# 8 Assessment of other issues

*This chapter provides an assessment of the project's potential impacts that were not identified as key issues by either the Director-General's environmental assessment requirements or the environmental risk analysis (see Chapter 9).*

*The issues discussed in this chapter have either been directly identified by the project team or have emerged through the consultation process (see Chapter 6). The level of assessment reflects the fact that these are issues commonly associated with road projects and are appropriately addressed through the design process or by implementing best practice management and mitigation measures.*

## 8.1 Climate change

This section assesses potential climate change impacts that need to be considered in the design of the project. The major objectives of the climate change risk assessment were to:

- Identify possible risks caused by climate change and to support the bridge concept design and project evaluation.
- Minimise future possible damage to the replacement bridge (maximise its useful life) based on identified climate change risks.
- Provide guidance for design decisions to take into account climate change adaptation and the identification of further investigations of detailed climate change options during detailed design construction and operation of the replacement bridge.

Climate change is discussed further in the Ecologically Sustainable Development assessment (see **Section 11.1.3**) and the Hydrology assessment (see **Section 7.7**).

A risk management approach has been used to incorporate climate change considerations into decision making for bridge construction, operation and maintenance to 2116 (assuming a 100 years life of the bridge and the bridge being built by 2016). This approach was undertaken in accordance with the *Australian and New Zealand Standard for Risk Management* (ISO/AS/NZS 31000: 2009) and supplemented by the *Climate Change Impacts and Risk Management – A guide for Business and Government Report* (AGO, 2006). Where appropriate, RMS' overall project risk assessment framework has been utilised to enable the climate change risk assessment to be incorporated into the RMS standard approach for risk identification.

### 8.1.1 Climate change and risk context

Current climate projections produced by the Australian and NSW Governments (NSW Climate Impact Profile DECCW, 2010) indicate that the climate of Sydney is likely to change significantly over the operating life of the project. The projected consequences of increased atmospheric concentrations of greenhouse gases include:

- Increased temperatures.
- Sea level rise.
- Shifts in current patterns of climate variability.
- Increased intensity of extreme events (eg. droughts, floods, severe storm events).
- Changes in seasonality and amount of precipitation (the direction and magnitude of changes will vary between geographic locations).

The projected change in key climate variables for 2050 (minimum and maximum emissions scenarios) in Windsor are:

- The mean daily maximum and minimum temperatures are expected to increase in all seasons. The magnitude of the projected increases ranges from 1.5-3°C.
- Summer rainfall is projected to increase across the Sydney and Central Coast regions, with smaller increases predicted for autumn and spring. Winter rainfall is likely to decrease moderately.
- Increased evaporation is likely in spring and summer, however modelling does not provide a clear pattern for autumn and winter.
- Sea level rise coupled with increased incidence of flooding is "virtually certain" (DECCW, 2010) to put infrastructure and property at risk. Projected increases in sea levels for the NSW coast are 40 centimetres by 2050 and 90 centimetres by 2100.
- Within the Hawkesbury-Nepean catchment the likely change in extreme rainfall is noted to be between -3 and +12% up to 2030 and -7 and +10% up to 2070. It is expected that the volume and peak discharge for various frequency events will also increase.
- The greatest changes in wind speed (increases) are likely to occur in summer. This coincides with the expected increase in storm activity for the same period.
- Increased carbonation of concrete will become a concern for structures expected to have a long service life (greater than 60 years).

### 8.1.2 Construction impacts

For the construction period of 2013 to 2015, the climate change impacts would be negligible and therefore have not been considered further.

There are no climate change risks identified for the demolition of the existing bridge.

### 8.1.3 Operation impacts

There are three broad ways in which climate change may potentially affect the project in the longer term:

1) Climate change can alter the risk of a natural hazard to which the project may be exposed (ie. increase the frequency of flooding).
2) Climate change may affect the risk posed to the surrounding environment from the operation or legacy of the project.
3) Climate change can affect the availability and supply capacity of natural and social resources required for the project.

