

Appendix Y

# Compilation of environmental management measures

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Ref	Phase	Impact	Environmental management measure	Location
<b>Traffic and transport – construction</b>				
CTT1	Pre-construction	Construction traffic	A road dilapidation report will be prepared, in consultation with relevant councils and road owners, identifying existing conditions of local roads and mechanisms to repair damage to the road network caused by heavy vehicle movements associated with the project.	WHT/WFU
CTT2	Pre-construction	Maritime construction	Moorings impacted during construction will be relocated elsewhere in Sydney Harbour in consultation with the lease holders.	WHT
CTT3	Pre-construction	Maritime construction	Opportunities to relocate the Birchgrove Ferry Wharf will be investigated during construction planning.	WHT
CTT4	Construction	Construction traffic	Ongoing consultation will be carried out with (as relevant to the location) the Sydney Coordination Office, the Port Authority of NSW, local councils, emergency services and bus operators to minimise traffic and transport impacts during construction.	WHT/WFU
CTT5	Construction	Construction traffic	The community will be notified in advance of proposed transport network changes, and maritime restrictions through appropriate media and other appropriate forms of community liaison.	WHT/WFU
CTT6	Construction	Construction traffic	Construction road traffic will be managed to minimise movements during peak periods.	WHT/WFU
CTT7	Construction	Construction traffic	Vehicle access to and from construction sites will be managed to ensure pedestrian, cyclist and motorist safety. Depending on the location, this may require manual supervision, physical barriers, temporary traffic signals and modifications to existing signals or, on occasion, police presence.	WHT/WFU
CTT8	Construction	Construction	Directional signage and linemarking will be used to direct and guide	WHT/WFU

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		traffic	drivers, cyclists and pedestrians past construction sites and on the surrounding network. This will be supplemented by Variable Message Signs to advise drivers of potential delays, traffic diversions, speed restrictions, or alternative routes.	
CTT9	Construction	Construction traffic	Where provision of construction on-site parking cannot accommodate the full construction workforce, feasible and reasonable management measures that minimise impacts on parking on local roads will be identified and implemented. Depending on the location, management measures may include workforce shuttle buses and the use of public transport.	WHT/WFU
CTT10	Construction	Construction traffic	Any adjustments to existing bus stops will be determined in consultation with relevant stakeholders including other divisions of Transport for NSW and advanced notification will be provided to affected bus customers. Relocations will be as close as feasible and reasonable to their existing position.	WHT/WFU
CTT11	Construction	Construction traffic	Truck marshalling areas will be identified and used where feasible and reasonable, to minimise potential queueing and traffic and access disruptions in the vicinity of construction support sites.	WHT/WFU
CTT12	Construction	Construction traffic	Activities requiring partial and full road closures will occur outside of peak periods and/or during night time to minimise the impact of these activities on the road network where feasible and reasonable.	WHT/WFU
CTT13	Construction	Construction traffic	Partial or full closures of Warringah Freeway will be carried out in consultation with the Sydney Coordination Office.	WFU
CTT14	Construction	Construction traffic	Haulage of spoil by barge will be considered as an alternative to road based haulage.	WHT
CTT15	Construction	Maritime construction	Construction vessels will be required to operate in a manner that minimises wash to areas of shoreline.	WHT

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		traffic		
CTT16	Construction	Maritime construction traffic	Construction marine traffic activities will be scheduled to avoid times and locations of high recreational marine traffic where feasible and reasonable.	WHT
CTT17	Construction	Maritime construction traffic	Harbour closures scheduling will be carried out in consultation with Port Authority of NSW, other divisions of Transport for NSW and other relevant stakeholders.	WHT
CTT18	Construction	Maritime construction	Construction vessel movements will be managed so that they will not interfere with port operations or the navigation of seagoing ships and ferries, unless prior approval has been obtained from the Harbour Master.	WHT
<b>Traffic and transport – operation</b>				
OT1	Operation	Operational traffic	A review of operational network performance will be carried out 12 months and five years from the opening of the project to confirm the operational impacts of the project on surrounding arterial roads and major intersections. The assessment will be based on updated traffic data at the time and the methodology used will be comparable with that used in this assessment.	WHT/WFU
OT2	Operation	Operational traffic	Conversion of transit lanes to regular traffic lanes along Gore Hill Freeway will be considered if there is a traffic performance requirement/benefit in peak times.	WFU
<b>Noise and vibration</b>				
CNV1	Pre-Construction	Construction noise and vibration impacts	A Construction Noise and Vibration Management Plan will be developed for the project. This plan will: a) Identify relevant criteria and management levels in relation to noise and vibration b) Identify noise and vibration sensitive receivers and features in the	WHT/WFU

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			<p>vicinity of the project</p> <p>c) Include standard and additional mitigation from the <i>Construction Noise and Vibration Guideline</i> (Roads and Maritime, 2016a) and detail how and when these will be applied in the project</p> <p>d) Describe the approach that will be adopted for carrying out location and activity specific constructing noise and vibration impact assessments to assist with designing and selecting of the appropriate mitigation and management measures</p> <p>e) Include protocols that will be adopted to manage works required outside standard construction hours</p> <p>f) Detail the methodology and approach for managing residual construction noise impacts</p> <p>g) Detail the process for managing construction vibration, including heritage structures considering all types of vibration generating works, including blasting</p> <p>h) Outline the procedures and approach for noise and vibration monitoring to be carried out to confirm construction noise and vibration levels in relation to noise and vibration management levels</p> <p>i) Where feasible and reasonable, detail how construction noise impacts from concurrent or consecutive nearby construction works associated with the project will be managed.</p> <p>The Construction Noise and Vibration Management Plan will be implemented for the duration of construction of the project.</p>	
CNV2	Pre-construction	Construction noise and vibration impacts	<p>Detailed Construction Noise and Vibration Impact Statements will be carried out for all construction support sites and major construction works required for the project prior to the commencement of construction.</p> <p>The Statements will consider the proposed site layouts and noise and vibration generating activities that will take place during all major stages of the construction support site, assess predicted noise and vibration levels against the relevant management levels, and incorporate feasible and reasonable mitigation and management measures in accordance with the requirements of the <i>Interim Construction Noise Guideline</i> (DECC,</p>	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
			2009) and the <i>Construction Noise and Vibration Guideline</i> (Roads and Maritime, 2016a).	
CNV3	Construction	Construction noise and vibration impacts during out of hours work	<p>An out of hours works protocol will be developed for the construction of the project. The protocol will include:</p> <ul style="list-style-type: none"> <li>a) Details of works required outside standard construction hours, including acceptable justifications for works outside of standard construction hours, what types of works are allowed to take place outside of construction hours, and justifications of why the activities are required outside standard construction hours</li> <li>b) Details of the assessment and approval process (internal and external) for works proposed outside standard construction hours</li> <li>c) Noise and vibration mitigation and management measures that are to be considered and implemented where appropriate to manage potential impacts associated with works outside standard construction hours</li> <li>d) The noise and vibration impact assessment processes that will be followed to identify potentially affected receivers, clarify potential impacts and determine appropriate mitigation and management measures.</li> </ul> <p>The protocol will be prepared in consultation with the Department of Planning, Industry and Environment and the NSW Environment Protection Authority, and independently endorsed. The project protocol will be implemented during the duration of the construction of the project.</p>	WHT/WFU
CNV4	Construction	Construction noise and vibration impacts	<p>Construction noise and vibration impacts will be monitored periodically throughout all stages of the construction support sites to ensure that:</p> <ul style="list-style-type: none"> <li>a) Impacts are consistent with the noise and vibration levels detailed in the relevant Construction Noise and Vibration Impact Statements</li> <li>b) Noise and vibration impacts are being appropriately managed</li> <li>c) Mitigation measures are effective.</li> </ul>	WHT/WFU
CNV5	Construction	Construction	Where feasible and reasonable, unless compliance with the relevant	WHT/WFU

