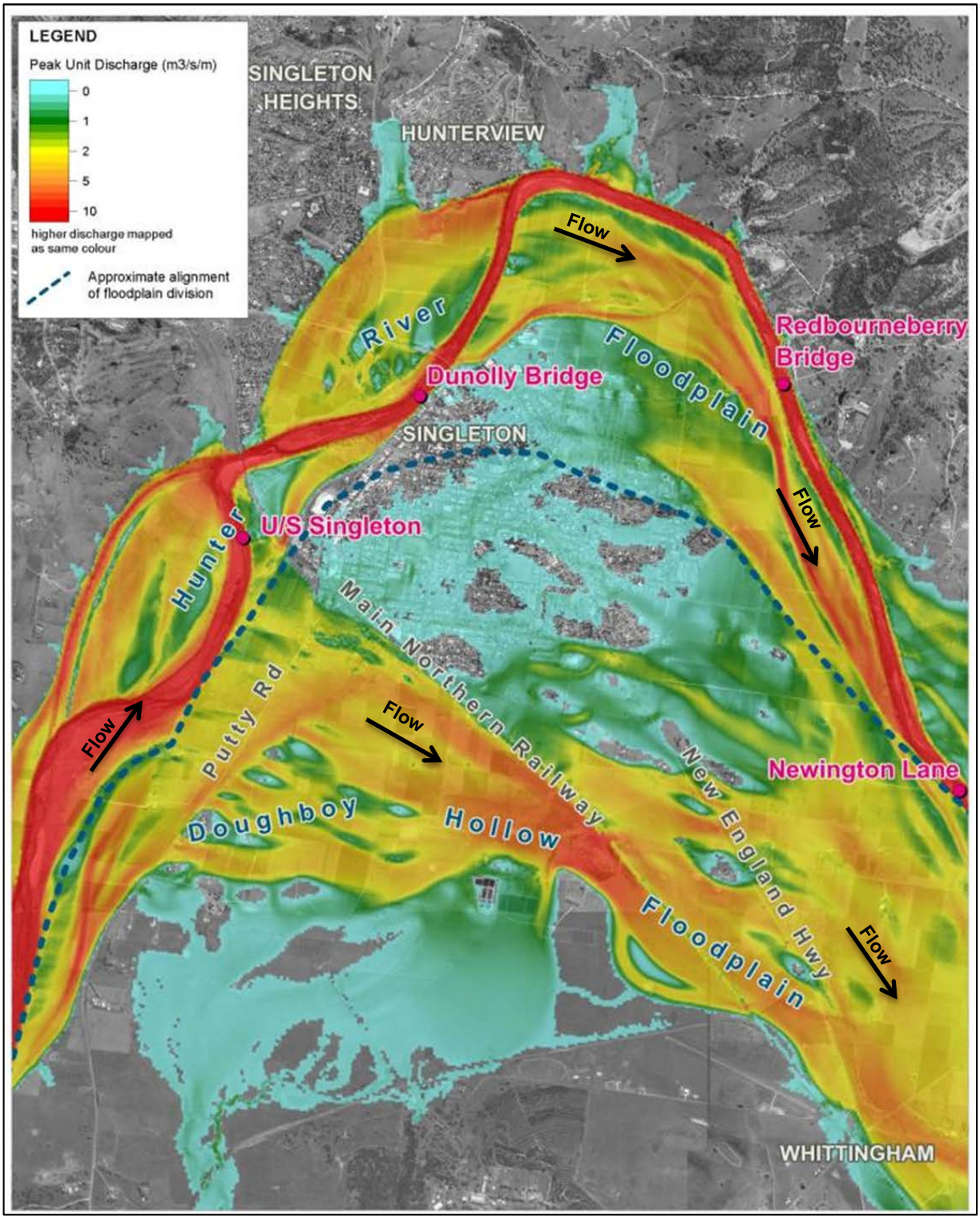
Results indicate flooding caused by a one in 100 year event would overtop the Main Northern Railway in the vicinity of John Street (south) and the railway station, resulting in extensive flooding of residential properties. There would be a significant damming effect next to the railway embankment and a small ridge near the wastewater treatment works. This would result in deep flooding in the Doughboy Hollow floodplain, and increase the likelihood of overtopping of the railway line, which would lead to flooding of the township.

In the Whittingham area, the New England Highway currently experiences a level of flood immunity somewhere between the one in 10 year and one in 20 year events.

An illustration of the one in 100 year flood behaviour is in **Figure 23**. It shows the two main flow path alignments. These are:

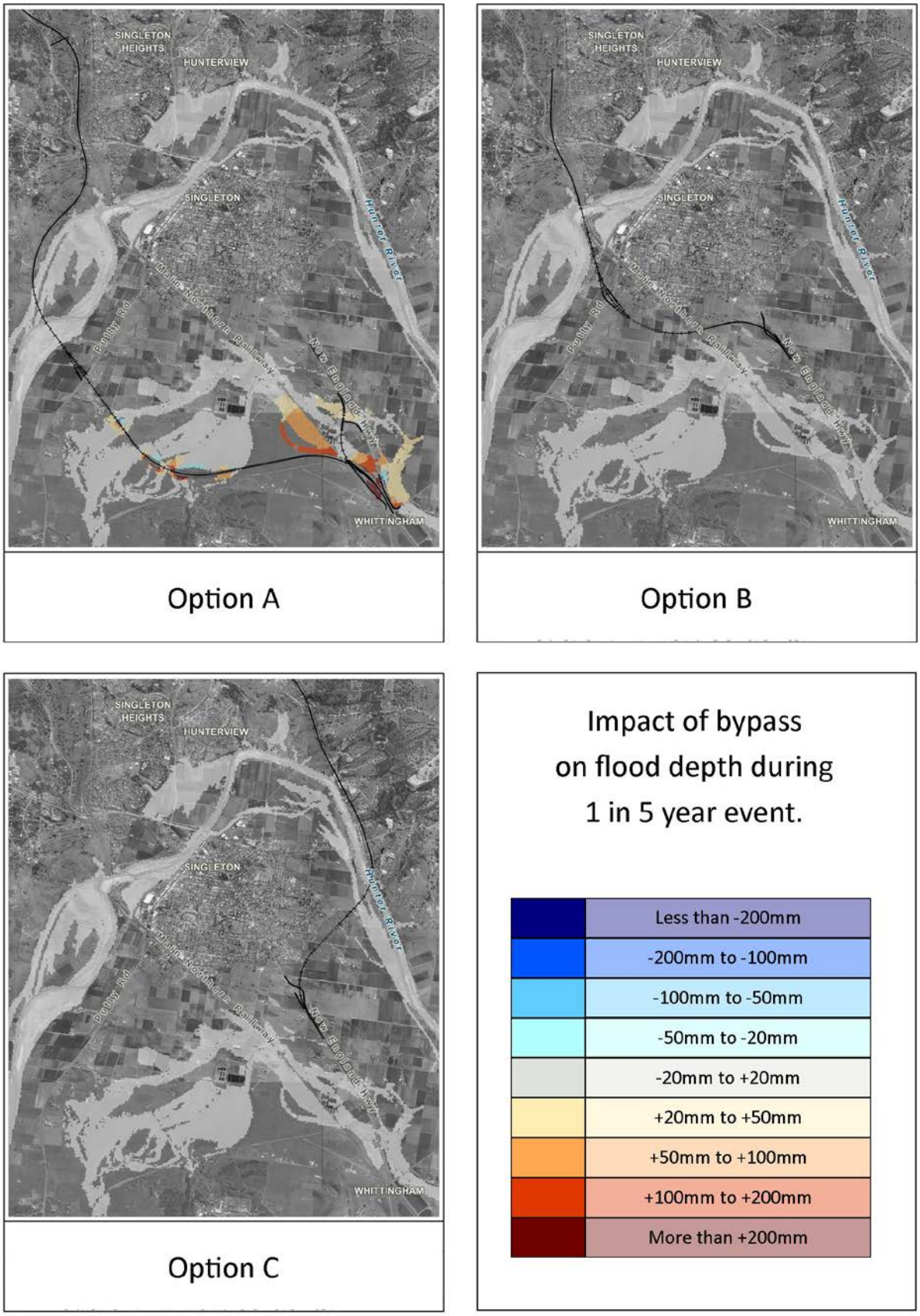
- The Hunter River channel and floodplain flowing around the northern side of Singleton
- The Doughboy Hollow floodplain, which breaks away from the Hunter River at Glenridding and flows around the southern side of Singleton, before combining with the Hunter River floodplain again at Whittingham.