The following components of the project were considered:

- Bridge structure (including footings, piers, abutments, retaining walls, kerbs, gutters, barriers, drainage, pavement bitumen, asphalt, street lighting, signage and closed-circuit television.
- Access roads (including vehicle crossings and ramps).
- Windsor township (including local residences).
- Natural environment (including natural vegetation).

The potential risks of climate change for the operation of the project include:

- Damage to the bridge piles in a 2000 year flood event.
- Increased scour of bridge piers and abutments.
- Increased scour of retaining walls.
- Increased frequency of inundation for flood affected properties.
- Enhanced flood levels.

The greatest risk to the project (would be related to increased rainfall intensity and increased peak flood flows. As the replacement bridge would be designed to undergo regular immersion by floodwaters many of the risks associated with increased flooding and flows would be addressed. The greatest potential risk would be extreme events such as the 1 in 2000 year flood event or high intensity rainfall events that produce extremely high flows as these may result in flow velocities greater than the design criteria. However, based upon previous studies and the Hawkesbury River catchment characteristics, these types of events would generally result in greater areas of flood water inundation for longer periods, rather than significantly increased flow velocities.

The project would contribute to increased flood levels at a number of properties immediately upstream of the new bridge during a 5 year ARI flood event. The increased bulk of the new bridge would obstruct floodwaters and increase the flood levels at these locations. This is discussed further in **Section 7.7.4**. Climate change may contribute to these properties being more regularly flooded at this level. The project would have a negligible contribution to increases in upstream flood height for floods greater than a 1 in 5 year ARI flood.

Increasing concentrations of atmospheric carbon dioxide and temperatures are projected to have an increased effect on the degradation of concrete structures such as Windsor bridge, where increased depth of penetration of the carbonation can lead to structural issues if left unchecked.

Whilst other risks as a consequence of climate change have been identified, they would not be expected to be significant and current management procedures (and some consideration during future design stages) would mitigate this risk.

### 8.1.4 Environmental management measures

Environmental management measures for the identified risks would be associated with consideration of the potential impacts during detailed design. The potential for increased scour of bridge piers, bridge abutments and increased frequency of inundation of flood affected properties would be considered in the detailed design process.

Mitigation measures for the properties that would experience increased flood levels due to the project are outlined in the hydrology chapter (see **Section 7.7.5**). These would involve investigation of environmental management options during the detailed design in consultation with the landholders. Appropriate measures would be identified, developed and implemented as required to minimise the impacts on the building structure, building access and business opportunities.

An adaptive management approach would be adopted for other climate change impacts.

## 8.2 Greenhouse gases

This section assesses the greenhouse gas impacts of the project. The major objective of the greenhouse gas assessment was to identify and assess key emissions sources and sinks so that management measures to reduce these emissions could be developed.

### 8.2.1 Assessment methodology and guidelines

As relevant to road infrastructure, emissions were categorised into three broad scopes as follows:

- Scope 1: All direct greenhouse gas emissions (including emissions from the fuel consumed by project plant, equipment and vehicles).
- Scope 2: Indirect greenhouse gas emissions (typically from the consumption of purchased electricity).
- Scope 3: Other indirect greenhouse gas emissions, including but not limited to the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the project, electricity-related activities (eg transmission and distribution losses not covered in Scope 2, outsourced activities and waste disposal).

These three categories have been used in this greenhouse gas assessment (see **Section 8.2.3**).

Greenhouse gases emissions from vehicles using the project have not been assessed and they would be the same even if the project was not to proceed.

### 8.2.2 Existing environment

Greenhouse gases absorb outgoing heat energy that is reflected from the earth. The absorption of this heat warms the air and is known as the greenhouse effect. The primary human produced greenhouse gas is carbon dioxide. Human activities such as the combustion of carbon-based fuels increase the amount of greenhouse gases in the atmosphere. This leads to greater absorption of heat and increase in atmospheric temperatures, known as the enhanced greenhouse effect.