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		noise and vibration impacts	traffic noise criteria can be achieved, or alternative arrangements have been agreed with affected receivers, construction vehicle movements will not occur on local roads beyond those required for direct access to construction sites.	
CNV6	Construction	Construction vibration impacts	<p>Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels.</p> <p>Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure.</p> <p>For heritage items, the more detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.</p>	WHT/WFU
CNV7	Construction	Construction ground-borne noise impacts	Feasible and reasonable measures will be implemented to minimise ground-borne noise where exceedances are predicted.	WHT/WFU
CNV8	Construction	Construction impacts from surface road works	<p>Mitigation measures will be implemented for surface road works, local area and utility works, where construction activities are predicted to exceed noise management levels at receivers. Where feasible and reasonable the approaches that will be used include:</p> <ul style="list-style-type: none"> <li>a) Carrying out works during the daytime period when near residential receivers</li> <li>b) Selection of plant and equipment to minimise noise and vibration impacts</li> <li>c) Management of plant and equipment to minimise the generation of noise and vibration impacts</li> <li>d) Community consultation, engagement and notification</li> <li>e) Detailed programming and respite protocols</li> <li>f) Where out of hours works are required, programming the noisiest</li> </ul>	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
			<p>activities to occur during the less sensitive time periods</p> <p>g) Out of hours works protocols</p> <p>h) Limiting timing of noise intensive work</p> <p>i) Use of portable noise barriers around particularly noisy equipment such as concrete saws and rock hammers in cases where it will effectively reduce noise levels at nearby receivers</p> <p>j) Management of construction traffic to minimise movements during the night periods along local roads</p> <p>k) Establishing minimum vibration buffer distances for vibration intensive works</p> <p>l) Vibration and blasting trials and/or monitoring along with building condition surveys.</p>	
CNV9	Construction	Construction blasting impacts	<p>A Blast Management Strategy will be prepared in consultation with the NSW Environment Protection Authority to demonstrate that all blasting and associated activities will be carried out in a manner that will not generate unacceptable noise and vibration impacts or pose a significant risk impact to structures and sensitive receivers. The strategy will:</p> <p>a) Detail the blasting to be performed including location, method and justification of the need to blast</p> <p>b) Identify any potentially affected noise and vibration sensitive sites including heritage buildings and utilities</p> <p>c) Establish appropriate criteria for blast overpressure and ground vibration levels at each category of noise sensitive site</p> <p>d) Detail storage and handling arrangements for explosive materials and the proposed transport of those materials to the construction support site</p> <p>e) Identify hazardous situations that may arise from the storage and handling of explosives, the blasting process and recovery of the blast site after detonation of the explosives</p> <p>f) Determine potential noise and vibration and risk impacts from blasting and appropriate best management practices</p> <p>g) Detail community consultation procedures.</p>	WHT/WFU



Ref	Phase	Impact	Environmental management measure	Location
CNV10	Construction	Cumulative construction noise impacts	<p>Construction noise from concurrent and consecutive construction works will be managed to minimise cumulative construction noise impacts. Where feasible and reasonable the approaches that will be used include:</p> <ul style="list-style-type: none"> <li>a) Coordinating work between project construction sites and construction works to avoid cumulative noise impacts</li> <li>b) Consideration of additional at source or near source mitigation where construction noise levels may result in cumulative construction noise impacts, where programming is not practical to avoid cumulative noise impacts</li> <li>c) Community consultation throughout the project to gauge construction key noise impacts and issues and any unknown impacts from concurrent or consecutive sets of constructions works</li> <li>d) Incorporating additional noise mitigation and management measures with consideration of cumulative and consecutive construction noise impacts based upon coordination between projects.</li> </ul>	WHT/WFU
ONV1	Operation	Operational road traffic noise	The operational noise performance of the project will be reviewed during detailed design and operational noise mitigation (low noise pavement, noise barrier, at-property treatment or a combination of treatments) will be confirmed in accordance with relevant policies and guidelines.	WHT/WFU
ONV2	Operation	Operational road traffic noise	Within 12 months of the commencement of the operation of the project, actual operational noise performance will be compared to predicted operational noise performance (as reviewed during detailed design) to analyse the effectiveness of the operational road traffic noise mitigation measures. Additional reasonable and feasible mitigation will be considered where any additional receivers are identified as qualifying for consideration of noise mitigation under the <i>Noise Mitigation Guideline</i> (Roads and Maritime, 2015b).	WHT/WFU
ONV3	Operation	Operational fixed facilities	Operational fixed facilities will be designed to meet project specific noise criteria derived in accordance with the <i>Noise Policy for Industry (NSW)</i>	WHT/WFU

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			<i>EPA, 2017a).</i>	
<b>Air quality</b>				
AQ1	Pre-construction	General	<p>Standard construction air quality mitigation and management measures will be detailed in construction management documentation and implemented during construction, such as:</p> <ul style="list-style-type: none"> <li>a) Reasonable and feasible dust suppression and/or management measures, including the use of water carts, dust sweepers, sprinklers, dust screens, site exit controls (eg wheel washing systems and rumble grids), stabilisation of exposed areas or stockpiles, and surface treatments</li> <li>b) Selection of construction equipment and/or materials handling techniques that minimise the potential for dust generation</li> <li>c) Management measures to minimise dust generation during the transfer, handling and on site storage of spoil and construction materials (such as sand, aggregates or fine materials) (eg the covering of vehicle loads)</li> <li>d) Adjustment or management of dust generating activities during unfavourable weather conditions, where possible</li> <li>e) Minimisation of exposed areas during construction</li> <li>f) Internal project communication protocols to ensure dust-generating activities in the same area are coordinated and mitigated to manage cumulative dust impacts of the project</li> <li>g) Site inspections will be carried out to monitor compliance with implemented measures.</li> </ul>	WHT/WFU
AQ2	Construction	General	Dust and air quality complaints will be managed in accordance with the overarching complaints handling process for the project. Appropriate corrective actions; if required, will be taken to reduce emissions in a timely manner.	WHT/WFU

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<b>Human health</b>				
HH1	Construction	Underwater noise impacts	<p>Monitoring during piling activities will be carried out to validate the predicted underwater acoustic thresholds and management areas, and to further adapt management measures (as required). This will include a monitoring program with an initial trial of piling with corresponding communication measures to validate the predicted underwater acoustic thresholds and management areas.</p> <p>The monitoring results and management areas will be peer-reviewed prior to implementation to ensure they are appropriately protective of health.</p>	WHT (Sydney Harbour)
HH2	Construction	Underwater noise impacts	<p>Communication and management measures will be implemented during construction to manage potential underwater noise impacts to water-based recreational users during dredging and piling activities in Sydney Harbour. The communication tools and management measures that will be contemplated within the management zone include:</p> <ul style="list-style-type: none"> <li>a) Coordination of piling programs to minimise interaction with significant planned events on the harbour, where feasible and reasonable</li> <li>b) Communication of the piling program and management area so that recreational users know when the piling, dredging and other noise generating activities will be taking place, what they can expect, and the zones to minimise the possibility of being startled from a sudden increase in sound pressure underwater</li> <li>c) Direct communication with key local recreational stakeholders during the piling and dredging program to provide up-to-date scheduling</li> <li>d) Use of advertisements, signage, letter box drops and project updates to communicate the implementation of a management area during the works. This could include floating markers or signage on approach to the construction work</li> <li>e) Surveillance within the areas in which the precautionary guideline level is exceeded to proactively monitor users prior to and during relevant activities that could pose a risk to recreational users.</li> </ul>	(WHT) Sydney Harbour