Figure 23 Singleton flood features during a modelled one in 100 year flood event



Source: BMT WBM 2016

Figure 24 One in five year peak flood level impact



Source: WBM 2016

8.3. One in five year peak flood level impact

The modelled impact of the one in five year event peak flood levels for each of the options are presented in **Figure 24**.

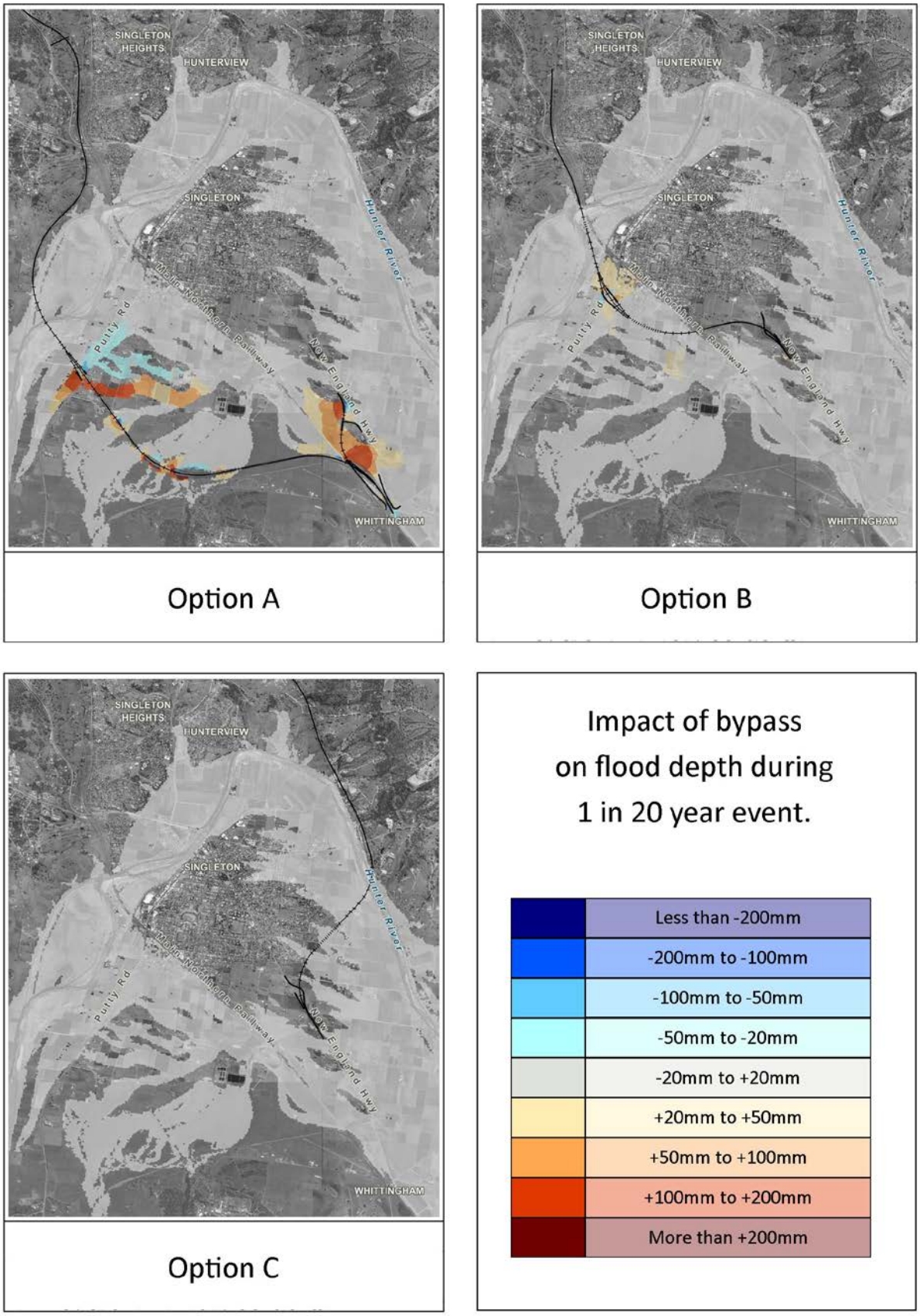
Option A: There would be localised increases to peak flood levels across the Doughboy Hollow floodplain crossing south-west of the waste water treatment works. The impacts of this would not extend far from the bypass (about 100 metres) and no existing dwellings would be affected.

There would be more extensive impacts at Whittingham, where the bypass connects to the existing New England Highway. This location is in the main outlet of the Doughboy Hollow floodplain. While an extensive group of culverts would be provided, upstream flood impacts of just more than 100 millimetres would remain. The extent of the increased flood levels would not impact on existing dwellings.

Option B: There would be no significant impact on the modelled peak flood levels. This is largely due to the minimal extent of flooding present along this route, and the large bridge provided over the Hunter River and floodplains.

Option C: There would be no significant impact on the modelled peak flood levels. This is largely due to the minimal extent of flooding present along this route, and the large bridge provided over the Hunter River and floodplains.

Figure 25 One in 20 year peak flood level impact



Source: WBM 2016

8.4. One in 20 year peak flood level impact

The modelled impact of the one in 20 year event peak flood levels for each of the options are presented in **Figure 25**.

Option A: Impacts would be limited to localised increases upstream of the Doughboy Hollow floodplain crossing. However these impacts would not extend far from the bypass (about 100 metres) and no existing dwellings would be affected.