Greenhouse gases include carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydroflurocarbons and perfluorocarbons. These greenhouse gases have different heat absorbing capacity, or global warming potential. To achieve a basic unit of measurement, each greenhouse gas is compared to the warming potential of carbon dioxide ($CO_2$). This provides a global warming potential for each greenhouse gas which can be applied to the estimated emissions. The resulting estimate is referred to in terms of $CO_2$-equivalent ($CO_2e$) emissions.

### 8.2.3 Construction impacts

Construction impacts include all significant emissions from initial ground breaking to the completed project. This includes earthworks, embodied emissions in construction materials and fuel used during construction and management activities. Results are presented broken down into individual construction activities and then by scope of emission (see **Table 8-1**).

**Table 8-1 Summary of greenhouse gas emissions (general) for construction stage**

| Source | Scope 1 ($tCO_2e$) | Scope 2 ($tCO_2e$) | Scope 3 ($tCO_2e$) | Total ($tCO_2e$) |
|---|---|---|---|---|
| Site Offices/General Areas | 228 | 85 | 34 | 347 |
| Demolition and Earthworks | 132 | - | 10 | 142 |
| Construction - Pavements | 334 | - | 492 | 825 |
| Construction - Structures | 248 | - | 2,785 | 3,033 |
| Construction - Drainage | 54 | - | 67 | 120 |
| Construction - Road Furniture* | 1 | - | 58 | 60 |
| **Total** | **997** | **85** | **3,445** | **4,528** |

* Road furniture is a generic term for items such as road safety barriers and noise walls.

**Table 8-1** shows that the construction of the bridge (ie 'structures') is the construction stage with the greatest impact. This includes the emissions associated with production of the construction materials (concrete and reinforcing steel) as well as the fuel used during construction.

The stage with the next greatest impact is the laying of the pavement, for which a combination of asphalt roadway and concrete paths are included.

### 8.2.4 Operational impacts

Emissions associated with the operation of the bridge over a 50 year timescale have been assessed. This includes energy required for street lighting. The project emissions are shown in **Table 8-2**.

**Table 8-2 Emissions associated with operation**

| Source | | Scope 1 ($tCO_2e$) | Scope 2 ($tCO_2e$) | Scope 3 ($tCO_2e$) | Total ($tCO_2e$) |
|---|---|---|---|---|---|
| Operation | Lighting | 0 | 284 | 0 | 284 |

The total project greenhouse gas emissions, from 2016 to 2066 are forecast to be approximately 4,812 $tCO_2e$ (See **Table 8-3**). The construction element represents about 95 per cent of the total emissions over a 50 year period. Operational energy consumption contributes less than five per cent.

**Table 8-3 Total project greenhouse gas emissions over 50 years (2016 – 2066)**

| Source | Total ($tCO_2e$) |
|---|---|
| Construction | 4,528 |
| Operation | 284 |
| **Total** | **4,812** |

### 8.2.5 Environmental management measures

#### Construction

Where possible, construction material will be selected that has lower embodied greenhouse gases including:

- Concrete with a greater proportion of flyash. Higher flyash content would lower the carbon footprint of the mix.
- Recycled steel as opposed to virgin steel.
- Sourcing local materials.
- Fuel efficient plant and equipment will be selected, where practicable.
- Where practicable, biofuels will be used (biodiesel, ethanol or blends).
- Where practicable, waste material will be reused on site such as general fill, rock, aggregate and mulch from cleared vegetation.

#### Operation

Implementation of the project would not result in any substantial reduction in transport related greenhouse gas emissions. However, the following opportunities exist for reduction of operational greenhouse gas emissions through the following:

- Use of LED or other energy efficient lighting will be investigated during detailed design. This has the potential to reduce electrical energy consumption. Appropriate energy efficient lighting would only be used where the standard of lighting can meet AS/NZS lighting design standards for major roads and pedestrians.