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<b>Non-Aboriginal heritage</b>				
NAH1	Design	Sydney Harbour Bridge	The Lavender Street toll gantry will be designed to avoid direct impact with the heritage item and to minimise visual obstruction of the Lavender Street arch in consultation with relevant stakeholders. All works potentially affecting the Sydney Harbour Bridge will be carried out in accordance with <i>Sydney Harbour Bridge Conservation Management Plan 2007</i> .	WFU - Sydney Harbour Bridge
NAH2	Design	Non-Aboriginal heritage impacts	Appropriate heritage interpretation will be incorporated into the urban design for the project in accordance with the <i>NSW Heritage Manual</i> (NSW Heritage Office and Department of Urban Affairs and Planning, 1996), <i>Interpreting Heritage Places and Items: Guidelines</i> (Roads and Maritime, 2005f), and the <i>Heritage Interpretation Policy</i> (NSW Heritage Council, 2005).	WHT/WFU
NAH3	Design / Construction	ANZAC Park	Impacts to areas of archaeological potential will be avoided by the project. In the event that works are required in the location of the air raid trenches, an archaeological excavation will be required with a test excavation methodology prepared in consultation with relevant stakeholders prior to the disturbance of this area.	WFU - ANZAC Park
NAH4	Pre-construction	Ongoing non-Aboriginal heritage impacts	Should at-property noise treatment be required at a premises that is heritage listed, this will be carried out in a manner to minimise heritage impact, and advice of a heritage conservation architect will be sought prior to undertaking the works. Any treatment will be sympathetic to the heritage values of the item, designed with heritage architect input and be reversible where feasible and reasonable.	WHT/WFU
NAH5	Pre-construction	Impacts on specific non-Aboriginal heritage items	Archival recording will be carried out in accordance with the <i>Photographic Recording of Heritage Items Using Film or Digital Capture</i> guideline for areas/items subject to change within the following terrestrial items, in accordance with Appendix J (Non-Aboriginal heritage working paper):	WHT/WFU - Specific sites listed

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			a) Item 2: The Valley Heritage Conservation Area, Rozelle and Balmain b) Item 4: Yurulbin Park, Birchgrove c) Item 7: BP site, Waverton d) Item 9: North Sydney Bus Shelters e) Item 10: St Leonards Park (including W. Tunks Memorial Fountain, War Memorial, and North Sydney Oval), North Sydney f) Item 14: Cammeray Park (including Golf Course), Cammeray g) Item 15: Cammeray Conservation Area, Cammeray. Archival recording will be completed prior to any works that have the potential to impact upon the items, and deposited with appropriate stakeholders as determined during detailed design (eg local councils).	
NAH6	Pre-construction	Yurulbin Park	A condition survey will be completed prior to works commencing. Opportunities to temporarily remove, store and reinstate these elements on completion of construction work will be investigated and implemented if these elements need to be temporarily removed.	WHT - Yurulbin Park
NAH7	Pre-construction	Woodleys Shipyard	Should heritage buildings be changed externally, such as by adding cladding or extensions, further assessment will be carried out to identify approaches to avoid heritage fabric and/or minimise impact on heritage significance. This will include consideration of how works can be carried out to facilitate subsequent adaptive reuse or to minimise incremental impacts.	WHT - Woodleys Shipyard
NAH8	Pre-construction	Cammeray Golf Course	A thematic heritage study of golf courses in Sydney will be prepared for the region north of the Sydney Harbour. This study will assist in identifying other potential heritage items in the region that demonstrate the same or similar significance as the Cammeray Golf Course.	WFU – Cammeray Golf Course
NAH9	Pre-construction and construction	Impacts on archaeology	Archaeological investigations will be carried out at: a) Item 4: Yurulbin Park, Birchgrove b) Item 7: BP site, Waverton.	WHT

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NAH10	Construction	Unexpected discovery of historical heritage materials, features, or deposits	If at any time during construction of the project, historical heritage materials, features and/or deposits are encountered during construction, the <i>Standard Management Procedure: Unexpected Archaeological Finds</i> (Roads and Maritime, 2015d) will be followed.	WHT/WFU
NAH11	Construction	Unexpected discovery of human remains	In the event that construction of the project reveals possible human skeletal material (remains), <i>Standard Management Procedures – Unexpected Heritage Items</i> (Roads and Maritime, 2015e) will be implemented.	WHT/WFU
NAH12	Construction	Heritage impacts during construction	Non-Aboriginal historical heritage awareness training will be provided for contractors prior to commencement of construction works to ensure understanding of potential heritage items that may be impacted during the project, and the procedure required to be carried out in the event of discovery of historical heritage materials, features or deposits, or the discovery of human remains.	WHT/WFU
NAH13	Construction	BP Site	The heritage item will be rehabilitated and returned to an equivalent state as soon as practicable. Reinstatement of the site will include investigating the adaptive reuse of the site for the wider community.	WHT - BP Site
NAH14	Construction	Impacts to North Sydney bus shelters	The North Sydney bus shelters (Item 9) will be temporarily removed, stored and relocated on completion of construction work with council.	WFU
NAH15	Design and construction	Maritime non-Aboriginal heritage impacts – Berrys Bay	Investigation into the potential to relocate or redesign the temporary wharves at the proposed temporary construction facility WHT7 in Berrys Bay will be carried out to minimise impact on maritime heritage. Where this is not feasible then appropriate mitigation will be implemented before construction in accordance with the <i>Maritime Heritage</i>	WHT – Berrys Bay

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			<i>Management Plan</i> (Mitigation Measure NAH16). Such mitigation will include carrying out archaeological excavation and documentation under the direction of a qualified archaeologist across all areas of impact at the site.	
NAH16	Pre-construction	Maritime non-Aboriginal heritage impacts	<p>A Maritime Heritage Management Plan that details the objectives and methodologies to conserve maritime heritage and mitigate impacts will be prepared by a qualified and experienced maritime archaeologist. The Maritime Heritage Management Plan should specify:</p> <ul style="list-style-type: none"> <li>a) Unexpected finds protocols relevant to each type of activity such as dredging or piling</li> <li>b) Artefact management procedures, including identification of approved submerged reburial locations</li> <li>c) Relevant work method requirements and maritime heritage inductions tailored for each type of work activity such as dredging or piling</li> <li>d) Exclusion zone, archival, baseline and periodic monitoring protocols including before and during construction, and final site inspections within three months of completion of works for the following maritime heritage sites: <ul style="list-style-type: none"> <li>• Balls Head Coal Loader wharf</li> <li>• Yurulbin Park maritime infrastructure</li> <li>• Unidentified Balls Head Bay 2 wreck</li> <li>• Collapsed wharf, BP site, Berrys Bay</li> </ul> </li> <li>e) Requirements for any mitigation recovery or archaeological excavations.</li> </ul>	WHT
NAH17	Pre-construction	Maritime non-Aboriginal heritage impacts	Any pre-dredge clearance of the bed of the harbour in Sydney Harbour will be carried out in the presence of a qualified maritime archaeologist who will identify any additional inspection or documentation that should be carried out during the clearance dives. This may include inspecting the locations of known or suspected submerged cultural heritage, detailed recording, or recovery and relocation of heritage objects.	WHT

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NAH18	Pre-construction	Maritime non-Aboriginal heritage impacts	<p>Archival recording of the following maritime heritage sites will be carried out prior to works commencing in order to mitigate against predicted or potential impacts, and to establish a baseline against which to measure any changes to these sites due to works at:</p> <ul style="list-style-type: none"> <li>a) Balls Head Coal Loader wharf</li> <li>b) Unidentified Balls Head Bay 2 wreck</li> <li>c) Yurulbin Park maritime infrastructure</li> <li>d) Collapsed timber wharf, BP site, Berrys Bay</li> <li>e) Slipway No. 1, former Woodleys Shipyard, Berrys Bay.</li> </ul> <p>The archival recording will include:</p> <ul style="list-style-type: none"> <li>a) Creation of a detailed site plan by a surveyor; for Balls Head Coal Loader, Yurulbin Park maritime infrastructure, collapsed timber wharf and Slipway No. 1, former Woodley's shipyard</li> <li>b) Detailed recording and inventory of all site elements</li> <li>c) Detailed diver survey and recording of submerged sites and site elements, primarily in the form of video and photography.</li> </ul> <p>All archival recordings are to be prepared consistently with the current NSW Heritage Council endorsed standards and guidelines.</p>	WHT
NAH19	Pre-construction	Maritime non-Aboriginal heritage impacts	<p>A side scan sonar survey will be prepared for sections of the Sydney Harbour crossing not already included in the side scan sonar coverage in Area A in the Appendix K (Technical working paper: Maritime heritage).</p> <p>A qualified maritime archaeologist will assess the results of the side scan survey to identify any additional potential heritage items requiring investigation and assessment.</p>	WHT
NAH20	Pre-construction	Maritime non-Aboriginal heritage impacts	<p>Transport for NSW will give reasonable time and notice for the vessel owners of the historic vessels <i>M.V Cape Don</i> and <i>Baragoola</i> to find a suitable alternate berthing within Sydney Harbour before construction commences.</p> <p>Transport for NSW will take no action that results in the degradation of the heritage items until relocation occurs.</p>	WHT