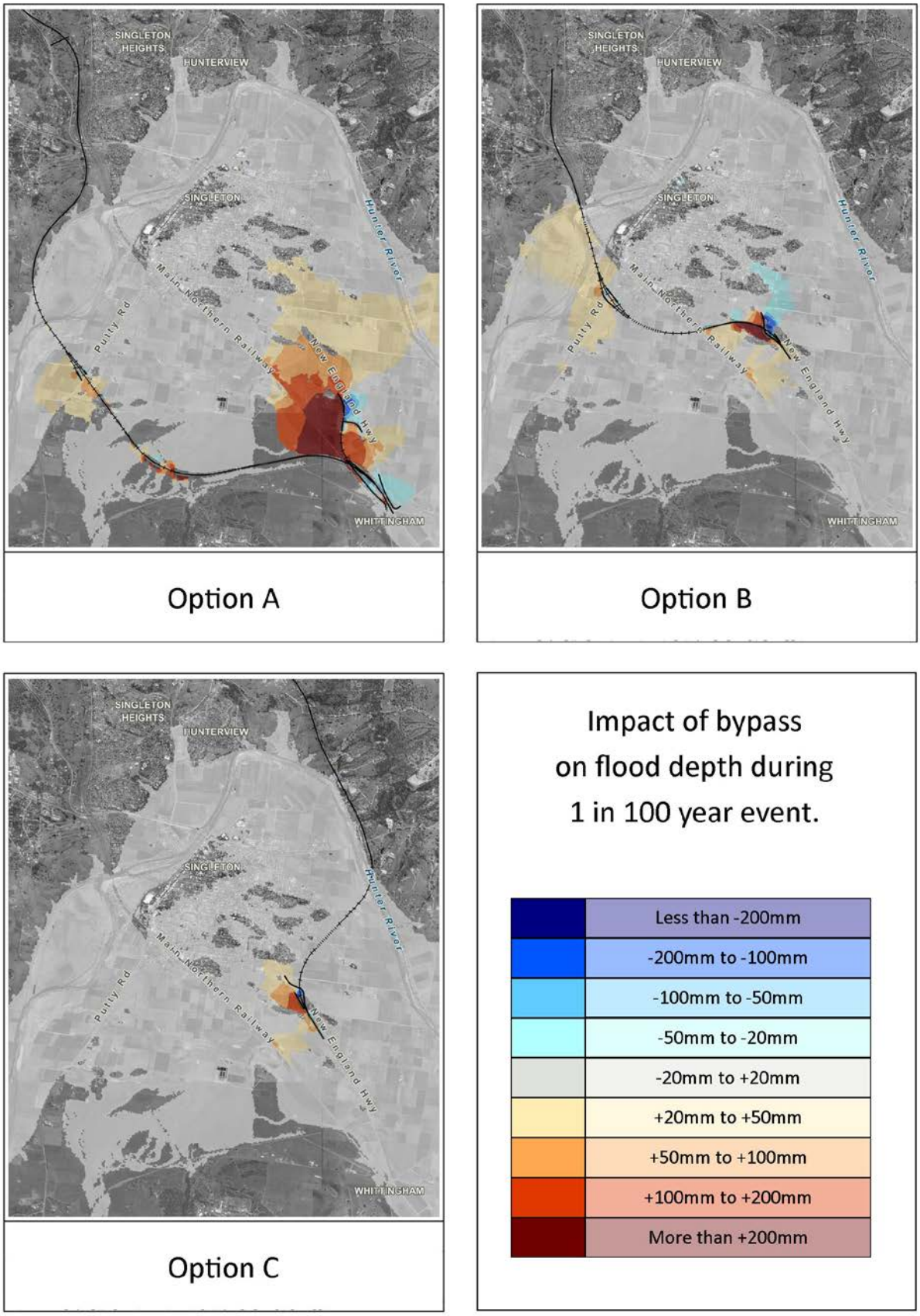
At the proposed Putty Road interchange, earthworks for ramps would increase the upstream flood levels and the levels of the flood pathway, which would start upstream of the interchange. The area impacted by the increase would be agricultural land with no impact to existing dwellings or buildings.

There would be more extensive impact at Whittingham with upstream flood impacts of just more than 100 millimetres. The extent of the increased flood levels would include the New England Highway and a few existing properties.

Option B: A number of residential properties situated within the floodplain in the vicinity of the Putty Road interchange would experience peak flood level impact in the order of 20 to 50 millimetres. Putty Road would also be affected.

Option C: There would be no significant impact on the modelled peak flood levels. This is largely due to the minimal extent of flooding present along the route and the proposed large bridge over the Hunter River and floodplains.

Figure 26 One in 100 year peak flood level impact



Source: WBM 2016

8.5. One in 100 year peak flood level impact

The modelled impact of the one in 100 year event peak flood levels for each of the options are presented in **Figure 26**.

Option A: Properties at the Putty Road interchange may be impacted by an increased flood level of about 20 millimetres.

At Whittingham there would be localised flood level increases of up to 600 millimetres. The affected area would include the New England Highway, Main Northern Railway and some existing properties. Modelled flood level increases would range from 30 millimetres to more than 200 millimetres in this area. The extent of the increased flood levels may reach the southern edge of Singleton, where a number of properties may be impacted by about 20 to 30 millimetres.

Option B: Embankments within the floodplain would be required at the proposed southern interchange. **Figure 26** shows these embankments would cause a build-up of flood water and a 300 millimetre increase in modelled peak flood level. The impacted area would be agricultural land with no impact to existing dwellings.

At the Putty Road interchange a few rural dwellings would be affected by the one in 100 year event by an increased flood level of about 20 to 50 millimetre.

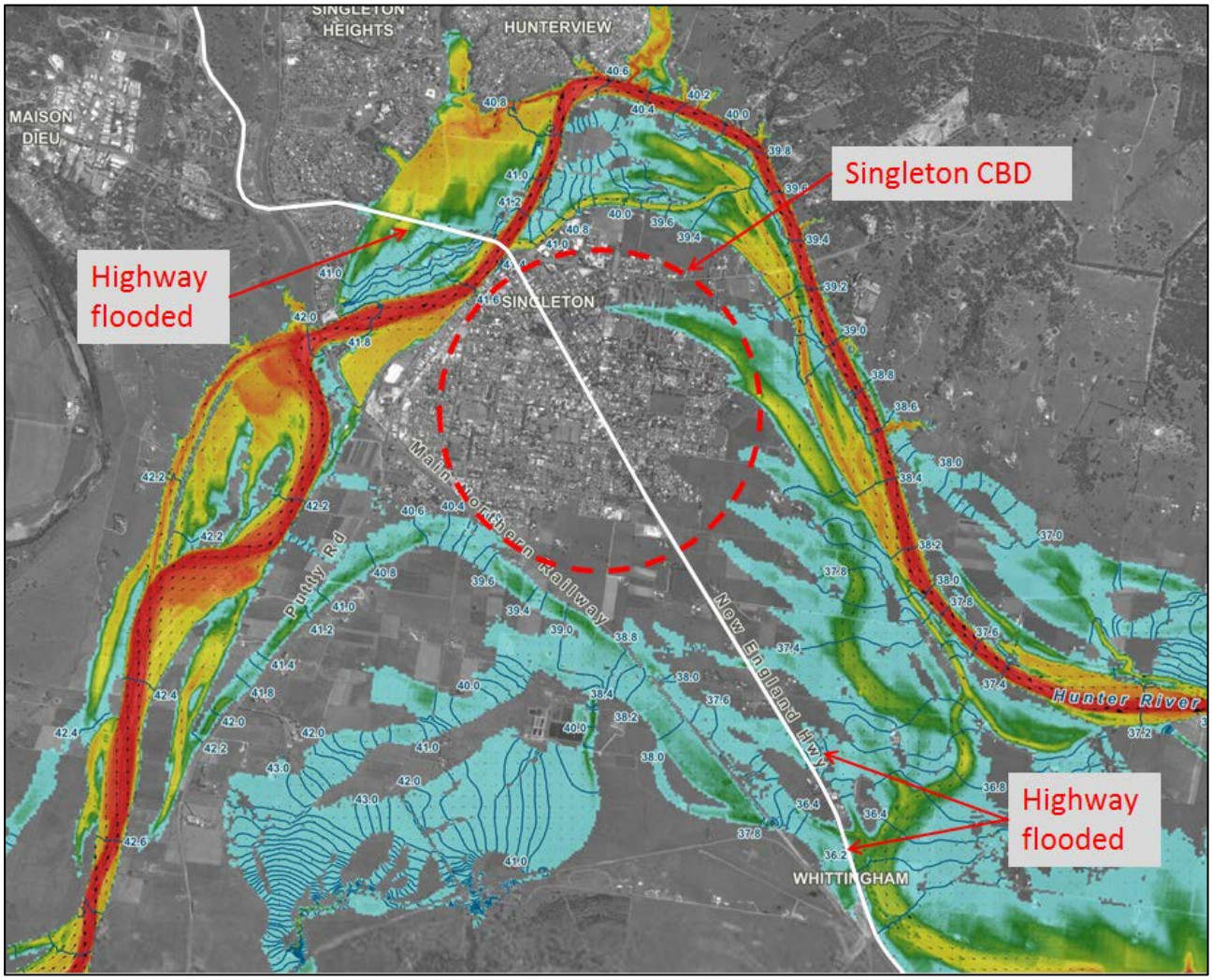
Option C: Earthworks within the one in 100 year floodplain would be required in the vicinity of the southern interchange at Whittingham. These earthworks would increase upstream flood levels by about 200 millimetres. Some agricultural properties in this location would be affected and a few existing dwellings would experience an increase of about 20 to 90 millimetres.