## 8.3 Hazards and risks

Major hazards and risks from the construction, demolition and operation of the project have been identified and environmental management measures have been summarised and referenced to the relevant section in the EIS (see **Table 8-4**).

While there are other hazards and risks associated with the project, these have been adequately addressed and mitigated in previous sections or are relatively minor and do not require special consideration.

**Table 8-4 Major hazards and risks**

| Hazard or risk | Environmental management measure |
|---|---|
| **Construction** | |
| *Heritage* | |
| An unknown archaeological site or heritage item is located during construction | **Section 7.1** and **7.2** contains detailed environmental management measures for Aboriginal and Historic heritage. The primary measures will be:<br>- A comprehensive archaeological investigation and salvage program that would identify, remove and record all heritage items within the construction footprint.<br>- An unexpected find protocol for heritage items. |
| A heritage item or building is damaged during construction due to vibration | **Section 7.5** contains detailed environmental management measures for noise and vibration impacts. The primary measures will be:<br>- Preparation of dilapidation reports for all heritage items and buildings.<br>- Exclusion zones around heritage items for high vibratory activities.<br>- Use of low vibration construction techniques.<br>- Vibration monitoring. |
| *Traffic and transport* | |
| A crash or accident involving a construction vehicle | **Section 7.4** contains detailed environmental management measures for traffic and transport impacts. The primary measures will be:<br>- Preparation of a Construction Traffic Management Plan which would contain details about the management of accidents. |
| Soil, sediments, water and waste | |
| Release of turbid water from the construction site | **Section 7.6** contains detailed environmental management measures for soil, sediment and water impacts. The primary measure will be:<br>- Preparation and implementation of a Soil and Water Management Plan which contains detailed mitigation measures to reduce the risk of the release of turbid water from construction sites including works in the river. |
| A chemical or fuel spill from construction sites or vehicles | **Section 7.6** contains detailed environmental management measures for soil, sediment and water impacts. The primary measure will be:<br>- Preparation and implementation of a Soil and Water Management Plan which contains detailed mitigation measures to reduce the risk of the chemical or fuels spills and clean up and response procedures |

| Hazard or risk | Environmental management measure |
|---|---|
| **Demolition** | |
| The escape of lead based paint into the environment during demolition of the bridge | **Section 7.6** contains detailed environmental management measures for soil, sediment and water impacts. The primary measure will be:<br>- Preparation and implementation of a demolition management plan which would included containment, stabilisation or removal of lead based paints on the existing bridge. |
| **Operation** | |
| A chemical or fuel spill due to a road accident | The design of the project includes a spill retention basin on the northern bank and a shut-off valve for the southern stormwater system to contain spills within the stormwater system. |

## 8.4 Cumulative impacts

Cumulative impacts of the project have been considered as part of the assessment of each of the key issues (Chapter 7) and non-key issues (Chapter 8). This section considers the cumulative impacts associated with the construction and operation of the Windsor bridge replacement project and other relevant projects.

### 8.4.1 Background and assessment methodology

Cumulative impacts occur when incremental environmental, social or economic effects caused by past, present and reasonably foreseeable activities combine to create an impact. Cumulative impacts can result from multiple infrastructure and other development projects being constructed and/or coming into operation at approximately the same place and time.

Impacts resulting from the project may create cumulative regional or local impacts that may be short or long term. These impacts include:

- Impacts on local, regional and State traffic, transport and road users.
- Social and economic effects, including changes to land use, access, settlements, employment and businesses.
- Changes to local and regional amenity, including noise, vibration, visual quality and air quality.
- Environmental changes including effects on water quality, hydrology and biodiversity.