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NAH21	Construction	Maritime non-Aboriginal heritage impacts	An exclusion zone will be established around the former Balls Head Coal Loader wharf extending at least 15 metres from the edge of the wharf apron and thus also covering the Unidentified Balls Head Bay 1 and 2 wrecks.	WHT - Balls Head Coal Loader Wharf
<b>Aboriginal cultural heritage</b>				
AH1	Pre-construction and construction	Aboriginal heritage – vibration, and settlement impacts	<p>Prior to construction, further consultation with Department of Premier and Cabinet (Heritage), the Metro LALC and the RAPs will be carried out to decide an appropriate course of action for previously recorded Aboriginal sites not assessed during archaeological surveys due to site accessibility constraints.</p> <p>If new information regarding site condition and location is identified during consultation suggesting the sites may be subject to impacts due to vibration and settlement, then mitigation measures AH2, AH3 and AH4 will apply.</p> <p>If during construction works a site is located, Department of Premier and Cabinet (Heritage), an appropriately qualified archaeologist and the Metro LALC will be contacted and the site will be re-recorded in situ.</p> <p>If the site is determined to be within the construction footprint, consultation between Department of Premier and Cabinet (Heritage), Transport for NSW and Metro LALC and RAP groups will occur with the aim of avoiding, minimising and managing adverse impacts on the site before construction works at the location recommence.</p>	<p>Yerroulbin Cave (45-6-2287)</p> <p>Long Nose Point 1 (45-6-1901)</p> <p>5 Hands Shelter (45-6-2967)</p> <p>Shed Cave (45-6-2672)</p>
AH2	Pre-construction and construction	Aboriginal heritage – vibration impacts	<p>The following process will be carried out to confirm where vibration monitoring at terrestrial AHIMS sites will be required:</p> <ol style="list-style-type: none"> <li>Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound</li> <li>Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound</li> <li>A screening of vibration intensive activities within 50 metres of</li> </ol>	All registered AHIMS sites located within 50 metres of the project construction footprint

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			<p>structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second</p> <p>d) Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.</p>	
AH3	Construction	Aboriginal heritage – vibration impacts	<p>Vibration monitoring will be carried out at AHIMS sites that have been identified as requiring monitoring in accordance with the process outlined in mitigation measure AH2.</p> <p>Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites.</p>	All registered AHIMS sites subject to vibration intensive activities determined to be structurally unsound (see AH2)
AH4	Construction	Aboriginal heritage – vibration impacts	<p>If vibration monitoring identifies that vibration levels exceed 2.5 millimetres per second at AHIMS sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly.</p> <p>Condition surveys may include further photogrammetry and 3D-capture techniques.</p>	All registered AHIMS sites subject to vibration intensive activities determined to be structurally unsound (see AH2)
AH5	Construction	Unexpected discovery of historical heritage materials, features, or deposits	<p>If at any time during construction of the project, any items of potential Aboriginal archaeological or cultural heritage conservation significance or human remains are discovered they will be managed in accordance with the <i>Standard Management Procedure: Unexpected Heritage Items</i> (Roads and Maritime Services, 2015e).</p>	WHT/WFU
AH6	Construction	Aboriginal heritage –	<p>Cultural and historic heritage awareness training will be carried out for personnel engaged in work that may impact heritage items before</p>	WHT/WFU

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		impacts	commencing works for the project.	
AH7	Pre-construction	Maritime Aboriginal heritage impacts	The need for further high-resolution geophysical survey/s to identify the presence of submerged rock overhangs concealed by marine sediments will be investigated in consultation with a maritime archaeology advisor. If it is determined that a high resolution geophysical survey could produce the desired results, the geophysical survey will be carried out.	Sydney Harbour south and north cofferdams (WHT5 and WHT6)
AH8	Construction	Maritime Aboriginal heritage impacts	<p>The following mitigation measures will be carried out if the geophysical survey described in AH7 is inconclusive or if the geophysical survey identifies rock overhangs at least 1.2 metres in height:</p> <ul style="list-style-type: none"> <li>a) Excavations will be visually monitored after WHT5 and WHT6 cofferdams have been de-watered in order to identify voids within the bedrock and identify potential rock shelters</li> <li>b) In consultation with a suitably experienced geomorphologist, criteria will be established for the identification of pre-inundation soil deposits (peat, charcoal, roots, etc.), and where necessary samples of marine sediments will be collected to identify if pre-inundation soil deposits are evident</li> <li>c) If pre-inundation soil deposits are evident then a controlled archaeological investigation will be carried out to recover any artefacts, subject to bed rock conditions and safety constraints within the cofferdams.</li> </ul>	Sydney Harbour south and north cofferdams (WHT5 and WHT6)
AH9	Pre-construction and construction	Maritime Aboriginal heritage impacts	<p>Prior to construction, determination of whether dredged soil units have potential to contain cultural material will be carried out by a palaeo-geomorphologist through review of existing borehole information.</p> <p>If the potential to encounter cultural material is identified, then an appropriate sampling protocol will be designed so that samples can be collected during construction if feasible.</p>	Dredging works in the immediate vicinity of borehole B215W in Area A, located between Yurulbin Point and Balls Head (Appendix L (Technical working paper: Cultural

