9 Summary of environmental management measures

This chapter collates the environmental management measures for the project that were identified through the impact assessment process in **Chapter 7** and **Chapter 8**. All measures listed in **Table 9-1** would be incorporated into the Construction Environmental Management Plan and / or the operational framework for the project.

Table 9-1 Summary of environmental management measures

Impact	ID	Environmental management measure	Timing
Traffic and transport			
Construction			
General	TT1	A traffic management plan(s) (TMP) would be prepared as part of the construction environmental management plan(s) (CEMP). The TMP would include: • Signage requirements (eg temporary speed restrictions, changes to the road environment, traffic management controls deployed). • Lane possession and approval process during periods of online construction (eg line marking and temporary barriers). • Traffic control devices such as temporary traffic signals. • A local and regional communications strategy. This would include methods to provide advanced notice of any major or prolonged impacts (eg leaflets and local media), and real-time information regarding current impacts (eg variable message signs, radio traffic news). • Details of both the general approach to be used for access and egress to worksites (with consideration of minimum sight distances, maximum grade allowances, etc), and the specific controls required at selected locations (signage, barriers, signalling requirements). • Any specific provisions required to manage potential impacts to sensitive users such as schools, child care centres, health facilities, etc).	Pre-construction
Impacts to road network performance (delays) and safety	TT2	Construction methods and staging would be designed to minimise road closures, subject to other project constraints, and ensure that disruptions to existing traffic are minimised as much as feasible and reasonable.	Construction

Impact	ID	Environmental management measure	Timing
	TT3	Offline construction would be carried out wherever feasible and reasonable.	Construction
	TT4	Works which would significantly reduce the performance of the road network would be scheduled for periods of typically lower traffic volumes where feasible and reasonable.	Construction
	TT5	Where offline construction is not practical, and for tie-ins between online and offline sections of the project, construction sequencing and any temporary works identified would aim to minimise user delay while providing sufficient flexibility for the selected contractor to safely and efficiently construct the project.	Construction
	TT6	Signage would be used to clearly indicate the traffic controls in use. This could also include temporary speed restrictions and passing constraints if required to maintain road safety levels.	Construction
	TT7	In some instances lane closures would be implemented to remove road traffic from construction zones altogether. Where practical this is proposed to occur outside of peak periods including at night to maintain network capacity.	Construction
	TT8	Access to local roads / streets and properties would be maintained. If local roads / streets need to be closed (short or long term), arrangements would be made to provide access to properties of affected residents and their visitors.	Construction
	TT9	Road occupancy licences would be obtained for work that impacts traffic on existing roads.	Construction
Impacts to emergency services	TT10	The TMP would be developed in consultation with local emergency services and procedures would be implemented to maintain priority access and a safe environment for emergency vehicles to travel through construction areas.	Construction
	TT11	Local emergency services would be frequently updated on the staging and progress of construction works.	Construction
	TT12	Communication systems would be in place with traffic controllers to provide appropriate access and routes (eg gaps in concrete barriers, side-tracks, wide verges etc) for emergency vehicles to bypass queued traffic.	Construction
Operation			
Impacts to road safety	OpTT1	A road safety audit would be undertaken by qualified auditors as part of the detailed design, and again immediately prior to project opening, to examine the design from a road safety perspective and identify potential safety issues. This process would be undertaken in accordance with the Roads and Maritime Accident Reduction Guide Part 2: Road Safety Audits (RTA, 2005a).	Detailed design and prior to operation

Impact	ID	Environmental management measure	Timing
Noise and vibration			
Construction			
General	NV1	A Construction Noise and Vibration Management Plan(s) would be prepared and implemented, and would include the following: • Identification of nearby residences and other sensitive land uses. • Description of approved hours of work. • Description and identification of all construction activities, including work areas, equipment and duration. • Description of what work practices (generic and specific) would be applied to minimise noise and vibration. • A complaints handling process. • Noise and vibration monitoring procedures. • Overview of community consultation required for identified high impact works.	Pre-construction
Construction noise	NV2	Induction and training would be provided to relevant staff and sub-contractors outlining their responsibilities with regard to noise.	Construction
	NV3	Work would be undertaken during standard construction hours as far as feasible and reasonable.	Construction
	NV4	Noisy activities that cannot be undertaken during standard construction hours would be scheduled as early as possible during the evening and / or night-time periods.	Construction
	NV5	Particularly noisy activities such as the use of impact piling rigs, road and concrete saws, rockbreakers, would be scheduled around times of high background noise where feasible and reasonable to provide masking.	Construction
	NV6	Deliveries would be carried out during standard construction hours where feasible and reasonable.	Construction
	NV7	A protocol would be developed to identify the need for and provision of respite measures for residential receivers in accordance with the Interim Construction Noise Guidelines. Respite measures may include the restriction to the hours of construction activities resulting in impulsive or tonal noise (such as rock breaking, rock hammering, pile driving), or other appropriate measures agreed between the contractor and residential receiver such as alternative accommodation.	Construction
	NV8	Appropriate plant would be selected for each task.	Construction

Impact	ID	Environmental management measure	Timing
	NV9	Alternative works methods such as use of hydraulic or electric-controlled units in place of diesel units would be considered and implemented where feasible and reasonable.	Construction
	NV10	Equipment would be regularly inspected and maintained to ensure it is in good working order.	Construction
	NV11	The distance between construction plant and noise sensitive receivers would be maximised as much as feasible and reasonable.	Construction
	NV12	Site access and egress points would be located as far as feasible and reasonable from noise sensitive receivers.	Construction
	NV13	Noisy equipment would be orientated away from residential receivers.	Construction
	NV14	Acoustic sheds would be erected at the ancillary construction facilities that would support 24 hour tunnelling activities, being: • Southern interchange compound (C5). • Wilson Road compound (C6). • Trelawney Street compound (C7). • Northern interchange compound (C8). The attenuation level of the acoustic sheds would be reviewed and optimised during the construction planning phase.	Construction
	NV15	Permanent noise barriers would be scheduled for completion as early as possible in order to mitigate construction noise.	Construction
	NV16	Where feasible and reasonable, the use of temporary noise hoardings would be considered where ancillary construction facilities are in proximity to sensitive receivers.	Construction
	NV17	Noise monitoring would be conducted at the commencement of construction activities and periodically during the construction program.	Construction
	NV18	A protocol would be developed to identify the need for and provision of respite measures for residential receivers in accordance with the Interim Construction Noise Guidelines. Respite measures may include the restriction to the hours of construction activities resulting in impulsive or tonal noise (such as rock breaking, rock hammering, pile driving), or other appropriate measures agreed between the contractor and residential receiver such as alternative accommodation.	Construction

