



Australian Government



Coffs Harbour Bypass

Amendment Report
Volume 1C. Chapter 5 (Sections 5.9- 5.13),
Chapters 6-8



Chapter 5

Additional assessment
Sections 5.9 – 5.13

5.9 Aboriginal cultural heritage

5.9.1 Assessment methodology

An Aboriginal cultural heritage assessment methodology was developed as part of the EIS (Chapter 15, Aboriginal cultural heritage). The updated aboriginal cultural heritage assessment report is detailed in **Appendix G, Updated Aboriginal cultural heritage assessment report** and has been prepared in accordance with the SEARs to assess the potential impacts of the project, including the design and construction changes.

The assessment has been carried out in accordance with the following current guidelines:

- Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010c)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010b)
- Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011b)
- Procedure for Aboriginal cultural heritage consultation and investigation (PACHCI) (Roads and Maritime Services 2011).

Additional archaeological investigations carried out in response to proposed design and construction changes have resulted in changes to the description of the existing environment as reported in the EIS, and revised impacts which are presented below.

2020 Additional survey and assessment

An additional archaeological investigation including field survey was carried out in January 2020 to assess areas that are now inside the construction footprint as a result of the proposed design and construction changes. The aim of the survey was to identify any new Aboriginal archaeological sites or areas of potential archaeological deposit (PAD) in the additional areas. The field survey methodology was consistent with that previously used in the assessment of ancillary site areas in 2019 as outlined in the EIS and developed in consultation with registered Aboriginal stakeholder groups.

The assessment included a desktop review of previous archaeological findings, assessment of landscape context for the additional areas, the results of the 2018 and 2019 archaeological investigations and an archaeological survey. Representatives of registered Aboriginal stakeholder groups were invited to attend the field survey but chose not to participate.

The proposed design and construction changes were assessed against the cultural values identified in the EIS to determine whether the changes would result in a change in impact. An updated assessment of Aboriginal cultural values was carried out and is included as Appendix C of **Appendix G, Updated Aboriginal cultural heritage assessment report**.

Aboriginal community consultation

Since the exhibition of the EIS, the following consultation has been carried out:

- A fifth Aboriginal Focus Group (AFG) meeting was held on 23 September 2019 to discuss the findings of the 2019 investigations, the updated draft Cultural Heritage Assessment Report and ongoing assessment pathway
- A sixth AFG meeting was held on 10 March 2020 to discuss the findings of the 2020 investigations and the updated Cultural Heritage Assessment Report. Registered Aboriginal

Parties (RAPs) were asked to provide any comments on the updated draft Cultural Heritage Assessment Report within the statutory 28-day review period. This period was extended by one week following a request from the RAPs.

- In response to a request from the RAPs, a meeting was held on 30 April to discuss the salvage methodologies.

One formal comment was received on the updated draft Cultural Heritage Assessment Report, comprising a combined submission from CHDLALC, Garby Elders Aboriginal Corporation, Jagun Aged and Community Care Ltd and Muurbay Bundani Aboriginal Corporation. Further feedback was then received from CHDLALC on behalf of the RAPs. Comments and TfNSW responses are included in **Appendix G, Updated Aboriginal cultural heritage assessment report**. In summary the comments were about:

- Expansion of the cultural salvage within the construction corridor (Appendix E of **Appendix G, Updated Aboriginal cultural heritage assessment report**)
- The ongoing management of Aboriginal heritage before and during construction.

5.9.2 Existing environment

The landscape context and historical Aboriginal land use was described in Chapter 15, Aboriginal cultural heritage of the EIS and is still applicable to this assessment. Updates to the existing environment as a result of the 2020 additional survey and assessment are described below.

Identified sites

Following further survey and assessment in January 2020, two additional Aboriginal archaeological sites were identified, CHB AFT 16 and CHB PAD 27. The additional areas surveyed as part of the January 2020 survey are shown in **Figure 5.9-1**. The location of the two Aboriginal archaeological sites are shown in **Figure 5.9-2**. These sites were located outside of the areas previously assessed for Aboriginal heritage and comprised new recordings in the northern portion of the study area. Given the surface archaeological deposits at these sites, their landform context and the existing data regarding site type and distribution available from previous investigations for the project, the newly identified archaeological sites were determined to be consistent with previous findings within the study area. The sites would be further investigated as part of the proposed archaeological salvage program.

Beyond the identified Aboriginal sites, the remainder of the additional areas within the amended construction footprint were considered to display low archaeological potential because of combinations of archaeologically unfavourable topography, geology, erosion, or land use disturbance.

CHB AFT 16

CHB AFT 16 comprised a low-density artefact scatter and associated area of potential subsurface deposit located across a spur crest and adjoining slopes. The site was located within proposed ancillary site 3A about 80 metres west of the Pacific Highway and 90 metres south of the intersection of the Pacific Highway and Bruxner Park Road. The site is located close to PAD 26, as described in the EIS. Landform comprises an east-west running spur crest and adjoining southern slopes down towards the creek. The spur descends from a terminal ridge crest to the west. One artefact was identified on the eroded edge of the track cutting across the spur crest. A single core of tuff was identified exhibiting multiple flake scars.

Site CHB AFT 16 was assessed as having moderate archaeological potential based on landform, generally low level of visible disturbance and a moderate likelihood for subsurface archaeological

deposit. Further investigation would contribute to the understanding of Aboriginal landscape use on the elevated landforms between the escarpment and the coast below Korora Lookout.

CHB PAD 27

Site CHB PAD 27 is a PAD located on the land alongside the creek, at the confluence of Pine Brush Creek and Williams Creek. The site was located about 30 metres west of the existing Pacific Highway and adjacent to, and partially within a property on Old Coast Road.

Site CHB PAD 27 was assessed as having moderate archaeological potential based on landform, generally low level of visible disturbance and a moderate likelihood for subsurface archaeological deposit. Further investigation would contribute to the understanding of Aboriginal landscape use on elevated land alongside creeks between the escarpment and the coast.

Identified areas of cultural significance

There were no additional areas of cultural significance identified beyond those outlined in the EIS.

5.9.3 Assessment of potential impacts

Aboriginal archaeology

Construction of the project would impact 26 Aboriginal archaeological sites, 24 of which were identified during the archaeological test excavations carried out between 2017 and 2019 as outlined in the EIS. The two additional Aboriginal archaeological sites identified are located at the proposed Pine Brush Creek and Williams Creek realignment design change and proposed new ancillary site 3A (refer **Table 5.9-1**).

No other proposed design or construction changes would result in changes to impact on Aboriginal cultural heritage compared to the EIS.

Table 5.9-1 Change to impact as a result of proposed design and construction changes

Proposed change	Site name	Site features	Assessed significance	Change to impact on Aboriginal cultural heritage
New ancillary site 3A	CHB AFT 16	Surface artefacts	Moderate	The proposed new ancillary site 3A would have an impact on site CHB AFT 16. The impact to the site would be a direct and total impact, resulting in a total loss of value.
Pine Brush Creek and Williams Creek realignment	CHB PAD 27	Potential archaeological deposit	Moderate	The proposed design change would have an impact on site CHB PAD 27. The impact to the site would be a direct and total impact, resulting in a total loss of value.

Cultural values

Five sites of cultural significance were identified within the general construction footprint area during the cultural values assessment process outlined in the EIS. No additional sites were identified during the 2020 assessment process.

As outlined in the EIS, the West Korora Living Place is a historic living place located on Mackays Road in the 1940s. This site has medium significance for the Aboriginal community as a historical living place used in the 1940s and understood to be located on an older traditional campsite area.

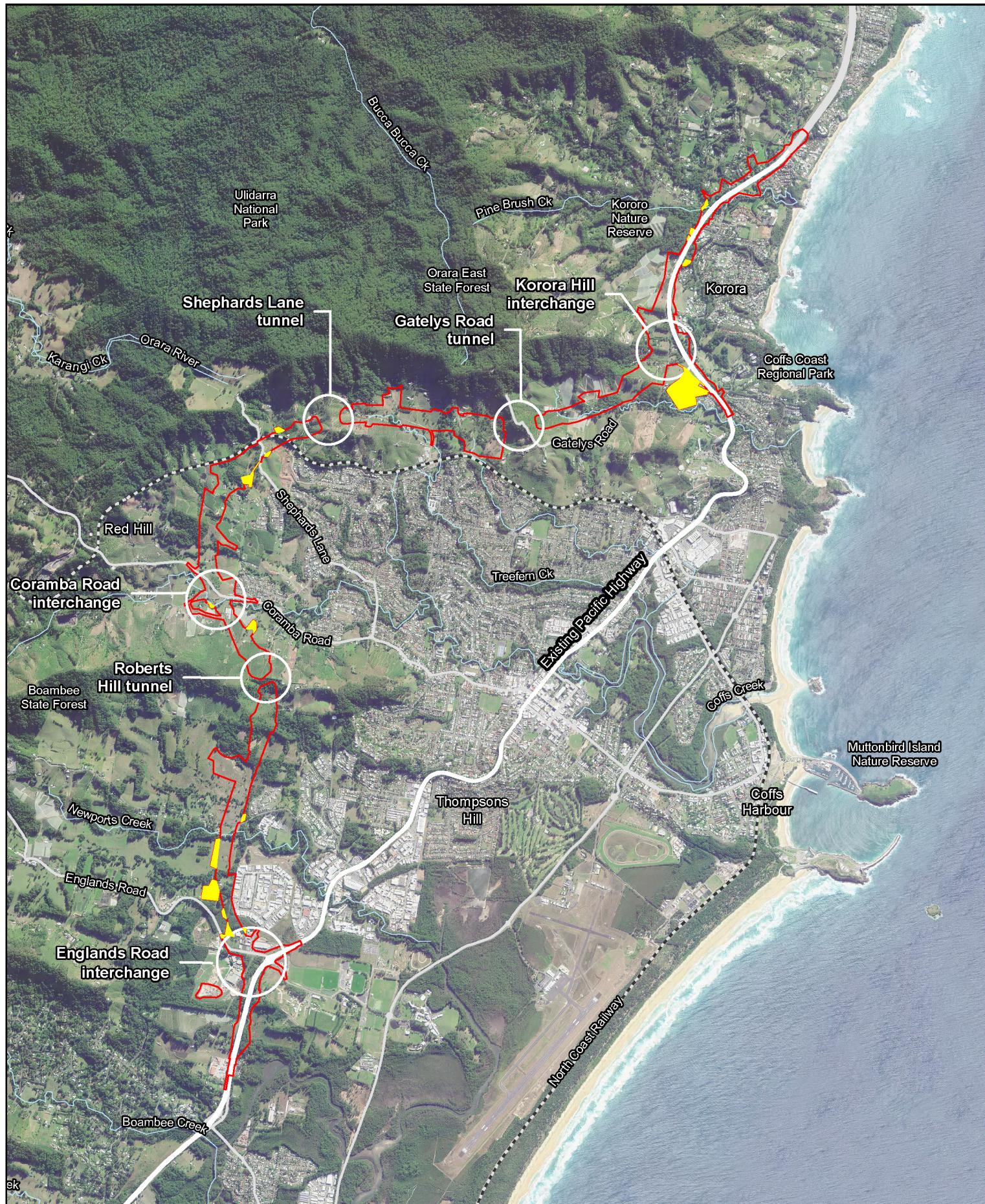
As part of the Mackays Road boundary adjustment, the construction footprint has been extended to include a portion of the privately-owned Mackays Road. The boundary change would not result in any physical changes, rather it is to capture the change in ownership to a public road. As such, the site would not be physically impacted, and specific mitigation measures would not be required. The overall impact on West Korora Living Place would remain consistent with that described in the EIS. The potential impact to the West Korora Living Place is outlined in **Table 5.9.2**. Notwithstanding, further consultation would be required during detailed design with CHCC regarding the application of the local road geometrical standards for Mackays Road provided as part of the EIS submission. Should this result in a change in impact to that described above further consultation with the identified knowledge holders and RAPs would be undertaken.

In addition, there would be minor increases and decreases in area of the construction footprint within the other four sites of cultural significance. As the boundary change would not result in any physical changes, the impacts remain consistent with the impacts identified in the EIS.

Table 5.9-2 Potential impacts on West Korora Living Place

Description	Cultural heritage significance	Impact EIS	Impact Amended design
West Korora Living Place is an historic living place located on Mackays Road in the 1940s. It is understood that this site is located on an older traditional campsite area.	This site has medium significance for the Aboriginal community as a historical living place used in the 1940s and understood to be located on an older traditional campsite area.	The site would not be impacted by the project and specific mitigation measures are not required.	The extension of the construction footprint into West Korora Living Place reflects a change in ownership of an existing privately-owned road to a public road with no physical impacts. As a result, the site would not be physically impacted, and specific mitigation measures are not required. Should any changes be required during detailed design, further consultation with the identified knowledge holders and RAPs would be undertaken.

There would be no additional impacts to cultural values, beyond those identified above and in the EIS.

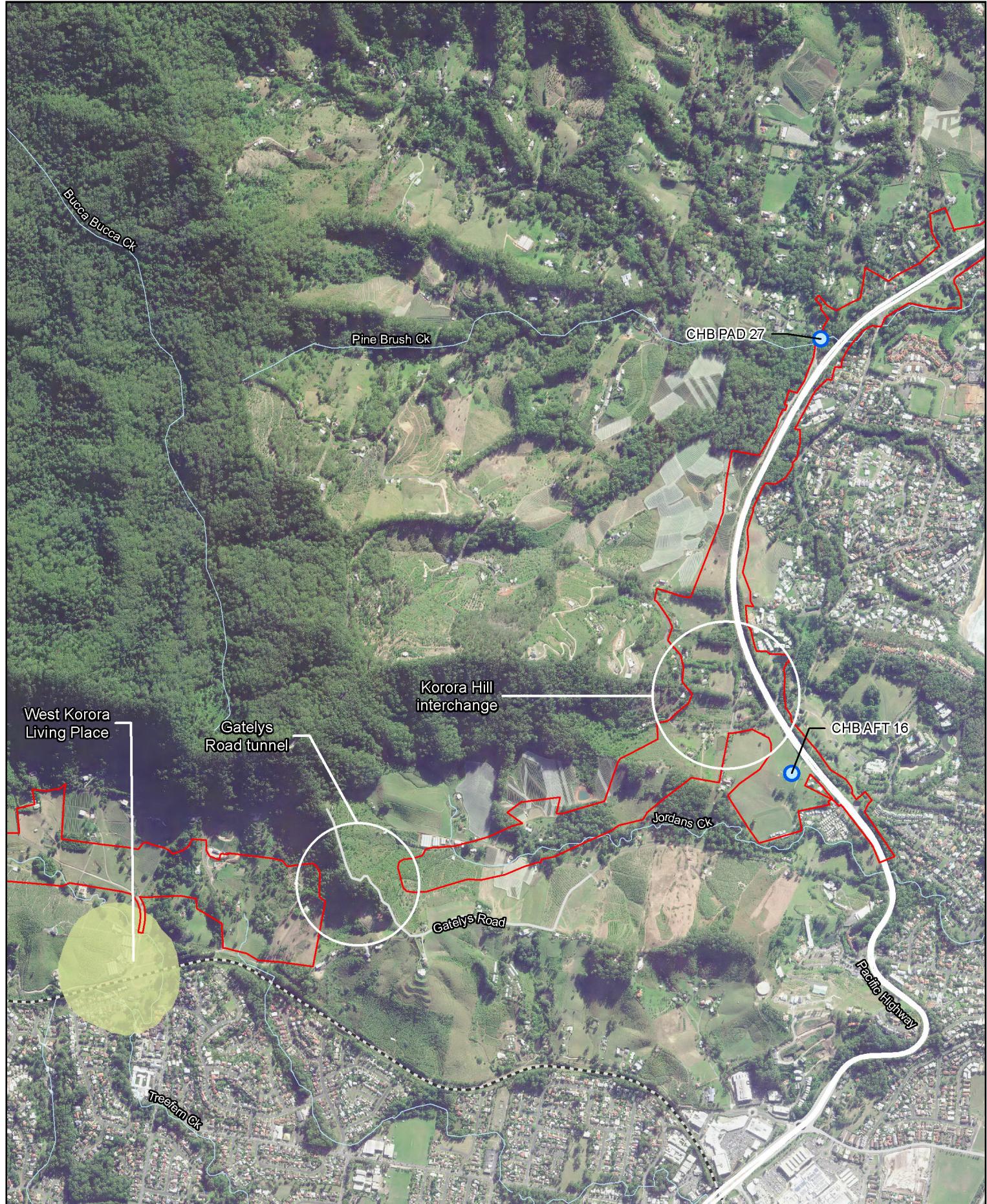


Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Additional Aboriginal cultural heritage survey areas

Coffs Harbour Bypass
Additional Aboriginal cultural heritage surveys January 2020
Figure 5.9-1

0 0.5 1 1.5 km
Scale @ A4: 1:50,000
GDA 1994 MGA Zone 56
N



Legend

- Construction footprint (Red outline)
- North Coast Railway (Dashed black line)
- Watercourse (Light blue line)
- Additional Aboriginal heritage sites (Blue circle)
- West Korora Living Place (Green shaded area)

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Additional Aboriginal heritage sites and areas within the construction footprint

Figure 5.9-2

0 0.2 0.4 0.6 N
Scale @A4: 1:20,000
GDA 1994 MGA Zone 56

5.9.4 Revised environmental management measures

It is recommended that recorded surface artefacts are collected from site CHB AFT 16, and both site CHB AFT 16 and site CHB PAD 27 undergo salvage excavation in accordance with the methodology detailed in Appendix E of **Appendix G, Updated Aboriginal cultural heritage assessment report**. The salvage excavation would be carried out with the involvement of the RAPs.

As a result of submissions made by RAPs and EESG, DPIE, cultural salvage would be carried out after completion of the archaeological salvage by the RAPs, with assistance from TfNSW. The cultural salvage methodology includes provision for cultural salvage at seven sites which contain moderate or potentially moderate densities of archaeological objects. The cultural salvage methodology includes the use of grader scrapes or similar to expose the ground surface over portions of land associated with archaeological deposits. Refer to Appendix F of **Appendix G, Updated Aboriginal cultural heritage assessment report** for further information.

A summary of the proposed mitigation approach for each additional Aboriginal site affected by the proposed design and construction changes is outlined in **Table 5.9-3**.

Table 5.9-3 Mitigation approach for additional Aboriginal archaeological sites

Mitigation measures	Archaeological site
Salvage excavation	CHB AFT 16 CHB PAD 27
Collection of surface artefact(s)	CHB AFT 16
Cultural salvage [^]	CHB AFT 16 CHB PAD 27

[^] Cultural salvage will also be undertaken at CHB AFT 1, CHB AFT 5, CHB AFT 8, CHB AFT 11, CHB AFT 13, CHB AFT 16, CHB PAD 27. Refer to Appendix F of **Appendix G, Updated Aboriginal cultural heritage assessment report** for further information.

The management measures presented within the EIS to address Aboriginal cultural heritage impacts have been reviewed in consideration of the identified design and construction changes. Minor amendments have been made to the management measures. New additions are shown in italics and deletions are presented as strikethrough in **Table 5.9-4**. Other management measures presented in the EIS are still considered to be relevant and accurate and are provided in **Chapter 6, Revised environmental management measures** for completeness.

Table 5.9-4 Proposed amendments to management measures from the EIS

Impact	ID No.	Environmental management measure	Responsibility	Timing
Impacts on known Aboriginal sites or places	AH03	Archaeological salvage excavation as detailed in Table 15-7 must be carried out in accordance with the methodology specified in Appendix L, Aboriginal cultural heritage assessment report .	TfNSW / Contractor	Impacts on known Aboriginal sites or places

Impact	ID No.	Environmental management measure	Responsibility	Timing
Impacts on known Aboriginal sites or places	AH03	<i>Collection of surface artefacts and archaeological salvage excavation must be carried out in accordance with the methodology specified in Section 9 and Appendix E of Appendix G, Updated Aboriginal cultural heritage assessment of the Amendment Report.</i>	TfNSW/Contractor	Prior to construction
	AH04	Where archaeological salvage excavation, <i>cultural salvage</i> or surface collection has been nominated for impacted sites, no construction activities (including pre-construction activities of minimal environmental impact) can occur on the land to be investigated until the relevant archaeological excavations and <i>cultural salvage</i> at the nominated site have been completed.	TfNSW/Contractor	Prior to construction
	AH05	<i>Cultural salvage must be carried out in accordance with the methodology specified in Section 9 and Appendix F of Appendix G, Updated Aboriginal cultural heritage assessment of the Amendment Report.</i>	TfNSW/Contractor	Prior to construction
Impacts to intangible cultural values associated with impacted cultural sites	AH09	A booklet (in a format appropriate for local publication) will be prepared by a cultural heritage specialist on the cultural values and historical records of the cultural sites. As part of the process, the visual documentation of the cultural landscape will occur before construction. The report will be full colour and distributed to local libraries and educational institutions. The final content of the booklet will be developed in consultation with identified Aboriginal knowledge holders and the RAPs.	TfNSW	Prior to and during construction
	AH10	Interpretative signage relevant to the cultural sites will be prepared in consultation with identified knowledge holders. Consultation with the knowledge holders and RAPs will	TfNSW	During and post construction

5. Additional assessment

Impact	ID No.	Environmental management measure	Responsibility	Timing
		occur in regard to potential locations for the placement of the signage. <i>The final location(s) for interpretative signage will be subject to property owner agreement.</i>		

5.10 Flooding and hydrology

5.10.1 Assessment methodology and approach

A flooding and hydrology assessment was prepared as part of the EIS (Chapter 17, Flooding and hydrology). The updated flooding and hydrology assessment is detailed in **Appendix H, Updated flooding and hydrology assessment** and has been prepared in accordance with the SEARs to assess the potential impacts of the project, including the design and construction changes considering current guidelines.

Following exhibition of the EIS, several updates have been made to the hydrologic and hydraulic models (refer to **Section 5.10.2**). These updates have resulted in changes to the existing case modelled flooding behaviour (refer to **Section 5.10.3**). In addition, the amended design in combination with model updates have resulted in revised design case flooding behaviour. The amended design includes the proposed design changes (as discussed in **Chapter 2, Design changes**), and minor design refinements as part of ongoing design development (refer to **Section 5.10.4**).

This amended design case flooding behaviour has been assessed against the revised existing case flooding behaviour to identify the impacts of the amended design. This methodology is outlined in **Figure 5.10-1**. The impacts of the amended design have been compared with the EIS design impacts and is discussed in **Section 5.10.6**.

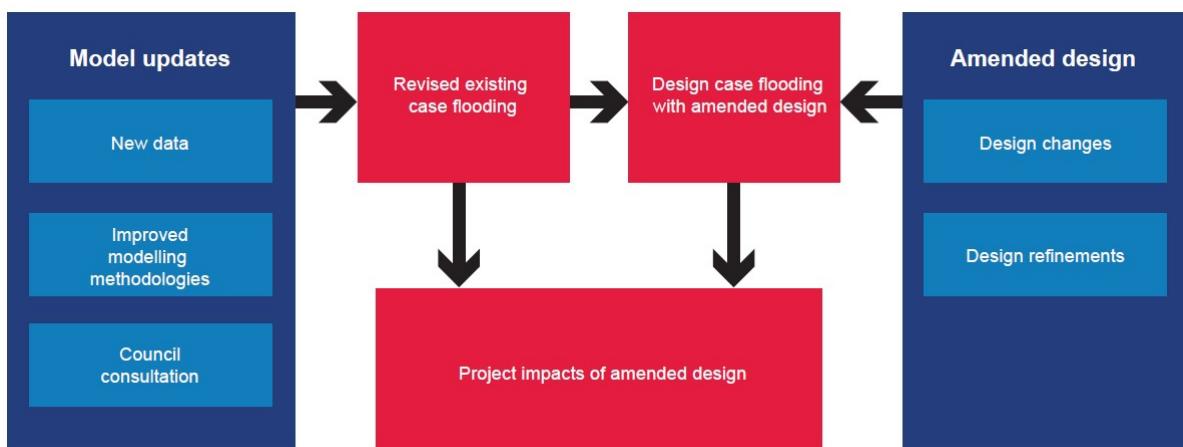


Figure 5.10-1 Assessment methodology

5.10.2 Model updates

Updates to the hydrologic and hydraulic models relate to the collection of new data (eg topographical survey data, culvert dimensions and invert), improvements to modelling methodologies and consideration of consultation that followed the EIS exhibition.

New data

A detailed digital terrain survey was completed following exhibition of the EIS which required model updates. This includes detailed survey of Shephards Lane detention basin which was constructed in 2018 after the collection of data used in the EIS (note assumptions were made to represent the basin in the EIS). The detailed survey also showed the bed of waterways to be lower and banks to be better defined than was assumed for the EIS modelling. This new data improves the representation of waterways in the models. In addition to this, a review of the terrain data used in the EIS resulted in

changes to the representation of terrain data in the hydraulic models. Further discussion on this can be found in Section 2.6 of **Appendix H, Updated flooding and hydrology assessment**. Maps highlighting the difference in modelled terrain between the EIS and the updated model are shown in Appendix F1 of **Appendix H, Updated flooding and hydrology assessment**.

Structure information was also collected in the detailed survey for drainage structures within the construction footprint and at some additional critical locations, such as under the North Coast Railway (ES166 and ES168), within the Isles Drive bypass channel (ES257), at the outlet to Shephards Lane detention basin (ES36) and under the existing Pacific Highway near the Coffs Harbour Health Campus (ES04 and ES05). This is discussed in detail in Section 2.6 of Appendix H, Updated flooding and hydrology assessment.

Improved modelling methodologies

Improvements to the hydrologic and hydraulic models include:

- Consistent application of rainfall factors to represent the effect of the nearby ridgeline on rainfall intensities (orographic factors)
- Updated land use classifications for consistency across the project
- Revised hydrologic parameters for the northern creeks catchment to better reflect the catchment characteristics
- Improved representation of the change in impervious area in brownfield areas
- Revised inflow locations in areas outside of the influence of the project in the northern creeks catchment
- Inclusion of inflow to account for the Kororo Public School bus interchange and Luke Bowen footbridge design change
- Manual modification of the Intermittently Closed and Open Lake or Lagoon (ICOLL) to align with upstream detailed survey in the northern creeks catchment.

These improvements are discussed in detail in Section 2.5 and Section 2.6 of **Appendix H, Updated flooding and hydrology assessment**.

Council consultation

The downstream boundary of the North Boambee Valley hydraulic model used in the EIS was influencing the modelled behaviour at the project and existing Pacific Highway. This reduced the EIS model accuracy of the impact assessment and the existing flooding behaviour (eg existing highway flood immunity). This issue was raised during consultation with CHCC. Following discussions with CHCC, the North Boambee Valley model boundary was extended by an additional 240 hectares to remove the influence of the downstream boundary on flood model behaviour near the project. The downstream boundary is now about 600 metres to 900 metres downstream of the existing Pacific Highway. This is discussed in further detail in Section 2.6.1 of **Appendix H, Updated flooding and hydrology assessment**.

5.10.3 Revised existing case flooding

The model updates discussed in **Section 5.10.2** have resulted in revised existing case flooding conditions in each catchment. The following sections provide more detail on the changes in modelled existing case flood conditions in each catchment following the exhibition of the EIS. Existing flooding

conditions for all catchments are described in detail in Section 2.6 of **Appendix H, Updated flooding and hydrology assessment**.