The extent of the increased flood levels would then reach the southern edge of Singleton, where about a 10 millimetre increase would occur. This is not likely to result in any significant impact to existing properties.

8.6. Flood evacuation routes

Currently access routes to and from the Singleton town centre can be closed for a number of days during major flood events until peak floodwaters subside. Typically events are equivalent to the one in 10 year flood event shown in **Figure 27**. The New England Highway is not accessible to the north near Bridgman Road, and to the south near Range Road. Western access via Putty Road is inaccessible, as is eastern access via Gresford Road.

Figure 27 One in 10 year modelled peak flood condition



The shortlisted options would not impact the overall duration of flood inundation.

The shortlisted options would provide additional access to the Singleton town centre during flood events. These are presented in **Table 10**. In all cases Singleton town centre traffic would need to access the bypass and travel north to Muswellbrook. From Muswellbrook, access to the Lower Hunter would be via the Golden Highway.

Table 10 Singleton town centre flood access

Route option	Singleton town centre flood access
Option A	• In a one in 10 year event a vehicle can travel south along the New England Highway to access the bypass using the southern interchange • In a one in 10 year event access to the Putty Road interchange would not be possible • Option A would generally provide the least access to and from the Singleton town centre during a flood event.
Option B	• In a one in 20 year event a vehicle could travel south along the New England Highway to access the bypass using the southern interchange • In a one in 10 year event a vehicle could travel west along Putty Road to access the bypass using the Putty Road interchange • Option B would generally provide the most access to and from the Singleton town centre during a flood event.
Option C	• In a one in 20 year event a vehicle could travel south along the New England Highway to access the bypass using the southern interchange • Option C was considered to provide the second best access to and from the Singleton town centre during a flood event. This is similar to Option B but without a secondary access point such as Putty Road.

8.7. Flood impact summary

The broad scale impacts on the floodplain are driven by the length of the bridges and the interchange locations. Bridge lengths have been developed to minimise the impact on flooding for up to a one in 100 year event.

In general, the modelling showed changes in floodwater velocity are relatively localised for all options considered. The main exception to this is near the southern interchange of Option A during major flood events.

Option C performs best as it is the only option that does not cross the Doughboy Hollow floodplain. The majority of the route, including the Bridgman Road interchange, is also located outside of the floodplain so has no flooding impact.

Options A and B cross the Doughboy Hollow floodplain, which is relatively wide with a complex system of flood flow paths. The introduction of embankments at Putty Road in this floodplain results in localised minor flooding.

Option A performs the worst of the shortlisted options as the southern connection to the New England Highway is located in deep fast flowing floodwater. The increased flood levels in this area are the most extensive of the shortlisted options.

Option B provides the best access of the shortlisted options. Access to and from the town centre would be via the southern interchange for up to a one in 20 year event. Evacuation access is also possible via Putty Road in a one in 10 year event, which would provide a comparatively significant time saving when connecting to the Lower Hunter.

9. Community consultation

9.1. Consultation objectives

The objectives of the community consultation carried out in 2015 were to:

- Inform the community and stakeholders of the three shortlisted options
- Invite feedback on the three shortlisted options
- Gather local knowledge to help with the selection of a preferred bypass route.

The project team consulted with the community on the three shortlisted options to seek feedback from local residents and interested stakeholders.

9.2. Consultation summary

The shortlisted options were displayed for community and stakeholder feedback between 28 September and 23 October 2015 and 168 submissions were received in response to the display, including:

- 97 emails
- 27 letters
- 44 telephone calls.

A total of 27 issues were raised in the submissions received. Some submissions contained multiple comments and raised multiple issues. Submissions were received from interested community members and groups, residents, Singleton Council and businesses in the Singleton area.

Roads and Maritime follows issues based decision making, which means that although preferences on options are noted, Roads and Maritime examines the issues raised throughout the consultation period using a fact based assessment process.

The most commonly raised issues included:

- Changes to hydrology and potential impact to local flooding (13%)
- Property acquisition/compensation (12%)
- Traffic forecasts, use of local routes and travel times (9%)
- Isolation or fragmentation of agricultural land (8%)
- Impact on business/trade loss (6%)
- Property value (5%).

A number of submissions included a preference or dislike for a particular route option along with key reasons for this preference or dislike. From the preferences stated, it was clear there was a significant dislike for Option C. Options A and B were roughly equal in preference.

10. Assessment of options

The process of comparing and assessing the shortlisted options enabled key constraints and opportunities to be considered and addressed throughout the design process.

A value management process was used to carry out the options assessment. Values important to the project were identified through desktop investigations and during collaborative workshops and meetings with key stakeholders. These values informed the assessment criteria which were used to identify a preferred option.

10.1. Value Management Workshop

A Value Management Workshop was held in March 2016 and included representatives from the local community, local public transport operators, Singleton Council, Roads and Maritime and AECOM.

The objectives of the workshop were to obtain a common understanding of the work carried out to date, review the three shortlisted options and evaluate each against defined assessment criteria and their costs, and recommend a preferred option to progress the project.

The workshop process used the knowledge and expertise of the participants to clarify what the project must achieve to be successful, as well as aspects considered important.

To be considered successful, the group agreed the project needed to meet the project objectives.

Assessment criteria developed under three key categories – technical/functional, socio-economic, and environmental were used to differentiate and evaluate the options. Weighting of the criteria was established by using a paired comparison process. The agreed assessment criteria and weightings are provided in **Table 11.**

Table 11 Assessment criteria for the Value Management Workshop

Technical/functional criteria	Weighting
Improve road transport efficiency through travel time savings	33%
Reduce traffic congestion in Singleton	27%
Ease of construction of the bypass	7%
Ease of bypass infrastructure maintenance	20%
Ease of future duplication	0%
Allows for incident management (crashes, fire, etc)	13%
Socio-economic criteria	**Weighting**
Limit community severance impact	13%
Optimise the ability of highway traffic to access Singleton town centre to minimise business impact	30%
Minimise the footprint of the bypass on LEP residential zones: R1 General Residential; R2 Low Density Residential; and E4 Environmental Living	7%
Minimise the impact on high quality agricultural land	23%
Improve flood access routes to Singleton	7%
Proximity of residents to the bypass	20%

Environmental criteria	Weighting
Minimise biodiversity impact	35%
Minimise impact on Aboriginal heritage	35%
Minimise the visual impact of the bypass	10%
Minimise flooding impact on quality agricultural land	20%
Minimise impact on Crown land subject to Aboriginal land claims	0%

Information for the three shortlisted options was reviewed, together with key features, strengths and weaknesses to form a common understanding of the differences, opportunities and constraints to be evaluated.