Assessment of the cumulative impacts also requires an understanding of other development activities within the region. Major projects listed in the Department of Planning and Infrastructure's Major Projects development assessment tracking system (http://majorprojects.planning.nsw.gov.au/) and major development applications being considered by the Hawkesbury City Council and the Joint Regional Planning Panel (JRPP) have been used as a basis for the assessment.

As the project would not be staged, there would be no cumulative impacts from multiple construction stages.

### 8.4.2 Major projects and other developments

Five major projects were identified within the Hawkesbury LGA that have been determined since 2006, or are currently in the planning phase of development. These projects include two water infrastructure projects, two residential subdivisions and one transport infrastructure project. One other relevant project is a new concrete batch plant in South Windsor being determined by JRPP.

The transport infrastructure project was the upgrade of the railway line between Quakers Hill to Vineyard. Stage 1 of this upgrade is largely complete and would not have any cumulative impacts in conjunction with the project.

The two water infrastructure projects are the provision of water and wastewater services to various precincts in the North West Growth Centre. The precincts that are subject to the major project applications are south of Windsor. Due to their distance from the project, their scale and their program for construction, no cumulative impacts would be expected.

One of the residential subdivision projects is located at Pitt Town and would involve the subdivision and development of about 660 urban and rural residential lots in the township. The timing for development of the lots would be dependent upon market demand. While Pitt Town is located outside the project area and to the south of the Hawkesbury River and the project, Pitt Town Road, the main access to the area, intersects with Windsor Road just south of the project. While construction of the project would coincide with development of one or more residential precincts in Pitt Town, the volume of construction traffic generated by both developments would be minor in comparison to the existing traffic on Windsor Road.

The other local residential subdivision is the Jacaranda Ponds development located at Glossidia which includes the subdivision and development of about 580 residential lots. As discussed in **Section 3.1**, Hawkesbury City Council would only support the development if there was satisfactory progress on a replacement bridge at Windsor. Therefore Jacaranda Ponds development would be unlikely to gain support from Hawkesbury City Council until the construction of a replacement bridge commences. Also to progress the development further studies and design needs to be undertaken before the final submission of planning documents to the Department of Planning and Infrastructure. The Department of Planning and Infrastructure would then need to approve the subdivision before any works on providing services to the development could commence. Based upon the current program, the replacement bridge would be complete well before any significant works on the Jacaranda Ponds development would commence.

The concrete batch plant is south of the project and is unlikely to generate significant volumes of traffic during its construction. Once the plant become operational it would generate additional traffic, however, it is likely that many of the potential customers would be to the south, east and west of Windsor in more developed areas.

No other major developments or subdivisions north of the Hawkesbury River or in Windsor adjacent to the project are known to be planned.

As discussed in Chapter 3, the *Hawkesbury Residential Land Strategy* (Hassell, 2011) was developed to guide future residential development within the Hawkesbury LGA over the next 30 years and ensure future residential development is sustainable and meets the needs of the Hawkesbury population. The Hawkesbury Residential Land Strategy nominated areas within the LGA that were suitable for future urban development based on a number of environmental, economic, land use and other criteria.

While the specific development targets of the Hawkesbury Residential Land Strategy were not expressly included in traffic growth estimates, the traffic growth due to changes in land use and residential development have been considered on a regional scale using growth rates derived from the Sydney Strategic Transport Model (SSTM). This is the accepted model used for such projections and is supplied by the Bureau of Transport Statistics. The traffic impact assessment for the project indicates that with a 25 per cent growth in traffic using the Windsor river crossing (see **Section 7.3**), the project would operate at an acceptable level of service.

### 8.4.3 Assessment of cumulative impacts

As the project would involve the replacement of an existing bridge and approach roads, there are unlikely to be any significant cumulative impacts from the project as:

- The project itself would not generate additional traffic.
- The existing bridge and approach roads would be removed so there would be no duplication of the bridge and roads.
- The new alignment is adjacent to the existing alignment.

Other potential cumulative impacts are discussed in **Table 8-5**.