North Boambee Valley

The key differences in the existing case flood conditions in North Boambee Valley catchment compared to those reported in the EIS include:

- **Existing Pacific Highway:** The existing Pacific Highway crossings of Newports Creek and its southern tributary are located south and north of the Coffs Harbour Health Campus access. Following the model extension described in **Section 5.10.2**, the modelled existing case flood conditions have changed. Modelling now predicts that the northbound access across the southern tributary (towards the health campus near ES04 and ES05) is affected by the 5 per cent annual exceedance probability (AEP) event on the northbound lanes with a peak depth of up to 300 mm. Southbound access across the southern tributary (from the health campus) is affected by the 2 per cent AEP event on the southbound lanes with a peak depth of up to 90 mm. This result is consistent with the CHCC flood modelling. Access across Newports Creek from the north (near ES270) is affected in the 2 per cent AEP event with peak depths of up to 100 mm at the intersection of the Pacific Highway and Isles Drive
- **Coffs Harbour Health Campus:** The health campus is within the updated model extents. Revised existing case flooding conditions show it is affected in the 10 per cent AEP event within the Rural Clinical School and localised areas of road on the eastern side
- **North Boambee Valley floodplain:** The waterways, terrain and drainage features within the project boundary and at other critical locations were surveyed following exhibition of the EIS. Modelling methodologies have also been revised, resulting in reduced inflows. Revised flood modelling shows reduced peak water levels on floodplain land near North Boambee Road.

Coffs Creek

The key differences in the existing case flood conditions in the Coffs Creek catchment compared to those reported in the EIS include:

- **North Coast Railway:** The cross-drainage structures under the railway (ES166 and ES168) were surveyed following exhibition of the EIS (refer **Section 5.10.2**). Revised flood modelling shows the railway overtops during the 18 per cent AEP event north of Jensen Close, with a peak overtopping depth of 100 mm
- **Shephards Lane detention basin:** The basin and outlet structures (ES36) were surveyed following exhibition of the EIS, as construction of the basin was not completed at the time of previous surveys (refer **Section 5.10.2**). Revised flood modelling shows no inundation of existing structures downstream of the basin with the basin overtopping in the 0.05 per cent AEP event.

Northern creeks

The key differences in the existing case flood conditions in the northern creeks catchments compared to those reported in the EIS include:

- **Pacific Bay Resort:** The waterways, terrain and drainage features (including ES99, ES152 and ES158) were surveyed following exhibition of the EIS. Revised flood modelling shows reduced flood extents on the Pacific Bay Resort golf course
- **Campbell Close:** The waterways, terrain and drainage features (including ES83 and ES84) were surveyed following exhibition of the EIS. Revised flood modelling shows reduced flood extents and peak depths upstream and downstream of Campbell Close
- **Pine Brush Creek:** The waterways, terrain and drainage features were surveyed following exhibition of the EIS. This new information led to revising the methodology for modelling the coastal lagoon. Revised flood modelling shows increased flow through the lake
- **West Korora Road:** The modelling methodology used for inputting inflows adjacent to West Korora Road (upstream of the existing Pacific Highway) was revised. Revised flood modelling shows reduced flood extents on land near West Korora Road.

5.10.4 Amended design

Updates to the models that influence project impacts relate to design changes and design refinements as part of ongoing design development since the exhibition of the EIS.

Design changes

The proposed design changes are discussed in detail in **Chapter 2, Design changes**. The design changes that influence flooding behaviour at relevant points of interest are outlined in **Table 5.10-1**. The proposed Coramba Road bus stop design change is not within the flood extents and therefore has no influence on predicted flooding behaviour.

Table 5.10-1 Design changes and relevant points of interest

Design change	Relevant points of interest
Englands Road interchange	B, C, D, W, X
North Boambee Valley vertical alignment	E, F, Y, Z, AA, BA
Coffs Creek flood mitigation	H, I, AQ, BM
Korora Hill interchange	Q, AX, AY, AZ, BF, BI
Kororo Public School bus interchange and Luke Bowen footbridge	R
Pine Brush Creek and Williams Creek realignment	R
Operational water quality basins	B

Design refinements

As part of ongoing design development, several minor design refinements have been made within the construction footprint including:

- Minor changes to bridge span, soffit level and pier arrangement at waterway crossings

- Modifications to the length, capacity (eg size and blockage) and in some cases the location of transverse drainage
- Introduction of localised flood detention areas, including the localised flood detention area within the construction footprint at Mackays Lane and downstream of point of interest L (DS108 and DS109 are drainage outlets from the detention area).

5.10.5 Assessment of construction impacts

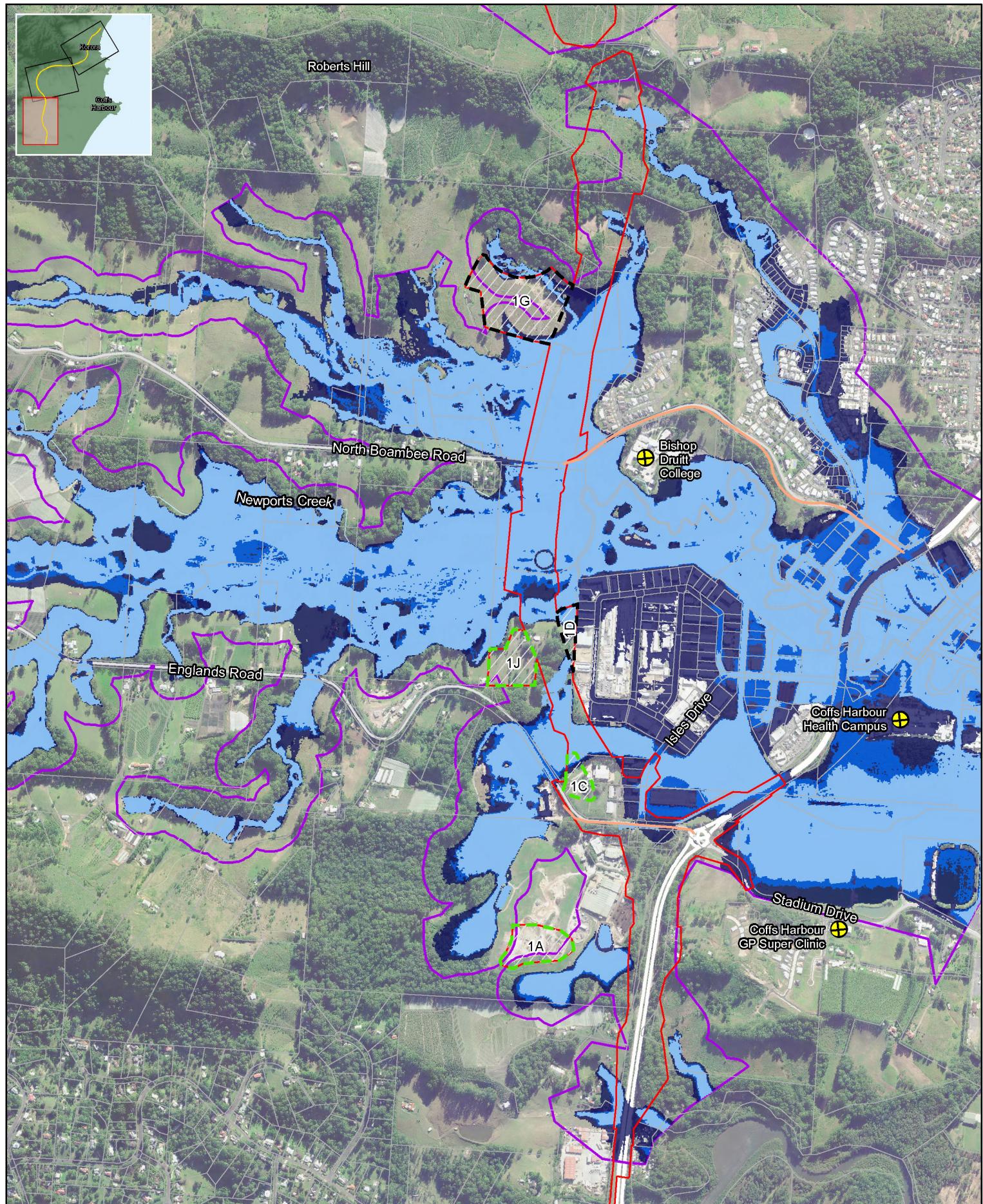
Ancillary site 3C which was assessed in the EIS is no longer proposed as a potential facility and is not considered any further. Of the six new/revised construction ancillary facilities discussed in **Section 3.3, New and revised ancillary site**, four sites are, to varying extents, within the flood extent. Two sites, 1A and 1J, are not within the flood extents. The flood extents and construction zones (including ancillary facilities) are shown in **Figure 5.10-2 to Figure 5.10-4**. These sites and the associated potential hydrology and flooding impacts of the sites within the flood extents are presented in **Table 5.10-2**. The construction updates associated with additional blasting, revised traffic management and revised construction sediment basins are not relevant to the changes to flooding and hydrology and so are not considered further.

The assessment methodology is consistent with the methodology presented in the EIS. This assessment is based on the proximity of the construction ancillary facilities to flood hazard and depths for the existing case. This approach has been adopted as these facilities could exist before construction of the project in the early phases of construction. Qualitative assessments of the likely change to the flood risks during the construction phase have also been carried out to ascertain if the management measures require adaptation during this phase. Further flood modelling assessments of potential flood impacts of the construction ancillary facilities would be carried out during detailed design to inform the appropriate uses within these facilities.

Table 5.10-2 Hydrology and potential flooding impacts of new/amended potential ancillary facilities

Site	Description of change	Flood risk and potential impact	Management measure
1C	Changed footprint. This site has moved north. This site was not within the flood extents in the EIS.	The northern portion of this site (0.2 ha/15% of the total site area) is part of the Newports Creek floodplain. It is within the 5% AEP flood extent and is at risk of frequent (18% AEP) high flood depths and velocities. Isles Drive industrial area and the existing Pacific Highway (providing access to the Coffs Harbour Health Campus) are downstream of this site. Locating site compounds or other facilities within the flood-prone portion of this site could cause higher risk of impacts to Englands Roads, Isles Drive and nearby industrial lots.	A Construction Flood Management Plan (CFMP) will be prepared to manage potential flood risk. Site compounds, stockpiling and plant machinery should be placed outside of the flood-prone portion of the site.

Site	Description of change	Flood risk and potential impact	Management measure
3A	New site	<p>The south eastern part of this site (1.5 ha/17% of the total site area) is within the 5% AEP flood extent and is at risk of frequent (18% AEP) high flood depths and velocities.</p> <p>Locating ancillary facilities within the area of frequent flooding may result in flood impacts to surrounding areas (ie the Banana Coast Caravan Park) and cause previously flood free areas to be inundated.</p>	<p>A CFMP will be prepared to manage potential flood risk.</p> <p>Site compounds, stockpiling and plant machinery should be placed outside of the flood-prone portion of the site.</p>
3D	Changed footprint. This site has expanded within the construction footprint. This site was not within the flood extents in the EIS.	<p>This area is predominately flood immune apart from three flow paths flowing to Kororo Basin waterway which pass through the site in all events.</p> <p>Redirection of these flows may cause previously flood free areas to be impacted, however, because the site is in the upper reaches of the catchment, potential impacts on flooding are expected to be minimal.</p>	<p>A CFMP will be prepared to manage potential flood risk.</p> <p>Conveyance of existing small tributaries within the site and their associated flows should be maintained where possible.</p>
3F	New site	<p>This site is flood immune in the 1% AEP event and is subject to flooding during a probable maximum flood (PMF) event (in the existing case). With the project in place, about 20% of the site would experience shallow inundation in a 1% AEP event.</p> <p>Use of this area for ancillary facilities has a relative low flood risk and the consequence of inundation is low because surrounding areas are predominantly recreational land.</p>	<p>Management of the site uses, outside of the PMF event, are not required because of the low probability of flooding.</p> <p>As the construction phase progresses, consideration of changes to the flood risk need to be carried out.</p>

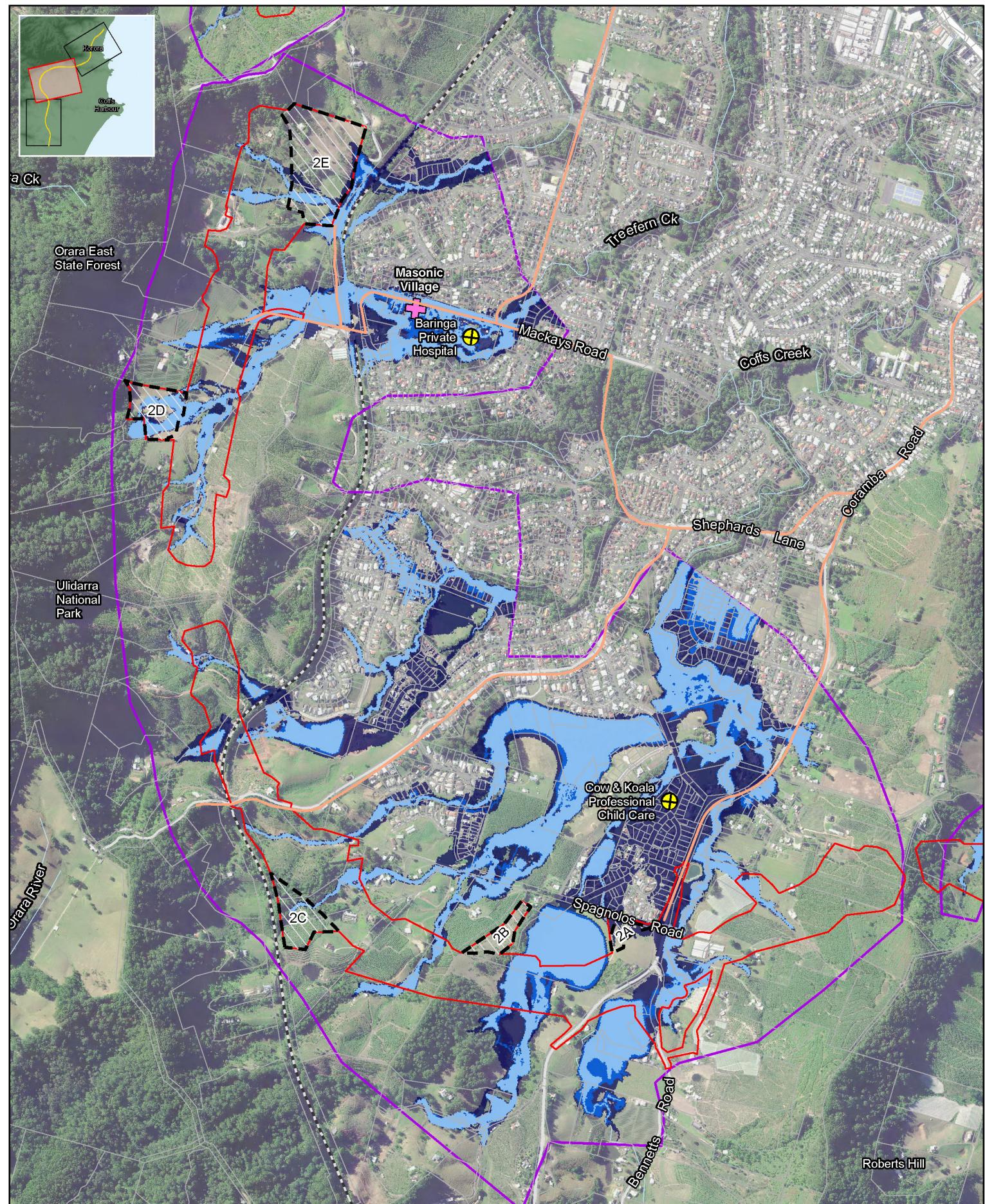


Legend

- North Coast Railway
- Cadastre
- Construction footprint
- Flood model extents
- ⊕ Critical Infrastructure
- + Assembly areas
- Potential construction access
- Potential ancillary sites
- New/revised ancillary sites
- Existing case 5 % AEP flood extent
- Existing case 1 % AEP flood extent
- Existing case PMF flood extent

Coffs Harbour Bypass
North Boambee Valley ancillary sites peak flood inundation
Figure 5.10-2

0 0.15 0.3 0.45 km
Scale @A4: 1:17,500
GDA 1994 MGA Zone 56



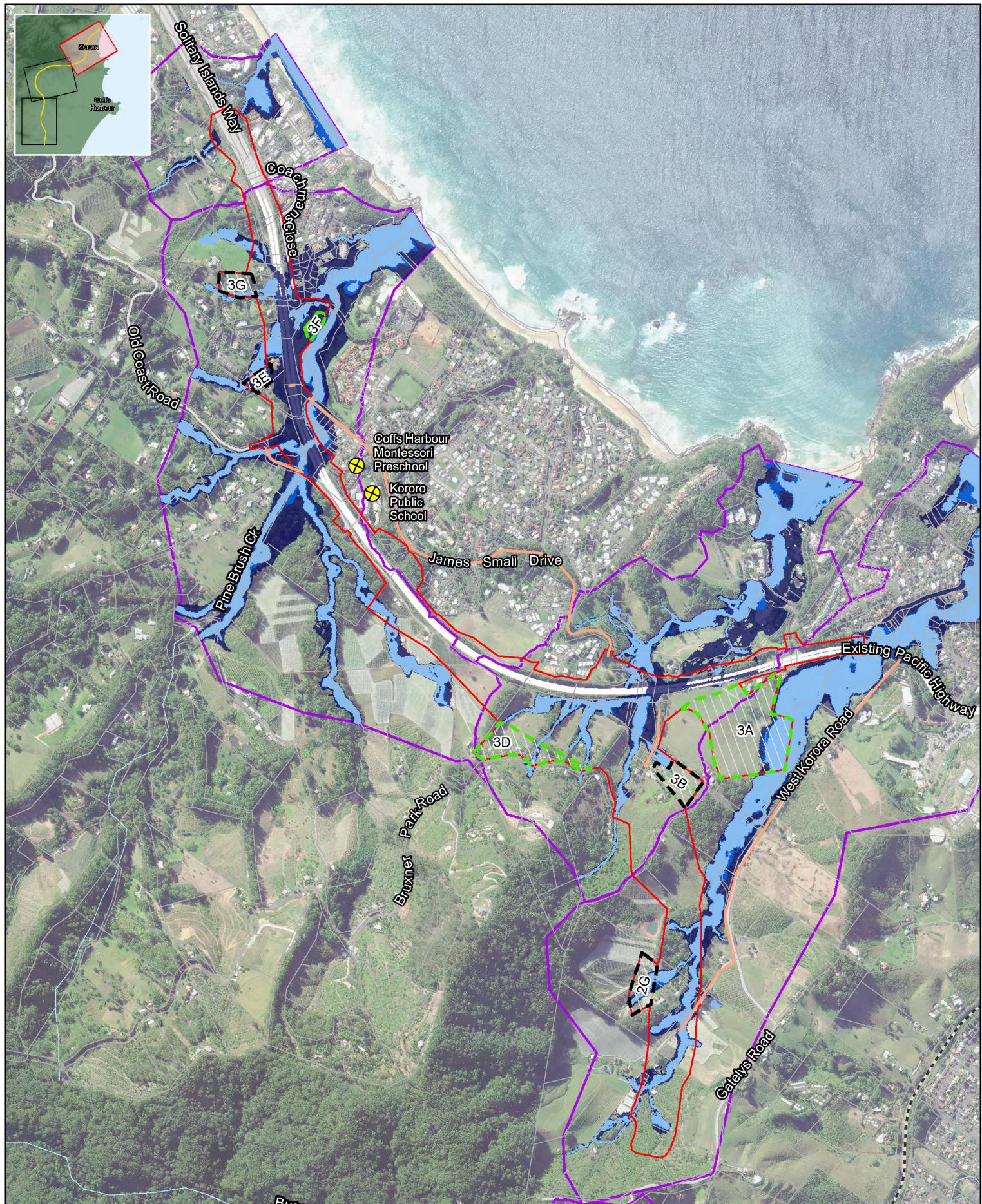
Legend

- Legend**

 - North Coast Railway
 - Cadastre
 - Construction footprint
 - Flood model extents
 - Critical Infrastructure
 - Assembly areas
 - Potential construction access
 - Potential ancillary sites
 - New/revised ancillary sites
 - Existing case 5 % AEP flood extent
 - Existing case 1 % AEP flood extent
 - Existing case PMF flood extent

Coffs Harbour Bypass Coffs Creek ancillary sites peak flood inundation Figure 5.10-3

0 0.15 0.3 0.45
 km



Legend

--- North Coast Railway		Existing case 5 % AEP flood extent
--- Cadastre		Existing case 1 % AEP flood extent
--- Construction footprint		Existing case PMF flood extent
--- Flood model extents		
		Potential construction access
		Potential ancillary sites
		New/revised ancillary sites

Coffs Harbour Bypass
Northern creeks ancillary sites peak flood inundation
Figure 5.10-4

0 0.15 0.3 0.45 km
Scale @A4: 1:17,500
GDA 1994 MGA Zone 56

5.10.6 Assessment of operational impacts

Following the model updates and amended design discussed in **Section 5.10.2** and **Section 5.10.4**, an assessment of the potential project impacts of the amended design was carried out. This assessment was consistent with the methodology outlined in the EIS (Chapter 17, Flooding and hydrology). A complete assessment of all locations, including those impacted in the EIS which are no longer impacted, is discussed in further detail in Section 5 of **Appendix H, Updated flooding and hydrology assessment** where afflux mapping of the full range of modelled storm events is available.

The documentation of impacts of the amended design below includes a comparison with the impacts presented in the EIS. In the comparison of impacts, some locations are listed as having impacts ‘consistent’ with those in the EIS. This does not imply that the impacts are exactly the same. It does imply that:

- Where the impacts in the EIS were compliant with the flood management objectives, then ‘consistent’ means that the impacts are also compliant for the amended design
- Where the impacts in the EIS were not compliant with the flood management objectives, then any change (either improvement or worsening) to these impacts is documented
- If the impacts in the EIS were indicating an improvement and that improvement is no longer predicted for the amended design (but the impacts for the amended design are compliant), then this is noted but not considered to be worsening.

North Boambee Valley

Assessment of the potential operational impacts of the project on flooding and hydrology in the North Boambee Valley catchment against the design criteria and flooding objectives outlined in the EIS (Chapter 17, Flooding and hydrology) are discussed in the following sections.

Flood immunity of project infrastructure

Flood immunity outcomes of the project for North Boambee Valley are consistent with those presented in the EIS except for the required clearance at waterway crossing DS10 (BR 03). The clearance achieved by this bridge is about 170 mm, which is 330 mm less than the required clearance of 500 mm¹ above the 1 per cent AEP flood level. Opportunities to increase clearance for this bridge will be investigated during detailed design of the project. A detailed assessment is discussed in Section 5.1 of **Appendix H, Updated flooding and hydrology assessment**.

Flood impact of the project

The methodology used to assess potential operational flooding and hydrology impacts of the project for the amended design is consistent with the methodology outlined in the EIS. A detailed assessment of all impacts in the North Boambee Valley catchment is discussed in Section 5.2.1 of **Appendix H, Updated flooding and hydrology assessment**. Changes to impacts from those presented in the EIS are discussed in the following sections.

Level

Potential flood level impact changes for the North Boambee Valley catchment compared with the EIS include:

- Consistent impacts for point of interest C and G
- Improvements (flood level reductions) at points of interest B, D and E because of model updates and design developments
- Slight worsening (flood level increases) at points of interest A, F/Z, AA and Y.

¹ The 500 mm clearance above the 1 per cent AEP flood level is a design requirement in Upgrading the Pacific Highway – Design Guidelines (Roads and Maritime Services 2015b).

Peak level impacts for the 1 per cent AEP event for the North Boambee Valley catchment are shown in **Figure 5.10-5**. Locations where impacts are improved are compared in **Table 5.10-3**. Locations where impacts have worsened are compared in **Table 5.10-4**.

The tables focus on the change in peak water level. Changes to duration of inundation are discussed only for locations where significant increases to peak water level, in comparison to the existing peak water levels, are predicted, such as point of interest B.

The mitigation measures presented in the EIS would be applicable for the residual impacts of the amended design.

Scour and velocity

Scour and velocity impacts are generally consistent with those presented in the EIS. That is, impacts are generally localised and contained within the construction footprint. In addition to this, increased peak velocity impacts are predicted downstream of DS03 at point of interest A. This increase is localised and does not affect the nearby residential building. This additional impact is because of new data and nearby design refinements which include widening of the highway embankment and filling of the adjacent storage area.

Access

Potential access impacts for the North Boambee Valley catchment compared with the EIS include:

- Consistent impacts at points of interest B, D, X, Y, AA and Z
- Improved impacts at point of interest W
- Modified impacts at point of interest A.

Improved and modified impacts are compared in **Table 5.10-5**.

Table 5.10-3 Changes to level of access in the North Boambee Valley catchment

POI	Affected road/driveway	Level of access for EIS design	Level of access for amended design	Change in impact
A	Lot 232 DP740659	Increased	Maintained	New data and design refinements have reduced peak water level reductions on the driveway. The amended design does not impact this access location.
W	Isles Drive	Maintained	Increased	New data and design refinements have increased the existing level of access at this location. The Englands Road interchange design change improves the level of access.

Direction

Realignment of a northern tributary of Newports Creek is required as it passes beneath the project north of North Boambee Road. In the EIS design, about 130 metres of realignment was required as the tributary was redirected through bridge BR 05. As part of the North Boambee Valley vertical alignment design change, BR 05 has been replaced with culverts (DS14). The culverts would require

about 130 metres of the northern tributary of Newports Creek to be realigned as it passes through the culverts beneath the project. The realignment would include a low flow channel to provide for fish passage, including through one of the culverts beneath the carriageways, which would be designed in accordance with Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003). The alignment of the creek through the culverts (directly beneath the carriageways) would be straightened, and there would be limited opportunity to meander the creek through this section, compared with the EIS which provided more space below bridge BR 05 to enable design of a more natural creek alignment. Scour protection is likely to be needed on the upstream and downstream side of the culverts. The scour protection would be designed and constructed in a way that would accommodate a low flow channel and where possible provide an opportunity to include a meander. The extent of scour protection would be determined during detailed design in accordance with the requirements detailed in Chapter 5, Project description and Chapter 6, Construction of the EIS.

At all other locations, creek realignments and impacts relating to direction in the North Boambee Valley catchment are consistent with those presented in the EIS.

Hazard

Potential hazard impacts for the North Boambee Valley catchment compared with the EIS include:

- Improved (reduced) hazard impacts at point of interest E
- Slightly worsened (increased) impacts at point of interest B
- No additional impacts at any additional locations.

Modified hazard impacts for the North Boambee Valley catchment are compared in **Table 5.10-6**.

Table 5.10-4 Changes to hazard impacts in the North Boambee Valley catchment compared to the EIS

Location/ POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
E	The project was predicted to increase the flood hazard to high, over an area of around 1.5 ha for design flood events.	The project is predicted to increase the flood hazard to high, over an area of less than one hectare for all design AEP flood events.	The extent of hazard impacts has been reduced for the amended design. This is because of new data and improved modelling methodologies as well as the North Boambee Valley vertical alignment design change.
B	An increase of flood hazard was also predicted on the upstream side of Englands Road within forested land during the PMF event.	An increase of flood hazard is also predicted within forested land in events greater than the 5% AEP. An increase in flood hazard is predicted on Englands Road during the PMF.	Impacts to hazard classification at this location have increased for the amended design. This is because of new data and improved modelling methodologies as well as design refinements adopted to mitigate potential impacts of the project.