Ref	Phase	Impact	Environmental management measure	Location
				heritage assessment report))
<b>Geology, soils and groundwater</b>				
SG1	Design	Ground movement impacts	Detailed predictive settlement models will be developed for areas of concern to guide tunnel design and construction methodology, including the selection of options to minimise settlement where required.	WHT/WFU
SG2	Pre-construction	Impact to registered groundwater bores	The viability of domestic bores GW109209, GW107764 and GW108991 will be confirmed prior to construction. If drawdown at the bores exceeds two metres (in accordance with the Aquifer Interference Policy), measures will be taken to 'make good' the impact by restoring the water supply to pre development levels. The measures taken will be dependent upon the location of the impacted bores and will be determined in consultation with the affected licence holder but could include, deepening the bore, providing a new bore or providing an alternative water supply.	WHT
SG3	Pre-construction	Impact to registered groundwater bores	An Independent Property Impact Assessment Panel, comprising geotechnical and engineering experts, will be established prior to the commencement of works to independently verify building condition survey reports, resolve any property damage disputes and establish ongoing settlement monitoring requirements.	WHT/WFU
SG4	Pre-construction	Ground movement impacts	Building/structure condition surveys will be prepared for properties (and heritage assets) within the zone of influence of tunnel settlement (for example within the 5 millimetre predicted surface settlement contour and within 50 metres of surface works) prior to the commencement of construction.	WHT/WFU
SG5	Construction	Erosion and sedimentation	Erosion and Sediment measures will be implemented at all work sites in accordance with the principles and requirements in 'Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom, 2004) and	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
			Volume 2D (NSW Department of Environment and Climate Change, 2008), commonly referred to as the 'Blue Book'.	
SG6	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of contaminated material	<p>Potentially contaminated areas directly affected by the project will be investigated and managed in accordance with the requirements of guidance endorsed under section 105 of the <i>Contaminated Land Management Act 2008</i>.</p> <p>This includes, but is not limited to, further investigations in potential areas of environment interest in the project footprint, including:</p> <ul style="list-style-type: none"> <li>• Easton Park</li> <li>• Birchgrove peninsula (including Yurulbin Park)</li> <li>• Balls Head peninsula</li> <li>• Waverton Park</li> <li>• Warringah Freeway (from North Sydney to Cammeray).</li> </ul> <p>Subject to the outcomes of the investigations, a Remediation Action Plan will be implemented in the event that site remediation is warranted prior to construction.</p> <p>The Remediation Action Plan will be prepared and implemented in accordance with Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land (Department of Urban Affairs and Planning and EPA, 1998).</p> <p>An independent NSW EPA Accredited site Auditor will be engaged to review all contamination reports and evaluate the suitability of sites for a specified use as part of the project.</p>	WHT/WFU
SG7	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of contaminated material	Any soil/fill materials surplus to construction will be classified in accordance with the NSW EPA (2014a) Waste Classification Guidelines.	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
SG8	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of contaminated material	Asbestos handling and management will be carried out in accordance with relevant legislation, codes of practice and Australian standards.	WHT/WFU
SG9	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of contaminated material	A hazardous materials assessment will be carried out prior to and during the demolition of buildings. Demolition works will be carried out in accordance with the relevant Australian Standards and relevant NSW WorkCover Codes of Practice, including the NSW Work Health and Safety Regulation 2011.	WHT/WFU
SG10	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of contaminated material	The Construction Waste Management Plan for the project will include procedures for handling and storing potentially contaminated substances.	WHT/WFU
SG11	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of	The discovery of previously unidentified contaminated material will be managed in accordance with an unexpected contaminated lands discovery procedure, as outlined in the <i>Guideline for the Management of Contamination</i> (Roads and Maritime, 2013a).	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
		contaminated material		
SG12	Construction	Impacts from disturbance of acid sulfate soils	Prior to ground disturbance in high risk acid sulfate areas at Birchgrove Park, Rozelle Rail Yards, Sydney Harbour (tunnel crossing, White Bay and Berrys Bay) and Whites Creek, testing will be carried out to determine the presence of acid sulfate soils. If acid sulfate soils are encountered, they will be managed in accordance with the Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998b).	WHT
SG13	Construction	Ground gas impacts	Ground gas investigations will be carried out in Easton Park, Rozelle Rail Yards and Waverton Park to assess for the potential presence landfill generated gas which could impact on the construction and/or operation of the project. Ground gas investigations will be carried out in accordance (where applicable) with the Guideline for the Assessment and Management of Sites Impacted by Hazardous Ground Gases (NSW EPA, 2012b).	WHT
SG14	Construction	Groundwater drawdown during construction	Where groundwater inflows exceed 1L/sec/km during construction, feasible and reasonable measures to manage inflow will be applied.	WHT
SG15	Construction	Marine contamination impacts	The appropriateness of offshore disposal will be assessed in accordance with the Department of the Environment, Water, Heritage and the Arts' National Assessment Guidelines for Dredging (Department of Environment, Water, Heritage and the Arts, 2009). Offshore disposal will only be appropriate for material that meets the NADG criteria.	WHT
SG16	Construction	Marine contamination impacts	Marine sediments requiring disposal to landfill will be assessed in accordance with the NSW EPA (2014a) Waste Classification Guidelines.	WHT

Ref	Phase	Impact	Environmental management measure	Location
SG17	All phases	Groundwater drawdown	Outcomes of updated groundwater modelling will identify any requirements for further groundwater monitoring, and management of groundwater drawdown and associated impacts.	WHT/WFU
SG18	Pre-construction and pre-operation	Groundwater drawdown	As more information becomes available through ongoing groundwater monitoring, groundwater modelling will be updated. Construction and operational inflow predictions will be updated prior to construction, and operational inflow and impact predictions will be updated at the end of the construction period.	WHT/WFU
SG19	Construction and operation	Groundwater drawdown	The existing groundwater monitoring program will be continued through construction and onto the operational phase.	WHT/WFU
SG20	Construction and operation	Groundwater drawdown	A groundwater quality monitoring program will be developed and implemented, taking into consideration the location of areas subject to medium and high risk of groundwater contamination during construction and operation. Where relevant, modelling/mass balance analysis will be carried out to assess potential impacts on beneficial aquifer use and the likely quality of groundwater inflows.	WHT/WFU
SG21	Construction and operation	Groundwater drawdown	If the groundwater quality monitoring and associated analysis identifies potential impacts to beneficial aquifer use from the migration of contaminated groundwater, or the quality of groundwater tunnel inflows, feasible and reasonable management measures will be identified and implemented.	WHT/WFU
SG22	Construction and operation	Groundwater modelling update	As more information becomes available through ongoing groundwater monitoring, groundwater modelling will be updated to refine the predictions documented in this technical working paper. Inflow predictions will be updated during further design development and operational inflow and impacts predictions will be updated at the end of the construction period. If refined predictions indicate that groundwater inflows and water table	WHT/WFU



Ref	Phase	Impact	Environmental management measure	Location
			drawdown will be greater than the impacts documented in this this technical working paper, feasible and reasonable measures will be implemented.	
SG23	Construction and operation	Contamination due to leakage or spills and accidental spills during operation	Emergency Spill measures will be developed to avoid and manage accidental spillages of fuels, chemicals, and fluids to minimise the risk of human health impacts and contamination of groundwater.	WHT/WFU
<b>Hydrodynamics and water quality</b>				
WQ1	Construction	Erosion and sedimentation	Erosion and sediment measures will be implemented at all work sites and surface road upgrades in accordance with the principles and requirements in <i>Managing Urban Stormwater – Soils and Construction, Volume 1</i> (Landcom, 2004), <i>Managing Urban Stormwater: Volume 2D Main Road Construction</i> (NSW Department of Environment and Climate Change, 2008) and relevant guidelines, procedures and specifications of Transport for NSW. A soil conservation specialist will be engaged by both Transport for NSW and the Contractor for the duration of construction of the project to provide advice regarding erosion and sediment control including review of Erosion and Sediment Control Plans (ESCPs).	WHT/WFU
WQ2	Construction	Spills and leakages	Emergency spill procedures will be developed to avoid and manage accidental spillages of fuels, chemicals or fluids during construction.	WHT/WFU
WQ3	Construction	Wastewater discharge	Construction wastewater treatment plants will be designed to treat wastewater generated from tunnel groundwater ingress, rainfall runoff in tunnel portals, heat and dust suppression water and washdown runoff generated during construction. Site-specific trigger values will be developed during construction planning to set the wastewater treatment plant discharge criteria ensuring wastewater will be treated to a level that is representative of background	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
			concentrations of a suitable reference site or the ANECC/ARMCANZ (2018) guidelines.	
WQ4	Construction	Freshwater quality monitoring	<p>A freshwater quality monitoring program for the construction of the project will be developed and implemented, with consideration of the freshwater monitoring being carried out for the M4-M5 Link and Beaches Link and Gore Hill Freeway Connection projects.</p> <p>The program will be developed in consultation with the Environment Protection Authority, Department of Planning, Industry and Environment (Regions, Agriculture and Resources), Department of Planning, Industry and Environment (Water), and relevant councils.</p> <p>Sampling locations and monitoring methodology will be in accordance with the <i>Guideline for Construction Water Quality Monitoring</i> (RTA 2003b).</p> <p>Each monitoring/discharge point will have a specific concentration of pollutant that cannot be exceeded at the discharge point. Should any of the site-specific trigger values be exceeded, a management response will be triggered. This response will be documented within the construction freshwater quality monitoring program.</p>	WHT/WFU
WQ5	Construction	Local stormwater system capacity	Further design development will confirm the local stormwater system capacity to receive construction wastewater treatment plant inflows. In the event that there is a stormwater infrastructure capacity issue with existing infrastructure, mitigation measures such as storage detention to control water outflow during wet weather events will be implemented within the construction support site.	WHT
WQ6	Construction	Dredge plumes	Ongoing monitoring of dredge plumes will be carried out to validate the dredge plume dispersion predictions. Exceedances of the predicted dredge plume extents and intensities will trigger subsequent management responses that will include a range of strategies including, assessing whether secondary impacts are occurring (eg seagrass stress) and if so then further levels of management actions that may ultimately result in the	WHT