**Table 8-5 Potential cumulative impacts**

| Aspect | Construction | Operation |
|---|---|---|
| Heritage | A significant residual impact during construction would be from the disturbance of historic archaeological material.<br>The archaeological value of the site is comprised with each new development in Thompson Square. However the project presents the opportunity for archaeological research to improve understanding of heritage in the vicinity of the project. | A significant residual heritage impact from operation of the project would be visual impact on heritage vistas and values of Thompson Square. This impact over time would not change or would be unlikely to be compounded by any future known development. |
| Urban design and Visual | There would be no cumulative impacts on the visual environment during construction. | The project would have a visual impact on heritage vistas and values of Thompson Square. This impact over time would not change or would be unlikely to be compounded by any future known development.<br>Removal of the current Bridge Street alignment from the middle of Thompson Square parkland would substantially improve the form and character of the parkland space, creating a more unified and usable space, and improve pedestrian connectivity between the town centre and the river foreshore. |

| Aspect | Construction | Operation |
|---|---|---|
| Transport and Traffic | There would be increased traffic and traffic management during construction, however this is not expected to impact significantly on the level of service of the existing roads. As there are no other developments occurring concurrently, no cumulative impacts would be expected. | The operation of the project would improve traffic and transport efficiency and road network capacity.<br>The project would also improve pedestrian and cyclist safety access around Thompson Square, to Macquarie Park and to east Windsor.<br>There is the opportunity to integrate the project with Hawkesbury City Council's foreshore masterplan and the proposed Great River Walk. |
| Flora and fauna | Only a small area of vegetation would be cleared and this area mainly contains weeds. No EECs would be cleared and no threatened species would be impacted so there are no regional impacts to consider. While there would be a temporary loss of some riparian vegetation, this would be replaced and enhanced with the landscaping associated with the project. | The operation of the project would not result in cumulative impacts on flora and fauna. |
| Noise and vibration | There are no other known major projects that would be constructed concurrently in close proximity to the project and therefore no cumulative noise or vibration impacts are expected. | The project would not generate any additional traffic and is not located adjacent to any other major road corridors – therefore there would be no cumulative noise impacts from operation. |
| Air quality | There are no other known major projects that would be constructed concurrently in close proximity to the project and therefore no cumulative air quality impacts are expected. | The project would not generate any additional traffic and is not located adjacent to any other major air quality pollution sources – therefore there would be no cumulative air quality impacts from operation. |
| Hydrology | During construction of the project there would be a cumulative impact on flooding as the existing bridge would not yet be demolished while the new bridge is being constructed. Mitigation measures to minimise this risk have been developed. (See **Section 7.7**) | There would be no cumulative impact on hydrology from the project with other identified major projects. |
| Soil, sediment and water | There are no other known major projects that would be constructed concurrently in close proximity to the project and therefore no cumulative soil, sediment and water impacts are expected. | There would be an improvement in the quality of stormwater runoff from the project when compared to the existing situation. |

| Aspect | Construction | Operation |
|---|---|---|
| Land use | During construction, public land would be used for construction compounds including the Lower Thompson Square Parkland and nearby car park. During construction these areas would not be available for public use and may have cumulative effects on local business and tourism. | With the operation of the project there would be an increase in public space and parkland in Thompson Square and on the northern bank.<br>There would be a small area of private agricultural land acquired for the project. On regional scale the area acquired is not significant and the land use is common. Therefore there would be cumulative impacts from the project. |
| Socio-economic impacts | There are no other known major projects that would be constructed concurrently in close proximity to the project and therefore no cumulative socio-economic impacts are expected. | There would be both positive and negative socio-economic impacts from the project. However these impacts and benefits are relatively minor and would not result in regional or longer term impacts. |

### 8.4.4 Environmental management measures

No additional specific environmental management measures are required to minimise cumulative impacts beyond those already detailed in Chapters 7 and 8.