Impact	ID	Environmental management measure	Timing
Construction traffic noise	NV19	Truck drivers would be advised of designated vehicle routes, parking locations, acceptable delivery hours and other relevant practices (ie minimising the use of engine brakes, and no extended periods of engine idling).	Construction
	NV20	Deliveries and spoil removal would be planned to avoid queuing of trucks around construction sites.	Construction
	NV21	Construction sites would be arranged to limit the need for reversing movements.	Construction
	NV22	Non-tonal reversing alarms would be used where feasible and reasonable, and taking into account the requirements of the Workplace Health and Safety legislation.	Construction
	NV23	The use of local roads for night-time spoil transport would be reviewed during construction planning.	Construction
Vibration impacts	NV24	Prior to the commencement of tunnelling or other vibration intensive works at each site, existing condition surveys would be undertaken on properties and structures within the preferred project corridor (the zone on the surface equal to 50 metres from the outer edge of the tunnels) and within 50 metres of surface works.	Construction
	NV25	The safe working distances would be complied with where feasible and reasonable. This would include the consideration of smaller equipment when working in close proximity to existing structures.	Construction
	NV26	In the event that vibration intensive equipment would be used within the safe working distances for cosmetic damage, vibration monitoring would be undertaken to warn operators when vibration levels are approaching the peak particle velocity objective.	Construction
Operation			
Road noise impact	OpNV1	Feasible and reasonable mitigation measures would be developed and implemented to minimise noise impacts consistent with the requirements of the NSW Road Noise Policy and the Environmental Noise Management Manual. Specific noise mitigation measures for the project may include, where feasible and reasonable: • Low noise road surfaces. • Noise barriers. • At property acoustic treatments.	Detailed design

Impact	ID	Environmental management measure	Timing
	OpNV2	Operational traffic noise would be monitored at sensitive receivers between six months and one year after opening. If the traffic noise levels are above the predicted levels, consideration of additional feasible and reasonable mitigation measures would be undertaken.	Operation
Operational ancillary facilities	OpNV3	Operational ancillary facilities would be designed to meet project specific noise criteria derived in accordance with the NSW Industrial Noise Policy.	Detailed design
Air quality			
Construction			
General	AQ1	Site inductions and ongoing toolbox talks would be provided to make construction works aware of air quality control practices and responsibilities.	Construction
	AQ2	Construction activities would be modified, reduced or controlled during high or unfavourable wind conditions if they would potentially increase off-site dust emissions.	Construction
	AQ3	Measures would be implemented to control dust emissions, such as the use of water carts, sprinklers, sprays and dust screens. The frequency of use would be modified in response to weather conditions.	Construction
	AQ4	Dust extraction and filtration systems would be installed for tunnel excavation works.	Construction
	AQ5	Should odour emissions arise from the groundwater treatment plant or stockpiles, a management plan would be developed to identify and implement appropriate mitigation measures.	Construction
	AQ6	Disturbed areas would be stabilised as soon as practicable to prevent or minimise windblown dust.	Construction
	AQ7	Cutting of materials such as concrete or bricks would be undertaken in a manner that minimises the generation of dust, such as the wetting of the cutting face.	Construction
	AQ8	Controls, such as rumble grids or wheel wash facilities, would be implemented to minimise the tracking of dirt onto public roads.	Construction
	AQ9	Hardstand areas and surrounding public roads would be cleaned, as required.	Construction
	AQ10	Speed limits would be posted and observed by all construction vehicles on the construction site.	Construction
	AQ11	Loaded haulage trucks would be covered at all times on public roads and on-site where there is a risk of release of dust or other materials.	Construction
	AQ12	Haul trucks, plant and equipment would be switched off when not in operation for periods of greater than 15 minutes.	Construction

Impact	ID	Environmental management measure	Timing
	AQ13	Construction plant, vehicles and machinery would be maintained in good working order and in accordance with manufacturers' specifications.	Construction
Monitoring	AQ14	A formal dust observation program would be implemented during construction, involving daily reviews of weather forecasts, observations of meteorological conditions and on site dust generation. This would inform mitigation measures or alterations to construction activities to be implemented during unfavourable weather conditions (such as dry weather and strong winds).	Construction
Operation			
In-tunnel air quality monitoring	OpAQ1	A management framework would be developed and implemented to ensure that significant congestion is effectively managed and that acceptable in-tunnel air quality is maintained. The framework would include: • In-tunnel monitoring of carbon monoxide, nitrogen dioxide and / or visibility (extinction coefficient). • Monitoring of traffic conditions and traffic speeds within the main alignment tunnels, and upstream and downstream of the project. • Measures to limit and manage traffic entering the project tunnels in the event of significant congestion conditions that may lead to unacceptable in-tunnel air quality. This may include measures such as lane closures, rapid responses to incidents / breakdowns, and broader traffic network management. • Operational requirements to ensure that operation of the project's ventilation system reflects traffic volumes and in-tunnel air quality requirements. • Provision for the review of the management framework after a period of operation, once sufficient actual in-tunnel air quality and traffic data have been gathered. • Contingency measures in the event of elevated, unexpected in-tunnel air quality (including measures to manage emergency situations). • Provision for publication of relevant in-tunnel air quality performance data. • Review of the performance of smoky vehicle regulation / enforcement and whether additional or amended measures may be required.	Operation