Ref	Phase	Impact	Environmental management measure	Location
			cessation of dredging for a period sufficient to remove the stress.	
WQ7	Construction	Watercourse geomorphology	Construction drainage and discharge outlet infrastructure will direct flows downstream to minimise alterations and erosion of watercourse bed and banks. Energy dissipation and erosion scour protection will be implemented as appropriate. Construction work activities within or next to the watercourses and drainage lines will be minimised as much as feasibly possible to minimise disturbance of sediments in or near the waterway.	WHT/WFU
WQ8	Design and post-construction	North Sydney Council stormwater harvesting scheme	Reasonable and feasible opportunities to provide an interim or permanent solution for the relocation of the existing storage dam at Cammeray Golf Course earlier in program will be identified in consultation with North Sydney Council during detailed construction planning. During periods when the storage dam is no longer operational, Transport for NSW will come to an arrangement with North Sydney Council concerning the period in which the storage dam is no longer operational for the increased demand on other water sources.	WHT
WQ9	Design and operation	Wastewater discharge	The permanent wastewater treatment plant at Rozelle will be designed to treat wastewater generated from tunnel groundwater ingress and rainfall runoff in tunnel portals. The level of treatment provided will consider the characteristics of the receiving environment (Rozelle Bay). Discharge from WWTP during the operation of the project will be required to meet specific discharge criteria as per ANZG (2018) 95% species protection levels; ANZG (2018) 99% protection levels for contaminants that bioaccumulate and the NHMRC (2008b) recreational guidelines water quality criteria for iron. These criteria will be defined during the construction planning phase to assist in determining wastewater treatment plant discharge criteria and ensure neutral or beneficial impacts to water quality of Rozelle Bay. Should any of the criteria be exceeded, a management response will be triggered. The management response will be documented within the	WHT

Ref	Phase	Impact	Environmental management measure	Location
			Water Quality Monitoring Program.	
WQ10	Design and operation	Local stormwater system capacity	The capacity for the local stormwater system to receive operational wastewater treatment plant inflows will be confirmed during further design development. In the event that there is a stormwater infrastructure capacity issue with existing infrastructure, mitigation measures such as storage detention to control water outflow during wet weather events will be implemented at the Rozelle Rail Yards.	WHT
WQ11	Operation	Operational monitoring	Operational monitoring will be carried out in line with the <i>Guideline for Construction Phase Water Quality Monitoring</i> (RTA, 2003b) to: <ul style="list-style-type: none"> <li>• Assess and manage impacts on the receiving waters as the sites stabilise</li> <li>• Assist in deciding when the site has stabilised</li> <li>• Identify water quality conditions after development</li> <li>• Identify appropriate measures to improve water quality performance.</li> </ul> As a minimum, monthly monitoring will be carried out for the first year of operation. Should any of the discharge criteria be exceeded, a management response will be triggered. The management response will be documented within the operational water quality monitoring program.	WHT/WFU
<b>Flooding</b>				
F1	Design	Impact of the project on flood behaviour	Impact of the project on flood behaviour during construction and operation will be confirmed during further project development. This will include the consideration of future climate change and a partial blockage of the local stormwater drainage system. A floor level survey will be carried out in affected areas to determine whether the project would increase flood damage in adjacent development (i.e. in properties where there is a potential for increases in peak flood levels for storms of up to 1% AEP in intensity). The design of the project will incorporate measures that are aimed at mitigating the impact of the project on flood behaviour in	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
			properties where existing buildings would experience above-floor inundation under present day conditions during storms of up to 1% AEP in intensity.	
F2	Design	Flooding on the Warringah Freeway	Where feasible and reasonable, the hydraulic capacity of the existing transverse drainage of the Warringah Freeway will be designed to comply with relevant guidelines and standards.	WFU
F3	Construction	Flooding impacts to tunnel excavation	Entries to tunnel excavations, including cut and cover sections of tunnel, will be protected against frequent flooding by locating openings outside flood prone areas, and/or the provision of local bunding and flood protection barriers.	WHT
F4	Construction	Flooding impacts to tunnel excavation	The flood standard adopted at each tunnel entry during construction will be developed taking into consideration the duration of construction, the magnitude of inflows and the potential risks to personal safety and the project works.	WHT
F5	Construction	Flood impacts to construction sites	Spoil stockpiles will be located in areas which are not subject to frequent inundation by floodwater, ideally outside the 1% AEP flood extent. The exact level of flood risk accepted at stockpile sites will depend on the duration of stockpiling operations, the type of material stored, the nature of the receiving drainage lines and also the extent to which that would impact flooding conditions in adjacent development.	WHT/WFU
F6	Construction	Flood impacts to construction sites	Site facilities will be located outside high flood hazard areas based on a 1% AEP flood.	WHT/WFU
F7	Construction and operation	Impact of flooding on the project	Flood emergency management measures for construction and operation of the project will be incorporated into relevant environmental and/or safety management documentation.	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
<b>Biodiversity</b>				
B1	Construction	Removal of native vegetation and threatened species habitat	Vegetation removal will be further minimised, where feasible and reasonable.	WHT/WFU
B2	Construction	Removal of native vegetation and threatened species habitat	Vegetation removal will be carried out in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011a).	WHT/WFU
B3	Construction	Removal of native vegetation and threatened species habitat	The unexpected species find procedure included in <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011b) will be followed if threatened ecological communities, flora or fauna species, not assessed in the biodiversity assessment, are identified in the construction footprint.	WHT/WFU
B4	Construction	Removal of native vegetation and threatened species habitat	Vegetation will be re-established, where feasible and reasonable, in accordance with <i>Guide 3: Re-establishment of native vegetation</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011c).	WHT/WFU
B5	Construction	Removal of threatened flora species	Pre-clearing surveys for threatened flora species will be carried out in accordance with <i>Guide 1: Pre-clearing process</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011d).	WHT/WFU
B6	Construction	Noise, vibration and light impacts	Carry out inspections of Eastern Bentwing-bat roosting sites in the surrounding locality (eg concrete box culverts, jetties) prior to construction, to determine the roosting capacity of each site at times roosting numbers are expected to be high.	WHT

Ref	Phase	Impact	Environmental management measure	Location
B7	Construction	Noise, vibration and light impacts	Monthly monitoring of Eastern Bentwing-bats in the Coal Loader tunnel will be carried out prior to construction (in the months of March to September), preferably by utilising thermal camera imaging at tunnel entrances (a less invasive method than carrying out counts within the tunnel itself).	WHT
B8	Construction	Noise, vibration and light impacts	Monthly monitoring of Eastern Bentwing-bats in the Coal Loader tunnel during construction (in the months of March to September) will be carried out, preferably by utilising thermal camera imaging at tunnel entrances (a less invasive method than carrying out counts within the tunnel itself).	WHT
B9	Construction	Noise, vibration and light impacts	Adaptive management measures (supplemented by additional monitoring if required) to minimise impacts on the Eastern Bentwing-bat will be developed in consultation with Department of Planning, Industry and Environment (Environment, Energy and Science, and the Regions, Industry, Agriculture and Resources divisions), North Sydney Council and an appropriately qualified expert in microbat biology and behaviour, if monthly monitoring during construction suggests Eastern Bentwing-bat behaviour is affected by construction noise.	WHT
B10	Construction	Injury and mortality of fauna	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011e).	WHT/WFU
B11	Construction	Injury and mortality of fauna	Pre-clearing surveys will be carried out in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011d).	WHT/WFU
B12	Construction	Injury and mortality of fauna	Pre-clearing surveys for microbat roosts will be carried out on the wharf structures to be demolished at Yurulbin Point (WHT4) and Berrys Bay (WHT7) construction support sites. If microbats are identified roosting in these structures, individuals will be excluded from this roosting habitat.	WHT