When the qualitative evaluation was complete, each assessment was scored using the weightings to establish a relative overall ranking for each option in each of the three key categories.

The three shortlisted options were evaluated against the assessment criteria. These outcomes were compared against the relative cost estimates.

10.1.1. Assessment for technical/functional criteria

The workshop assessments for the technical/functional criteria are presented in **Table 12**.

Table 12 Assessment of options using the technical/functional criteria

Assessment Criteria	Improve road transport efficiency through travel time savings	Reduce traffic congestion in Singleton	Ease of construction of bypass	Ease of bypass infrastructure maintenance	Allows for incident management	Rank [score]
Weighting	**33%**	**27%**	**7%**	**20%**	**13%**	
Option A						
Rating	3	4	2	3	2	**2**
Score	[99]	[108]	[14]	[60]	[26]	**[307]**
Option B						
Rating	4	4	3	1	4	**1**
Score	[132]	[108]	[21]	[20]	[52]	**[333]**
Option C						
Rating	1	2	4	4	3	**3**
Score	[33]	[54]	[28]	[80]	[39]	**[234]**

Key observations from this assessment are below.

Improve road transport efficiency through travel time savings

- Option B rated the best as it had the fastest travel time and provided a north-west connection
- Option A performed the next best and also provided a north-west connection
- Option C performed the worst with the longest travel time and had no north-west connection.

Reduce traffic congestion in Singleton

- Options A and B were much the same and rated the best
- Option C would attract traffic but not as many trips as Options A and B (by a medium amount).

Ease of construction of the bypass

- Option C rated the best as it provided the best balance of earthworks as importing fill would be a risk for the project
- Option B was rated the next best although there would be issues with duplication of the Putty Road ramps, medium floodplain risks and a skewed rail crossing

- Option A rated worse due to the same issues as Option B but Option A has a higher skew to the rail line for the crossing.

Ease of bypass infrastructure maintenance

- Considerations included traffic diversions from the bypass for major maintenance, and weathering of steel bridges, which would require repainting
- Option C was rated the best with no steel bridges
- Option B rated the worst as it has a steel bridge over the rail line which would be more difficult to maintain due to access permits over the railway. Option B also has the greatest length of bridges
- Option A rated between Option C and Option B.

Allows for incident management

- Option B rated the best due to its flexibility (ie in the event of a crash on the bypass, traffic could be diverted to Putty Road)
- Option C was rated the next best
- Option A rated the worst overall due to the more limited half diamond interchange at Putty Road.

10.1.2. Assessment for socio-economic criteria

The workshop assessments for the socio-economic criteria are presented in **Table 13**.

Table 13 Assessment of options using the socio-economic criteria

Assessment Criteria	Limit community severance impact	Optimise the ability of highway traffic to access Singleton town centre	Minimise the footprint of bypass on LEP residential zones	Minimise the impact on high quality agricultural land	Improve flood access routes to Singleton	Proximity of residents to the bypass	Rank [score]
Weighting	**13%**	**30%**	**7%**	**23%**	**7%**	**20%**	
Option A							
Rating	3	2	3	2	1	4	**2**
Score	[39]	[60]	[21]	[46]	[7]	[80]	**[253]**
Option B							
Rating	4	4	4	3	4	3	**1**
Score	[52]	[120]	[28]	[69]	[28]	[60]	**[357]**
Option C							
Rating	1	1	1	4	3	1	**3**
Score	[13]	[30]	[7]	[92]	[21]	[20]	**[183]**

Key observations from this assessment are below.

Limit community severance impact

- Option B rated the best option as it is close to the existing boundary between residential and agricultural land use
- Option C rated the worst as it goes through existing and proposed residential land
- Option A rated between Options B and C and divides agricultural land only.

Optimise the ability of highway traffic to access Singleton town centre to minimise business impact

- Option B rated the best option as it has more ramps and is closer to town at the southern end and at Putty Road
- Option A rated the next best option as it has less ramps than Option B, is 2.5 kilometres from the town centre and the southern interchange is further away. Singleton is also not visible from the southern interchange so traffic may be more likely to pass by Singleton without making a stop
- Option C rated the worst option as there is no western link to the Mt Thorley industrial estate, and the Bridgman Road interchange is a long distance from the town centre (5 kilometres).

Minimise the footprint of the bypass on LEP residential zones

- Option B rated the best as it has the least length in a residential zone, it is on the edge of the LEP residential zones and would have the least impact on future residential development areas
- Option A rated as a minor difference to Option B. It has more impact in an area zoned as residential at Gowrie, but not as much as Option C.
- Option C rated the worse option as it has the longest length in residential zones and has the greatest impact on existing houses.

Minimise the impact on high quality agricultural land

- Option C rated best as it has the shortest length through agricultural land. Most of this land would be bridged and on the edge of the agricultural zone.
- Option A rated worst as it has the longest length through agricultural land and has significant embankments. The southern interchange also impacts agricultural land.
- Option B rated between Options C and A. Option B is longer than Option C but has long bridges to minimise impact.

Improve flood access routes to Singleton

- Option B rated best as it is closer to town, would have better emergency access in a one in 50 year flood event via the southern interchange and would leave Putty Road open in a one in 10 year event
- Option C rated the next best as it would have emergency access in a one in 50 year flood event via the southern interchange
- Option A was rated worst as it provides no improvement to flood access as the southern interchange and the Putty Road interchange would be cut during flood events.

Proximity of residents to the bypass

- Option A rated the best as the southern half is in rural, sparsely developed land and north of Gowrie Gates it is between the rail line and the New England Highway. This existing infrastructure generates noise so the bypass may have less impact on residents.

- Option B rated the next best as it is close to town but close to the rail line. This option is also between the rail line and the New England Highway north of Gowrie Gates so the impact would be greater than Option A but less than Option C.
- Option C was rated the worst option as it is the closest to residential areas especially when considering new houses and zoned residential land.

10.1.3. Assessment for environmental criteria

The workshop assessments for the environmental criteria are presented in **Table 14**.

Table 14 Assessment of options using the environmental criteria

Assessment Criteria	Minimise bio-diversity impact	Minimise impact on Aboriginal heritage	Minimise the visual impact of the bypass	Minimise flooding impact on quality agricultural land	Rank [score]
Weighting	**35%**	**35%**	**10%**	**20%**	
Option A					
Rating	4	3	1	1	**2**
Score	[140]	[105]	[10]	[20]	**[275]**
Option B					
Rating	4	4	4	3	**1**
Score	[140]	[140]	[40]	[60]	**[380]**
Option C					
Rating	1	1	2	4	**3**
Score	[35]	[35]	[20]	[80]	**[170]**

Key observations from this assessment are below.

Minimise biodiversity impact

- Options A and B rated equally the best as they had the least impact on Endangered Ecological Communities (EEC)
- Option C rated worst due to its impact on EEC vegetation communities and fauna associated with the EEC to the north of the study area.