Critical infrastructure

Impacts relating to critical infrastructure in the North Boambee Valley catchment are consistent with those presented in the EIS.

Emergency management

Impacts to evacuation routes in the North Boambee Valley catchment are consistent with those presented in the EIS. That is, there are no impacts to all identified evacuation routes. It is important to note that the modelled existing flooding behaviour on the existing Pacific Highway (near the Coffs Harbour Health Campus) has changed because of the downstream extension of the flood model. This is discussed in **Section 5.10.3**. The amended design is predicted to maintain the current level of access to the Coffs Harbour Health Campus and cause slight reductions, in the order of 10 to 30 mm, in peak water level on the existing Pacific Highway in the 1 per cent AEP event.

Boambee Newports Creek Floodplain Risk Management Plan

Impacts relating to the Boambee Newports Creek Floodplain Risk Management Plan are consistent with those presented in the EIS.

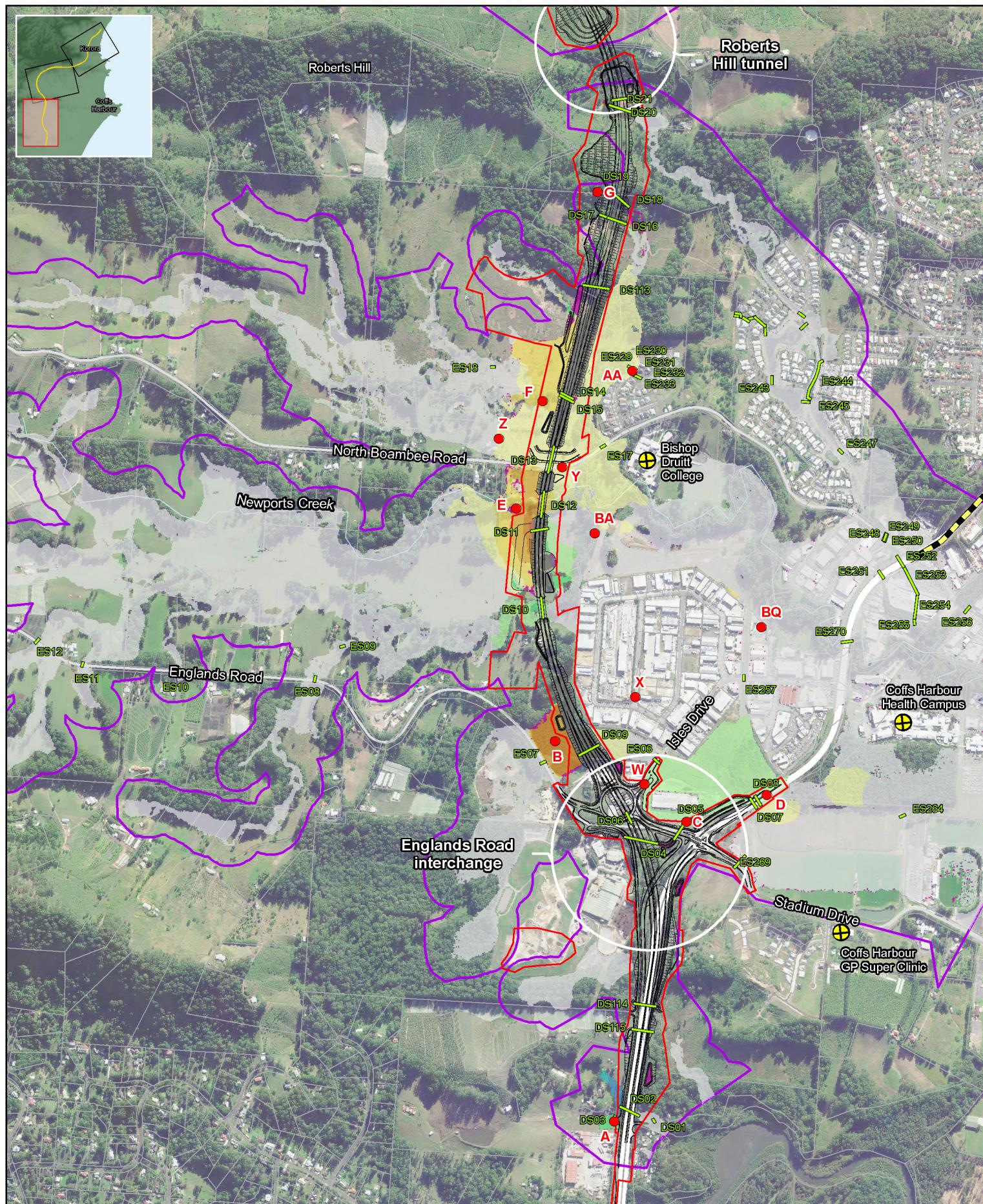
Table 5.10-5 Improvements to predicted flood level impacts in the North Boambee Valley catchment compared to the EIS

POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
B	<p>The project has the potential to impact the tributary adjacent to Englands Road at point of interest B.</p> <p>Afflux up to 850 mm was predicted in the 1% AEP event which was contained on land owned by TfNSW between the project and Englands Road. The afflux was contained to the heavily vegetated floodplain with no impact to Englands Road flood immunity.</p> <p>Time of inundation was predicted to increase from 10 hours 35 minutes to 10 hours 40 minutes and as such this minor increase in duration of 5 minutes was not expected to impact environmental processes.</p>	<p>The project has the potential to impact the tributary adjacent to Englands Road at point of interest B.</p> <p>Afflux up to 350 mm is predicted in the 1% AEP event which would be contained on land owned by TfNSW between the project and Englands Road. The afflux is contained to the heavily vegetated floodplain with no impact to Englands Road flood immunity.</p> <p>Time of inundation is predicted to increase by 5 minutes. This minor increase in duration is not expected to impact environmental processes.</p>	<p>Impacts have improved with the amended design. Afflux in the 1% AEP event is reduced from 850 mm for the EIS design to 350 mm for the amended design. The increase in duration of inundation of 5 minutes is consistent with what was predicted in the EIS.</p> <p>This change in afflux is because of new data, design refinements and water quality basins design changes.</p>
D	<p>The tie-in with the existing Pacific Highway slightly modifies the road profile and embankment width affecting flood conveyance. There was a localised increase in flow velocities downstream of the culverts because of the project.</p>	<p>The tie-in with the existing Pacific Highway slightly modifies the road profile and embankment width affecting flood conveyance and storage causing the following impacts in the 1% AEP event:</p> <ul style="list-style-type: none"> • Decreases in peak water level on the northbound lanes of up to 22 mm • Increases in peak water level of up to 17 mm on vegetated recreational areas downstream of design structures (DS07, DS08). 	<p>The EIS showed the existing Pacific Highway as 'flood free' (up to the 1% AEP flood). Updated modelling now predicts the existing Pacific Highway to be affected at point of interest D in several events. This is because of new data, improvements to modelling methodologies and outcomes of consultation with CHCC, as described in Section 5.10.2.</p> <p>The amended design is predicted to slightly reduce peak water levels on the existing Pacific Highway. This is because design refinements, which include the addition of another four 1050 mm culverts, have been made to mitigate adverse impacts to the existing Pacific Highway caused by the project.</p>

POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
			Improved and modified level of access impacts are discussed further below and compared in Table 5.10-5 . Refer to Appendix H, Updated flooding and hydrology assessment for a comparison of the level of access at this location.
E	<p>The project traverses the Newports Creek floodplain at this location and the project embankments affect flood storage and conveyance to the main creek channels. Localised afflux of up to 500 mm in the 1% AEP event was predicted immediately upstream of the project. Afflux reduced to around 200 mm as the extent of flood depth increase extended upstream to:</p> <ul style="list-style-type: none"> • The existing agricultural/forested areas • The residential property adjacent to North Boambee Road (property is owned by TfNSW). Flood depth increase by 200 mm in the 1% AEP event • Towards North Boambee Road. <p>There was no change to the PMF flood hazard category upstream of the project throughout the North Boambee Valley (West) urban release area.</p>	<p>The project traverses the Newports Creek floodplain at this location and the project embankments affect flood storage and conveyance to the main creek channels. Localised afflux of up to 380 mm in the 1% AEP event is predicted immediately upstream of the project. Afflux reduces to around 65 mm as the flood extends upstream to:</p> <ul style="list-style-type: none"> • The existing agricultural/forested areas • The residential property adjacent to North Boambee Road (property is owned by TfNSW). Flood depth increases by 180 mm in the 1% AEP event • Towards North Boambee Road. 	<p>Impacts have improved with the amended design. Localised afflux immediately upstream of the project is reduced from 500 mm in the EIS design to 380 mm for the amended design. Afflux on agricultural/forested areas and the residential property is reduced from 200 mm to 65 mm. Afflux towards North Boambee Road is reduced from 200 mm to 180 mm.</p> <p>These improvements are because of new data, improved modelling methodologies and the North Boambee Valley vertical alignment design change.</p>

Table 5.10-6 Worsening of predicted flood level impacts in the North Boambee Valley catchment compared to the EIS

POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
A	The project widens the road embankment into the low-lying area currently drained by the existing culvert (ES01) and the driveway access of Lot 232 DP740659. Afflux up to 120 mm in the 1% AEP event was noted over the current dam.	<p>The project widens the road embankment into the low-lying area currently drained by the existing culvert (ES01) causing the following flood impacts:</p> <ul style="list-style-type: none"> • Increase in peak water level in events up to the 2% AEP over the current dam, with a maximum increase of 380 mm predicted in the 18% AEP event • Peak water level is reduced (ie negative afflux) from 5.1 mAHD to 5.0 mAHD in the 1% AEP event on Lot 232 DP740659. It is noted that the flood extent does not extend to the residential building. 	<p>Impacts have increased for the amended design. The maximum afflux on the farm dam has increased. Note the residential property is not adversely impacted, which is consistent with the EIS.</p> <p>These changes are because of new data and design refinements which include widening of the highway embankment and filling of the adjacent storage area.</p> <p>Improved and modified level of access impacts are discussed further below and compared in Table 5.10-5. Refer to Appendix H, Updated flooding and hydrology for a comparison of the level of access at this location.</p>
F/Z/ AA/ Y	<p>The project traverses the Newports Creek floodplain. Embankments reduce floodplain storage in this area resulting in predicted afflux up to 35 mm in the 1% AEP event on the surrounding pastoral/forested areas and the northern extent of Highlander Drive.</p> <p>Afflux of up to 18 mm was predicted at the residential property of Lot 1 DP711234 – on the north side of North Boambee Road near point of interest Z</p>	<p>The project traverses the Newports Creek floodplain. Embankments reduce floodplain storage in this area (point of interest F) resulting in afflux up to 110 mm in the 1% AEP event on the surrounding pastoral/forested areas west of point of interest F (outside of the construction footprint).</p> <p>Within the northern extent of Highlander Drive (point of interest AA) afflux of up to 16 mm is predicted on the road in the 1% AEP event. No residential buildings are impacted at point of interest AA. Afflux of up to 25 mm is predicted at the residential property of Lot 1 DP711234 on the north side of North Boambee Road (point of interest Z). Survey of the residential building determined that the floor level is about 450 mm above the predicted 1% AEP flood levels.</p>	<p>Impacts from the amended design are greater than the EIS design impacts. Afflux on the pastoral/forested areas is increased from 35 mm to 110 mm for the amended design. Afflux on the residential property is increased by 7 mm from 18 mm to 25 mm in the amended design. Note that the 1% AEP peak water level is below floor level of the house. Afflux on Highlander Drive is increased by 1 mm at point of interest AA.</p> <p>These changes are because of new data, improved modelling methodologies and the North Boambee Valley vertical alignment design change.</p>



Legend

- North Coast Railway
- Critical Infrastructure
- Assembly areas
- POI
- Modelled structures
- Was wet now dry
- Was dry now wet
- Cadastre
- Construction footprint
- Flood model extents

Peak level impact (m)



Coffs Harbour Bypass
North Boambee Valley 1 % peak flood level difference
Figure 5.10-5

0 0.15 0.3 0.45 km
Scale @A4: 1:17,500
GDA 1994 MGA Zone 56

Coffs Creek

Assessment of the potential operational impacts of the project on flooding and hydrology in the Coffs Creek catchment against the design criteria and flooding objectives outlined in the EIS (Chapter 17, Flooding and hydrology) are discussed in the following sections.

Flood immunity of project infrastructure

Flood immunity outcomes of the project for Coffs Creek are consistent with those presented in the EIS.

Flood impact of the project

The methodology used to assess potential operational flooding and hydrology impacts of the project for the amended design is consistent with the methodology outlined in the EIS. A detailed assessment of all impacts in the Coffs Creek catchment is discussed in Section 5.2.2 of **Appendix H, Updated flooding and hydrology assessment**. Changes to impacts from those presented in the EIS are discussed in the following sections.

Level

Potential flood level impacts for the Coffs Creek catchment compared with the EIS include:

- Consistent impacts for points of interest H, K, L, N and BM
- Improvements (flood level reductions) at points of interest I, J, M, and AQ
- No worsening (flood level increases) at any locations.

Peak level impacts are for the 1 per cent AEP event for the Coffs Creek catchment are shown in **Figure 5.10-6**. Locations where impacts are improved are compared in **Table 5.10-7**.

The mitigation measures presented in the EIS remain applicable for the residual impacts of the amended design.

This includes refinement of the cross-drainage design at point of interest J to provide a better balance between holding water upstream of the project and managing downstream flood levels. Since the EIS exhibition, it has been identified that the highway embankment at this location could be a Declared Dam under the Dams Safety Act 2015. The flood detention basin immediately downstream, Spagnolos Basin, is a Declared Dam under the Act. This is noted in Chapter 5, Clarifications, corrections and further information of the Submissions Report.

Scour and velocity

Potential scour and velocity impacts for the Coffs Creek catchment compared with the EIS include:

- Consistent impacts for minor tributaries
- Improved (reduced) impacts within Treefern Creek
- Worsened (increased) impacts within Coffs Creek.

Improved and worsened impacts are compared below in **Table 5.10-8**.

Table 5.10-7 Changes to scour and velocity impacts in the Coffs Creek catchment compared to the EIS

Location	EIS potential flood impact	Amended potential flood impact	Change in impact
Coffs Creek	Minor (up to +0.2 m/s) peak velocity increases were predicted within Coffs Creek downstream of Bennetts Road detention basin that may have resulted in localised scour instances during peak events.	Peak velocity increases (up to +1.5 m/s in the 1% AEP event) are predicted within Coffs Creek downstream of Bennetts Road detention basin that may increase scour potential during flood events. Predicted peak velocity increases are less than 0.5 m/s downstream of the construction footprint.	Impacts for the amended design are increased. These changes are because of new data and improved modelling methodologies.
Treefern Creek	The proposed Mackays Road bund (point of interest M) redistributes flows and hence increases peak flood velocities (up to 0.5 m/s) were predicted to the vegetated area to the east. Absolute velocities were still relatively low in the 18% AEP event, increasing from 1.4 m/s in existing conditions to 2.1 m/s post-project conditions	Not impacted.	Impacts for the amended design are reduced. These changes are because of new data, including the detailed survey of culverts under the North Coast Railway (ES166 and ES168).

In addition to the mitigation measures presented in the EIS, localised earthworks within the construction footprint, downstream of Bennetts Road detention basin, would be required to reduce peak velocities in Coffs Creek.

Access

Potential access impacts for the Coffs Creek catchment compared with the EIS include:

- Consistent impacts to level of access for points of interest AD, AF, AL, AN, AI, AH, AJ, M and AP. At these locations the existing level of access is maintained
- Impacts at points of interest L and BL. Impacts were not predicted at these locations in the EIS. At these locations the existing level of access is maintained with the amended design
- Modified impacts at points of interest AE, AK, AM and AG. At these locations, the EIS reported improved levels of access with the project in place. New data and improved modelling methodologies increased the existing level of access and as a result the amended design now maintains the existing level of access.

Modified impacts and impacts not predicted in the EIS are compared in **Table 5.10-9**.

Table 5.10-8 Changes to level of access in the Coffs Creek catchment compared to the EIS

POI	Affected road/driveway	Level of access for EIS design	Level of access for amended design	Change in impact
AE	William Sharp Drive West	Increased	Maintained	New data and improved modelling methodologies increased the existing level of access from not being trafficable in any modelled events to being trafficable in the 1% AEP event. The amended design does not impact access at this location.
AK	Roselands Drive near Spagnolos Road	Increased	Maintained	New data and improved modelling methodologies increased the existing level of access from being trafficable in the 10% AEP event to being trafficable in the 1% AEP event. The amended design does not impact access at this location.
AM	Gillon Street	Increased	Maintained	New data and improved modelling methodologies increased the existing level of access from being trafficable in the 5% AEP event to being trafficable in the 1% AEP event. The amended design does not impact access at this location.
AG	Spagnolos Road	Increased	Maintained	New data and improved modelling methodologies increased the existing level of access from being trafficable in the 2% AEP event to being trafficable in the 1% AEP event. The amended design does not impact access at this location.
L	Mackays Road Treefern Creek North	Not impacted	Maintained	Modelling now predicts this location to be impacted as a result of design refinements in this area. Note the amended design maintains the existing level of access.
BL	Mackays Road	Not impacted	Maintained	New data in this area modified the existing flooding behaviour. Note that the amended design maintains the existing level of access.

Direction

Impacts relating to direction in the Coffs Creek catchment are consistent with those presented in the EIS.

Hazard

Potential hazard impacts for the Coffs Creek catchment compared with the EIS include:

- Consistent impacts to hazard classification at point of interest J
- Improved hazard impacts at the Baringa Private Hospital, Cow & Koala Professional Child Care and at other localised areas
- No worsening at any locations.

Modified hazard impacts for the Coffs Creek catchment are compared in **Table 5.10-10**.

Table 5.10-9 Changes to hazard impacts in the Coffs Creek catchment compared to the EIS

Location	EIS potential flood impact	Amended potential flood impact	Change in impact
General	Increases in hazard classification in vegetated and open pasture areas in events between 5% AEP and PMF near point of interest L and east of point of interest M were predicted.	Localised increases in hazard levels in areas of increased flood extent.	Impacts for the amended design are reduced when compared to those presented in the EIS. Impacts at point of interest L and point of interest M are now predicted to be localised and fully contained within the construction footprint. These changes are because of new data, design refinements, and improved modelled methodologies.
Baringa Private Hospital	Increases in hazard in localised areas within Baringa Private Hospital in the PMF event were predicted, however there were no changes to hazard in smaller rainfall events.	Impacts are no longer predicted for the Baringa Private Hospital.	Impacts for the amended design are no longer predicted for this location in any modelled event. These changes are because of new data, including the detailed survey of culverts under the North Coast Railway (ES166 and ES168) and upstream design refinements including the provision of an additional localised flood detention area within the construction footprint (downstream of point of interest L).
Cow & Koala Professional Child Care	A decrease in hazard in the PMF event only was predicted, other events remained unchanged.	Impacts are no longer predicted for Cow & Koala Professional Child Care.	Impacts for the amended design are no longer predicted for this location in any modelled event. These changes are because of new data and upstream design refinements.

Since the EIS exhibition, it has been identified that the highway embankment at point of interest J could be a Declared Dam under the Dams Safety Act 2015. The flood detention basin immediately downstream, Spagnolos Basin, is a Declared Dam under the Act. This is noted in Chapter 5, Clarifications, corrections and further information of the Submissions Report.

Critical infrastructure

Modified impacts for critical infrastructure in the Coffs Creek catchment are compared in **Table 5.10-11**. At all critical infrastructure locations in the Coffs Creek catchment, the project is predicted to either maintain or improve flooding conditions.

Table 5.10-10 Changes to critical infrastructure in the Coffs Creek catchment compared to the EIS

Location	EIS potential flood impact	Amended potential flood impact	Change in impact
Baringa Private Hospital	Peak flood level reductions for all events except minor PMF increases of up to 18 mm, with a peak flood depth 954 mm. It is noted the accuracy of this location was limited without the upstream railway cross-drainage.	No change to peak flood levels for all design events. Minor peak flood level reductions are predicted for the PMF event.	As a result of collecting detailed survey of the upstream North Coast Railway culverts (ES166 and ES168), as discussed in Section 5.10.2 , the flooding conditions at the hospital have changed following exhibition of the EIS. This is discussed in Section 5.10.3 . The hospital is not adversely impacted with the amended design. This is consistent with the EIS. These changes are because of new data and design refinements including the provision of an additional localised flood detention area within the construction footprint (downstream of point of interest L).
Cow & Koala Professional Child Care	Cow & Koala Professional Child Care remained immune in events up to and including the 1% AEP event. Peak flood levels were reduced in the PMF event by up to 11 mm.	Cow & Koala Professional Child Care remains immune in design events up to and including the 1% AEP. Peak flood level reductions of up to 120 mm are predicted in the PMF event.	Impacts for the amended design are consistent with those presented in the EIS, except there are greater peak water level reductions predicted in the PMF event. This change is because of new data and design refinements to upstream drainage structures.

Emergency management

Impacts relating to emergency management in the Coffs Creek catchment are consistent with those presented in the EIS.

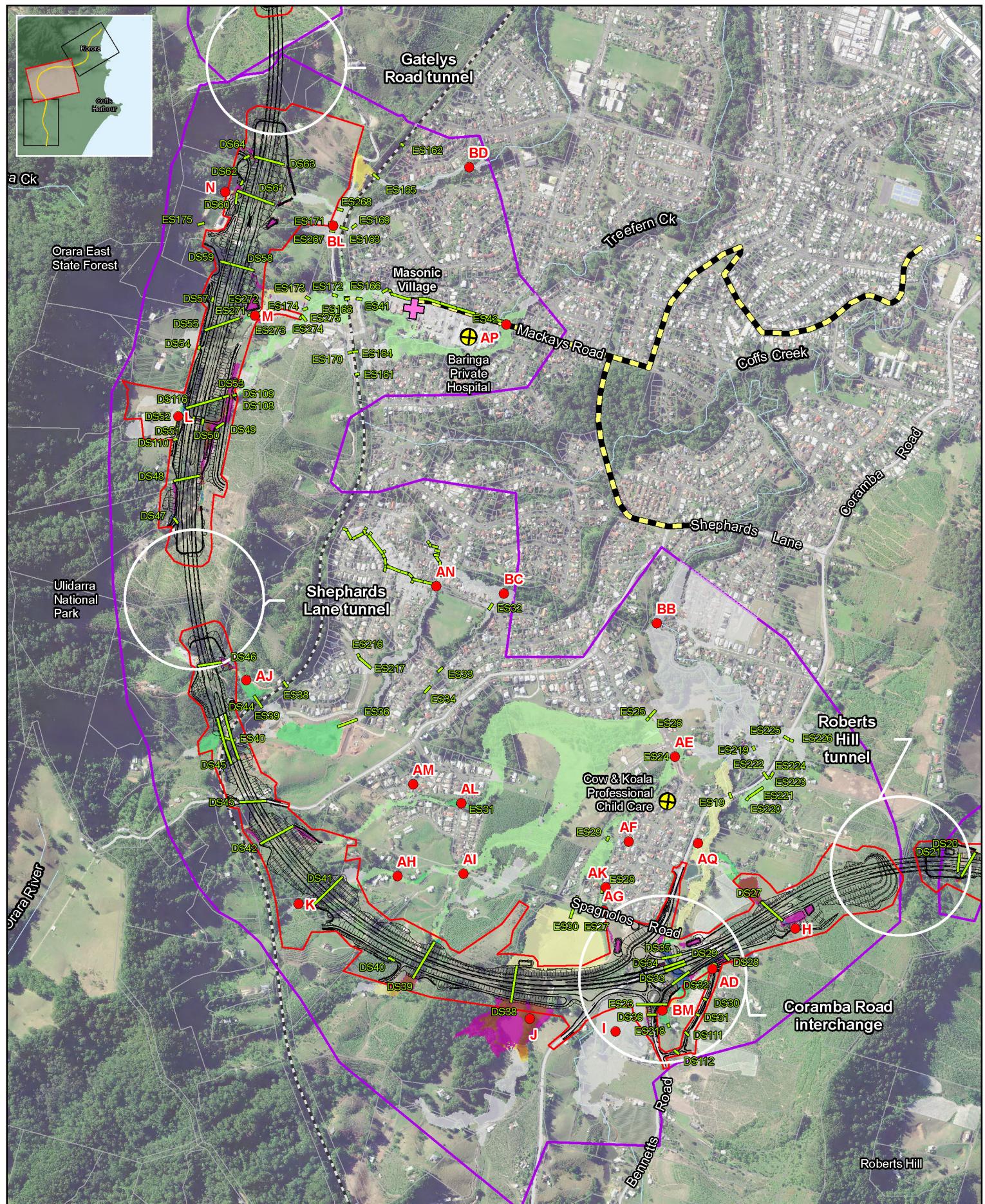
Coffs Creek Floodplain Risk Management Plan

Impacts relating to the Coffs Creek Floodplain Risk Management Plan are consistent with those presented in the EIS.

Table 5.10-11 Improvements to predicted flood level impacts in the Coffs Creek catchment compared to the EIS

POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
I	Predicted afflux in the 1% AEP flood event was 18 mm within the Bennetts Road detention basin because of the Coramba Road interchange immediately downstream of the basin and the impact this had on the outlet from the basin.	No adverse impact is predicted within the Bennetts Road detention basin.	Impacts have improved with the amended design. Afflux within the basin is no longer predicted for the amended design. These changes are because of new data, improved modelling methodologies, and the removal of originally proposed additional excavation within the Bennetts Road detention basin which is part of the Coffs Creek flood mitigation design change.
J	The project extends into the existing Spagnolos Road detention basin, decreasing storage volume and attenuation effectiveness. Predicted afflux upstream of the project and the Spagnolos Road detention basin in the 1% AEP flood event was up to 4000 mm. This afflux was contained to the heavily vegetated areas on land owned by TfNSW. There was a decrease in flood levels predicted within the Spagnolos Road detention basin in the 1% AEP flood event.	The project extends into the existing Spagnolos Road detention basin, decreasing storage volume and attenuation effectiveness. Predicted afflux upstream of the project in the 1% AEP flood event would be up to 3650 mm. This afflux is contained to the heavily vegetated areas on land owned by TfNSW. Downstream of the project, afflux of up to 40mm is predicted in Spagnolos Road detention basin for events up to the 1% AEP flood event.	Impacts have improved with the amended design. While the afflux is still significant, a better balance between impacts downstream in Spagnolos Road detention basin and upstream of the project has been achieved. Afflux has been reduced by 350 mm for the amended design. These changes are because of design refinements.

POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
M	<p>Afflux of up to 400 mm during the 1% AEP flood event was predicted within the Treefern Creek area downstream of project near point of interest M. The concept design for the project includes measures to direct flows crossing the main carriageway (via a proposed culvert DS55) away from Mackays Road to improve local access and reduce potential scour effects.</p> <p>Afflux was contained to vegetated creek areas and the proposed design resulted in no adverse flood impact to access.</p>	<p>Afflux of up to 100 mm during the 1% AEP flood event is predicted within the Treefern Creek area downstream of project near point of interest M.</p> <p>Afflux is contained to vegetated creek areas and the proposed design results in no adverse flood impact to access.</p>	<p>Impacts have improved with the amended design. Afflux is reduced from 400 mm to 100 mm.</p> <p>These changes are because of new data and design refinements, including the additional localised detention area downstream of point of interest L.</p>
AQ	<p>Predicted afflux in the 1% AEP flood event was 50 mm within Coffs Creek downstream of the project. The increase in flood level at this location was because of the increased area of impervious surfaces (the project pavement), resulting in additional stormwater runoff entering the creek.</p> <p>Afflux of up to 50 mm was predicted at the residential building. It was unconfirmed if the predicted afflux would affect existing structures. A finished floor level survey will be carried out during detailed design to confirm whether predicted afflux would affect the existing structure.</p>	<p>Predicted afflux in the 1% AEP flood event is 30 mm within Coffs Creek downstream of the project. The increase in flood level at this location is because of the increased area of impervious surfaces (the project pavement), resulting in additional stormwater runoff entering the creek.</p> <p>Afflux of up to 26 mm is predicted at the residential building. Survey of the residential building (Lot B DP363629) determined that the floor level was 900 mm above the predicted 1% AEP flood event.</p>	<p>Impacts have improved with the amended design. Afflux on the residential property has been reduced from 50 mm to 26 mm for the amended design. Predicted afflux within the waterway has been reduced from 50 mm to 30 mm.</p> <p>These changes are because of new data, improved modelling methodologies and because of the additional storage provided at point of interest H and at the outlet of DS27. These detention areas are part of the Coffs Creek flood mitigation design change. Note the additional excavation within the Bennetts Road Detention Basin (used for mitigation in the EIS) is no longer proposed.</p>



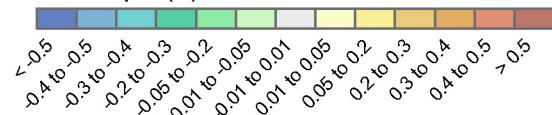
Legend

- North Coast Railway
- Evacuation routes
- Cadastre
- Construction footprint
- Flood model extents
- Modelled structures
- Critical Infrastructure
- Assembly areas
- POI

■ Was wet now dry

■ Was dry now wet

Peak level impact (m)



Coffs Harbour Bypass
Coffs Creek 1% peak flood level difference
Figure 5.10-6

Northern creeks

Assessment of the potential operational impacts of the project on flooding and hydrology in the northern creeks catchments against the design criteria and flooding objectives outlined in the EIS (Chapter 17, Flooding and hydrology) are discussed in the following sections.

Flood immunity of project infrastructure

Flood immunity outcomes of the project for the northern creeks catchment are consistent with those presented in the EIS.

Flood impact of the project

The methodology used to assess potential operational flooding and hydrology impacts of the project is consistent with the methodology outlined in the EIS. A detailed assessment of all impacts in the northern creeks catchment is discussed in Section 5.3.1 of **Appendix H, Updated flooding and hydrology assessment**. Changes to impacts from those presented in the EIS are discussed in the following sections.

Level

Potential flood level impacts for the Coffs Creek catchment compared with the EIS include:

- Consistent impacts for points of interest O and S
- Improvements (flood level reductions) at points of interest P, Q, R, T, U, V, and BI
- No worsening (flood level increases) at any points of interests.

Peak level impacts are for the 1 per cent AEP event for the Northern creeks catchment are shown in **Figure 5.10-6**. Locations where impacts are improved are compared in **Table 5.10-12**.

The mitigation measures presented in the EIS remain applicable for any residual impacts of the amended design.

Scour and velocity

Potential scour and velocity impacts for the northern creeks catchment compared with the EIS are described below in **Table 5.10-13**.

Table 5.10-12 Changes to scour and velocity impact in the northern creeks catchment compared to the EIS

Location	EIS potential flood impact	Amended potential flood impact	Change in impact
Pacific Bay Resort	Minor (up to +0.2 m/s) peak velocity increases were predicted within the current course flow-paths and lakes. Increases were generally limited to existing vegetated creeks and paved areas, except the new flow path downstream of ES57, subject to predicted velocities of around 0.5 and 0.7 m/s in the 18%	Minor (up to +0.2 m/s) peak velocity increases are predicted within the existing course flow paths and lakes. Peak velocity increases of up to 1.0 m/s are predicted downstream of ES57 and ES157 (point of interest BI), within the existing flow path.	Impacts for the amended design are within existing waterways and flow paths. The spatial extent of flooding and consequently the extent of velocity increases have reduced. However, there has been a minor worsening of the magnitude of the velocity increase. These changes are because of new data

Location	EIS potential flood impact	Amended potential flood impact	Change in impact
	and 1% AEP events respectively. It was noted that this will be reviewed during detailed design with a focus on water quality basin outlet location and possible outlet scour protection.		including detailed survey of nearby terrain and drainage structures. The design scenario flooding behaviour is also influenced by the Korora Hill interchange design change.
Pacific Bay Eastern Lands	Minor increases in peak velocity on Lot 14 in the 1 per cent AEP of up to 0.2 m/s. Increases were also predicted in the PMF event of up to 0.3 m/s on lots 14 to 22.	No impact is predicted for the approved development area of Pacific Bay Eastern Lands.	Impacts are no longer predicted for the amended design at this location. This is because of updated data including detailed survey of nearby terrain and drainage structures. The design scenario flooding behaviour is also influenced by the Korora Hill interchange design change.
Minor tributaries	Localised velocity increases were predicted downstream of design culverts DS70, DS71 and DS72 of up to 0.5 m/s in events above the 5% AEP event.	Localised increases in velocity are predicted at drainage structure outlets. Downstream of DS87 (point of interest T) an increase of up to 1.0 m/s is predicted in the 1% AEP event. This increase is localised and is contained within the waterway. At all other locations velocity increases are less than 0.2 m/s outside the construction footprint in the 1% AEP event.	Impacts for the amended design have increased at point of interest T from the impacts reported in the EIS. These changes are because of new data and design refinements to nearby drainage features.
Pine Brush Creek	Not impacted	Existing peak velocities reach approximately 3.5 m/s in Pine Brush Creek and 2.9 m/s in Williams Creek in the 1% AEP event. Peak velocity increases of up to 0.6 m/s are predicted through the	Impacts at the waterway realignment have increased within Williams Creek from the EIS. This change is because of new data and the Pine Brush Creek and Williams Creek waterway

Location	EIS potential flood impact	Amended potential flood impact	Change in impact
		<p>waterway realignment of Williams Creek in the 1% AEP event. Peak velocities for the amended design are predicted to reach 3.5 m/s in Pine Brush Creek and 3.5 m/s in Williams Creek in the 1% AEP event.</p> <p>Impacts are generally contained within the construction footprint and do not affect any residential buildings.</p>	realignment design change.

Since the EIS exhibition, opportunities to improve the highway crossing of Pine Brush Creek, adjacent creek realignments and associated flooding impacts have been identified. Design development at this location is ongoing and will be considered further during detailed design. Potential developments could include adjustments to the waterway realignment to better match existing waterway characteristics (such as length and slope).

Access

Potential access impacts for the northern creeks catchment compared with the EIS include:

- Consistent impacts to level of access for points of interest AS, AY, Q, AU, AZ (Ballantine Drive), R, and V. At these locations the existing level of access is maintained or improved by the project
- Improved impacts at points of interest AR, AX/P, AZ (James Small Drive), T and S (Lot 1 DP527497)
- Modified impacts at point of interest S (Lot 1 DP270147 and Lot 100 DP1112799). At this location, the EIS reported improved levels of access with the project in place. New data and improved modelling methodologies increased the existing level of access and as a result the amended design now maintains the existing level of access.
- No worsening (increases) at any locations. There are zero access locations where the level of access is predicted to be reduced by the project with the amended design.

Improved impacts are compared in **Table 5.10-14**.

Table 5.10-13 Changes to level of access in the northern creeks catchment compared to the EIS

POI	Affected road/driveway	Level of access EIS	Level of access amended design	Change in impact
AR	West Korora Road, Jordans Creek	Maintained	Increased	Impacts to access have been improved with the amended design. This is because of improved modelling methodologies, new data and design refinements to nearby drainage structures. A greater level of access is predicted with the amended design.
AX/P	Lot 19 DP771618	Decreased	Increased	Impacts to access have been improved with the amended design. Access for the EIS design was provided via West Korora Road. Access is provided from Bruxner Park Road in the amended design. This is part of the Korora Hill interchange design change. A greater level of access is predicted with the amended design.
AZ	James Small Drive	Decreased	Maintained	Impacts to access have been improved with the amended design. This is because of the improvements to modelling methodologies. Modelling now shows this access location to be outside the flood extents in the existing case. The amended design does not impact access at this location.
T	Opal Boulevard	Decreased	Increased	Impacts to access have been improved with the amended design. New data and improved modelling methodologies increased the existing level of access from being trafficable in the 5% AEP event to being trafficable in the 2% AEP event. The amended design increases the level of access at this location because of nearby drainage design refinements.
S	Lot 1 DP270147	Increased	Maintained	The EIS design predicted improvements to access at this location. The amended design does not impact access at this location. These changes are because of new data and improved modelling methodologies.

POI	Affected road/driveway	Level of access EIS	Level of access amended design	Change in impact
S	Lot 100 DP1112799	Increased	Maintained	Improvements to modelling methodologies have reduced the flood extents in this area. Modelling now shows this access location to be outside the flood extents in the existing case. The amended design does not impact access at this location.
S	Lot 1 DP527497	Decreased	Maintained	Impacts to access have been improved with the amended design. New data and improved modelling methodologies reduced the predicted level of access from being trafficable in the 1% AEP event to not being trafficable in the 18% AEP event under existing conditions. The amended design maintains the level of access at this location because of nearby drainage design refinements.

Direction

As part of the Pine Brush Creek and Williams Creek realignment design change, additional creek realignment is required at DS85 (BR21). Details on this realignment can be found in **Chapter 2, Design changes**. The realignment includes the relocation of the confluence of the two creeks to about 20 metres upstream of the existing confluence location. In addition to this, Williams Creek and Pine Brush Creek have been realigned by about 90 metres and 85 metres respectively to maintain existing velocities and hydraulic grades upstream of the confluence. These changes result in improved flood flow management through the three bridges.

At all other waterway crossings, the EIS design and the amended design both result in minimal changes to surface water source and direction where possible, except for constriction into, and expansion out of structures and constructed diversions, in line with the project floodplain management objectives.

Hazard

Potential hazard impacts for the northern creeks catchment compared with the EIS include:

- Improved hazard impacts at the Pacific Bay Resort and at minor tributaries
- No worsening at any locations.

Modified hazard impacts for the northern creeks catchment are compared in **Table 5.10-15**.

Table 5.10-14 Changes to hazard impacts in the northern creeks catchment compared to the EIS

Location	EIS potential flood impact	Amended potential flood impact	Change in impact
Minor tributaries	Increases in flood hazard classifications were predicted over some areas immediately upstream of the project (DS67, DS69, DS70, DS86).	Increases in flood hazard classifications are predicted over the area immediately upstream of the culvert DS86 in the PMF event.	Impacts for the amended design are reduced when compared to those presented in the EIS. These changes are because of new data, design refinements, and improved modelled methodologies.
Pacific Bay Resort	Localised increases were predicted around the Pacific Bay Resort and golf course (downstream of culverts ES57 and ES58) during the 5 and 1% AEP events.	Impacts are no longer predicted for the Pacific Bay Resort.	Impacts are no longer predicted for the amended design. This is because of new data including detailed survey of nearby terrain and drainage structures. The design scenario flooding behaviour is also influenced by the Korora Hill interchange design change.

Critical infrastructure

Impacts relating to critical infrastructure in the northern creeks catchment are consistent with those presented in the EIS.

Emergency management

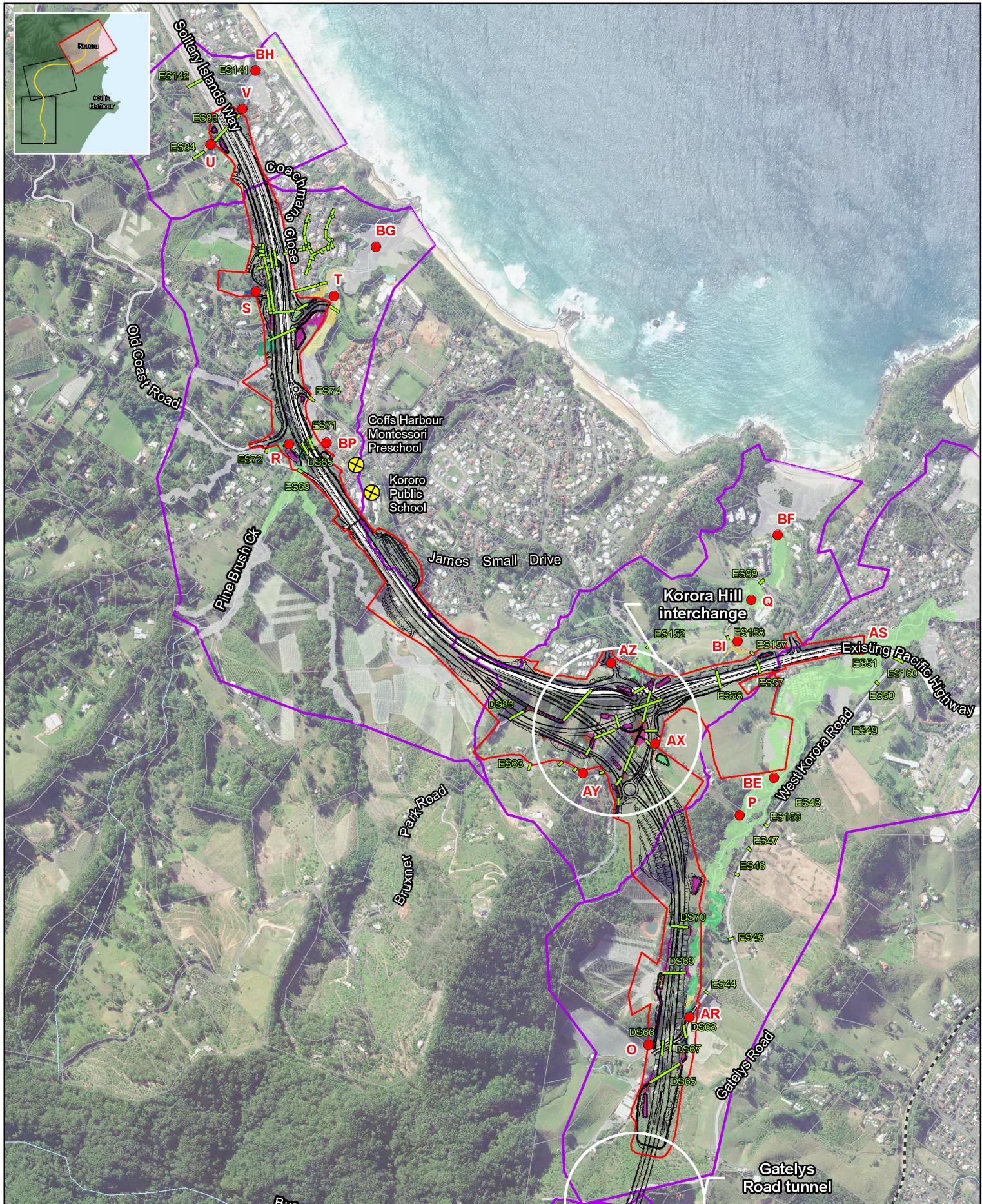
Impacts relating to emergency management in the northern creeks catchment are consistent with those presented in the EIS.

Table 5.10-15 Improvements to predicted flood level impacts in the northern creeks catchment compared to the EIS

POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
P	Existing access to Lot 19 DP771618 via Bruxner Park Road is proposed to be provided via West Korora Road with a new connection provided across Jordans Creek. Predicted afflux in the 1% AEP flood event was 1200 mm within Jordans Creek next to the proposed access crossing.	No adverse impact is predicted at this location.	Impacts have improved with the amended design. Afflux at point of interest P is no longer predicted. These changes are because of new data and relocated property access which is part of the Korora Hill interchange design change.
Q	The Korora Hill interchange results in the removal of the Bruxner Park Road intersection detention, increased road runoff and redistribution of flood flows to the downstream Pacific Bay Resort. Predicted afflux in the 1% AEP flood event was up to 200 mm within the vegetated creek and lakes, golf course and carpark areas.	The Korora Hill interchange results in the removal of the Bruxner Park Road intersection detention, increased road runoff and redistribution of flood flows to the downstream Pacific Bay Resort. Afflux of 35 mm is predicted in the 18% AEP flood event within the vegetated creek and lakes, golf course and carpark areas. No impacts are predicted in other events up to the 1% AEP flood event. Peak water level reductions of up to 40 mm are predicted in the 1% AEP event.	Impacts have improved with the amended design. Afflux is reduced from 200 mm to 35 mm. These changes are because of new data and the redesigned interchange which is part of the Korora Hill interchange design change.
R	The project reconfigures the existing Pacific Highway Pine Brush Creek crossings (ES71) including additional bridges and embankment work. Predicted afflux in the 1% AEP flood event was up to 200 mm over heavily vegetated creek areas. No adverse flood impact was predicted to the existing Old Coast Road (ES69 and ES72) bridges. *Note that impacts downstream of the Pine Brush Creek crossings (ES71) were reported under point of interest R in the EIS. Impacts downstream of the	The project reconfigures the existing Pacific Highway Pine Brush Creek crossings (ES71) including additional twin bridges (DS85 (BR21)), embankment work and creek realignments. Localised peak water level reductions of up to 200 mm are predicted within the waterway in the 1% AEP flood event. No flood impact is predicted to the existing Old Coast Road (ES69 and ES72) bridges.	Peak water level impacts of up to 200 mm were predicted in the EIS. Peak water level reductions of up to 200 mm are now predicted in the 1% AEP event. These changes are because of new data, improved modelling methodologies and modifications which are part of the Pine Brush Creek and Williams Creek realignment design change.

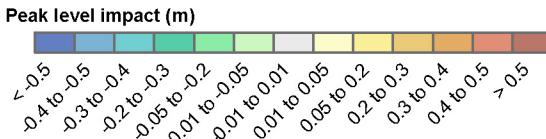
POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
	bridges have now been separated for clarity and are reported in point of interest BP.		
BP	The project reconfigures the existing Pacific Highway Pine Brush Creek crossings (ES71) including additional bridges and embankment work. Predicted afflux in the 1% AEP flood event was up to 70 mm over heavily vegetated creek areas. No adverse flood impact was predicted to the existing James Small Drive (ES74) bridges. *Note that these impacts (downstream of the Pine Brush Creek crossings (ES71)) were reported under point of interest R in the EIS. Impacts downstream of the bridges have now been separated for clarity.	Predicted afflux in the 1% AEP flood event is up to 13 mm over heavily vegetated creek areas (outside the project boundary). No adverse flood impact is predicted to the existing James Small Drive (ES74) bridges. Survey of the residential building (Lot 20 DP841807) determined that the floor level was at 11.14 mAHD. Afflux is predicted in events up to and including the 5% AEP. The peak water level in these events is below the floor level. The peak water level for the 1% AEP event under existing conditions is observed to be 11.39 mAHD. Afflux is not predicted in the 1% AEP event. This building is owned by TfNSW.	Impacts have decreased with the amended design. Afflux in the creek (downstream of the bridges) is reduced to 13 mm. The floor level of the residential building is above the peak water levels predicted in events up to and including the 5% AEP event. Afflux in events greater than the 5% AEP event are no longer observed. These changes are because of new data, improved modelling methodologies and modifications which are part of the Pine Brush Creek and Williams Creek realignment design change.
T	The Opal Boulevard access has been reconfigured, resulting in a modified flood distribution. Localised afflux of up to 300 mm was predicted in the 1% AEP event immediately upstream and downstream of the Opal Boulevard crossing of Pine Brush Creek.	The project reconfigures the existing Opal Boulevard access, resulting in a modified flood distribution. Localised afflux of up to 85 mm is predicted in the 1% AEP event immediately upstream and downstream of the Opal Boulevard crossing of Pine Brush Creek.	Impacts have improved. Afflux is reduced from 300 mm to 85 mm for the amended design. These changes are because of new data, improvements to modelling methodologies and design refinements such as reconfiguration of upstream drainage channels and structures. There have been no changes to the road design following exhibition of the EIS.
U	The proposed water quality basins extend into the waterway of the main Sapphire Beach tributary. This resulted in predicted localised afflux of up to 200 mm over vegetated areas of a residential	The proposed water quality basins extend into the waterway of the main Sapphire Beach tributary, resulting in localised afflux of up to 90 mm within	Impacts have been improved with the amended design. Afflux is reduced from 200 mm to 90 mm for the amended design.

POI	EIS design potential flood impact	Amended design potential flood impact	Change in impact
	property located on Campbell Close, Korora. Existing buildings were not affected.	the waterway. No change to the existing flood extents is predicted.	These changes are because of new data, improvements to modelling methodologies and design refinements.
V	The project tie-in was predicted to result in up to 11 mm of afflux to the downstream area of Nautilus Villas. Greater peak level impacts of up 28 mm were predicted on three residential properties immediately adjacent to the waterway.	No impact is predicted for the Nautilus Villas.	Impacts have improved with the amended design. Afflux at point of interest V is no longer predicted. These changes are because of new data and improvements to the modelling methodologies.
BI	Increased runoff was predicted with the approved development area of Pacific Bay Eastern Lands from the interchange at Korora Hill. Predicted afflux in the 1% AEP flood event was up to 100 mm on Lot 14 of the approved development. New flow paths were predicted through Lots 14 to 16 and Lots 18 to 21 with depths of 30 mm and 50 mm respectively in the 1% AEP flood event. Previous consultation with the proponent of the Pacific Bay Eastern Lands during preparation of the EIS had indicated that the future proposals are also being investigated within the area subject to flooding impact.	No impact is predicted for the approved development area of Pacific Bay Eastern Lands.	Impacts have improved with the amended design. Afflux at point of interest BI is no longer predicted. These changes are because of new data and the redesigned interchange which is part of the Korora Hill interchange design change.



Legend

- The legend is divided into two columns. The left column contains five entries with black outlines: 'North Coast Railway' (dashed line), 'Evacuation routes' (yellow line), 'Cadastral' (white box), 'Construction footprint' (red box), and 'Flood model extents' (purple box). The right column contains four entries with colored outlines: 'Modelled structures' (green line), 'Critical Infrastructure' (yellow circle with a plus sign), 'Assembly areas' (magenta cross), and 'POI' (red circle).



Coffs Harbour Bypass Northern creeks 1 % peak flood level difference Figure 5.10-7

5.10.7 Climate change effects of the amended design

The methodology used to assess the potential effects of climate change on the project and the potential effects of the project under climate change conditions for the amended design is consistent with the methodology outlined in the EIS. A detailed assessment is discussed in Section 6 of **Appendix H, Updated flooding and hydrology assessment**.

Impact of the project

The impact of the project under 2050 and 2100 climate change scenarios for the 1 per cent AEP event for the amended design, are generally consistent with the impacts presented in the EIS for all catchments.

Impact to the project

Flood immunity of the project does not change under the climate change scenarios, with the main carriageway remaining trafficable in the 1 per cent AEP event in the 2050 and 2100 climate scenarios. This is consistent with the outcomes of the EIS.

5.10.8 Stability of riverbanks and watercourses associated with amended design

The method for assessing impacts to the stability of riverbanks and watercourses is unchanged from the EIS. Flood modelling results were used to assess changes to flood velocities and hazards that could impact the stability of riverbanks and watercourses.

Consistent with the EIS, changes to hazard categorisation are highly localised and limited to locations where new drainage channels and culvert outlets are proposed. Appropriate culvert outlet scour protection and velocity dissipation design would be confirmed during detailed design to mitigate any risks of erosion and bank stability at these locations.

The amended design has resulted in changes to the design of the waterway realignments, specifically at Newports Creek, Pine Brush Creek and Williams Creek. These realignments are discussed in detail in **Chapter 2, Design changes** and are summarised below in comparison to the EIS design:

- An additional realignment of a minor tributary of Newports Creek (north of North Boambee Road) as it passes through culverts (DS14) beneath the project. This is part of the North Boambee Valley vertical alignment design change and replaces the bridge crossing (BR 05) in the EIS design
- Further realignment of Pine Brush Creek and additional realignment of Williams Creek as part of the Pine Brush Creek and Williams Creek realignment design change. The design changes incorporate realignment between the existing bridge over Pine Brush Creek (BR 20) and Old Coast Road and an additional 55 metres of realignment for Williams Creek.

The design of the proposed realignments will include consideration of the in-situ soil characteristics, predicted flood velocities and erosion potential following re-vegetation and landscaping treatments. Measures to maintain the stability of the banks during the construction phase and prior to the establishment of the landscaping are provided in **Chapter 6, Revised environmental management measures**. Similar to the assessment in Chapter 17, Flooding and hydrology of the EIS, impacts of these re-alignments on the stability of the banks of the watercourses are not anticipated to be significant.

5.10.9 Revised environmental management measures

The management measures presented within the EIS to address flooding and hydrology impacts have been reviewed in consideration of the proposed model updates and the proposed design and construction changes. Minor amendments have been made to the management measures and are shown in italics for new text and as strikethrough for deletions in **Table 5.10-16**. Other management measures provided in the EIS are still considered to be suitable for the project and are provided in **Chapter 6, Revised environmental management measures** for completeness.

As a result of a clarification made following the EIS, refer to Chapter 5, Clarifications, corrections and further information of the Submissions Report, an additional environmental management measure is required. This management measure is described in **Table 5.10-16**.