Impact	ID	Environmental management measure	Timing
Local air quality monitoring	OpAQ2	Air quality in the vicinity of the project would be monitored for a specified time period following project opening. If pollutant concentrations contributed by the project are above predicted levels, additional feasible and reasonable mitigation measures would be considered to meet applicable predicted limits.	Operation
Health			
• Operational air quality mitigation and monitoring identified in Section 7.3 (Air quality). • Construction and operational noise and vibration mitigation measures identified in Section 7.2 (Noise and vibration).			
Urban design, landscape character and views			
Construction			
Visual amenity	V1	Existing vegetation around the perimeter of construction sites would be retained where feasible and reasonable.	Construction
	V2	The early implementation of noise walls and landscape planting around ancillary facilities would be investigated in order to provide visual screening and minimise noise impacts during the construction phase.	Construction
	V3	Elements within construction sites would be located to minimise visual impacts as far as feasible and reasonable, eg locating equipment back from site boundaries.	Construction
	V4	The design of acoustic sheds would aim to blend into the background where feasible and reasonable.	Pre-construction / construction
	V5	Design of site hoardings would consider the use of artwork or project information.	Pre-construction / construction
	V6	Regular maintenance would be undertaken of site hoardings and perimeter areas including the prompt removal of graffiti.	Construction
	V7	Revegetation / landscaping would be undertaken progressively.	Construction
Construction lighting	V8	Cut-off and directed lighting would be used and lighting location considered to ensure glare and light spill are minimised.	Construction
Landscaping	V9	Opportunities would be investigated to provide passive irrigation of landscaped areas at the operational ancillary facilities through use of directed overland flow paths.	Pre-construction / construction
	V10	Opportunities would be investigated to flatten landscape batters at the operational ancillary facilities to maximise plant response and maintainability.	Pre-construction / construction
Signage	V11	A signage strategy would be developed during detailed design. Potentially affected receivers would be consulted on the final signage in relation to the location and associated	Pre-construction / construction

Impact	ID	Environmental management measure	Timing
		impacts.	
Operation			
Visual amenity	OpV1	Street tree plantings and landscaping would be used to visually soften operational ancillary facilities.	Construction / post-construction
	OpV2	The urban design and landscaping along the Hills M2 Motorway integration works would be consistent with the recently completed Hills M2 Motorway Upgrade project.	Detailed design
	OpV3	The visual impact of noise walls would be reduced through high quality urban design treatments in accordance with *Noise Wall Design Guideline* (RTA, 2006a).	Construction / post-construction
Landscaping	OpV4	Landscaped areas would be maintained.	Operation
Operational lighting	OpV5	Cut-off and directed lighting would be used at the interchanges, Hills M2 Motorway integration, motorway operations complex and M1 Pacific Motorway tie-in to minimise glare and light spill to surrounding receivers.	Detailed design
Biodiversity			
Construction			
General	B1	A Flora and Fauna Management Plan would be developed for the construction phase of the project to identify potential impacts and mitigation measures.	Pre-construction
Clearing of native vegetation	B2	The disturbance and clearance of established vegetation would be minimised as far as feasible and reasonable.	Pre-construction and construction
	B3	Areas of vegetation to be retained would be protected from accidental damage.	Construction
	B4	Pre-clearing surveys would be undertaken by a suitably qualified ecologist to identify to presence of: • Hollow-bearing trees and other habitat features. • Threatened flora and fauna.	Construction
	B5	Where feasible and reasonable, topsoil and habitat elements (such as woody debris and bushrock) would be stored and reused onsite or in adjacent bushland. Cuttings or seed material may also be gathered from the construction footprint for landscaping plant stock.	Construction
Adverse impacts to riparian zones and aquatic habitats	B6	Temporary watercourse crossings would be designed in accordance with relevant guidelines including Fish and Fauna Friendly Waterway Crossing (Fairfull and Witheridge, 2003).	Construction
	B7	Viaduct and bridge structural elements would be located out of the waterway where feasible and reasonable.	Construction
	B8	Creeks, riparian zones or vegetated buffers disturbed by the project would be revegetated	Construction

Impact	ID	Environmental management measure	Timing
		with the restoration to pre-disturbance conditions.	
Spread of weeds and pathogens	B9	Weeds within the construction footprint would be actively managed prior to vegetation clearing. Cleared weed material would be disposed of to a facility licensed to receive green waste.	Construction
	B10	Machinery would be is cleaned prior to entering the project construction sites.	Construction
	B11	The identification of pathogens would be undertaken as part of pre-clearing inspections. In the event that pathogens are identified within the construction footprint, appropriate mitigation measures would be identified and implemented.	Construction
Loss of Epacris purpurascens	B12	Relocation of *Epacris purpurascens* species where identified within disturbance footprints, ideally to areas identified as a biodiversity offset and / or where future disturbance is unlikely.	Construction
Loss of hollow bearing trees	B13	The loss of hollow bearing trees would be mitigated by: • Relocation / replacement of existing nest boxes impacted by construction. • Nest boxes would be provided as replacement for hollow bearing trees impacted by construction.	Construction
Impact on culverts or buildings with potential threatened bat habitat	B14	A microbat management plan would be developed and implemented including: • Conduct monitoring of existing culverts and buildings commencing at least six months prior to construction / demolition commencing at each relevant culvert or building. • Maintaining appropriate exclusion zones and managing night works through the breeding and lactation period in the vicinity of identified microbat habitat. • Filling pipe joins in culverts identified as not being microbat habitat prior to passive exclusion (eg installation of one-way flaps at potential grab hole locations) to ensure alternative roosting locations are not created in culverts. • Minimising light spill and noise impacts into surrounding native vegetation.	Construction
Impacts on fauna due to draining of stormwater basins	B15	Surveys of stormwater basins would be undertaken by a suitably qualified ecologist prior to draining works to identify the potential presence of fauna. Appropriate fauna handling and release protocols would be established to remove fauna from waterbodies prior to draining works.	Construction
Operation			
General	OpB1	A management plan would be developed and implemented to identify and mitigate potential ongoing impacts including procedures for: • Management of weeds.	Operation