Minimise impact on Aboriginal heritage

- Option B rated the best as a significant length is in the floodplain and Aboriginal heritage findings are considered less likely. It also has the shortest length
- Option A rated the next best although would impact on areas in Gowrie, which may have some Aboriginal heritage impacts

- Option C rated the worst as the route impacts on substantially more known Aboriginal heritage records than the other options.

Minimise the visual impact of the bypass

- Option B rated the best as it is in an urban context with existing infrastructure, such as the rail line
- Option C rated the next best
- Option A rated the worst as it would be exposed in the floodplain with less capacity to be absorbed within the landscape.

Minimise flooding impact on quality agricultural land

- Option C rated the best as it is outside the floodplain for the majority of its length and has the least impact on quality agricultural land
- Option B rated the next best
- Option A rated the worst as it would have most impact on areas within the floodplain (at the southern interchange).

10.1.4. Value Management summary

A summary of the rankings (and raw scores) of the options based on the qualitative assessment is presented in **Table 15**.

Table 15 Value Matrix ranking (and raw scores)

Option	Technical/ functional	Socio-economic	Environmental	Relative ranking
Option A	2 (307)	2 (253)	2 (275)	2 (835)
Option B	1 (333)	1 (357)	1 (380)	1 (1070)
Option C	3 (234)	3 (183)	3 (170)	3 (587)

The overall assessment against the three key categories (technical/functional, socio-economic, and environmental) presented in **Table 15** shows Option B rated the best of the shortlisted options, with Option C rating the worst.

By combining the qualitative assessment ranking and scores with the relative cost estimate for each option, it is possible to evaluate which option presents the greatest value for money. As shown in **Table 16** the cost estimates for Option B and C are considered to present the equal lowest cost. Option B therefore provides the best functional, social and environmental outcomes and has the equal lowest cost.

Table 16 Value matrix

Option	Relative ranking from assessment criteria	Relative strategic costs estimates
Option A	2 (835)	$+120M
Option B	1 (1070)	equal lowest cost
Option C	3 (587)	equal lowest cost

10.1.5. Key strengths and weaknesses for Option A

A summary of the key strengths and weaknesses for Option A are presented in **Table 17.**

Table 17 Option A key strengths and weaknesses

Technical / functional considerations	
Weaknesses	**Strengths**
• Option A requires a significant import of fill (about 1.7 million cubic metres) to construct embankments across low lying areas and at the northern interchange • Maintaining the Range Road and New England Highway intersection is complex with northbound traffic having a complex route to get to travel westbound on Range Road • A large footprint of embankment in the floodplain might require preloading, and could be susceptible to flooding during construction, particularly from the Doughboy Hollow Creek catchment.	• Further development of the vertical alignment could slightly reduce the imported fill volume • Traffic modelling results indicate bypass Options A and B could potentially provide the most significant improvements to the travel times.
Socio–economic considerations	
Weaknesses	**Strengths**
• The half interchange at Putty Road limits the ease of highway traffic to access Singleton town centre and return to the highway • The longer overall alignment length is likely to cause more property severance when compared to shorter options • The route it located through a large area of important/significant agricultural land • There may be an impact on future land development (golf course land) • There is no ability to improve flood evacuation from Singleton town centre.	• To minimise property severance the bridge across the floodplain has been designed with sufficient clearance for farm vehicles • About one third of the route is reasonably close to the existing New England Highway corridor • Option A would reduce the total weekday traffic on John Street by about 900 vehicles per day as the Putty Road interchange provides a connection between the north and west.
Environmental considerations	
Weaknesses	**Strengths**
• There is a large area of increased peak flooding levels near Whittingham as the route crosses the Doughboy Hollow flood pathway • The large southern interchange footprint also crosses the main Doughboy Hollow flood pathway.	• Option A will avoid a private grave site located south of Gowrie • The route is largely outside of the Hunter River floodplain.

10.1.6. Key strengths and weaknesses for Option B

A summary of the key strengths and weaknesses for Option B are presented in **Table 18.**

Table 18 Option B key strengths and weaknesses

Technical / functional considerations	
Weaknesses	**Strengths**
• Option B requires a moderate import of fill (about 0.7 million cubic metres) • The route crosses a significant length of floodplain which could present a high construction risk due to flooding susceptibility.	• Traffic modelling results indicate bypass Options A and B could potentially provide the most significant improvements for traffic • The southern interchange footprint does not interact with the main Doughboy Hollow flood pathway • There is a limited footprint of embankment in the floodplain which may require strengthening of existing ground.
Socio–economic considerations	
Weaknesses	**Strengths**
• Option B is located through a large area of important/significant agricultural land • There is a minor impact on future land development (golf course land, etc).	• To minimise property severance the bridge across the floodplain has been designed with sufficient clearance for farm vehicles • A full interchange close to the town centre makes it easier for traffic to access Singleton town centre for a short break then return to the highway • The short length of embankments and overall alignment are likely to cause less property severance compared to the other options • A majority of the route is reasonably close to the existing rail corridor • About one third of the route is reasonably close to the existing New England Highway corridor • Option B would reduce the total weekday traffic on John Street by about 900 vehicles per day as the Putty Road interchange provides a connection between the north and west.
Environmental considerations	
Weaknesses	**Strengths**
• There is a moderate area of increased peak flooding levels near the Putty Road interchange (one in 100 year event only) • The Hunter River bridge crosses over a parcel of Crown Land located in the southern side of the Hunter River.	Nil identified

10.1.7. Key strengths and weaknesses for Option C

A summary of the key strengths and weaknesses for Option C are in **Table 19.**

Table 19 Option C key strengths and weaknesses

Technical / functional considerations	
Weaknesses	**Strengths**
• Option C requires least import of fill (about 0.5 million cubic metres) • The potential upgrade of the New England Highway to the south needs to cross the Doughboy Hollow flood pathway • This route has the longest bypass travel time of the shortlisted options.	• There is a limited footprint of embankment in the floodplain which may require strengthening of existing ground • There is a full interchange at Bridgman Road • The majority of the route is in undulating terrain, so there may be opportunity to achieve more balanced earthworks.
Socio–economic considerations	
Weaknesses	**Strengths**
• The route is located through a moderate area of significant/important agricultural land • The route is constrained between the suburbs of Hunterview and Wattle Ponds which could adversely affect future development of this area • A majority of the route is in reasonably close proximity to residential areas • The Bridgman Road interchange has limited attraction to highway traffic for access to Singleton town centre • This has the longest length of overall alignment and is likely to cause the greatest property severance compared to other shortlisted options • None of the route is in close proximity to the existing New England Highway corridor or the rail corridor.	• To minimise property severance the bridge over the floodplain has been designed with sufficient height to allow farm vehicles to travel under it.
Environmental considerations	
Weaknesses	**Strengths**
• The route crosses parcels of Crown Land near Gresford Road • The route is constrained in the north by heritage items at Rixs Creek (Coke Ovens) and to the south-west of Clydesdale (Greenwood and Woolpack Inn) • The route passes close to and through sensitive and significant environmental areas containing EECs • The route passes through known Aboriginal heritage areas.	• The route crosses a limited length of floodplain so may be less susceptible to flooding during construction.

11. Economic analysis

11.1. Crash Forecasts

Crash forecasting for each of the scenarios was used as part of the options assessment.

For all of the existing roads that were not planned to be upgraded, the annual crash frequencies were assumed to be proportional to average annual daily traffic annual average daily traffic (AADT) such that a change in AADT would correlate with a proportional increase/decrease in the crash frequency for each of the road segments identified earlier in **Error! Reference source not found.**

For all sections of existing roads that were planned to be upgraded, crash rates were assumed to change in proportion to the change in AADT. Crash rates were also assumed to reduce as per the guidance of the *RTA NSW Crash Reduction Guide 2004* (TD 2004/RS01, March 2004).