Table 5.10-16 Additional environmental management measures for flooding and hydrology impacts

Environmental issue	New ID	Environmental management measure	Responsibility	Timing
Impacts on flood behaviour during construction	FH01	<p>A Construction Flood Management Plan will be prepared and implemented before construction to manage the impact of a 5% AEP flood event or greater on the operation of ancillary facilities. The plan will form part of the CEMP and will detail:</p> <ul style="list-style-type: none"> • The impacts on hydrology and flooding from the construction phase • Control measures and procedures for construction activities to avoid, minimise or manage potential adverse impacts to construction works in the event of a flood within or adjacent to the project • <i>Management responses for ancillary sites provided in Table 17-5 of the EIS and Table 5.10-2 of the Amendment Report</i> • Flood monitoring to forecast large rainfall and flood events and notification measures • Emergency response and evacuation procedures in the event of a flood during the construction phase • Suitable evacuation routes and procedures for evacuation of site personnel • A register of all materials stored in work areas prone to flooding • Control measures for stockpiling within the floodplain to minimise loss of material in flood events. • Protocols for equipment and materials that can be removed from the subject area during a flood event where reasonable and feasible 	Contractor	During construction

Environmental issue	New ID	Environmental management measure	Responsibility	Timing
		<ul style="list-style-type: none"> • Consultation and coordination with local residents, CHCC and other relevant stakeholders • Induction of all construction site staff and visitors to familiarise with the emergency response procedures. 		
Managing residual flood impacts	FH08	<p>Consultation with CHCC will be carried out during detailed design regarding any residual flood impacts. This will include, but not be limited to:</p> <ul style="list-style-type: none"> • A whole of government approach will be investigated which considers the relationship between the project and North Boambee Valley (West) URA and what reasonable and feasible options could be implemented to assist in managing potential flood impacts. • Modifications to the Bennetts Road detention basin. 	TfNSW	During detailed design
	FH08	<p>A whole of government approach will be investigated with CHCC which considers the relationship between the project and North Boambee Valley (West) Urban Release Area and what reasonable and feasible options could be implemented to assist in managing potential flood impacts.</p>	TfNSW	During detailed design
	FH09	<p>Consultation with the proponent of Pacific Bay Eastern Lands development will be carried out during detailed design to develop a reasonable and feasible design solution to mitigate flood impacts on the approved residential areas. Consultation will also consider future proposals that are being investigated.</p>	TfNSW	During detailed design
	FH10 FH09	<p>Proposed mitigation measures for the North Boambee Valley catchment as described in <i>Table 17 of Appendix H, Updated flooding and hydrology assessment of the Amendment Report EIS, Chapter 17, Flooding and hydrology Table 17-10</i>. The final design solution may involve combinations of the described mitigation options and the design response developed as part of the concept design and will be subject to further flood modelling and consultation with CHCC, Environment, Energy and Science Group, DPIE and adjacent property owners.</p>	TfNSW/ Contractor	During detailed design

Environmental issue	New ID	Environmental management measure	Responsibility	Timing
	FH11 FH10	Proposed mitigation measures for the Coffs Creek catchment as described in <i>Table 20 of Appendix H, Updated flooding and hydrology assessment of the Amendment Report Chapter 17, Flooding and hydrology Table 17-13 of the EIS</i> will be investigated during detailed design. The final design solution may involve combinations of the described mitigation options and the design response developed as part of the concept design and will be subject to further flood modelling and consultation with CHCC, Environment, Energy and Science Group, DPIE and adjacent property owners..	TfNSW/ Contractor	During detailed design
	FH12 FH11	Proposed mitigation measures for the Northern creeks catchment as described in <i>Table 23 of Appendix H, Updated flooding and hydrology assessment Chapter 17, Flooding and hydrology Table 17-16 of the EIS</i> will be investigated during detailed design. The final design solution may involve combinations of the described mitigation options and the design response developed as part of the concept design and will be subject to further flood modelling and consultation with CHCC, Environment, Energy and Science Group, DPIE and adjacent property owners.	TfNSW/ Contractor	During detailed design
Dam safety	FH13	<i>Consultation will be undertaken with Dams Safety NSW during detailed design regarding the potential for parts of the project to be Declared Dams under the Dams Safety Act 2015.</i>	TfNSW	<i>During detailed design</i>

5.11 Soils and contamination

5.11.1 Assessment methodology and approach

A soils and contamination assessment was prepared as part of the EIS (Chapter 18, Soils and contamination). This supplementary soils and contamination assessment has been prepared in accordance with the SEARs to assess the potential impacts to soils and contamination associated with the proposed design and construction changes. The assessment carried out as part of the EIS was reviewed and a qualitative assessment was carried out against the SEARs to identify potential changes in impacts associated with the proposed design and construction changes.

The assessment was carried out in relation to key contamination guidelines including:

- Guidelines for Consultants Reporting on Contaminated Sites (EPA 1997b)
- Managing Land Contamination: Planning Guidelines: SEPP55 – Remediation of Land (DUAP & EPA 1998)
- National Environment Protection (Assessment of Site Contamination) Measure (NEPC 1999 as amended 2013)
- Roads and Maritime Guideline for the Management of Contamination (Road and Maritime Services 2013d).

5.11.2 Existing environment

The existing environment is described in Chapter 18, Soils and contamination of the EIS and is still applicable to this assessment.

5.11.3 Assessment of potential construction impacts

Contamination

As identified in the EIS, activities during construction have the potential to interact with existing sources of contamination. Potential sources of contamination and conceptual source-pathway-receptor models were developed as part of Chapter 18, Soils and contamination of the EIS. Agricultural and infrastructure and industrial sources of contamination and potential contamination are mapped in **Figure 5.11-1**.

The proposed design and construction changes would result in increases and decreases to both agricultural sources of contamination and infrastructure and industrial sources of contamination. Overall, there would be an increased impact of about 2.1 hectares to former and existing banana plantations and an increased impact of about 1.1 hectares to infrastructure and industrial sources of contamination.

The proposed design change at Englands Road interchange would result in a reduction in impact to the Coffs Coast Resource Recovery Park compared to the project outlined in the EIS. The design change would result in a decreased impact of 0.43 hectares to the property, which was identified as a potential source of contamination.

The proposed design change for the Coffs Creek flood mitigation would have the largest positive impact to potential sources of contamination. The removal of the Bennetts Road detention basin from the construction footprint would result in reduced impacts of about 1.3 hectares to former and existing banana plantations and to the Bennetts Road detention basin, which was identified as a potential contaminated site.

By comparison, the proposed new and revised ancillary sites would result in an increased impact of about 4.6 hectares to former and existing banana plantations. Ancillary site 3A would have the greatest impact to former and existing banana plantations and would contribute about 4.2 hectares. Ancillary site 3F would contribute about 0.3 hectares and site 1J would contribute about 0.1 hectares.

While ancillary site 1A is proposed to be located within a former landfill area, it has subsequently been capped and operation of the ancillary site would be unlikely to disturb any potential contaminants. As such, the proposed new ancillary site 1A would not result in a change in impact to existing sources of contamination as reported in the EIS.

The impacts as a result of the proposed design and construction changes to existing sources of contamination would be consistent with the EIS.

Soil salinity

As identified in the EIS, there are unlikely to be any salinity impacts during the construction of the project. There would be no change to soil salinity as a result of the proposed design and construction changes.

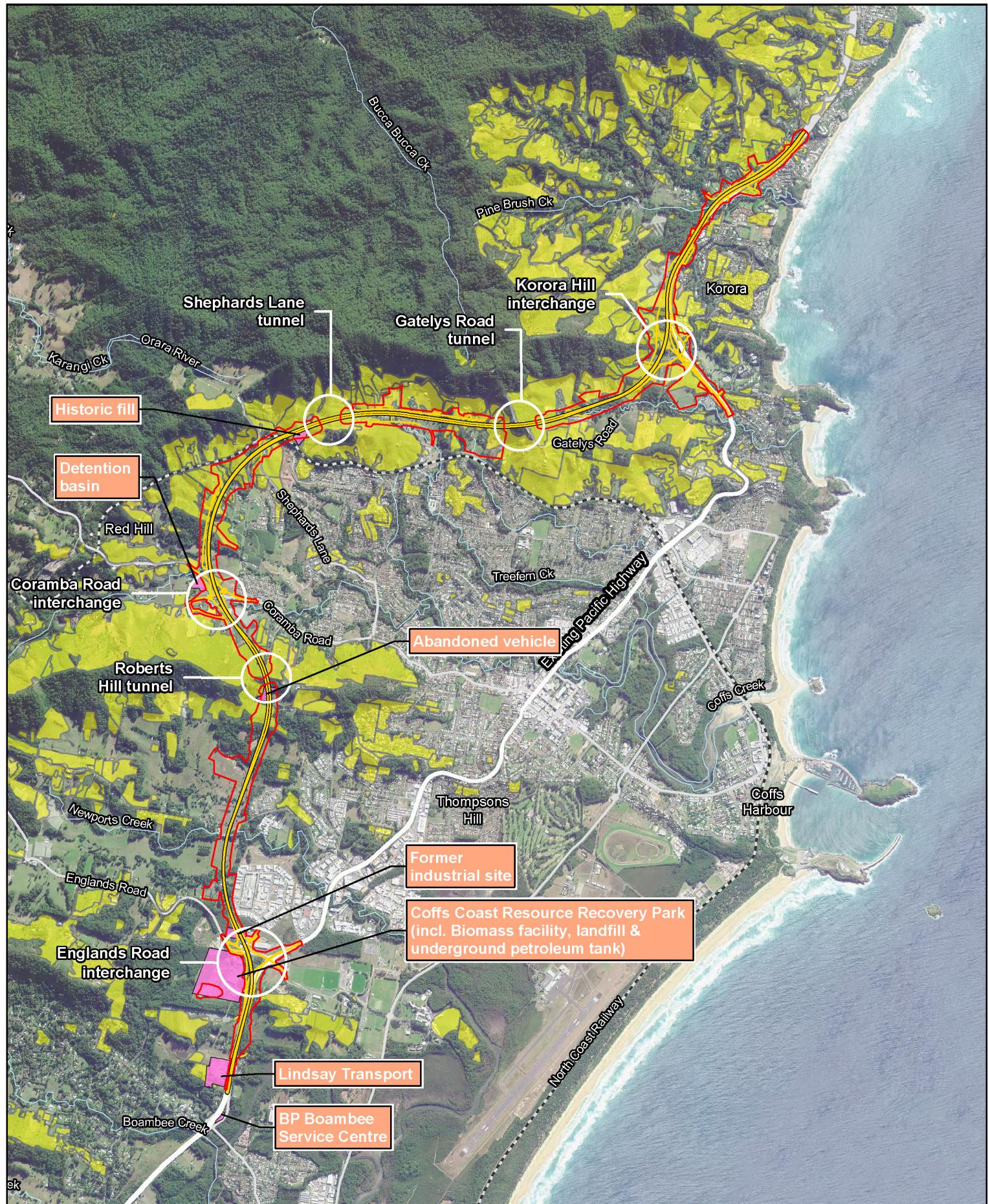
Acid sulfate materials

Construction of the project may result in the disturbance of potential acid sulfate soils (PASS). If acid sulfate soils (ASS) is exposed and oxidised, it may cause acid leachate to form which can lead to mobilisation of heavy metals and runoff of contamination into nearby soils, surface water and groundwater. Acid sulfate soils are mapped in **Figure 5.11-2**.

Areas of PASS were confirmed near Englands Road, North Boambee Road and Coramba Road. The proposed design changes at Englands Road and Coramba Road bus stop would not result in a change in impacts to PASS compared to the project assessed in the EIS. The proposed design change at North Boambee Valley would result in an increased construction footprint due to the excavation for improved flood conveyance and storage compared to the project described in the EIS. The design change results in the construction footprint increasing in an area mapped as low risk for ASS. As such, the North Boambee Valley vertical alignment design change may result in a minor increased risk of ASS disturbance.

Areas of high ASS risk are mapped near Pine Brush Creek. The proposed design change at Pine Brush Creek and Williams Creek would increase the construction footprint within mapped areas of high ASS risk.

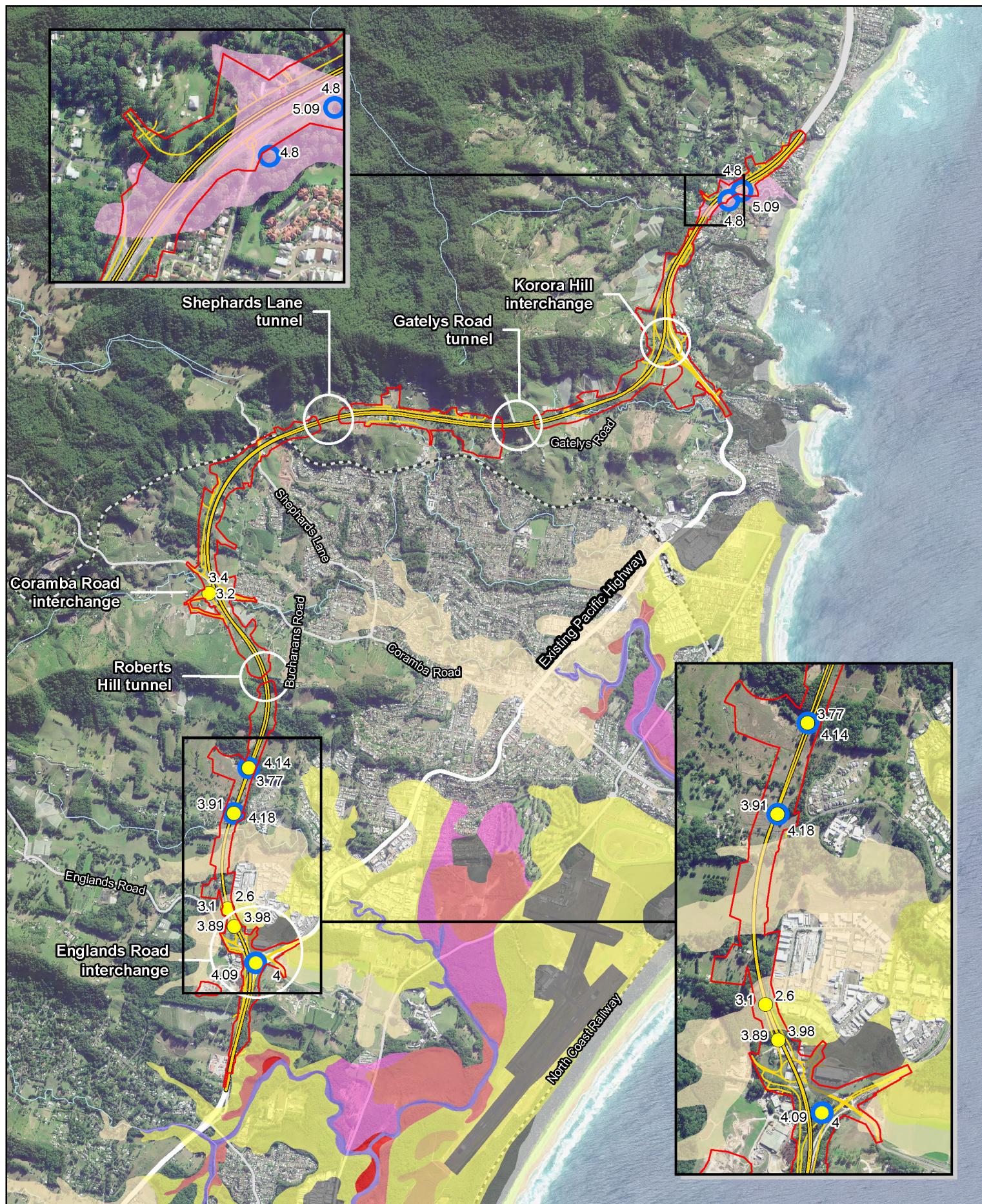
The impacts as a result of the proposed design and construction changes to ASS would be consistent with the EIS.



Legend

- | | |
|-------------------------|--|
| Construction footprint | Potential contaminated site |
| Alignment | Former and existing banana plantations |
| --- North Coast Railway | |
| Watercourse | |

Coffs Harbour Bypass
Potential sources of agricultural and industrial contamination
Figure 5.11-1



Legend

 	Construction footprint	Acid sulfate soil indicator testing	Acid sulfate soil risk	
 	North Coast Railway	● pH_{fox} ≤ 4	High Risk above 4m	Low Risk 2-4m
Watercourse	● pH_{fox} > 4	High Risk 0-1m	Water	
Alignment		High Risk Sediments	Low Risk above 4m	
		High Risk 1-2m	Disturbed Terrain	
		High Risk 2-4m	Low Risk Sediments	
		Low Risk 0-1m	Beach	
		Low Risk 1-2m	No Risk	

Coffs Harbour Bypass

Acid sulfate soils

Figure 5.11-2

0 0.5 1 1.5 km

Scale @A4: 1:50,000
GDA 1994 MGA Zone 56



5.11.4 Assessment of potential operational impacts

There would be no change to potential operational impacts to soil and contamination as a result of the proposed design and construction changes compared to the project described in the EIS.

5.11.5 Revised environmental management measures

The management measures presented within the EIS to address soils and contamination impacts have been reviewed in consideration of the proposed design and construction changes. The management measures provided in the EIS are still considered to be suitable for the project and are provided in **Chapter 6, Revised environmental management measures**.

5.12 Surface water quality

5.12.1 Assessment methodology and approach

A surface water quality assessment was prepared as part of the EIS (Chapter 19, Surface water quality). An updated surface water quality assessment has been prepared in accordance with the SEARs to assess the potential impacts of the project, including the design and construction changes.

The assessment in the EIS considered the potential impacts to surface water quality during both construction and operation phases of the project. The same assessment methodology used for assessing impacts to surface water quality in Section 19.1, Assessment methodology of the EIS was used to assess any changes to impacts associated with the proposed design changes. No additional field investigations were required as part of the assessment of the design changes.

5.12.2 Existing environment

The existing environment is described in the EIS and is still applicable to this assessment. No additional water quality sampling was done, and the baseline surface water quality results have not changed as part of the updated assessment of the proposed design changes.

The catchment area of the indicative road corridor has increased since the EIS due to minor changes in the indicative road corridor boundary (105.1 hectares in the EIS compared to an amended corridor area of 107.4 hectares). This has resulted in minor changes, less than five per cent, to the existing case pollutant loads. The updated pollutant loads for the existing case are documented in **Section 5.12.5**.

5.12.3 Potential construction impacts

This section provides a discussion on the changes to the potential construction impacts on surface water quality from those presented in the EIS. It discusses the significance of these changed impacts. All other construction impacts not discussed below remain unchanged in both nature and significance from those presented in the EIS.

Permanent and temporary waterway crossing structures

Changes to waterway structures compared with the EIS include the removal and replacement of a bridge (known as bridge BR 05 in the EIS) with a multi-cell culvert at the crossing of a northern tributary of Newports Creek. This tributary crosses the project about 250 metres north of North Boambee Road (near Highlander Drive). This change is an element of the North Boambee Valley vertical alignment design change and is described in more detail in **Chapter 2, Design changes**. This change would require the construction of a temporary diversion and crossing of the watercourse during the construction of the multi-cell culvert. The watercourse is a small creek with a width (top of bank to top of bank) of between 10 metres and 15 metres. The diversion would be about 130 metres long. This diversion would result in higher risks to surface water quality for the duration of the diversion. However, implementation of the environmental management measures described in **Chapter 6, Revised environmental management measures**, specifically FH03 and FH04, would manage the increased risks to water quality resulting from this temporary diversion. As outlined in Chapter 19, Surface water quality of the EIS, this temporary diversion and crossing of the watercourse would not be expected to have a significant impact on the water quality of the receiving environments with the application of the construction phase mitigation measures.

Apart from the additional temporary waterway diversion discussed above, the construction impacts associated with permanent and temporary waterway crossing structures are consistent with those presented in the EIS in both the nature and significance.

Waterway realignments

Changes to waterway realignments and adjustments compared with the EIS include:

- Changes to the realignment of a northern tributary of Newports Creek as it passes beneath the project about 250 metres north of North Boambee Road. At this crossing, the EIS design included a bridge structure (BR 05). As part of the North Boambee Valley vertical alignment design change, the amended design now includes a multi-cell culvert crossing to replace the bridge. The culverts would consist of six 2.4 metre x 2.4 metre box culverts about 45 metres long. The culverts would require about 130 metres of the northern tributary of Newports Creek to be realigned as it passes through the culverts beneath the project. The realignment would include a low flow channel to provide for fish passage, including through one of the culverts beneath the carriageways, which would be designed in accordance with the requirements of DPIE guidelines for fish conservation and management (Fairfull & Witheridge 2003). The alignment of the creek through the culverts (directly beneath the carriageways) would be straightened, and there would be limited opportunity to meander the creek through this section, compared with the EIS which provided more space below bridge BR 05 to enable design of a more natural creek alignment. Scour protection is likely to be needed on the upstream and downstream side of the culverts. The scour protection would be designed and constructed in a way that would accommodate a low flow channel and where possible provide an opportunity to include a meander. The extent of scour protection would be determined during detailed design in accordance with the requirements detailed in Chapter 5, Project description and Chapter 6, Construction of the EIS
- Changes to the realignment and temporary work at the Pine Brush Creek and Williams Creek crossing (BR 21). Changes to this realignment are part of the Pine Brush Creek and Williams Creek realignment design change. The realignment includes the relocation of the confluence of the two creeks to about 20 metres upstream of the existing confluence location. In addition to this, Williams Creek and Pine Brush Creek would be realigned by about 90 metres and 85 metres respectively to maintain existing velocities and hydraulic grades upstream of the confluence. This realignment is required for improved flood flow management through the three bridges.

These changes are discussed in further detail in **Chapter 2, Design changes**, and the proposed changes have been discussed with RIARG, DPIE and EESG, DPIE following the exhibition of the EIS (refer to **Chapter 4, Consultation**).

The detailed design of any waterway realignments would consider solutions to minimise impacts to water quality, including consideration of natural channel design principles such as meanders and riparian vegetation cover.

The required waterway realignments and adjustments are not expected to have a significant impact on the water quality of the receiving environments. These realignments would result in the movement of sediments during the initial phases of construction and potentially until the creek realignments are stable.

The realignments could also impact on the natural deposition of bed sediments within the waterway modifying the water quality and the biotic composition of the waterway, at least for a temporary period until the channel sediments are re-established and bedded in.

As outlined in Chapter 19, Surface water quality of the EIS, the required waterway realignments and adjustments are not expected to have a significant impact on the water quality of the receiving environments because of the described construction and operational phase mitigation measures.

Water quality impacts from construction-phase sediment basin discharge limits

As described in Chapter 19, Surface water quality of the EIS, construction phase impacts to surface water quality in waterways and sensitive receiving environments were identified through the development of a conceptual erosion and sediment management report (SEEC 2019), which included a preliminary erosion and sediment control plan identifying treatment and mitigation strategies.

As part of the preparation of the erosion and sediment management report, preliminary water quality modelling of the proposed construction-phase sediment basin discharge limits was also carried out using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) to assess against the NSW Water Quality Objectives (NSW WQOs). Similar to the operational water quality modelling, the three pollutants of concern assessed for the construction phase were total suspended solids (TSS), total nitrogen (TN) and total phosphorous (TP).

The erosion and sediment management report prepared for the EIS has been updated due to the development of the proposed design and construction changes (refer to Appendix B, Updated erosion and sediment management report of the Submissions Report). Accordingly, an updated construction sediment basin discharge assessment report has been prepared and is included as Appendix C, Construction sediment basin discharge assessment report of the Submissions Report.

The updated construction sediment basin discharge assessment report expands on the assessment prepared for the EIS and considers issues and recommendations raised by EPA. Specifically, the updated construction sediment basin discharge assessment report has been prepared to:

- Assess water quality issues associated with discharge from sediment control structures to be constructed as part of the project against the NSW WQOs
- Consider the sensitive receiving environments as identified in Chapter 19, Surface water quality of the EIS
- Address the project SEARs as relevant
- Meet the 10 steps to implement the Water Quality Management Framework as the part of the National Water Quality Management Strategy.

Table 5.12-1 to Table 5.12-3 provide a summary of model results carried out for the EIS and amended design compared against the NSW WQOs within each sub-catchment. Similar assumptions for the modelling and results have been provided for the updated construction sediment basin discharge assessment report compared to that described in Chapter 19, Surface water quality of the EIS and includes:

- MUSIC modelling was carried out to assess the impacts of proposed construction sediment basin discharge limits on the receiving environment of the project and determine whether the recommended discharge limit for TSS (ie 50 mg/L) from Managing Urban Stormwater: Soils and Construction (Landcom 2004) is appropriate for this site or if need to be amended to account for the NSW WQOs in the receiving environment and the potential for impacts on watercourses as a result of sediment basin discharges
- All data results are the average results that were experienced within the sub-catchment when rainfall was experienced. This includes minor rainfall (eg less than five mm) to large storm events

- Pump days are those days when water within the basins would be discharged after it has been treated to meet the discharge limit of 50 mg/L TSS concentration. The construction-phase sediment basins are assumed to be discharged within five days following the end of a rainfall event (on the pump day). It is also assumed that there no rainfall during pump days
- As the MUSIC modelling results are not available in NTU, the TSS results were converted to NTU using the assumed conversion ratio of 1:2 for TSS:Turbidity (ie 10 NTU has been converted to 5mg/L), which is consistent with the approach in Chapter 19, Surface water quality of the EIS.

Table 5.12-1 Summary of average water quality data from MUSIC model during basin discharge for Boambee wetlands

Indicator	EIS design		Amended design		NSW WQO
	All data	Pump days	All data	Pump days	
TSS [mg/L]	36.56	4.65	39.49	4.72	-
Turbidity (NTU)	73.12	9.29	78.98	9.44	6-50
TP [mg/L]	0.070	0.022	0.070	0.023	0.025
TN [mg/L]	0.56	0.31	0.55	0.34	0.35

Table 5.12-2 Summary of average water quality data from MUSIC model during basin discharge for Coffs Creek

Indicator	EIS design		Amended design		NSW WQO
	All data	Pump days	All data	Pump days	
TSS [mg/L]	48.48	4.97	45.72	5.12	-
Turbidity (NTU)	96.95	9.95	91.44	10.24	6-50
TP [mg/L]	0.091	0.023	0.093	0.027	0.025
TN [mg/L]	0.66	0.35	0.68	0.37	0.35

Table 5.12-3 Summary of average water quality data from MUSIC model during basin discharge for Korora basin

Indicator	EIS design		Amended design		NSW WQO
	All data	Pump days	All data	Pump days	
TSS [mg/L]	41.76	4.94	44.92	4.88	-
Turbidity (NTU)	83.52	9.88	89.84	9.76	6-50
TP [mg/L]	0.057	0.019	0.063	0.021	0.025
TN [mg/L]	0.49	0.26	0.48	0.30	0.35

The results in **Table 5.12-1** to **Table 5.12-3** generally show the EIS results are comparable to the updated results for the amended design. As such, the description of impacts for the amended design on the proposed construction-phase sediment basin discharge limits would be consistent with the EIS. The exception to the is a slight exceedance of TP concentration against the NSW WQOs on the days of discharge for the Coffs Creek catchment. However, and as noted in the Chapter 19, Surface water quality of the EIS, exceedances of TP concentrations are characteristic of the prevailing catchment conditions. As such, this minor modelled exceedance is likely to result in negligible impacts to the receiving environment. Further detail on the results of the updated construction sediment basin discharge assessment can be found in Appendix C, Construction sediment basin discharge assessment report of the Submissions Report. This also includes a qualitative discussion on other pollutants and key indicators.

Overall, TSS, TP and TN concentrations are predicted to be close to, or below, the NSW WQO trigger values for these indicators during days of construction phase sediment basin discharge.

Notwithstanding, TfNSW have committed to implementing a comprehensive suite of erosion and sediment control measures to manage the risks to surface water quality and protection of human health and the environment during construction. These are further described in Appendix B, Updated erosion and sediment management report of the Submissions Report, Appendix C, Construction sediment basin discharge assessment report of the Submissions Report and **Chapter 6, Revised environmental management measures**. The project's Soil and Water Management Plan would provide the overarching management document during construction and will describe the site-specific management measures and general monitoring requirements to ensure the implemented controls are effective.

In addition, during detailed design and prior to applying for an environmental protection licence for road construction under chapter 3 of the *Protection of the Environment Operations Act 1997*, TfNSW will undertake further updates to the erosion and sediment management report and associated preliminary erosion and sediment control plan to reflect the advancement of the design.

5.12.4 Potential operational impacts

Refinement of operational water quality measures

The operational water quality management strategy as documented in Chapter 5 of the EIS remains consistent for the amended design. That strategy was developed for the project with the aim of maintaining or improving water quality running off the project before it enters the local creek system.

The strategy comprises a system of catch drains, piped drainage, swales, sediment basins and gross pollutant traps in tightly constrained environmentally sensitive locations. The swales, sediment basins and proprietary spill capture units would treat day-to-day runoff from the road. The sediment basins and proprietary spill capture units would be designed to accommodate a spill volume of up to 40,000 L which would contain a major accidental spill from a traffic accident.