Impact	ID	Environmental management measure	Timing
		• Management of riparian areas associated with the discharge of treated water. • Maintenance of nest boxes.	
Social and economic			
Construction			
Traffic delays and road closures	SEc1	A community involvement plan would be developed and implemented to provide timely, regular and transparent information about changes to access and traffic conditions, details of future work programs and general construction progress throughout the construction phase of the project. Information would be provided in a variety of ways including letter box drops, media releases, internet site, signage and a hotline.	Pre-construction and construction
Reduced parking availability	SEc2	Where feasible and reasonable construction parking would be limited to facility sites to minimise the impact on public parking.	Construction
	SEc3	The need for parking restrictions around the Trelawney Street compound (C7) would be monitored and discussed with Hornsby Shire Council.	Construction
Reduced access to businesses	SEc4	Appropriate signage would be provided to ensure motorists' understanding of access to local businesses adjacent to construction works, including signage relating to parking for stopping motorists.	Construction
Impacts to business	SEc5	A business impact risk register would be maintained to identify and manage the specific impacts associated with construction related works for individual businesses.	Construction
	SEc6	The business stakeholder forum would continue to run throughout the detailed design and construction stages to ensure business concerns are addressed.	Construction
Hydrogeology and soils			
Construction			
General	HS1	A Construction Soil and Water Quality Management Plan would be prepared to manage surface and groundwater impacts during construction of the project.	Pre-construction and construction
Acid sulfate soils	HS2	If acid sulfate soils are encountered, they would be managed in accordance with the Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998).	Construction
Contamination	HS3	A Construction Environmental Management Plan prepared for the project would include provisions to manage unexpected finds and hazardous materials identified during site preparation and / or construction works.	Pre-construction
	HS4	Potentially contaminated areas directly affected by the project would be investigated and managed in accordance with the requirements of the *Contaminated Land Management Act 1997* and Contaminated Sites: Guidelines for Consultants Reporting on Contaminated	Pre-construction

Impact	ID	Environmental management measure	Timing
		Sites (EPA, 1997).	
	HS5	Appropriate mitigation measures including stockpiling and management of potentially contaminated material would be undertaken at building demolition sites to prevent movement of material into receiving waters.	Construction
	HS6	If excavation and off-site disposal of soil is to take place in an area of potential contamination, further delineation and / or waste classification would be undertaken.	Construction
	HS7	Hazardous Materials Assessments would be undertaken, and Hazardous Materials Management Plans implemented, prior to and during the demolition of buildings. Demolition works would be undertaken in accordance with Australian and NSW WorkCover Standards.	Pre-construction and construction
Groundwater management	HS8	A groundwater monitoring plan would be prepared for the duration of the construction period. Parameters to be monitored would include groundwater levels and groundwater quality with field parameters, laboratory parameters and sample frequency to be developed prior to construction.	Pre-construction and construction
	HS9	A groundwater monitoring network to monitor groundwater levels and groundwater quality would be established during the construction phase. The groundwater monitoring network would contain monitoring wells along the project corridor intersecting groundwater in both Ashfield Shale and Hawkesbury Sandstone.	Construction
	HS10	Groundwater captured during construction would be tested, treated and discharged to meet the requirements of the project EPL.	Construction
	HS11	The management of groundwater and surface water inflow into the tunnels, including the design of capture, treatment and discharge methods would be undertaken in consultation with the Environment Protection Authority.	Construction
	HS12	Where available, and of appropriate chemical and biological quality, subject to a health risk assessment, stormwater, recycled water, groundwater inflows to tunnels or other water sources would be used in preference to potable water for construction activities, including concrete mixing and dust control.	Construction
	HS13	Compliance records of groundwater monitoring undertaken would be retained.	Construction
Ground movement	HS14	Further assessments would be undertaken during detailed design to determine the level of potential impact on structures and to identify feasible and reasonable mitigation and management measures required to minimise potential ground movement impacts.	Construction

Impact	ID	Environmental management measure	Timing
Operation			
General	OpHS1	Operations personnel would be competent and trained in systems and procedures.	Operation
Contamination	OpHS2	Procedures to address spills, leaks and tunnel washing would be developed and implemented during operation of the project.	Operation
Groundwater management	OpHS3	The project has been designed to achieve a maximum water discharge quality equivalent to the 95 per cent protection level specified for freshwater eco-systems in accordance with ANZECC guidelines. The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during the detailed design phase taking into consideration the current water quality of the receiving watercourses.	Detailed design
	OpHS4	Feasible and reasonable opportunities would be identified for the reuse of captured groundwater.	Operation
Surface water			
Construction			
General	SW1	A Construction Soil and Water Quality Management Plan would be prepared to manage surface and groundwater impacts during construction of the project.	Pre-construction and construction
Erosion and sedimentation	SW2	Progressive erosion and sediment control plans (ESCPs) would be prepared and implemented in advance of construction, including earthworks and stockpiling. ESCPs would be updated as required.	Pre-construction and construction
	SW3	Erosion and sediment controls, including sedimentation basins, would be designed, installed and managed in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Managing Urban Stormwater: Soils and Construction Volume 2D, Main Road Construction (DECC, 2008).	Pre-construction and construction
	SW4	A project soil conservationist would be engaged and consulted during construction to provide advice on erosion and sediment control design, installation and maintenance.	Pre-construction and construction
	SW5	Works would be programmed to minimise the extent and duration of disturbance to vegetation.	Pre-construction and construction
	SW6	Cleared native vegetation would be mulched for use in erosion and sediment control where feasible and reasonable, in accordance with the Environmental Direction Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012b).	Pre-construction and construction
	SW7	Site induction and ongoing toolbox talks would be provided to project personnel, including relevant sub-contractors on soil erosion and sediment control requirements and practices	Construction