Assumed crash rates have been adopted from the *Foxground and Berry Bypass Traffic and Transport Assessment* (March 2012) as it was considered to be a similar bypass to Singleton.

Table 20 Assumed crash rates per 100MVKT for bypass

Fatal	Injury	Tow away	Total
0.0	7.9	8.6	16.5

Source: Princes Highway Upgrade – Foxground and Berry Bypass Traffic and Transport Assessment March 2012

For the modelled scenarios the extent of road upgrades on the existing road network were considered to be limited or negligible and so would not result in any reduction in crash rates. The forecasted annual crash rates for each of the options are shown in **Table 21**.

Table 21 Crash analysis outputs

Scenario	2022	2022	2022	2032	2032	2032	2042	2042	2042
	Fatal	Injury	Non-injury	Fatal	Injury	Non-injury	Fatal	Injury	Non-injury
Do Minimum	0.63	26.01	38.10	0.76	30.97	45.08	0.81	30.86	43.28
Option A	0.58	22.53	31.84	0.68	26.13	36.40	0.82	30.78	42.32
Option B	0.57	22.45	31.70	0.68	26.02	36.15	0.78	31.19	42.75
Option C	0.58	22.78	32.47	0.69	26.62	37.35	0.80	31.78	43.88
Relative difference to Do Minimum									
Option A	0.05	3.48	6.26	0.07	4.85	8.68	-0.01	0.08	0.96
Option B	0.06	3.57	6.40	0.07	4.95	8.93	0.03	-0.33	0.53
Option C	0.05	3.23	5.63	0.07	4.35	7.73	0.00	-0.92	-0.60

11.2. Strategic cost estimate

The strategic cost estimate has been prepared by consultants AECOM in accordance with the *Roads and Maritime's Estimating Manual (2008)* and the *Roads and Maritime ProjectPack Estimating procedure ILC-MI-TP0-601* using a schedule of rates based on Roads and Maritime construction specifications. Estimate costing and rates were based on the project being delivered by a competitive tender non-alliance process.

The construction cost estimate adopted a nominal construction duration of three years.

Escalation and GST has not been included in the estimate. The estimate amounts are considered representative of construction costs as at quarter two 2015. The estimate has been reviewed by Roads and Maritime's Project Management Office (PMO). The estimates provide a reasonable basis for assessing the cost relativity and merits of individual options, with a consistent estimate approach being adopted for each option.

Table 22 Strategic cost estimates

Strategic cost estimate	Option A	Option B	Option C
Cost in Q2 2015$ millions	$600m-$650m	$500m-$550m	$500m-$550m

11.3. Cost-benefit analysis framework

The cost-benefit analysis is an assessment of whether the incremental benefits over a 30 year period associated with the operation of the bypass would exceed the whole-of-life costs of the bypass.

Incremental benefits comprise:

- Savings in travel time costs as a result of traffic moving from the New England Highway (which is increasingly experiencing congested conditions and a posted speed limit of 50km/h in Singleton) to the bypass
- Savings in vehicle operating costs as a result of traffic moving from the New England Highway (which is increasingly experiencing stop-start driving conditions) to the bypass
- Savings in crash costs as a result of traffic moving from the New England Highway (which has a higher crash rate being a lower standard road and having a greater mix of vehicular and non-vehicular traffic being in the town centre) to the bypass
- Avoided external environmental costs as a result of traffic moving from the New England Highway (which has higher external environmental costs being located in the town centre) to the bypass.

11.4. Cost-benefit analysis economic indicators

The cost-benefit analysis terms used in the analysis are defined as follows:

Benefit-cost ratio (BCR): Measures the benefits received per dollar of project cost. It is used to indicate value for money. BCR is calculated by dividing the present value (PV) of all benefits by the PV of all costs (including recurring operating and maintenance). A project with a BCR greater than one means the PV of benefits exceeds the PV of costs and is considered to provide value for money.

First year rate of return (FYRR): Measures the benefits received in the first full year of a project's operation per dollar of capital cost. It is used to indicate the best start date for a project's implementation. FYRR is calculated by dividing the PV of first year benefits by PV of capital costs (those used to initially complete the project). The timing of a project which has a FYRR greater than the specified discount rate is considered to be economically appropriate. The implementation of a project which has a FYRR less than the specified discount rate should be deferred until the FYRR exceeds the discount rate.

Internal rate of return (IRR): The discount rate at which the present value of benefits equals the present value of costs. An IRR greater than the discount rate indicates an economically worthwhile project.

11.5. Sensitivity analysis

Sensitivity testing was conducted on the main assumptions of the cost-benefit analysis – the discount rate, project capital costs, the annual expansion factor and travel time cost savings. None of these tests changes the findings of the main analysis.

Two alternative scenarios were also analysed to assess the influence that the modelled increasing congestion and acceleration in vehicle hours of travel in the Base Case after 2032 has on the economic results. Although it was found the acceleration in modelled vehicle hours of travel between 2032 and 2042 had a significant effect on the economic results, it did not change the finding that the project is economically viable.

11.6. Summary of cost-benefit analysis results

The cost-benefit analysis results used during the Value Management Workshop are shown in **Table 23**. The analysis used an appraisal period of three years for project construction and 30 years of economic benefits.