The water quality treatment devices listed above are designed in response to the project catchment areas and the discharge points from the project boundary to external watercourses. The design changes and design refinements throughout the project have resulted in changes to the catchment areas of runoff from the project as well as the space and locations available for water quality treatment devices. This has consequently resulted in changes to type and location of quality treatment devices throughout the project. However, the objectives and features of the water quality management strategy remain unchanged.

As discussed above, the design changes and design refinements have resulted in changes to the catchment areas and points of discharge from the project. These changes to the catchment areas discharging to the two types of operational water quality measures (water quality basins and proprietary devices) are documented in **Table 5.12-4**. As well, the changes to the catchment areas that are not treated are documented in **Table 5.12-4**.

Table 5.12-4 Area of contributing project catchments for each treatment type

Catchment	EIS design catchment areas (ha)			Amended design catchment areas (ha)			Change in total catchment area within indicative road corridor
	Water quality basin	Untreated*	Proprietary Devices	Water quality basin	Untreated*	Proprietary Devices	
Boambee wetlands	23.4	0.8	4.6	24.5	2.2	2.8	+ 2.6%
Coffs Creek	27.2	2.6	7.8	33.0	3.3	1.7	+ 1.2%
Korora Basin	30.6	0.8	7.3	30.6	0.5	8.7	+ 2.7%
Total	81.2	4.2	19.7	88.2	6.0	13.2	+ 2.2%

* Small catchments treated by swales are assumed to be untreated to provide a conservative estimate of performance

Minor design refinements have also resulted in changes to the operational water quality measures from those that were detailed in the EIS. **Figure 5.12-1** to **Figure 5.12-6** show the changes to the location of the permanent water quality basins and proprietary devices.

There is an increase in the number of proprietary devices compared to the EIS design from 10 to 20. This increase is comprised of 17 devices at new locations and seven devices removed, compared to the EIS design (so a net increase of ten). These proprietary devices may incorporate both water quality and spill containment functions. The increase in the number of proprietary devices is because of the following:

- Most of the increase devices are required to treat runoff from local roads (which were not included in the EIS design due to a change in design approach since the EIS)

- Changes to the grade of the road results in some proprietary device locations for the EIS becoming not feasible and treatment has been changed to a water quality basin or a swale
- An overlap of a drainage culvert and a proprietary device resulted in one proprietary device becoming two individual proprietary devices.

A summary of the changes to catchment areas from the EIS design is provided below:

- Increase in the area of catchments treated by water quality basins. This resulted in an increase in the number of water quality basins from 32 in the EIS design to 35 in the amended design. This increase is comprised of water quality basins at nine new locations and six water quality basins removed, compared to the EIS design (so a net increase of three). **Figure 5.12-1-01** to **Figure 5.12-1-06** provide further detail on the location of the permanent water quality basins in the amended design (compared to the EIS design)
- Increase in the area of catchments in Boambee wetlands and Coffs Creek that are untreated largely because of the inclusion of local roads in the amended indicative road corridor catchments **Figure 5.12-1-01** to **Figure 5.12-1-06** show the area of untreated catchments for the amended design
- A 2.2 per cent increase in the indicative road corridor because of the proposed design changes.

The changes to the catchment areas have occurred for the following reasons:

Boambee wetlands catchment

- The amended Englands Road interchange resulted in a small portion of the roundabout discharging untreated to Isles Drive because it was not possible to drain this area to the water quality treatment system. This contributed to an increase in untreated catchments compared with the EIS
- Changes to Englands Road interchange resulted in changes to the total catchment area within the indicative road corridor. There have also been adjustments to cuttings south of the interchange
- Catchments have been refined to incorporate more local roads being altered by the project. This has slightly increased the total catchment area within the indicative road corridor. Most of these areas would be untreated catchment area.

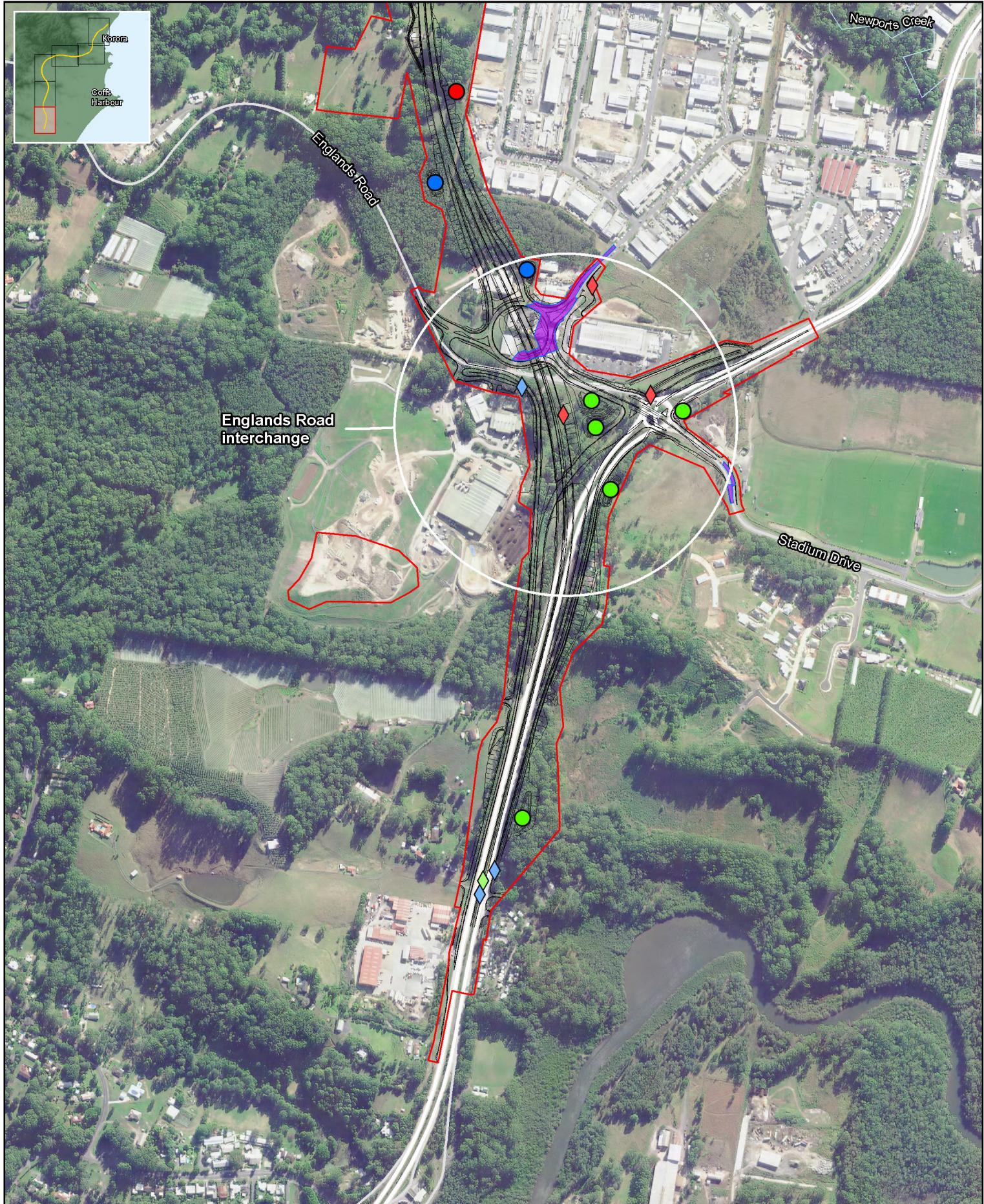
Coffs Creek catchment

- Catchments have been refined to incorporate more local roads being altered by the project. This has slightly increased the total catchment area within the indicative road corridor area. Most of these areas would be untreated catchment area.

Korora Basin catchment

- The indicative road corridor area was altered by the design changes at Korora Hill interchange and alterations to the tie-in with Charlesworth Bay Road intersection
- Catchments have been refined to incorporate more local roads being altered by the project. This has slightly increased the total indicative road corridor area. Most of these would be treated by proprietary products.

The above discussion is focused on the water quality treatment processes within the indicative road corridor. However, there would be numerous locations where runoff from within the project would pass through existing open channels and drains before entering a defined watercourse. Along these reaches, there would be additional pollutant reduction that is not accounted for in the pollutant reduction results discussed below. In addition, the assumptions regarding runoff from road surfaces do not account for the minor absorptive capacity of open graded asphalt. As such, this would indicate that the pollutant reduction performance discussed below is conservative.



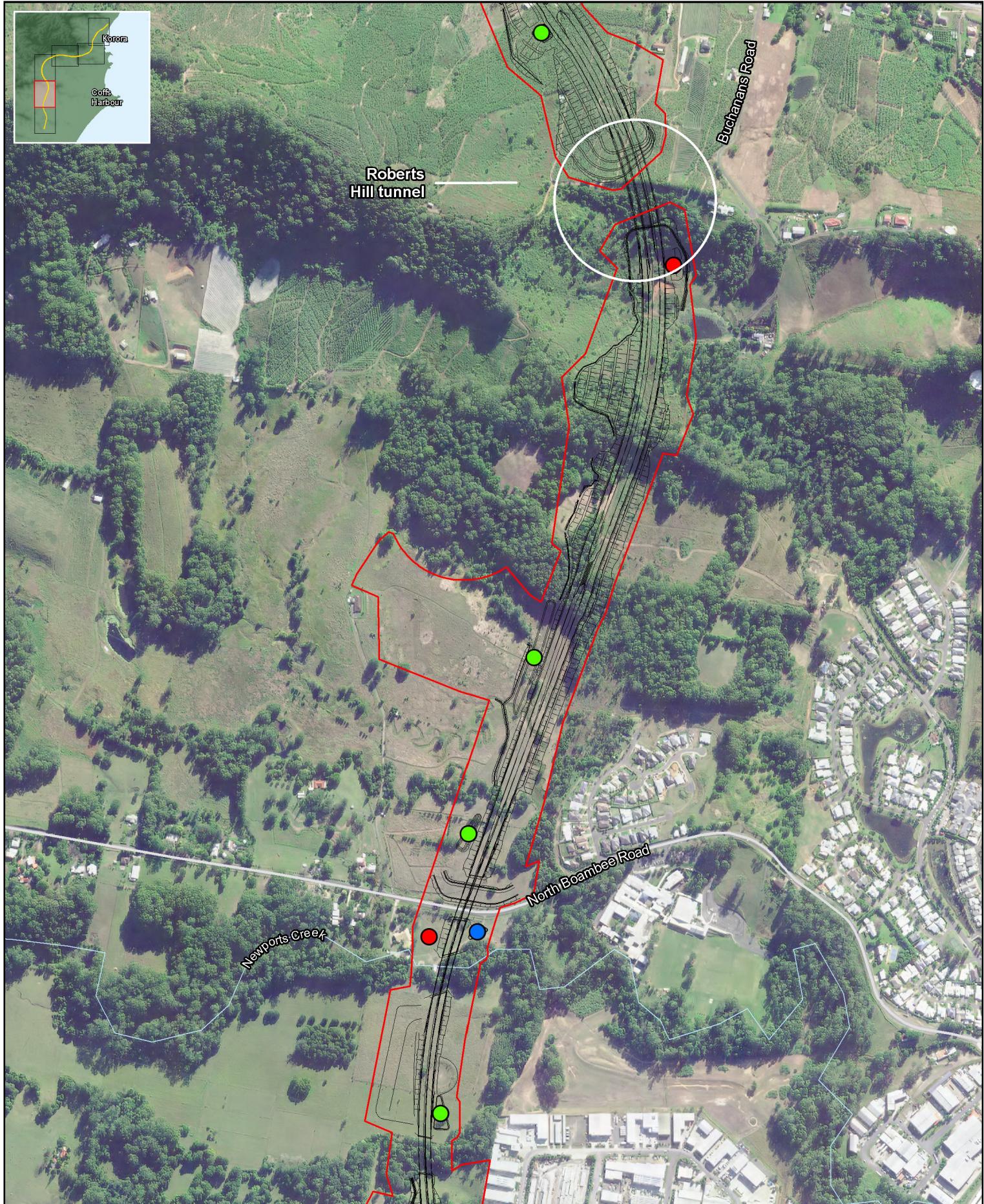
Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Untreated catchment areas

- | Indicative permanent water quality basins | Indicative proprietary devices |
|--|--|
| ● Additional to EIS design
● EIS design and amended design
● Removed from amended design | ◆ Additional to EIS design
◆ EIS design and amended design
◆ Removed from amended design |

Coffs Harbour Bypass
Water quality treatment devices for the EIS design and amended design
Figure 5.12-1-01

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Untreated catchment areas

Indicative permanent water quality basins

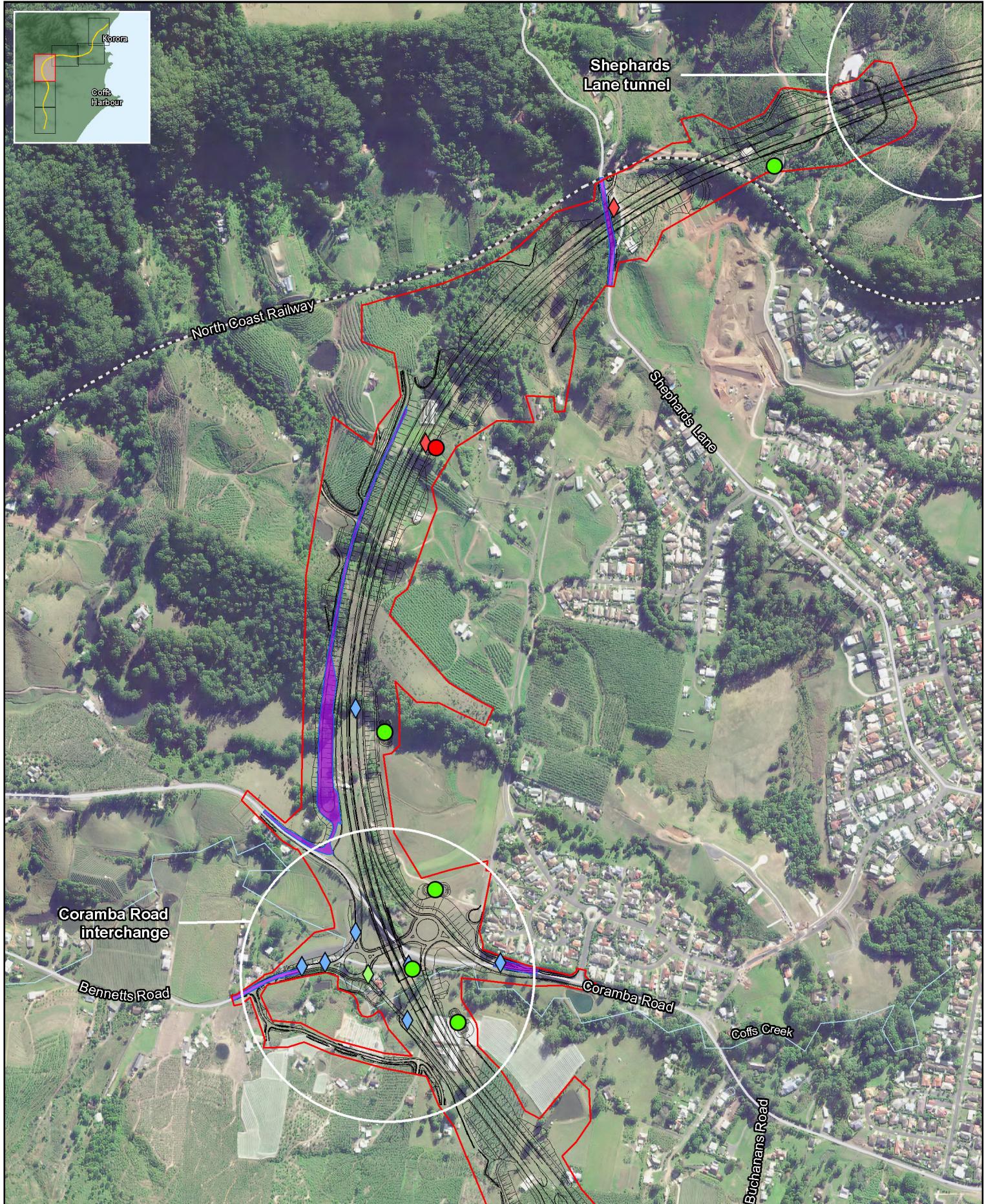
- Additional to EIS design
- EIS design and amended design
- Removed from amended design

Indicative proprietary devices

- ◆ Additional to EIS design
- ◆ EIS design and amended design
- ◆ Removed from amended design

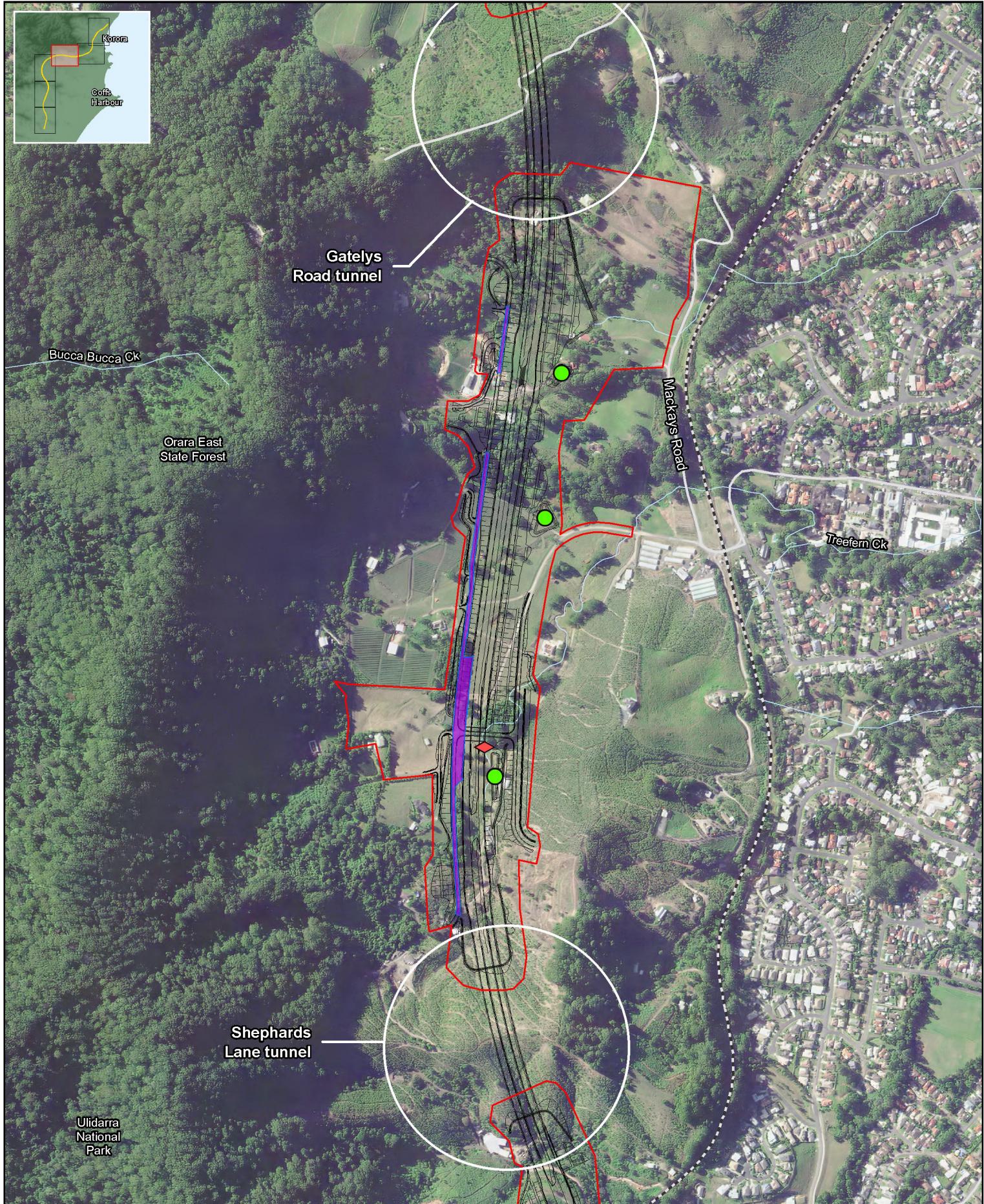
Coffs Harbour Bypass
Water quality treatment devices for the EIS design and amended design
Figure 5.12-1-02

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Coffs Harbour Bypass
Water quality treatment devices for the EIS design and amended design
Figure 5.12-1-03

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Untreated catchment areas

Indicative permanent water quality basins

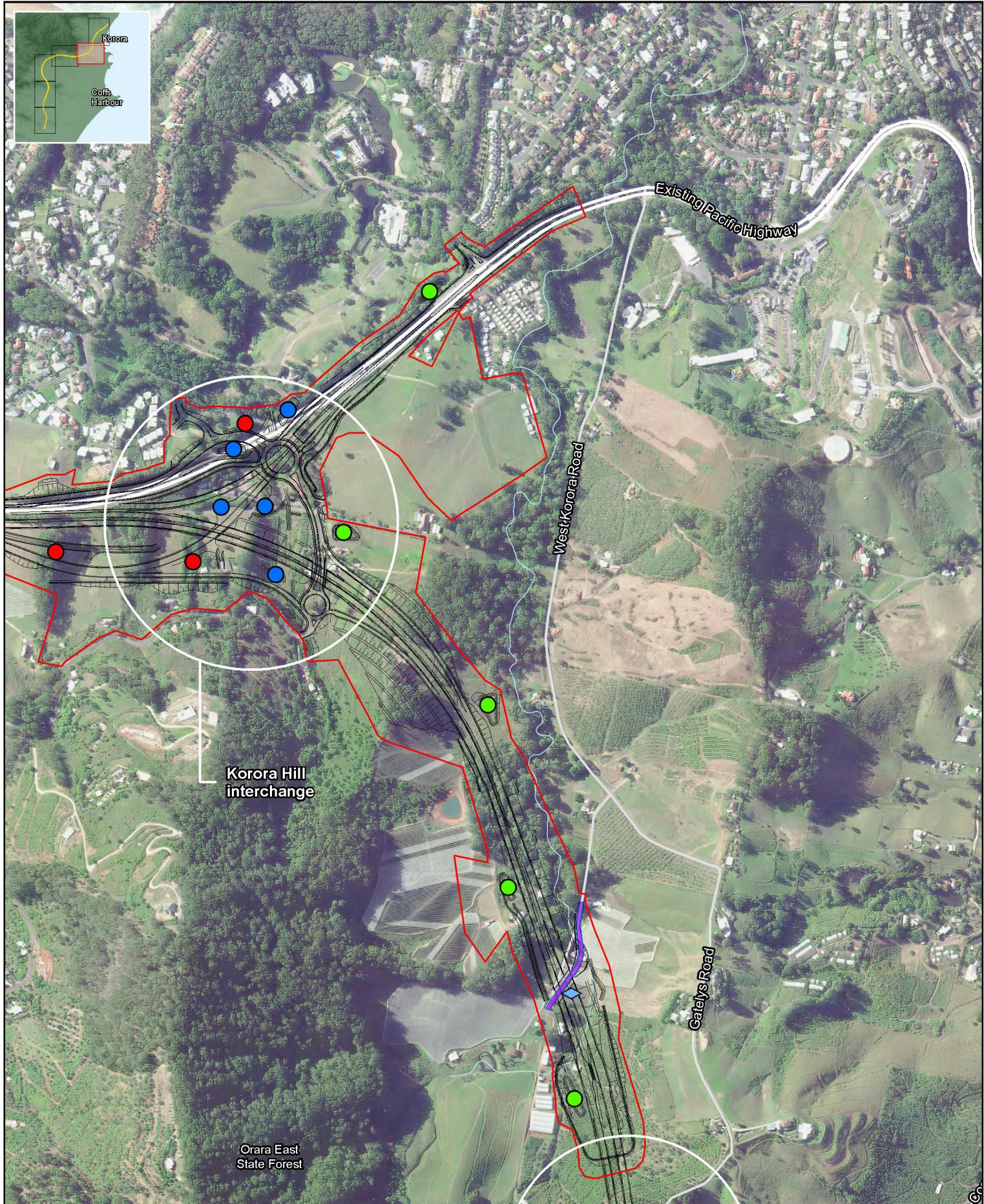
- Additional to EIS design
- EIS design and amended design
- Removed from amended design

Indicative proprietary devices

- ◆ Additional to EIS design
- ◆ EIS design and amended design
- ◆ Removed from amended design

Coffs Harbour Bypass
Water quality treatment devices for the EIS design and amended design
Figure 5.12-1-04

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Untreated catchment areas

- | Indicative permanent water quality basins | Indicative proprietary devices |
|--|--|
| ● Additional to EIS design
● EIS design and amended design
● Removed from amended design | ◆ Additional to EIS design
◆ EIS design and amended design
◆ Removed from amended design |

Coffs Harbour Bypass
Water quality treatment devices for the EIS design and amended design
Figure 5.12-1-05

0 0.1 0.2 0.3 km
 Scale @A4: 1:10,000
 GDA 1994 MGA Zone 56



Legend

- Construction footprint
- North Coast Railway
- Watercourse
- Untreated catchment areas

- | Indicative permanent water quality basins | Indicative proprietary devices |
|--|--|
| ● Additional to EIS design
● EIS design and amended design
● Removed from amended design | ◆ Additional to EIS design
◆ EIS design and amended design
◆ Removed from amended design |

Coffs Harbour Bypass
Water quality treatment devices for the EIS design and amended design
Figure 5.12-1-06

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

Operational water quality modelling

The results of the modelled pollutant loads for the amended design are shown in **Table 5.12-5** and pollutant concentrations are shown in **Table 5.12-6**. Similar to Chapter 19, Surface water quality, the pollutants modelled included TSS, TN and TP.

Table 5.12-5 Indicative road corridor pollutant loads

Indicator	Existing conditions	Unmitigated conditions	Mitigated conditions (amended design)	Reduction (EIS design)	Reduction (amended design)	Design reduction target
Boambee wetlands catchment						
TSS [kg/yr]	50,800	150,000	39,100	77.8%	73.9%	80%
TP [kg/yr]	72.3	252	108	57.6%	57.1%	45%
TN [kg/yr]	546	1030	811	22.7%	21.3%	NA
Coffs Creek catchment						
TSS [kg/yr]	57,800	192,000	51,300	74.5%	73.3%	80%
TP [kg/yr]	76.8	322	136	53.2%	57.8%	45%
TN [kg/yr]	58	1,310	1,040	22.2%	20.6%	NA
Korora Basin catchment						
TSS [kg/yr]	62,700	201,000	42,200	78.3%	79.0%	80%
TP [kg/yr]	122	334	145	57.2%	56.7%	45%
TN [kg/yr]	817	1380	1,060	23.0%	23.2%	NA

Changes to the modelled load-based results for the amended design are negligible and do not represent a substantial departure from the results presented in the EIS. The minor changes to the load-based results compared to the EIS include:

- TSS loads are slightly increased in the Boambee wetlands and Coffs Creek catchments but reduced for Korora Basin catchment.
- TP and TN loads are slightly increased in the Boambee wetlands and Korora Basin catchments but reduced for Coffs Creek catchment.