Impact	ID	Environmental management measure	Timing
		and their responsibilities.	
	SW8	Erosion and sediment control structures would remain installed and maintained until sufficient stabilisation is achieved.	Construction
	SW9	Soil and land rehabilitation would occur as soon as practicable following construction. This would include rehabilitation in stages as the construction process allows.	Construction and post construction
	SW10	Temporary stockpile locations for both site establishment and earthworks would be specified prior to the commencement of construction activities in that area. Diversion drains and erosion and sediment control measures would be in place prior to the commencement of any stockpiling activities. Material would only be stockpiled in designated stockpiling areas.	Pre-construction and construction
Protection of riparian areas	SW11	Scour protection and erosion protection measures would be implemented downstream of the watercourse crossings and surface water discharge points.	Pre-construction
	SW12	Where water is released into local creeks, outlet scour protection and energy dissipation would be implemented. The discharge point would be at the upstream end of a large pool where feasible and reasonable, to allow for slowing of water.	Pre-construction
Water efficiency	SW13	Water efficiency measures would be implemented with a focus on achieving water savings and targeting water recycling and re-use.	Pre-construction and construction
Dewatering	SW14	A specific Work Method Statement for dewatering and discharging from open exposed excavations and sediment controls would be prepared, in accordance with the Technical Guideline Environmental Management of Construction Site Dewatering (Roads and Maritime, 2011d).	Construction
	SW15	Water discharge quality would comply with the requirements of an environmental protection licence issued for the project.	Construction
Refuelling and storage of chemicals and fuels on-site	SW16	Where refuelling on-site is required, a Work Method Statement would be prepared and the following management practices would be implemented: • Refuelling would be undertaken on level ground and away from drainage lines, waterways and / or environmentally sensitive areas. • Refuelling would be undertaken within the designated refuelling areas with appropriate bunding and / or absorbent material. • Refuelling activities would be attended at all times. • Spill kits would be readily available and personnel trained in their use. A spill kit would be kept on the refuelling truck at all times.	Construction

Impact	ID	Environmental management measure	Timing
Localised flooding of receiving watercourses	SW17	The discharge of treated groundwater would be managed to ensure that discharge does not exceed the capacity of the downstream system.	Construction
Blocking of fish passage	SW18	Maintain the flow along the current Cockle Creek and Darling Mills Creek alignment through appropriate design.	Construction
	SW19	Design waterway crossings, structures, bridges and culverts to maintain fish passage with reference to the guidelines contained in Guidelines and Policies for Aquatic Habitat Management and Fish Conservation' (Smith and Pollard 1999), Why do fish need to cross the road? Fish passage requirements for waterway crossings (Fairfull and Witheridge, 2003) and Fish and Fauna Friendly Waterway Crossings (Fairfull & Witheridge, 2003).	Pre-construction and construction
Monitoring	SW20	A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring program would commence prior to commencement of any construction works and would build on available water quality data.	Pre-construction and construction
	SW21	Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance.	Construction
Operation			
Operational Environmental Management Plan	OpSW1	The management of potential surface water impacts during the operation of the project would be detailed as part of an OEMP.	Operation
Contaminant spill	OpSW2	Procedures to quickly address any contaminant spill or accident would be developed prior to operation and implemented during operation project.	Operation
Water treatment and discharge	OpSW3	Treated tunnel water would be discharged to the local stormwater system. The project has been designed to achieve a maximum water discharge quality equivalent to the 95 per cent protection level specified for freshwater eco-systems in accordance with ANZECC guidelines (ANZECC & ARMCANZ, 2000). The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during the detailed design phase taking into consideration the current water quality of the receiving watercourses.	Detailed design
Water re-use	OpSW4	All feasible and reasonable opportunities for captured surface water reuse would be utilised in the first instance.	Operation
Increased water flow	OpSW5	On-site detention would be provided where required to mitigate impacts associated with increased impervious areas. This would involve the augmentation of existing basins and the construction of new basins.	Operation

Impact	ID	Environmental management measure	Timing
	OpSW6	The exact location of discharge to Blue Gum Creek or Darling Mills Creek would be further investigated during the detailed design phase. Additional mitigation measures such as stream bed and bank stabilisation, or re-sizing of existing drainage infrastructure would be determined at this stage based on the location of discharge.	Detailed design
Water quality	OpSW7	Water Sensitive Urban Design principles would be incorporated into the design to minimise impacts on the existing hydrologic regime. Such measures would include: Minimising increases in peak flows through the use of detention and retention measures as appropriate. Treating stormwater through a range of at source and end point measures that are integrated with the urban landscape.	Detailed design
Drainage maintenance	OpSW8	Operational drainage infrastructure would be regularly inspected and maintained.	Operation
Non-Aboriginal heritage			
Construction			
General	NAH1	In the event of an unexpected cultural heritage find, the Standard Management Procedure – Unexpected Archaeological Finds (Roads and Maritime, 2012d) would be followed. This would include notification to the NSW Heritage Branch.	Pre-construction and construction
	NAH2	Construction personnel would be made aware of non-Aboriginal heritage sites as part the site induction. These sites would be identified on sensitive area plans and in the CEMP.	Pre-construction and construction
Removal of heritage listed vegetation	NAH3	Feasible and reasonable options for the relocation of the two mature Canary Island Palms (I762) would be investigated. If the trees cannot be relocated: • Archival samples would be collected in accordance with NSW Royal Botanic Gardens collection procedures. • Options would be investigated to collect seed samples for later propagation. • Oral histories (if relevant) would be obtained.	Detailed design