Ref	Phase	Impact	Environmental management measure	Location
B13	Construction	Injury and mortality of fauna	An observer qualified to spot Little Penguins will be used during marine construction activities. A stop-work procedure will be implemented upon sighting of the species in the proximity of the works area.	WHT
B14	Construction	Invasion and spread of weeds, pests, pathogens and disease	Weed species will be managed in accordance with <i>Guide 6: Weed management</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011f).	WHT/WFU
B15	Construction	Invasion and spread of weeds, pests, pathogens and disease	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011g).	WHT/WFU
B16	Construction	Impacts to marine vegetation and sensitive habitat	Transit routes for vessels entering and departing from construction support sites will be marked out with consideration for propeller wash and distances to sensitive marine habitats.	WHT
B17	Construction	Impacts to marine vegetation and sensitive habitat	Exclusion zones will be implemented to avoid disturbance to sensitive marine habitats not proposed to be directly impacted by the project. These include any intertidal sand and mudflats, intertidal rocky shore, subtidal rocky reef and seagrass habitats with potential to occur within or next to transit routes and vessel movements. Routine inspections and maintenance of exclusion fencing will be carried out.	WHT
B18	Construction	Impacts to marine vegetation and sensitive habitat	The velocity of wastewater treatment plant discharge will be minimised to avoid scour impacts on the marine environment.	WHT/WFU



Ref	Phase	Impact	Environmental management measure	Location
B19	Construction	Impacts to marine vegetation and sensitive habitat	To minimise the potential impact of turbidity (suspended sediment) on sensitive marine vegetation and habitats silt curtains will be installed around seagrass patches and subtidal rocky reef contained within the Zone of Influence.	WHT
B20	Construction	Impacts to marine vegetation and sensitive habitat	Silt curtains will be monitored for effectiveness particularly following inclement weather and maintenance carried out when required, Records of monitoring and maintenance will be kept.	WHT
B21	Construction	Impacts to marine vegetation and sensitive habitat	Subtidal rocky reef and intertidal rocky shore habitat removed along the shoreline at the Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6) will be rehabilitated and restored as close as possible to pre-construction conditions where feasible and reasonable.	WHT
B22	Construction	Invasion and spread of marine pests, pathogens and disease	Locally sourced vessels and equipment will be used where feasible and reasonable. Any vessels sourced internationally will be inspected for potential marine pests prior to departing from their previous port. Construction contractors will need to demonstrate that due diligence has been taken to avoid introducing marine pests, pathogens or disease from internationally sourced vessels and/or construction equipment prior to departure.	WHT
B23	Construction	Invasion and spread of marine pests, pathogens and disease	A targeted survey will be conducted of the dredge footprint to locate any areas of the marine algal pest <i>Caulerpa taxifolia</i> . If <i>Caulerpa taxifolia</i> is identified within the dredging footprint, surface sediments from these areas will be disposed of onshore rather than in the marine environment.	WHT
B24	Construction	Impacts to marine species	A stop work procedure will be developed to address marine mammal or reptile activity.	WHT
B25	Construction	Impacts to	Salvage of live fish and other native marine organisms (eg large, mobile	WHT

Ref	Phase	Impact	Environmental management measure	Location
		marine species	macroinvertebrates) will occur during cofferdam dewatering. All salvaged organisms will be immediately relocated to similar habitat nearby.	
B26	Construction	Underwater noise impacts to marine species	Visual monitoring from the harbour surface will be carried out to identify any underwater noise related impacts on fish. If required, additional at source protection measures will be considered.	WHT
<b>Land use and property</b>				
LP1	Pre-construction and construction	Property acquisition	Land acquisition for the project will be carried out in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> (NSW), the <i>Roads and Maritime Services Land Acquisition Information Guide</i> (Roads and Maritime, 2014a) and <i>Fact sheet: Property acquisition of subsurface lands</i> (Roads and Maritime, 2015) and in accordance with the land acquisition reforms announced by the NSW Government in 2016.	WHT/WFU
LP2	Construction	Temporary use of land	Land subject to temporary use, including areas of public open space, will be rehabilitated as soon as practicable to an appropriate land use, taking into consideration the location, land use characteristics, area and adjacent land uses. This will be carried out in consultation with the relevant council and/or the land owner.	WHT/WFU
LP3	Construction	Access impediments to private property	Where impacts to private property access is unavoidable during construction, property owners will be consulted in advance to develop appropriate alternative access arrangements.	WHT/WFU
LP4	Pre-construction and construction	Temporary relocation of moorings	Transport for NSW will consult with the owners and/or leaseholders and/or licence holders of moorings that require temporary relocation to determine alternative arrangements. All efforts will be made to relocate facilities as close to their original locations as possible.	WHT
LP5	All phases	Changes to lease arrangements	Transport for NSW will consult with existing lease holders regarding any changes to lease arrangements.	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
LP6	Operation	Residual land	Residual land remaining following construction of the project will be confirmed to identify appropriate land use, taking into consideration the location, land use characteristics, area and adjacent land uses.	WHT/WFU
LP7	Operation	Residual land at Cammeray Golf Course	Transport for NSW will continue to work with Cammeray Golf Club with a view to maintaining the long term viability of Cammeray Golf Course.	WHT/WFU
LP8	Operation	Air quality impacts for elevated receivers located around ventilation outlets and motorway facilities	Transport for NSW will assist Inner West Council, North Sydney Council and the Department of Planning, Industry and Environment (as appropriate) in determining relevant land use considerations applicable to future development in the immediate vicinity of ventilation outlets for inclusion in local environmental plans or development control plans, where required, to manage interactions between the project and future development. This may include procedures for identifying the requirement for consultation with Transport for NSW.	WHT/WFU
<b>Socio-economics</b>				
SE1	Design	Social infrastructure	Where feasible and reasonable, the extent of permanent impact on public open space areas (for example, ANZAC Park, St Leonards Park, Cammeray Golf Course) will be minimised in further design development.	WHT/WFU
SE2	Construction	Social infrastructure	Parks, open space and sport and recreation areas impacted by construction and not required for permanent infrastructure will be reinstated and rehabilitated.	WHT/WFU
SE3	Construction	Social infrastructure	Ongoing engagement will be carried out with managers of social infrastructure located near to surface construction works/construction support sites and sensitive social infrastructure above the tunnel alignment (for example, schools, places of worship, aged care, child care, health and medical facilities) about the timing and duration of construction works and management of potential impacts.	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
BU1	Pre-construction, construction	Business	Where businesses are affected by property acquisition, or lease cessation, the acquisition and compensation process will be implemented in line with the <i>Determination of compensation following the acquisition of a business guideline</i> . Compensation for a business conducted on land that is acquired will be determined in accordance with <i>the Land Acquisition (Just Terms Compensation) Act 1991</i> (NSW) as relevant.	WHT/WFU
BU2	Construction	Business	Specific consultation will be carried out with businesses potentially impacted during construction. Consultation will aim to identify specific potential construction impacts for individual businesses.	WHT/WFU
BU3	Construction	Business	Based on consultation with businesses, specific feasible and reasonable measures to maintain business access, visibility and parking and address other potential impacts as they arise through the construction process will be identified and implemented. A phone hotline that enables businesses to find out about the project or register any issues will be maintained.	WHT/WFU
<b>Landscape character and visual amenity</b>				
V1	Construction	Built form	Construction support sites will be developed to minimise visual impacts for adjacent receivers where feasible and reasonable.	WHT/WFU
V2	Construction	Built form	Storage areas and associated works will be located in cleared and otherwise disturbed areas away from residential areas where feasible and reasonable.	WHT/WFU
V3	Construction	Built form	Site hoardings will be in neutral colours and designs in proximity to open space to help blend them into the surrounding environment.	WHT/WFU
V4	Construction	Built form	Site hoarding and perimeter site areas will be maintained regularly to include the prompt removal of graffiti.	WHT/WFU
V5	Construction	Built form	Site lighting will be designed to minimise glare issues and light spillage into adjoining properties and be generally consistent with the	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
			requirements of Australian Standards and Guidelines 4282 – 1997 Control of the obtrusive effects of outdoor lighting.	
V6	Construction	Built form	Hoardings and temporary noise walls will be erected as early as possible within the site establishment phase to provide visual screening.	WHT/WFU
V7	Construction	Built form	High quality fencing suitable for parks and public spaces will be used where construction support sites are located in close proximity to sensitive residential receivers such as residents and users of recreational space.	WHT/WFU
V8	Construction	Vegetation/ landscaping	Existing trees adjacent to the works will be retained and protected where possible to screen construction support sites, minimising clearing where possible.	WHT/WFU
V9	Construction	Vegetation/ landscaping	Where possible, trees will be trimmed rather than removed. Works will be carried out by a qualified arborist.	WHT/WFU
V10	Construction	Vegetation/ landscaping	All areas disturbed by construction and not required for operation of the project will be restored to existing condition.	WHT/WFU
V11	Construction	Vegetation/ landscaping	Early planting works will be considered to provide a screening buffer that has time to mature before the project is fully operational.	WHT/WFU
<b>Hazards and risks</b>				
HR1	Construction	Storage of dangerous goods and hazardous substances	Dangerous goods and hazardous materials will be stored in accordance with supplier's instructions and relevant legislation, Australian Standards, and applicable guidelines and may include bulk storage tanks, chemical storage cabinets/containers or impervious bunds.	WHT/WFU
HR2	Construction	Transportation of dangerous goods and	Dangerous goods and hazardous substances will be transported in accordance with relevant legislation and codes, including the <i>Dangerous Goods (Road and Rail Transport) Act 2008</i> , Road and Rail Transport	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
		hazardous substances	(Dangerous Goods) (Road) Regulation 1998 and the <i>Australian Code for the Transport of Dangerous Goods by Road and Rail</i> (National Transport Commission, 2007).	
HR3	Construction	Bushfire	Adequate access and egress for fire fighting vehicles and construction vehicles and staff will be provided at the Berrys Bay construction support site (WHT7). Access roads will have a minimum width of four metres to allow passage of fire fighting vehicles.	WHT (Berrys Bay construction support site (WHT7))
HR4	Construction	Bushfire	Adequate setbacks from bush fire prone vegetation will be provided for the Berrys Bay construction support site (WHT7).	WHT (Berrys Bay construction support site (WHT7))
HR5	Construction	Bushfire	First response capabilities, including fire extinguishers, water carts and hoses, will be provided at the Berrys Bay construction support site (WHT7).	WHT (Berrys Bay construction support site (WHT7))
HR6	Operation	Fire and life safety	The fire and safety systems and measures adopted for the project will be equivalent to or exceed the fire safety measures recommended by NFPA502 (American), PIARC (European), AS4825 and AS3959-2009 (Australian) and relevant Transport for NSW standards.	WHT/WFU
HR7	Operation	Transportation of dangerous goods and hazardous substances	The transport of dangerous goods and hazardous substances will be prohibited through the mainline tunnels and on and off-ramp tunnels.	WHT/WFU
HR8	Operation	Incident response	The response to incidents within the motorway will be managed in accordance with the memorandum of understanding between Transport for NSW and the NSW Police Service, NSW Rural Fire Service, NSW Fire Brigade and other emergency services.	WHT/WFU
HR9	Operation	Aviation risks	The ventilation outlet and motorway facilities at Rozelle Interchange and	Ventilation outlet and