Table 23 Results of cost-benefit analysis for Singleton bypass

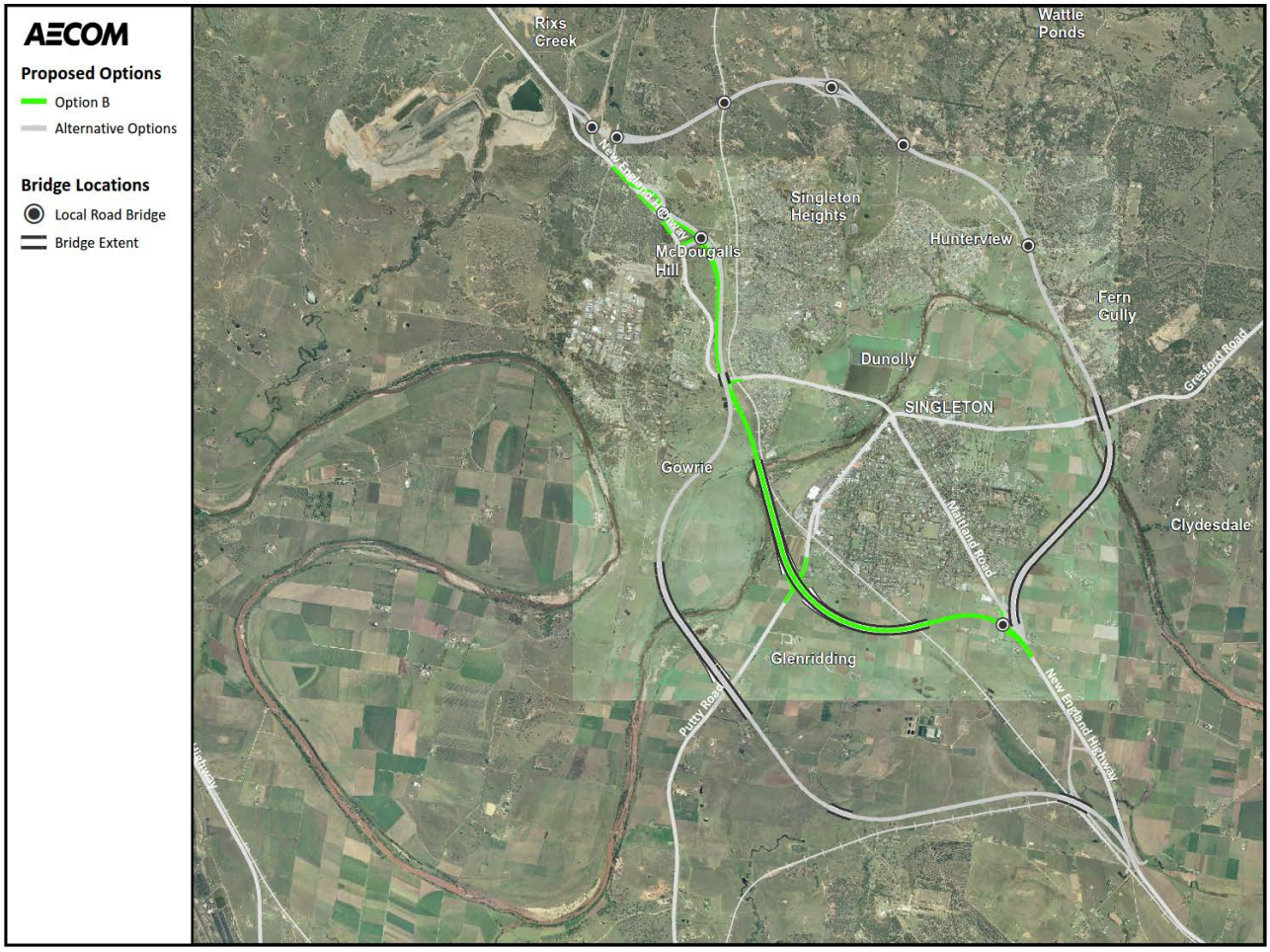
Strategic cost estimate	Option A	Option B	Option C
Cost in Q2 2015$ millions	$600m-$650m	$500m-$550m	$500m-$550m
Economic indicators			
Benefit-cost ratio	1.0	1.6	1.3
First year rate of return	4%	7%	6%
Internal rate of return	7%	11%	9%

12. Recommendation

The preferred route for the Singleton bypass has been identified through an extensive assessment and review process as outlined in this report.

The preferred option adopted for securing the preferred route corridor in Singleton Council's Local Environmental Plan is Option B, as described in **Section 6.4.2** and shown on **Figure 28**.

Figure 28 Preferred option



13. Next steps

The NSW Government has committed $92 million towards the bypass under Rebuilding NSW, with $1.5 million in 2016-17 to progress planning.

The preferred route corridor will be included in Singleton Council's LEP, reserving the land for the bypass.

Roads and Maritime will carry out further consultation with affected landowners and key stakeholders, including Singleton Council.

Subject to approval, the project would move to the concept design and environmental assessment stage.

Timing for construction of the bypass has not been confirmed and would be subject to approval and funding availability.

14. Glossary and terms

Acronym or term	Definition
AADT	Annual average daily traffic. The total volume of traffic passing a roadside observation point over a period of a year, divided by the number of days per year
Aboriginal heritage	The tangible (objects) and intangible (dreaming stories, songlines, places) cultural practices and traditions associated with past and present day Aboriginal communities
AEP	Annual exceedance probability
AHD	Australian height datum
Alignment	The geometric layout (eg of a road) in plan (horizontal) and elevation (vertical)
Amenity	The look and feel of a place, or its attractiveness
Arterial road	A high capacity road connecting towns and cities and/or within urban areas
ATD	Average daily traffic
BCR	Benefit cost ratio. The ratio of the monetary benefits to the costs of a project as a measure of worth to the community
Biodiversity	The variety of life forms, including flora and fauna, the genes they contain and the ecosystems in which they live
Capacity	The nominal maximum number of vehicles that can travel along a road in a given time
Carriageway	The portion of a roadway used by vehicles including shoulders and auxiliary lanes
Catchment	The area from which a surface watercourse or a groundwater system derives its water
Constraint	Something that limits or restricts the project design, development or construction
Constructability	Refers to the ease in which a project can be built
Culvert	One or more adjacent enclosed channels for conveying a stream below formation level
Cut	The material excavated from a cutting
Design speed	A nominal speed which determines the geometric design features of a road
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock
Ecology	The relationship between living things and the environment
Economic analysis	An economic based approach that considers the merits of a project from the viewpoint of the community at large rather than that of the organisation responsible for the project
Embankment	An earthen structure where the road sub grade level is above the natural surface
Endangered ecological community (EEC)	An ecological community identified by relevant legislation that is likely to become extinct or is in immediate danger of extinction

Acronym or term	Definition
Environment	All aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings (from EP&A Act)
Environmental assessment (process)	Process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of proposals prior to major decisions being taken and commitments made
Fauna	Animals
Fill	The material placed in an embankment
Flora	Plants
Footprint	The extent (or area in plan) of a development on the land
Grade	The rate of longitudinal rise (or fall) with respect to the horizontal expressed as a percentage or ratio
Grade separated	The separations of road, rail or other traffic so that crossing movements at intersections are at different levels
Habitat	The place where a species, population or ecological community lives (whether permanently, periodically or occasionally). Habitats are measurable and can be described by their flora and physical components.
Heavy vehicle	A heavy vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System
Hydrology	The study of rainfall and surface water runoff processes
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment
Interchange	A grade-separated junction between roads where a road passes over or under the highway via a bridge or underpass structure with one or more interconnecting roadways
Landscape	A tract of land. Also a prospect or piece of scenery or land which may include villages, towns, cities and infrastructure
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features
LEP	Local environmental plan
LGA	Local government area
Local road	Roads that have a low speed limit, have a small footprint, serve local communities and that are generally conducive to walking and cycling. A road or street used primarily for access to abutting properties.
MCA	Multi Criteria Analysis
Merge	The converging of separate streams of traffic into a single stream
OLS	Obstacle Limitation Surfaces

Acronym or term	Definition
Origin-Destination (OD survey)	An origin-destination (OD) study is used to determine where and how much traffic is travelling during a typical day for a particular road network. Trips are defined as one-way movement, from where a trip starts (origin) to where the trip is going (destination).
PMO	Project Management Office
Preloading	Placing a mound of earth over an area and allowing it settle before building
Property	In the context of the project, property acquisition refers to purchasing property from owners to provide land for the project
PV	Present value
Sensitive receiver	Premises sensitive to noise. These can include residential dwellings, schools, hospitals, nursing homes and places of worship.
SEPP 44	State Environmental Planning Policy No 44 – Koala Habitat Protection
SMVU	Survey of Motor Vehicle Use
Stakeholder	Organisations, parties and/or special interest groups likely to have an interest in the proposal
Study area	The study area encompasses the proposal area and the area that may be indirectly impacted by the proposal
Threatened	As defined under the NSW *Threatened Species Conservation Act 1995*. A species, population or ecological community that is likely to become extinct or is in immediate danger of extinction.
Topography	The physical appearance of the natural features of an area of land, especially the shape of its surface.
Urban design	The process and product of designing human settlements and their supporting infrastructure, in urban and rural environments.
VHT	Vehicle Hours Travelled
Viaduct	A bridge with several spans
VKT	Vehicle Kilometres Travelled
Vulnerable	As defined under the Threatened Species Conservation Act 1995, a species that is likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

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13 22 13

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