Impact	ID	Environmental management measure	Timing
	NAH4	Feasible and reasonable options to avoid direct impacts to identified heritage listed vegetation along Woonona Ave, Wahroonga (I769) would be investigated during detailed design. If impacts cannot be avoided: • The street frontage would be revegetated in consultation with the landowner (Hornsby Shire Council). • Plantings that are representative species of the Blue Gum High Forest ecological community would be considered.	Detailed design
Construction vibration and / or ground settlement	NAH5	Where non-Aboriginal heritage items have been identified as having the potential to be impacted by construction vibration or ground settlement, the following would be implemented: • A ground settlement assessment would be undertaken during detailed design to confirm predicted impacts on heritage structures. • Completion of existing condition surveys prior to the commencement of construction for heritage items within the project corridor or that have been identified during detailed design to be within recommended safe working distances to surface works. A post-construction condition survey would also be undertaken of these items to identify if impacts have occurred. Additional feasible and reasonable mitigation and management measures to be implemented would be identified based on the above assessments. This would include the use of vibration monitoring where recommended maximum levels are predicted to be exceeded. The placement of vibration monitors would consider the heritage fabric of the item.	Pre-construction, construction and post-construction
Impacts to North Wahroonga heritage conservation area and Beecroft Cheltenham heritage conservation area	NAH6	Landscaping of ancillary infrastructure sites would be undertaken with consideration of the heritage values of the Wahroonga North heritage conservation area and Beecroft Cheltenham heritage conservation area.	Detailed design

Impact	ID	Environmental management measure	Timing
Impacts to heritage values due to changes in views (construction)	NAH7	The heritage values of items I771, I953, I956, I957 (including views and vistas from the items) would be considered during the detailed design of built elements of the project and the development of the landscaping plan.	Pre-construction
Removal of heritage listed structures	NAH8	The germination building at the Thornleigh Maltworks (A66) would be conserved. Prior to demolition of other structures: • A structural assessment of the germination structure would be conducted to ascertain the possible impact of the demolition of adjacent structures and to identify suitable mitigation methods to ensure the germination structure remains intact. Additional measures would be identified and implemented, if required, to treat the newly exposed surfaces of the germination structure to protect it from the elements as a result of the demolition of adjacent structures. • An archival recording of the industrial site would be undertaken to record the connection of the original structures to the modern upgraded structures. • An archaeological test excavation program would be undertaken to assess the archaeological potential of identifying evidence of the early malting industry in this area, and the relationship of the industrial to the urban site and evidence of the occupation of the Manager's house by the Chilvers family.	Pre-construction
Operation			
Impacts to heritage values due to changes in views (operation)	OpNAH1	The heritage values of items I771, I953, I956, I957 (including views and vistas from the items) would be considered during the detailed design of built elements of the project and the development of the landscaping plan.	Detailed design / Pre-construction
Aboriginal heritage			
Construction			
Impacts on culturally sensitive Aboriginal sites	AH1	The detailed design of the project would be developed to avoid direct impacts on ASA1 or ASA2 management zones. If direct impacts to ASA1 or ASA2 management zones cannot be avoided, a Stage 3 assessment would be conducted with reference to the Roads and Maritime PACHCI process (Roads and Maritime, 2011c).	Pre-construction and construction
	AH2	In the event that the project is required to extend outside the assessed construction footprint or study area, these additional areas would be assessed in accordance with PACHCI prior to the commencement of construction within those identified areas.	Pre-construction and construction

Impact	ID	Environmental management measure	Timing
Impacts on rockshelter sites	AH3	The identified rockshelter sites and overhangs located within 200 metres of the Hills M2 Motorway integration works should be clearly delineated prior to construction works.	Construction
Indirect impacts on rockshelter sites	AH4	During construction, vibration monitoring would be conducted for vibration intensive works within 50 metres of rockshelter sites and associated overhangs within management zone ASA2. The need for vibration monitoring would be informed by a preliminary screening of activities at this location to identify activities which have the potential for vibration at these areas of sensitivity.	Construction
Unexpected discovery of Aboriginal objects	AH5	If an Aboriginal object(s) is discovered during construction it would be managed in accordance with the standard management procedure: Unexpected Archaeological Finds (Roads and Maritime, 2012d), including: • Relevant works in the vicinity of the object(s), with the potential to directly or indirectly impact on the object(s), would cease. • The construction Environmental Representative, OEH and Registered Aboriginal Parties (RAPs) would be notified of the discovery. • A qualified archaeologist would be engaged to determine the nature, extent and scientific significance of the object(s). • Management recommendations would be developed in consultation with the qualified archaeologist, OEH and RAPs.	Construction
Unexpected discovery of human remains	AH6	If human remains are discovered during construction would be managed in accordance with the standard management procedure: Unexpected Archaeological Finds (Roads and Maritime, 2012d), including: • Relevant works in the vicinity of the remains, with the potential to directly or indirectly impact on the remains, would cease. • The construction Environmental Representative, OEH and NSW Police would be notified of the discovery. • Directions from the NSW Police and / or OEH, as relevant, would be followed depending on the nature of the remains and the outcomes of forensic investigations.	Construction
Land use and property			
Construction			
Property access	LP1	Affected property owners would be consulted where temporary property access would be required.	Pre-construction and construction