The increase in the number of treatment devices (basins and proprietary devices) does not correlate to increased pollutant reduction performance as the contributing catchments to each device has reduced due to drainage constraints and design changes. The total basin area across the project remains at about two per cent of the total contributing catchments. As such, the overall performance of the basins and propriety devices, as a whole, has not increased significantly. During detailed design, more detailed simulation of individual basins and their performance would be carried out to demonstrate compliance against the design reduction targets.

Table 5.12-6 provides results for concentration-based water quality modelling and uses the adopted TSS:turbidity correlation factor used in the EIS (1:2) to allow a comparison of the modelled parameters against the NSW WQOs.

Table 5.12-6 Indicative road corridor mean pollutant concentrations

Indicator	Existing conditions	Unmitigated conditions	Mitigated conditions (EIS design)	Mitigated conditions (amended design)	NSW WQOs
Boambee wetlands catchment					
TSS [mg/L]	40.10	349.74	79.38	91.34	-
Turbidity (NTU)	80.20	699.48	158.76	182.68	6-50
TP [mg/L]	0.09	0.59	0.23	0.26	0.025
TN [mg/L]	0.84	2.41	1.86	1.91	0.35
Coffs Creek catchment					
TSS [mg/L]	27.80	350.73	78.75	94.46	-
Turbidity (NTU)	55.6	701.46	188.92	157.5	6-50
TP [mg/L]	0.09	0.59	0.25	0.25	0.025
TN [mg/L]	0.87	2.40	1.91	1.86	0.35
Korora Basin catchment					
TSS [mg/L]	30.20	354.42	70.80	70.80	-
Turbidity (NTU)	60.4	708.84	141.6	141.6	6-50
TP [mg/L]	0.11	0.59	0.24	0.24	0.025
TN [mg/L]	0.93	2.41	1.84	1.84	0.35

Modelled results for the mitigated scenario indicate concentrations of TN and TP in surface water runoff directly from the indicative road corridor are consistent with those presented in the EIS but would be above the NSW WQOs. However, as for the EIS results, the concentrations fall within range of the surveyed ambient surface water quality conditions assessed during baseline water quality sampling at Treefern Creek, Boambee Creek and Newports Creek (refer to Chapter 19, Surface water quality of the EIS).

As discussed in the EIS, the MUSIC model predicts substantially higher TSS concentrations and turbidity when comparing the existing catchment with the unmitigated operational conditions. The model relies strongly on volumes of surface water flows to model TSS concentrations and turbidity. The existing catchment conditions within the indicative road corridor comprise of mainly permeable and vegetated surfaces of predominantly agricultural land uses. These land use types generate substantially less surface water flows and TSS/turbidity than impermeable surfaces, such as road pavement, due to the ability of vegetated surfaces and permeable surface to capture flows and TSS and reduce turbidity. The modelled concentrations of TSS and turbidity discharged from the project area are above the NSW WQOs. However, at a catchment wide scale these impacts would not be significant.

The modelled results indicate mean TSS concentrations would be increased and that these increases are more than those presented in the EIS for the Boambee wetlands and Coffs Creek catchments. The same conclusion can be drawn for predicted turbidity increases.

The proportionally larger increase in concentrations (compared to small increases in loads) is attributable to the non-linear nature of the concentration–load relationships. The project will increase the impervious fraction resulting in more runoff events (eg low rainfall events on existing pervious surfaces would result in runoff from impervious surfaces under the project case). The result is a highly non-linear relationship between changes to load and changes to concentrations. For example, in the design unmitigated case, TSS concentrations increase by a factor of around 10 to 12 while the loads increase by a factor of around three to four.

Similarly, for the design mitigated case with the proposed design changes modelled, TSS concentrations increase by a factor of around two to four while the loads do not change materially or even decrease.

It should also be noted that the stated concentration is a mean concentration for all times that the catchment is experiencing discharge. As such, changes to the duration of flow events will affect the mean concentration output from the modelling. For a road surface node in MUSIC, the duration of flow events are substantially less than the duration of flow events for an agricultural node, as water moves more slowly through an agricultural landscape. While there is a moderate decrease in the mass of pollutants, it would discharge from the indicative road corridor catchments in a much shorter period of time, leading to higher concentrations.

In regard to the performance against the NSW WQOs, these objectives are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways. The modelling indicates that under existing conditions the average pollutant concentrations generated in the indicative road corridor exceed the NSW WQO in all sub-catchments in the study area. Average pollutant concentrations that directly discharge from the project would increase during operation compared to the existing conditions as outlined in **Table 5.12-6**. However, with the proposed water quality treatment measures, this would reduce pollutant concentrations in all three catchments when compared to the unmitigated scenario. The modelling results show that the project has included measures to minimise impacts to water quality in receiving environments.

Impacts to receiving water environments as a result of operation of the project are not considered to be significant. As water from the indicative road corridor would be discharged into the surrounding waterways, it would experience mixing with the existing water in the creeks as part of perennial flows. Water from the wider catchment contributes to the majority of the flows within the receiving environments. The results of the ambient water quality sampling show that the water quality in the catchment is influenced by elevated nutrients and dissolved oxygen (refer to Table 19-8 of Chapter 19, Surface water quality of the EIS). Any changes to water quality associated with runoff from the indicative road corridor are expected to be localised at the point of discharge. The aquatic flora and fauna that occurs within these receiving environments would be adapted to the agricultural and urban environments in the catchment, and the localised changes to water quality are unlikely to have a significant impact to these features.

Consistent with the approach stated in the EIS, the type and design of the specific stormwater treatment measures would continue to be refined as part of the detailed design process with the aim of further reducing the potential impacts described above and to work towards meeting the NSW WQOs. This may result in the selection of devices and measures that would be more effective in managing the exceedances of the pollutants described above, eg use of bioretention swales or basins to more effectively manage TP and TN. However, the final selection of the specific stormwater treatment measures within the treatment train would be subject to reasonable and feasible considerations. This would include ongoing maintenance requirements, land use and property

impacts, community and maintenance personnel safety and additional environmental impact (should additional space be needed).

5.12.5 Sensitive receiving environments

Construction phase impacts

The assessment of construction phase impacts to sensitive receiving environments is unchanged from Section 19.3.3, Surface water quality of the EIS. As stated in the EIS, no work is anticipated within or directly adjacent to the NSW Solitary Islands Marine Park. However, construction work has the potential to result in indirect impacts to the Marine Park through sediment and pollutant runoff into the waterways.

Construction phase impacts to the downstream sensitive receiving environments within Boambee wetlands and Coffs Creek catchments are considered to be negligible as presented in Chapter 19, Surface water quality of the EIS. However, the extended length of proposed waterway realignment at Pine Brush Creek and Williams Creek has the potential for an increased impact to the water quality associated with the Solitary Islands Marine Park and Pine Brush Creek wetlands. Consistent with the EIS, management of these potential impacts will include implementation of site-specific controls during construction, such as coffer dams and/or silt curtains to prevent or minimise increased turbidity.

The strategies and measures for managing construction phase impacts to downstream sensitive receiving environments are consistent with those presented in the EIS.

Operational water quality modelling

Using the same methodology as discussed in Chapter 19, Surface water quality of the EIS, MUSIC modelling was carried out at a catchment-wide scale for the proposed design changes to compare existing water quality conditions with the operational conditions in the sensitive receiving environments. The modelling predicts average pollutant concentrations in the wider catchment and identifies modelled water quality conditions in sensitive receiving environments with proposed water quality treatment structures and without treatment (**Table 5.12-7**). Reporting results at a catchment-wide scale allows for a more meaningful assessment against the NSW WQOs and identification of potential impacts to the sensitive receiving environments.

The modelled results in **Table 5.12-7** show the modelled concentrations of TSS, TP, TN and gross pollutants (GP) in the sensitive receiving environments of each catchment.

Table 5.12-7 Mean concentration-based water quality modelling for receiving environments in the EIS design and amended design changes

Design water quality objective	Existing conditions	Operational unmitigated	Operational mitigated (EIS)	Operational mitigated (amended design)	NSW WQO
Boambee wetlands catchment					
TSS [mg/L]	22.70	24.54	22.50	22.60	-
Turbidity (NTU)	45.4	49.08	45	45.2	6 to 50

Design water quality objective	Existing conditions	Operational unmitigated	Operational mitigated (EIS)	Operational mitigated (amended design)	NSW WQO
TP [mg/L]	0.060	0.062	0.059	0.059	0.025
TN [mg/L]	0.55	0.55	0.56	0.55	0.35
GP [kg/day]	7.26	7.31	7.30	7.31	
Coffs Creek catchment					
TSS [mg/L]	25.50	27.93	25.00	24.90	-
Turbidity (NTU)	51	55.86	50	49.8	6 to 50
TP [mg/L]	0.078	0.08	0.076	0.075	0.025
TN [mg/L]	0.72	0.70	0.70	0.70	0.35
GP [kg/day]	5.75	5.92	5.89	5.92	-
Pine Brush Creek wetlands of Korora Basin					
TSS [mg/L]	25.50	31.52	24.60	24.60	-
Turbidity (NTU)	51	63.04	49.2	49.2	6 to 50
TP [mg/L]	0.066	0.06	0.064	0.064	0.025
TN [mg/L]	0.60	0.59	0.58	0.58	0.35
GP [kg/day]	2.13	2.17	2.17	2.17	-

The MUSIC modelling for the mean concentrations of pollutants in sensitive receiving environments for the proposed design changes show negligible or no changes to the model results for the EIS design. The modelled concentrations for Pine Brush Creek wetlands of Korora Basin show no changes for the proposed design changes. Changes to the modelled results for Coffs Creek wetlands are negligible, with marginal improvements to TSS, TP and TN in the proposed design changes in the order of less than 1.5 per cent. For the Boambee wetlands receiving environment, mean concentrations of TSS and TP are marginally increased by less than one per cent, while TN is marginally reduced by two per cent.

These changes identified in the modelled mean concentrations in sensitive receiving environments in the proposed design changes scenario are negligible and will not result in any measurable difference to conditions in the sensitive receiving environments.

5.12.6 Revised environmental management measures

The management measures presented within the EIS to address surface water quality impacts have been reviewed in consideration of the proposed design changes. The management measures provided in the EIS are still considered to be suitable for the project and are provided in **Chapter 6, Revised environmental management measures**.

5.13 Groundwater

5.13.1 Assessment methodology and approach

A groundwater assessment was prepared as part of the EIS (Chapter 20, Groundwater). The assessment carried out as part of the EIS was reviewed and a qualitative assessment was carried out against the SEARs to identify potential changes in impacts associated with the proposed design and construction changes.

The assessment methodology remains unchanged since the EIS and only considers the aspects potentially affected by the proposed design and construction changes. The impacts for all other aspects are consistent with the EIS.

5.13.2 Existing environment

The existing environment is described in Chapter 20, Groundwater of the EIS and is still applicable to this assessment.

5.13.3 Assessment of potential impacts

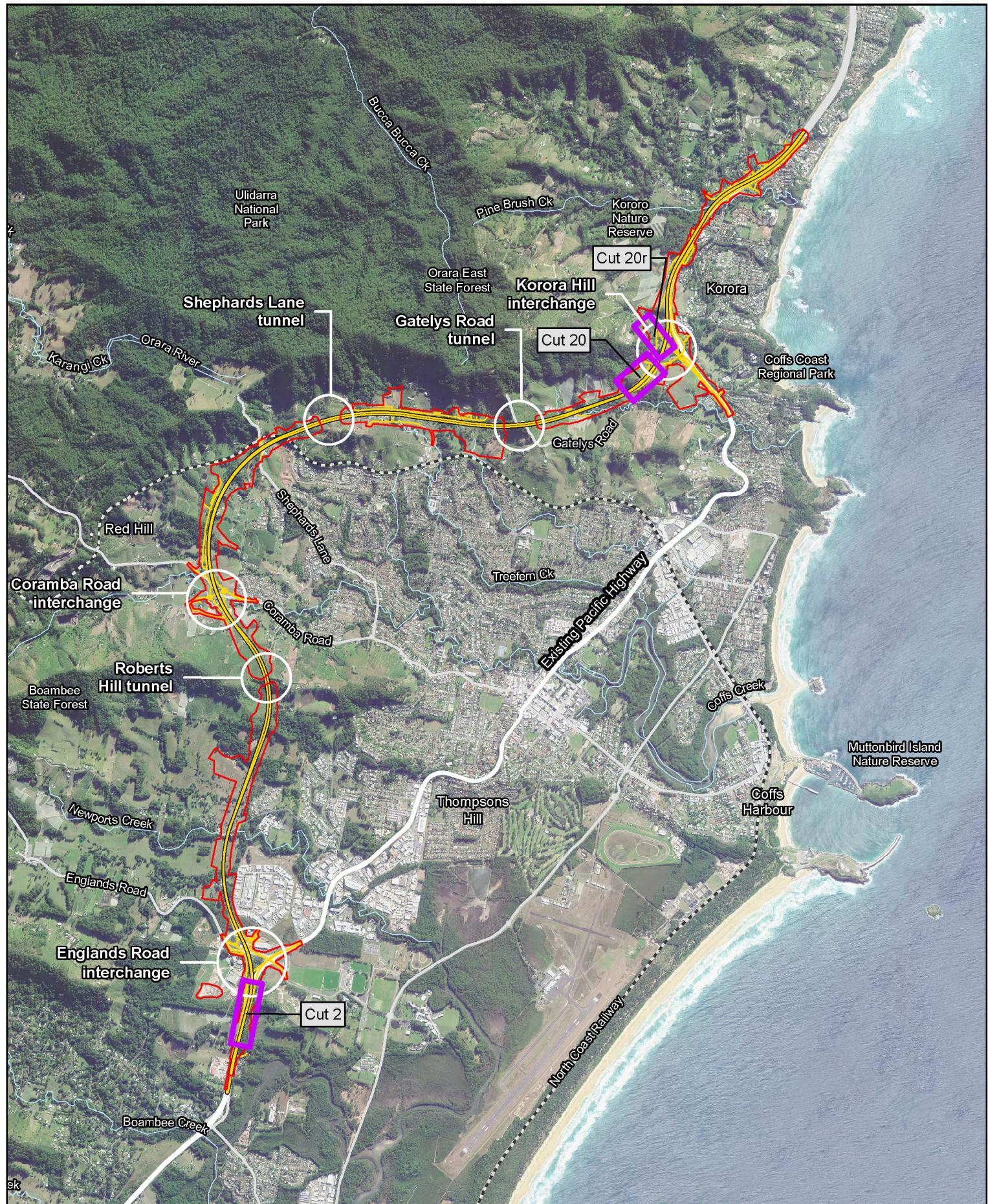
The potential impacts to groundwater associated with the proposed design change are highlighted in **Table 5.13-1** with further discussion provided below.

Table 5.13-1 Potential impacts associated with major design changes

Design change	Change to impact on groundwater
Englands Road interchange	This design change would result in a deeper and wider cut at Cut 2*. This design change was made to reduce property impacts on the Coffs Coast Resource Recovery Park, to improve the functionality of the interchange and to improve access to Isles Drive. The potential impacts to groundwater because of this design change are discussed below.
Korora Hill interchange	This design change would result in a slightly deeper and wider cut at Cut 20* to facilitate the northbound exit ramp, and a cut that is significantly shallower at Cut 20r*. The potential change in impacts to groundwater because of this design change are discussed below.

* Cut names have changed for the amended design. Cut 2 was named Cut 1 in the EIS. Cut 20 was named Cut 18 in the EIS. Cut 20r was named Cut 18r in the EIS.

The location of Cut 2, Cut 20 and Cut 20r are shown in **Figure 5.13-1** and a comparison of cross-sections for each cut is shown in **Figure 5.13-2** to **Figure 5.13-5**.



Legend

- Construction footprint
- Cutting
- Alignment
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Location of updated cuts
Figure 5.13-1

0 0.5 1 1.5 km
N
Scale @ A4: 1:50,000
GDA 1994 MGA Zone 56

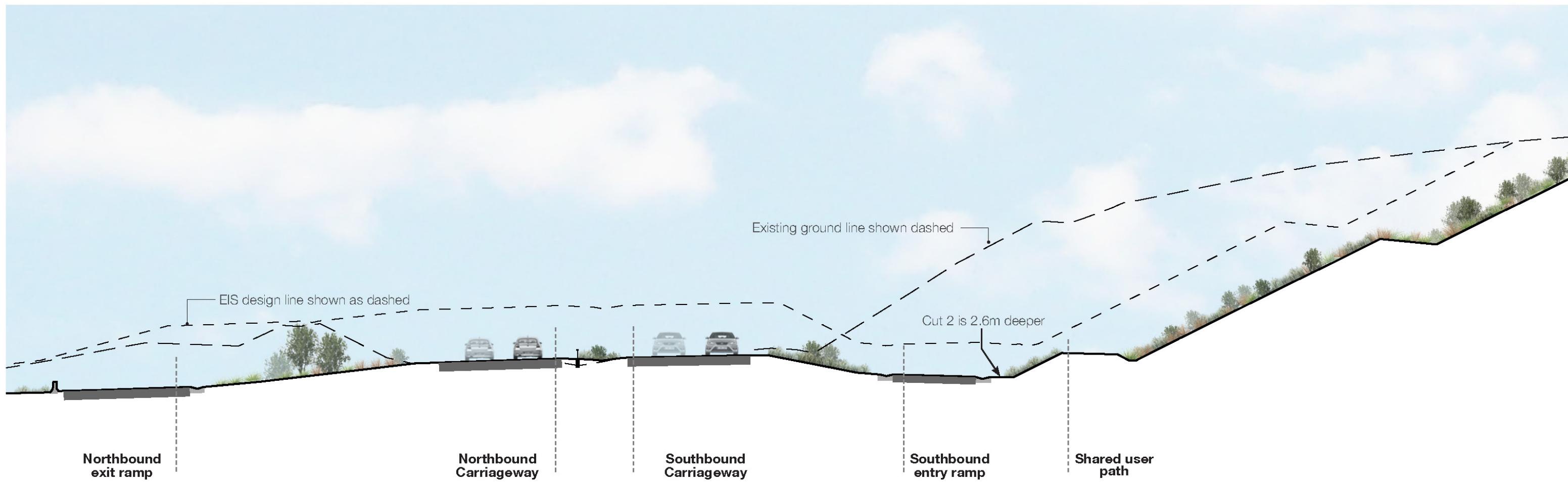


FIGURE 5.13-2 SECTION THROUGH CUT 2

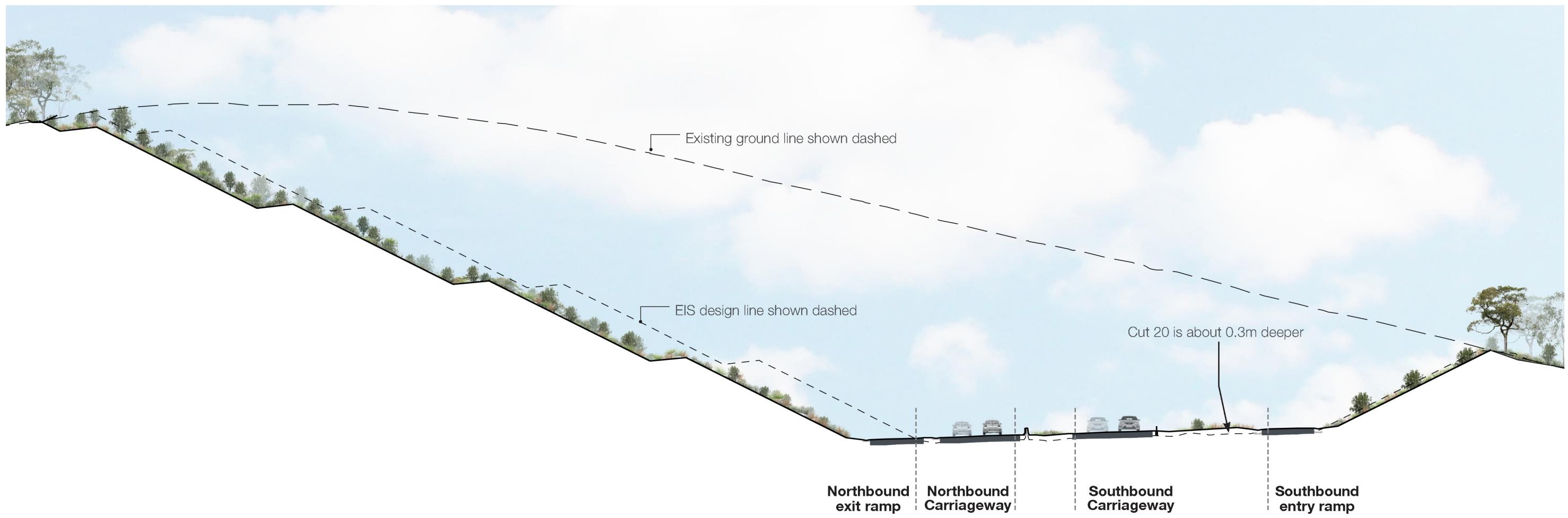


FIGURE 5.13-3 SECTION THROUGH CUT 20 AT DEEPEST POINT

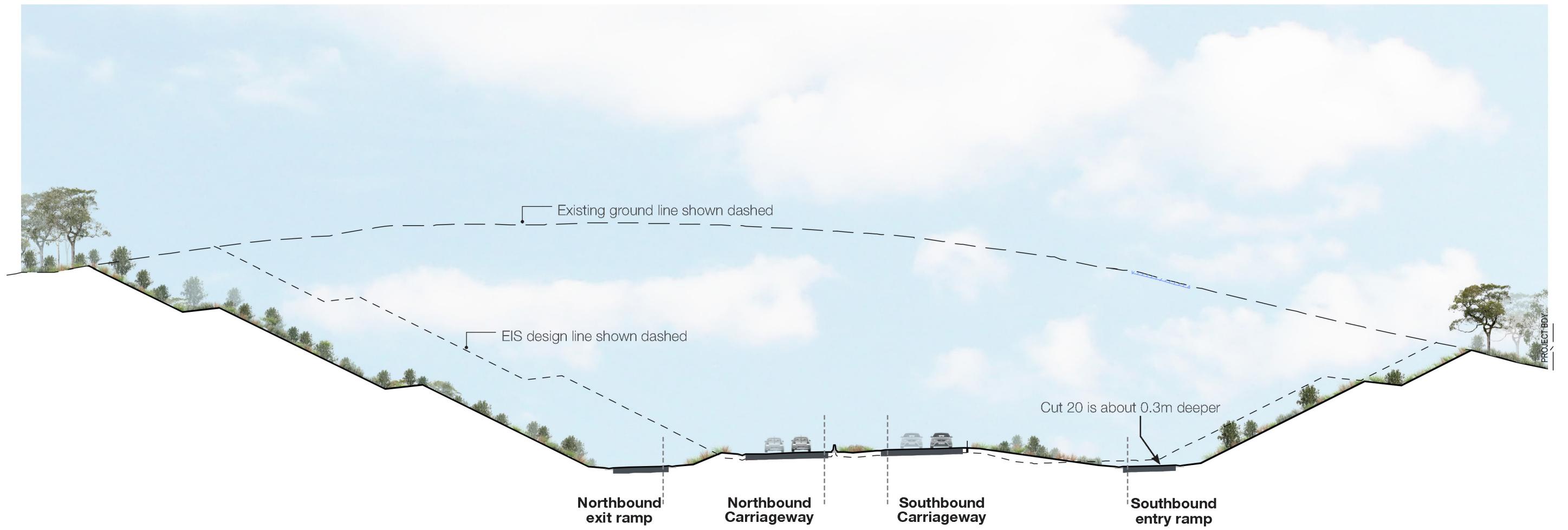


FIGURE 5.13-4 SECTION THROUGH CUT 20 AT WIDEST POINT

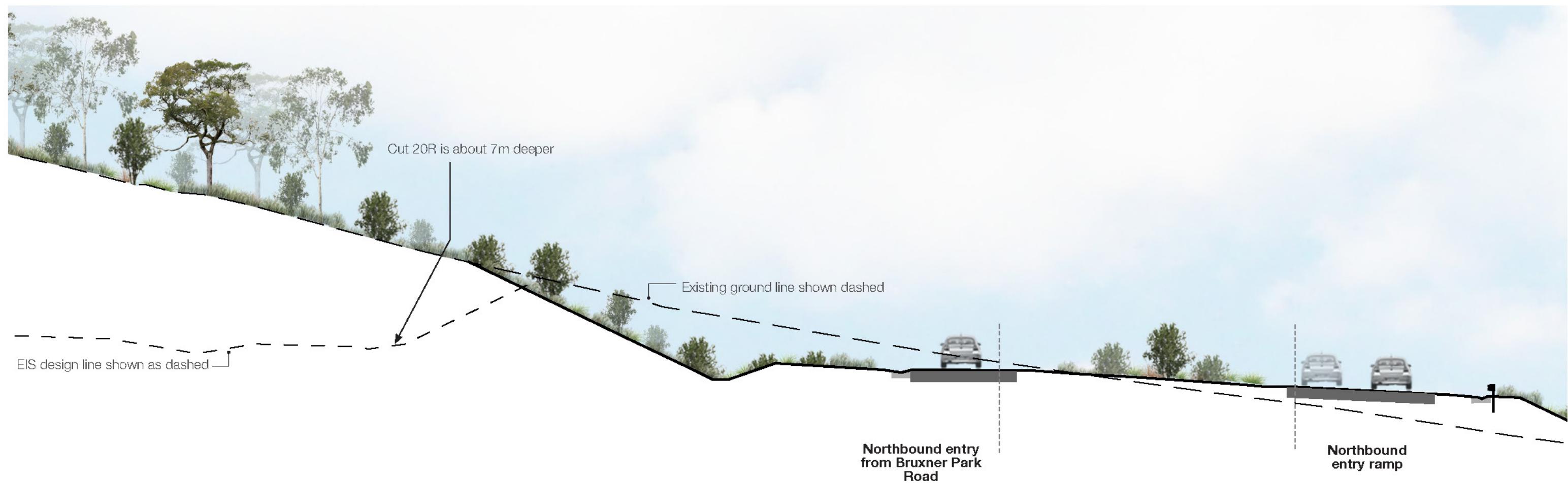


FIGURE 5.13-5 SECTION THROUGH CUT 20R

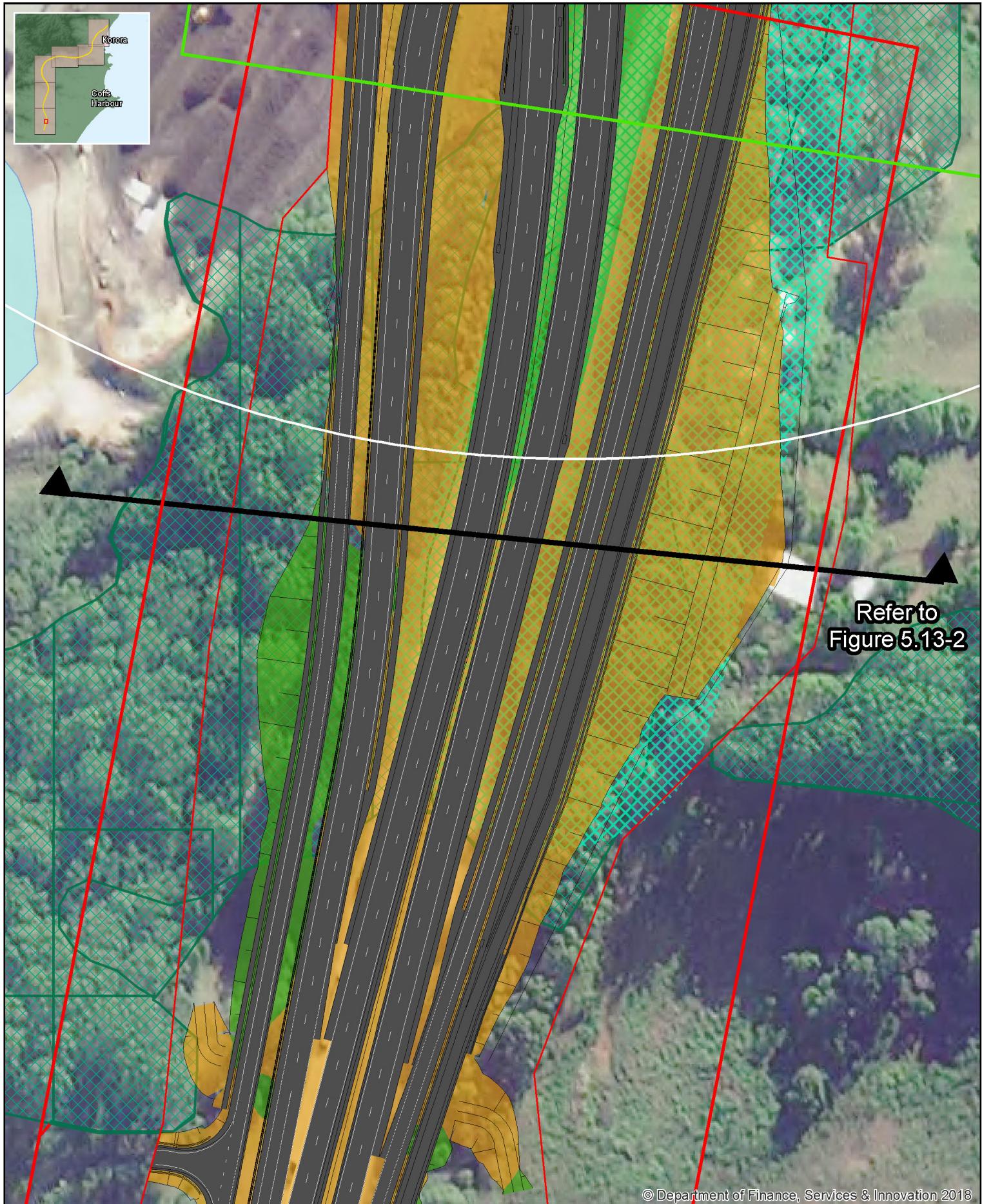
Englands Road interchange

The proposed design change at Englands Road interchange would result in a slightly deeper cut at Cut 2 compared to the EIS. The change in impacts because of the proposed design change are outlined in **Table 5.13-2**.