Ref	Phase	Impact	Environmental management measure	Location
			Warringah Freeway will be operated in accordance with any conditions of approval from the Secretary of Department of Infrastructure and Regional Development to manage penetration of the OLS and PANS-OPS surfaces.	motorway facilities at the Rozelle Interchange and at the Warringah Freeway
<b>Resource use and waste management</b>				
WM1	Construction	Resource use	Construction materials will be sourced in accordance with the project's Sustainability Framework and with a preference for Australian materials and prefabricated products with low embodied energy, where feasible and reasonable.	WHT/WFU
WM2	Construction	Resource management	The resource management hierarchy principles established under the <i>Waste Avoidance and Recovery Act 2001</i> of avoid/reduce/reuse/recycle/dispose will be applied.	WHT/WFU
WM3	Construction	Waste generation and disposal	Wastes will be classified in accordance with the NSW Environment Protection Authority <i>Waste Classification Guidelines: Part 1 Classifying Waste</i> .	WHT/WFU
WM4	Construction	Storage and transport of wastes	Wastes will be appropriately transported, stored and handled according to their waste classification and in a manner than prevents pollution of the surrounding environment.	WHT/WFU
WM5	Construction	Wastewater generation and disposal	Opportunities for wastewater reuse and recycling will be pursued, including recirculating water during tunnel excavation to use for dust suppression. Wastewater not used onsite will be appropriately treated to a level that is representative of background concentrations at the receiving environment prior to discharge into the local stormwater system.	WHT/WFU
WM6	Operation	Resource use and waste generation	The project will be operated in accordance with the relevant aims of the project's Sustainability Framework to optimise resource efficiency and waste management.	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
WM7	Operation	Waste generation and disposal	Waste will be managed and disposed of in accordance with relevant applicable legislation, policies and guidelines, including the <i>Waste Avoidance and Resource Recovery Act 2001</i> and the <i>NSW Waste Avoidance and Resource Recovery Strategy 2014–21</i> (NSW EPA, 2014b).	WHT/WFU
WM8	Operation	Water use and discharge	Opportunities to reuse treated groundwater during project operation will be considered where feasible and reasonable.	WHT
<b>Sustainability</b>				
SU1	Design	Project sustainability outcomes	Project sustainability objectives and targets will be finalised during further design development, informed by the requirements of the project planning approval.	WHT/WFU
SU2	Construction	Project sustainability outcomes	Activities to implement the sustainability framework, including requirements from the Infrastructure Sustainability rating scheme, will be implemented through a Sustainability Management Plan. The management plan will detail measures to meet the sustainability objectives and targets as well as achieving 'Design' and 'As Built' ratings of Excellent under the Infrastructure Sustainability Council of Australia rating scheme.	WHT/WFU
<b>Climate change risks</b>				
CC1	Design	Sea level rise, rainfall and flooding	The following actions will be carried out during further design development to ensure climate change is adequately addressed: a) Flood modelling will continue to use sea level rise projections and rainfall projections b) The extent of scour protection will be refined c) Sensitivity testing for climate change will be carried out for drainage channels and culverts. Increased capacity will be provided where feasible and reasonable d) Any specific property impacts from flooding will be addressed where	WHT/WFU



Ref	Phase	Impact	Environmental management measure	Location
			feasible and reasonable.	
<b>Greenhouse gas emissions</b>				
GHG1	Design	Energy efficiency	Energy efficiency will be considered during further design development with energy efficient systems installed where reasonable and practicable.	WHT/WFU
GHG2	Construction	Emission of greenhouse gases during construction	Greenhouse gas emissions will be managed and minimised as part of the Sustainability Management Plan which will be implemented to assist in achieving 'Design' and 'As Built' ratings of Excellent under the Infrastructure Sustainability Council of Australia rating scheme.	WHT/WFU
<b>Cumulative impacts</b>				
CI1	Pre-construction	Cumulative impacts	Considered and tailored multi-party engagement and cooperation will be established prior to construction to ensure all contributors to impacts are working together to minimise adverse impacts or enhance benefits of multiple projects occurring concurrently or consecutively. Haulage routes and road occupancy will be coordinated with other major transport projects via the Sydney Coordination Office.	WHT/WFU
CI2	Pre-construction	Cumulative construction fatigue	Multi-party engagement and cooperation will be established prior to construction to coordinate with the following projects to manage fatigue impacts where possible: a) M4-M5 Link b) Beaches Link and Gore Hill Freeway Connection c) Sydney Metro City & Southwest.	WHT/WFU
CI3	Construction	Cumulative impacts	Communication strategies for the project will be managed consistently across the NSW Government transport portfolio and in accordance with the Community Consultation Framework for the project, particularly with the Beaches Link and Gore Hill Freeway Connection project.	WHT/WFU
CI4	Construction	Cumulative	Cumulative complaints fatigue will be managed as outlined in Chapter 7	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
		complaints fatigue	(Stakeholder and community engagement). Complaint management tools for the project are outlined in Appendix E (Community consultation framework).	

WHT = Western Harbour Tunnel, WFU = Warringah Freeway Upgrade