Impact	ID	Environmental management measure	Timing
	LP2	Affected property owners would be provided with advanced notification of relevant project schedules, construction works and changes to access arrangements.	Construction
	LP3	Community updates would be provided on changes to the local road network within the project area during construction.	Construction
Temporary lease or acquisition of property required for the project	LP4	Consultation would occur with the relevant property owners in relation to temporary land leases and acquisition of properties required temporarily for the construction of the project. Where acquisition is identified as the preferred option, this would be undertaken in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2012c) and the *Land Acquisition (Just Terms Compensation) Act 1991.*	Construction
Community facilities	LP5	Appropriate signage would be provided advising of walking track closures and alternative walking routes.	Construction
Operation			
Acquisition of property required for the project	OpLP1	Land acquisition for the project would be undertaken in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2012c) and the *Land Acquisition (Just Terms Compensation) Act 1991*.	Detailed design / pre-construction
Loss of land use and property access	OpLP2	Property accesses that are affected as a result of the project would be reinstated in consultation with the affected landowners including relocation if required.	Detailed design / construction
Hazards and risks			
Construction			
General	HR1	Site-specific hazard and risk management measures would be included within the Construction Environmental Management Plan (CEMP), which may include items such as: • Details of the hazards and risk associated with construction activities for both surface and subsurface works. • Procedures to comply with legislative and industry standard requirements. • Contingency plans, as required. • Site-specific Work Health and Safety plans and Safe Work Method Statements. • Training for relevant personnel (including subcontractors) and site inductions, including the recognition and awareness of site hazards and locations of relevant equipment.	Pre-construction / construction
Storage of dangerous goods and hazardous substances	HR2	Storage of dangerous goods and hazardous materials would occur in accordance with supplier's instructions and relevant Australian Standards and may include bulk storage tanks, chemical storage cabinets / containers or impervious bunds.	Construction

Impact	ID	Environmental management measure	Timing
	HR3	Storage, handling and use of dangerous goods and hazardous substances would be in accordance with the *Occupational Health and Safety Act 2000* and the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005).	Construction
	HR4	Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids. Impervious bunds would be of sufficient capacity to contain at least 110 per cent of the volume of the largest stored container.	Construction
	HR5	Bunds would be provided around activities such as vehicle refuelling, servicing, maintenance or wash-down, where there is a potential for spills and contamination.	Construction
	HR6	Material Safety Data Sheets would be obtained for dangerous goods and hazardous substances stored on-site prior to their arrival.	Construction
Transportation of dangerous goods and hazardous substances	HR7	Transport of dangerous goods and hazardous substances would be conducted in accordance with relevant legislation and codes, including the *Road and Rail Transport (Dangerous Goods) (Road) Regulation 1998* and the Australian Code for the Transport of Dangerous Goods by Road and Rail (National Transport Commission, 2008).	Construction
Operation			
Fire and life safety	OpHR1	The fire and safety systems and measures adopted for the project would be equivalent to or exceed the fire safety measures recommended by NFPA502 (American), PIARC (European), AS4825 (Australian) and Roads and Maritime standards.	Detailed design
Storage of dangerous goods and hazardous substances	OpHR2	Storage of dangerous goods and hazardous materials would occur in accordance with supplier's instructions and relevant Australian standards and may include bulk storage tanks, chemical storage cabinets / containers or impervious bunds.	Operation
	OpHR3	Storage, handling and use of dangerous goods and hazardous substances would be in accordance with the *Occupational Health and Safety Act 2000* and the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005).	Operation
	OpHR4	Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids. Impervious bunds would be of sufficient capacity to contain at least 110 per cent of the volume of the largest stored container.	Operation
	OpHR5	Bunds would be provided around activities such as vehicle refuelling, servicing, maintenance or wash-down, where there is a potential for spills and contamination.	Operation
	OpHR6	Material Safety Data Sheets would be obtained for dangerous goods and hazardous substances stored on-site prior to their arrival.	Operation

Impact	ID	Environmental management measure	Timing
Transportation of dangerous goods and hazardous substances	OpHR7	The transport of dangerous goods and hazardous substances would be prohibited through the main alignment tunnels and on and off-ramp tunnels.	Operation
Incident response	OpHR8	An Incident Response Plan would be developed and implemented in the event of an accident or incident.	Operation
	OpHR9	The response to incidents within the motorway would be managed in accordance with the memorandum of understanding between Roads and Maritime and the NSW Police Service, NSW Rural Fire Service, NSW Fire Brigade and other emergency services	Operation
Electric and magnetic fields	OpHR10	The detailed design of the project substations would ensure that the exposure limits for the general public suggested by the Draft Radiation Standard (Australian Radiation Protection and Nuclear Safety Agency, 2006) would not be exceeded at the boundary of the substation sites.	Detailed design
Resources and waste			
Construction			
Resource consumption	RW1	Wherever feasible and reasonable, construction material would be sourced from within the Sydney region.	Pre-construction and construction
	RW2	Unnecessary resource consumption would be avoided by making realistic predictions on the required quantities of resources, such as construction materials.	Construction
	RW3	Resource recovery, which includes re-use, recycling and reprocessing, would be applied to the management of construction waste and would include: • Recovery of resources for reuse. Waste materials generated by the project would be re-used either on-site or off-site where possible, including the re-use of top soil in landscape works, and the use of mulch for erosion and sediment controls. • Recovery of resources for recycling. Resources would be segregated for recycling such as paper, plastic, glass, aluminium cans and other recyclable materials generated during construction. These materials would then be sent to an appropriate recycling facility for processing. • Recovery of resources for reprocessing. Cleared vegetation would be mulched or chipped on-site and used for landscaping, in the absence of a higher beneficial use being identified.	Construction

Impact	ID	Environmental management measure	Timing
Management of waste	RW4	Wastes would be managed and disposed of in accordance with relevant State legislation and government policies including the *Protection of the Environment Operations Act 1997, Waste Avoidance and Resource Recovery Act 2001,* Waste Avoidance and Resource Recovery Strategy 2007 (DECC, 2007c) and the Waste Reduction and Purchasing Policy (RTA, 2009).	Pre-construction and construction
	RW5	A Waste Management Plan would be prepared as part of the Construction Environmental Management Plan detailing appropriate procedures for waste management.	Pre-construction and construction
	RW6	Wastes would be managed using the waste hierarchy principles of: • Avoidance of unnecessary resource consumption to reduce the quantity of waste being generated • Recover of resources for re-use on-site or off-site for the same or similar use, without reprocessing. • Recover of resources through recycling and reprocessing so that waste can be processed into a similar non-waste product and re-used. • Disposal of residual waste.	Construction
	RW7	Residual waste would be disposed of to a suitably licensed landfill or waste management facility where there are no other feasible and reasonable options for waste avoidance, re-use or recycling. Waste materials requiring removal from the site would be classified, handled and stored on-site in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c) until collection by a contractor for disposal.	Prior to / during construction
	RW8	Off-site re-use of waste would comply with relevant EPA resource recovery exemptions and requirements.	Construction
	RW9	An asbestos survey would be undertaken of buildings to be demolished as part of the project. The survey would be conducted by a suitably qualified person.	Construction
	RW10	Asbestos handling and management would be undertaken in accordance with: • Work Health and Safety Act 2011. • Code of Practice for the Safe Removal of Asbestos 2nd Edition (NOHSC, 2005a). • Code of Practice for the Management and Control of Asbestos in Workplaces (NOHSC, 2005b). • Protection of the Environment Operations (Waste) Regulation 2005 – section 42 special requirements relating to asbestos waste. • AS2601:1991 Demolition of Structures.	Construction

Impact	ID	Environmental management measure	Timing
Excess spoil	RW11	A spoil management strategy would be developed prior to the commencement of construction and implemented during construction. The strategy would identify spoil disposal site and describe the management of spoil on -site and during off-site transport.	Pre-construction
	RW12	Where possible and fit for purpose, spoil would be beneficially re-used within the project before off-site re-use or disposal options are pursued.	Construction
	RW13	Before being transported from construction sites, excavated spoil would be classified in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c) to ensure appropriate reuse or disposal.	Construction
Wastewater	RW14	Feasible and reasonable opportunities for wastewater re-use on-site or for construction purposes would be pursued (such as dust suppression both in the tunnels and for surface works).	Construction
	RW15	Wastewater not used on-site would be discharged into the local stormwater system in accordance with the requirements of an environment protection licence issued for the project.	Construction
Contaminated soil	RW16	In the event of discovery of previously unidentified area(s) of potentially contaminated material, all relevant work would cease in the vicinity of the discovery. Relevant works would not recommence until the need for and scope of remedial action(s), if required, are identified in accordance with the requirements of the *Contaminated Land Management Act 1997*.	Construction
Operation			
Management of waste	OpRW1	Wastes would be managed and disposed of in accordance with relevant State legislation and government policies including the *Protection of the Environment Operations Act 1997, Waste Avoidance and Resource Recovery Act 2001,* Waste Avoidance and Resource Recovery Strategy 2007 (DECC, 2007c) and the Waste Reduction and Purchasing Policy (RTA, 2009).	Operation
	OpRW2	Any mercury containing light globes used for the operation of the tunnel and operational ancillary facilities would be recycled at an accredited recycling facility.	Operation
Operational water requirements	OpRW3	Opportunities for re-use of wastewater would be considered including irrigation of landscapes within the project, irrigation of Pennant Hills Golf Club and / or local parks in preference to discharge to the local stormwater system.	Operation
	OpRW4	In order to reduce demand on local water supplies, investigate options for providing water required for operation of the deluge system from wastewater produced through the tunnel drainage system where it meets appropriate quality parameters.	Operation

Impact	ID	Environmental management measure	Timing
Greenhouse gas and climate change			
Construction			
GHG emissions	GHG1	Emissions intensity of construction materials would be considered during procurement.	Procurement
	GHG2	Where feasible, recycled content road construction and maintenance materials such as recycled aggregates in road pavement and surfacing would be used.	Procurement
	GHG3	The fuel efficiency of the construction plant and equipment would be considered during selection.	Procurement / pre-construction
	GHG4	Project planning would be aim to minimise double handling of materials, long haulage distances and additional fuel use.	Prior to construction
	GHG5	Locally produced goods and services would be procured where feasible and cost effective to reduce transport fuel emissions.	Procurement / pre-construction
Climate change impacts	CC1	The risks of future climate change would be further considered during detailed design.	Detailed design
	CC2	Where high or medium risks to project infrastructure have been identified, the construction contractor would review existing design policies, specifications or practices to consider the impacts of climate change.	Detailed design
Operation			
GHG emissions	OpGHG1	The tunnel would be designed to minimise fuel use associated with motorist use of the road through the optimisation of design, for example the provision of a vertical alignment that allows consistent vehicle speeds to be maintained.	Detailed design
	OpGHG2	Low carbon energy generation options would be investigated as part of the design process in order to reduce the demand on mains electricity where feasible.	Detailed design
	OpGHG3	A life cycle assessment would be undertaken as part of the detailed design in order to select mechanical and electrical systems with increased energy efficiencies, such as the tunnel ventilation system, water treatment systems and electronic toll and surveillance systems.	Detailed design
Climate change impacts	OpCC1	A stop work threshold (eg for extreme heat, storm events) for operation and maintenance activities would be implemented in line with current workplace health and safety practices.	Operation
	OpCC2	Emergency planning and management controls would be implemented during operation to reduce the risk of adverse climate impacts, maintain public safety and minimise congestion. For example, bushfire management would include measures to ensure safety such as reduced speed limits and temporary tunnel closures where required (refer to **Section 8.2** Hazards and risk).	Operation

Impact	ID	Environmental management measure	Timing
	OpCC3	Maintenance regimes for road surface and other ancillary infrastructure would be developed to accommodate accelerated rates of asset degradation.	Operation
	OpCC4	The motorway operator would develop emergency response management plans in consultation with emergency management services, local governments and other relevant agencies to ensure better disaster management during extreme climate events.	Operation
	OpCC5	The motorway operator would monitor and review the performance of structures and materials in response to climate change related events. Where possible, the most cost-effective response would be to include adaptive measures in the regular maintenance of the project.	Operation