Table 5.13-2 Change to impact at Cut 2 because of the Englands Road interchange design change

Aspect	Change to impact at Cut 2
Groundwater levels and drawdown	<p>The impact on the groundwater levels because of the changes to Cut 2 has been estimated based on the changes in cut floor level and profile for the amended design shown in Figure 5.13 2. As impacts to groundwater levels and drawdown occur over an extended period of time, the construction and operation impacts are considered to be the same for this assessment as the assessment included in the EIS.</p> <p>The zone of predicted groundwater drawdown around Cut 2 for the proposed design change is shown on Figure 5.13 7. This zone is based on the distance upgradient and downgradient to the one metre drawdown extent and is estimated based on the depth of the cutting below groundwater level and the results of numerical modelling for other cuttings close to Cut 2, carried out previously for the EIS.</p> <p>In the EIS, Cut 2 was considered to have limited impact on groundwater because the cutting elevation was above the existing Pacific Highway road cutting, which would have already led to local changes to groundwater level over the long term.</p> <p>The proposed design change at Englands Road would result in a cut that is about 2.6 metres deeper and eight metres wider than the EIS design. This would result in Cut 2 being about two to three metres below the existing groundwater levels at its lowest point.</p> <p>The predicted zone of groundwater drawdown at Cut 2 is estimated to be around 45 metres. This would largely be within the construction footprint of the project and would be unlikely to impact on any feature outside of the alignment. The estimated maximum distance upgradient and downgradient at Cut 2 to the one metre drawdown extent for the amended design is 45 metres. By comparison, there was no drawdown anticipated for the EIS design.</p> <p><i>Groundwater supply wells</i></p> <p>There would be no change to the impacts to groundwater supply wells reported in the EIS because of the proposed design changes.</p> <p><i>Creeks and wetlands</i></p> <p>There would be no change to impacts on creeks and wetlands because of the proposed design change compared to the project outlined in the EIS.</p>

Aspect	Change to impact at Cut 2
	<p><i>Agricultural dams and lakes</i></p> <p>There would be no additional impacts to agricultural dams and lakes because of the proposed design change beyond those reported in the EIS.</p>
Water take	<p>There would be minor water take because of the proposed design change. It is anticipated to be a minor component of the total project water take. In comparison, the EIS did not report any water take at Cut 2.</p>
Groundwater dependent ecosystems and native vegetation communities	<p>The vegetation within the vicinity of Cut 2 was assessed as being low potential GDEs and no PCTs were recorded within the anticipated drawdown from Cut 2. There would be no change to impacts on GDEs and native vegetation communities as reported in the EIS.</p>
NSW Aquifer Interference Policy	<p>No additional bores would be located within the two metre drawdown extent because of the proposed design changes. As such, the potential impacts for the proposed design change would be consistent with the potential impacts outlined in the EIS.</p>
Summary	<p>The proposed design change would result in a cut that is wider and deeper than the project described in the EIS. The cut would have the potential to cause groundwater drawdown, where it was not previously expected. However, the predicted zone of drawdown is relatively small compared to other cuttings for the project. Impacts associated with the deeper and wider cut are likely to be within the construction footprint for the project and unlikely to impact on any groundwater dependent feature outside of the alignment.</p> <p>This design change would result in relatively minor impacts and are not expected to materially change the results identified within the EIS.</p>



Legend

- Construction footprint
- Ancillary sites
- Pavement
- Bridge
- Tunnel
- North Coast Railway
- Watercourse
- Earthworks cut
- Earthworks fill
- Agricultural / stock dams (DFSI 2018)
- Zone of groundwater drawdown (1m) Amended design
- Zone of groundwater drawdown (1m) EIS
- HydroArea
- Cross section location

Coffs Harbour Bypass

Cutting type and zone of drawdown of Cut 2

Figure 5.13-6

- | Cutting type | Terrestrial Groundwater Dependent Ecosystems |
|--------------|--|
| Type A | High potential GDE (regional studies) |
| Type B | High potential GDE (national assessment) |
| Type C | Moderate potential GDE (regional studies) |
| | Low potential GDE (regional studies) |
| | Low potential GDE (national assessment) |

0 0.015 0.03 0.045 km
Scale @A4: 1:1,500
GDA 1994 MGA Zone 56

Korora Hill interchange

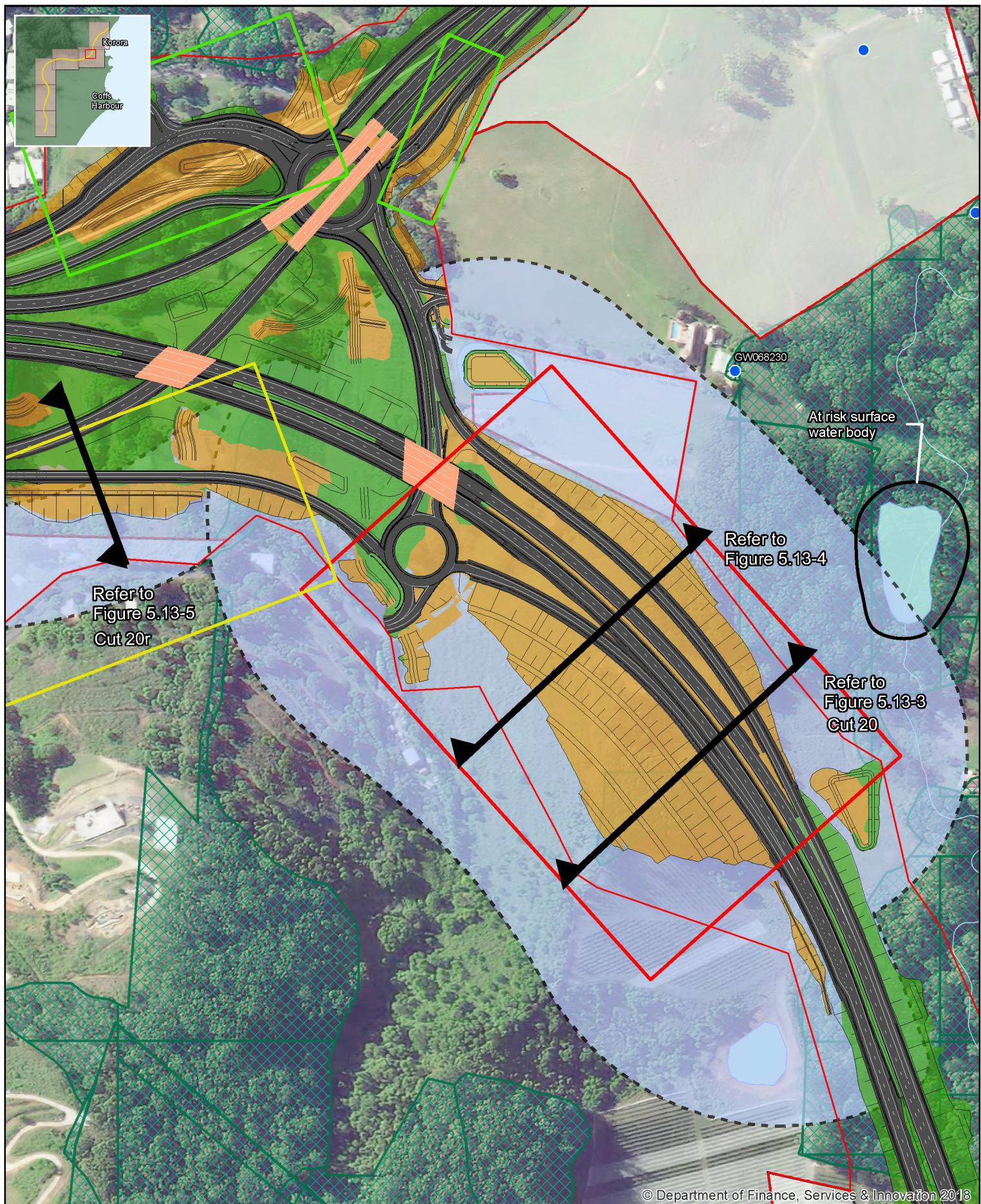
Cut 20

The proposed design changes at Korora Hill interchange would result in a slightly deeper and wider cut at Cut 20 compared to the project described in the EIS. The change in predicted impacts because of the proposed design change are outlined in **Table 5.13-3**.

Table 5.13-3 Change to impact at Cut 20 because of the Korora Hill interchange design change

Aspect	Change to impact at Cut 20
Groundwater levels and drawdown	<p>The impact on groundwater levels upgradient and downgradient of Cut 20 has been estimated based on the numerical model results for Cut 20 from the assessment carried out for the EIS. Consideration was also given to the relatively minor changes in cut floor level and profile for the amended design shown in Figure 5.13-3 and Figure 5.13-4. As impacts to groundwater levels and drawdown occur over an extended period of time, the construction and operation impacts are considered to be the same for this assessment.</p> <p>The proposed design changes are expected to result in a minor increase in the extent of drawdown when compared with the EIS design. The change to the magnitude of drawdown at the cutting is unlikely to be significant because the additional cut depth is relatively small, up to 0.3 metres, and there is a minor increase in the width of the cutting; up to 15 metres upgradient and up to six metres downgradient. Changes to groundwater inflows at the cutting are anticipated to be negligible as a result of the change of cut geometry.</p> <p>The zone of predicted groundwater drawdown around Cut 20 for the proposed design change is shown on Figure 5.13-7. This zone is based on the distance upgradient and downgradient to the one metre drawdown extent. The estimated maximum distance upgradient of Cut 20 is 221 metres, compared to 191 metres reported in the EIS. The estimated maximum distance downgradient of Cut 20 is 155 metres, compared to 125 metres reported in the EIS.</p> <p><i>Groundwater supply wells</i></p> <p>There would be no change to the impacts to groundwater supply wells reported in the EIS as a result of the proposed design changes.</p> <p><i>Creeks and wetlands</i></p> <p>Jordans Creek was identified in the EIS as potentially being affected because of its proximity to Cut 20. The proposed design change would result in an increase in the area of Jordans Creek that would be located within the zone of drawdown. Impacts to Jordans Creek were assessed in the EIS and given the relatively minor changes it is unlikely that there will be a significant effect on the results discussed within the EIS. As such, the impact to Jordans Creek is expected to be consistent with the impact described in the EIS.</p> <p>A surface water body to the south of the cut may be within the one metre drawdown extent because of the estimated increase in predicted drawdown</p>

Aspect	Change to impact at Cut 20
	<p>extent at Cut 20. This surface water body appears to align with Jordans Creek. This surface water body was identified in the EIS as potentially being at risk of impact because of reduction in throughput or changes to spring emergence upgradient. Site investigations for the project have not investigated the exact source of water for the surface water body, which means it is not possible to accurately predict the impact at this location. For this assessment, the precautionary principle has been applied and it is assumed that this water source could be impacted by a reduction in groundwater flow into the surface water body. The potential impact to this surface water body would be consistent with the impact outlined in the EIS.</p> <p><i>Agricultural dams and lakes</i></p> <p>There would be no additional impacts to agricultural dams and lakes as a result of the proposed design change beyond those reported in the EIS.</p>
Water take	<p>As a result of the proposed design changes there may be a negligible to minor increase in the predicted water take as reported in the EIS.</p>
Groundwater dependent ecosystems and native vegetation communities	<p>A GDE was identified within the estimated zone of drawdown from Cut 20 in the EIS. This GDE was identified as PCT 692 Blackbutt – Tallowwood moist ferny open forest of the coastal ranges of the NSW North Coast Bioregion. As a result of the proposed design changes there would be a minor increase in the area of affected vegetation community, because of the increase in drawdown extent. The impact to this GDE were assessed in the EIS and given the relatively minor changes it is unlikely there would be a significant effect on the results discussed within the EIS. As such, the potential impact to this GDE is expected to remain consistent with the impacts reported in the EIS.</p>
Summary	<p>The proposed design change would result in a cut that is only slightly (about 0.3 metres) deeper than the project described in the EIS. This design change would result in relatively minor impacts and unlikely to be beyond those identified in the EIS, both during construction and operation.</p>



Legend

- Construction footprint
 - Ancillary sites
 - Pavement
 - Bridge
 - Tunnel
 - North Coast Railway
 - Watercourse
 - Cross section location
- Earthworks cut
 - Earthworks fill
 - Agricultural / stock dams (DFSI 2018)
 - Groundwater bores
 - Zone of groundwater drawdown (1m) EIS
 - HydroArea

Groundwater Supply Wells

- Greater than 1m drawdown
- Less than 1m drawdown
- Within construction footprint

Terrestrial Groundwater Dependent Ecosystems

- High potential GDE (regional studies)
- High potential GDE (national assessment)
- Moderate potential GDE (regional studies)
- Low potential GDE (regional studies)
- Low potential GDE (national assessment)

Coffs Harbour Bypass

Cutting type and zone of drawdown of Cut 20 and Cut 20r

Figure 5.13-7

0 0.04 0.08 0.12 km
Scale @A4: 1:4,000
GDA 1994 MGA Zone 56

Cut 20r

The proposed design change at Korora Hill interchange would result in a significantly shallower and smaller cut at Cut 20r compared to the project described in the EIS. The change in impacts because of the proposed design change are outlined in **Table 5.13-4**.

Table 5.13-4 Change to impact at Cut 20r due to Korora Hill interchange

Aspect	Change to impact at Cut 20r due to Korora Hill interchange
Groundwater levels and drawdown	<p>The impact on groundwater levels upgradient and downgradient of Cut 20r has been estimated based on the numerical model results for Cut 20 from the assessment carried out for the EIS and considering the changes in cut floor level and profile for the amended design shown in Figure 5.13-5.</p> <p>The proposed design changes would result in a cut with a significantly reduced width and depth compared to the cut reported in the EIS. The cutting would likely be above groundwater levels in this area. As a result, Cut 20r would now be considered a Type B cutting (negligible to no impact to the groundwater regime). As part of the EIS, Cut 20r was assessed as being a Type A cutting (potential for moderate to high impact to the groundwater regime).</p> <p>The change in cutting type and the zone of predicted groundwater drawdown around Cut 20r for the proposed design change is shown on Figure 5.13-7. Since the cutting is anticipated to be above the groundwater table, no drawdown at this location is predicted. By comparison, the EIS design reported the estimated maximum distance upgradient and downgradient at Cut 20r to the one metre drawdown extent as 50 metres.</p> <p><i>Groundwater supply wells</i></p> <p>The EIS reported no impacts to groundwater supply wells at Cut 20r and there would be no change in impacts as a result of the proposed design changes. By comparison, the EIS design reported the estimated maximum distance upgradient and downgradient at Cut 20r to the one metre drawdown extent as 50 metres.</p> <p><i>Creeks and wetlands</i></p> <p>The EIS reported no impacts to creeks and wetlands at Cut 20r and there would be no change in impacts as a result of the proposed design changes.</p> <p><i>Agricultural dams and lakes</i></p> <p>The EIS reported no impacts to agricultural dams and lakes at Cut 20r and there would be no change in impacts as a result of the proposed design changes</p>
Water take	The groundwater assessment carried out as part of the EIS identified a minor estimated water take at Cut 20r. The proposed design changes would result in the cutting changing from Type A to Type B. As a result, there would be no water take at Cut 20r.

Aspect	Change to impact at Cut 20r due to Korora Hill interchange
Groundwater dependent ecosystems and native vegetation communities	No GDEs were identified as being within the estimated zone of drawdown from Cut 20r in the EIS. There would be no change in impacts to GDEs as a result of the proposed design change.
Summary	The proposed design change would result in a cut that is significantly reduced in its extent compared to the project described in the EIS. As such, the impacts on groundwater are reduced with the amended design. Impacts to construction and operation are considered to be negligible to low, compared to moderate to high impacts reported in the EIS.

Summary of potential impacts

Overall, the proposed design and construction changes are unlikely to result in significant changes to the predicted groundwater impacts across the length of the project compared to those described in the EIS. Changes to the design are relatively minor and are likely to result in small changes to the predicted drawdown and water take. As such, the potential impacts because of the proposed design changes would be consistent with those described in the EIS. Across the project, changes to groundwater seepage at the cuttings are anticipated to be negligible as a result of the change of cut geometry.

Groundwater levels and drawdown

There would be minor changes to groundwater levels and drawdown because of the proposed design changes. The estimated distance upgradient and downgradient at Cuts 2, 20 and 20r to the one metre drawdown extent for the amended design and for the EIS design are presented in **Table 5.13-5**.

The zone of drawdown is expected to be an overestimate as it assumes groundwater drawdown would occur uniformly across the entire length of the cuttings. The predicted drawdown however is modelled at the deepest part of the cut and as such is likely to be a conservative approach to identifying the potential area of impact.

Table 5.13-5 Change to estimated zone of influence for modelled cuts

Cut	Maximum predicted distance to upgradient 1 m drawdown (m)		Maximum predicted distance to down gradient 1 m drawdown (m)	
	EIS design	Amended design	EIS design	Amended design
Cut 2	-	45	-	45
Cut 20	191	221	125	155
Cut 20r	50	No drawdown	50	No drawdown

Groundwater supply wells

There would be no change to the impacts to groundwater supply wells reported in the EIS as a result of the proposed design changes.

Creeks and wetlands

Jordans Creek was identified in the EIS as potentially being affected because of its proximity to Cut 20. The proposed design change would result in an increased area of Jordans Creek that would be located within the zone of predicted drawdown from Cut 20. Impacts to Jordans Creek were assessed in the EIS and given the relatively minor changes it is unlikely there would be a significant effect on the results discussed within the EIS. As such, the impact to Jordans Creek is expected to be consistent with the impact described in the EIS. As a result of the proposed design changes, it is unlikely that there would be a change in overall impact compared to that assessed in the EIS.

Environmental management measure GW09 (now GW10) has been updated to refer specifically to Jordans Creek to ensure ground truthing and site inspections would be carried out to confirm predicted impacts and to determine the connection between Jordans Creek and groundwater. Refer to **Table 5.13-6** for updated management measures.

There would be no further impacts to creeks and wetlands, beyond those identified above and in the EIS.

Agricultural dams and lakes

There would be no additional impacts to agricultural dams and lakes because of the proposed design change beyond those reported in the EIS. As described, an additional surface water body in proximity to Cut 20 may be within the one metre drawdown extent because of the estimated increase in predicted drawdown at Cut 20. This surface water body was identified in the EIS as potentially being at risk of impact. The impact to this surface water body would be consistent with the impact outlined in the EIS.

Settlement

The extent and magnitude of settlement occurring within the rock mass surrounding cuttings and tunnels because of groundwater drawdown is anticipated to be less than five millimetres given the high stiffness of the bedrock. The risk associated with settlement of unconsolidated alluvial material because of groundwater drawdown is consistent with the impacts outlined in the EIS.

Groundwater quality

There would be no change to the impacts on groundwater quality during construction or operation as reported in the EIS.

Water take

There would be changes to water take at Cut 2, Cut 20 and Cut 20r as a result of the proposed design changes, compared to the project described in the EIS. The relative changes are expected to be within the range of uncertainty of the existing assessment. These locations are expected to contribute a minor proportion of the overall project water take and the overall water take for the amended design would be consistent with EIS.

Groundwater dependent ecosystems and native vegetation communities

A GDE was identified within the estimated zone of drawdown from Cut 20 in the EIS. This GDE was identified as PCT 692 Blackbutt – Tallowwood moist ferny open forest of the coastal ranges of the NSW North Coast Bioregion. There would be a minor increase in the area of vegetation community within the drawdown extent because of the proposed design changes. However, the potential impact to this GDE is expected to be consistent with the impacts reported in the EIS.

There would be no further impacts to GDEs, beyond those identified above and in the EIS.

NSW Aquifer Interference Policy

The potential impacts as a result of the proposed design changes would be consistent with the potential impacts outlined in the EIS.

5.13.4 Revised environmental management measures

The management measures presented within the EIS to address groundwater impacts have been reviewed in consideration of the proposed design and construction changes. Minor amendments have been made to the mitigation measures and are presented as strikethrough for deletions and italicised for new text in **Table 5.13-6**. Other mitigation measures presented in the EIS are still considered to be relevant and accurate and are provided in **Chapter 6, Revised environmental management measures** for completeness.

Table 5.13-6 Proposed amendments to management measures from the EIS

Impact	ID No.	Mitigation measure	Responsibility	Timing
Prevention of groundwater impacts from cuttings, tunnels and embankments	GW09 GW11	Additional ground truthing and site inspections will be undertaken for potentially impacted groundwater bores/supply wells (including supply well GW068986), springs, <i>Jordans Creek (near Cut 20)</i> , and agricultural dams within and immediately surrounding the zone of drawdown. The purpose of the ground truthing and site inspections is to confirm predicted impacts and develop make good provisions where required in consultation with affected property owners.	TfNSW	During detailed design

Chapter 6

Revised environmental management
measures

6. Revised environmental management measures

The Coffs Harbour Bypass EIS (TfNSW 2019) identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts.

After consideration of the amendments to the project and the issues raised in the public submissions, the environmental management measures for the project (refer to Chapter 26 of the EIS) have been revised where relevant. Should the project be approved, the environmental management measures in **Table 6-1** will guide the subsequent phases of the project.

Additional and/or modified environmental management measures to those presented in the EIS have been italicised and deleted measures, or parts of measures, have been struck out. Management measures that have changed as a result of the proposed design and construction changes as assessed in **Chapter 5, Additional assessment** are presented in green. Management measures that have changed as a result of responding to the EIS submissions or the review identified in Chapter 5, Clarifications, corrections and further information of the Submissions Report are presented in yellow.

Table 6-1 - Summary of environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Traffic and transport					
Disruption to public transport, including school bus services	TT01		Operational access for public transport services, including school bus services will be maintained as part of the project. The requirements for any temporary changes during construction will be confirmed following further consultation with the school bus operators, CHCC, Kororo Public School and Bishop Druitt College.	TfNSW / Contractor	Detailed design and during construction
Parking and access at Kororo Public School	TT02		Further consultation will be undertaken with Kororo Public School and NSW Department of Education School Infrastructure NSW to confirm final parking arrangements and access during construction.	TfNSW / Contractor	Detailed design and during construction
Use of James Small Drive during operation	TT03		Traffic management improvement opportunities for James Small Drive, including but not limited to restrictions to on-street parking and installation of traffic barriers, will be further evaluated and finalised during detailed design and in consultation with CHCC, Kororo Public School, Coffs Harbour Montessori Preschool, NSW Department of Education and the adjacent community.	TfNSW	Detailed design
Solitary Rural Fire Service access	TT04	TT03	Consultation with the Solitary Rural Fire Service Mid North Coast Team will be undertaken during detailed design <i>and prior to construction to confirm the requirements for relocating their services and to ensure the appropriate access requirements are achieved.</i>	TfNSW	Detailed design
Pacific Bay Western Lands access	TT05	TT04	Consultation with CHCC and the proponent of the Pacific Bay Western Lands residential development will be undertaken during detailed design to ensure future access arrangements are considered as part of the project.	TfNSW	Detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Pacific Bay Eastern Lands access	TT06	TT05	Consultation with CHCC and the proponent of the Pacific Bay Eastern Lands development will be undertaken during detailed design to ensure future access arrangements are considered as part of the project.	TfNSW	Detailed design
Traffic related risks during construction	TT07	TT06	<p>A Traffic Management Plan will be prepared and implemented as part of the CEMP. The plan will be prepared in accordance with Traffic Control at Work Sites Manual (Roads and Maritime Services 2018c). The plan will include:</p> <ul style="list-style-type: none"> • Confirmation of haulage routes • Measures to maintain access to local roads, properties and Kororo Public School • Measures that consider operation of Kororo Public School and Bishop Druitt College • <i>Consideration of alternative construction access for the section of the project between Shephards Lane tunnel and Gatelys Road tunnel that minimises impacts on adjoining community, sensitive receivers, eg Baringa Private Hospital and RFBI Coffs Harbour Masonic Village, and road users.</i> • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • A response plan for any construction traffic incident and consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms. 	Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Access	TT08	TT07	Existing accesses to properties will be maintained during construction. Where this is not feasible or reasonable, temporary alternative access arrangements will be provided following consultation with the affected property owners <i>and business operators</i> .	Contractor	During construction
Road condition reports	TT09	TT08	Pre-construction and post-construction road condition reports for local roads will be prepared. Any damage resulting from construction (not normal wear and tear) will be repaired unless alternative arrangements are made <i>with CHCC</i> . Copies of road condition reports will be provided to CHCC.	Contractor	Prior to construction and post construction
Permanent removal of parking areas	TT10	TT09	<p>Parking demand and use surveys will be undertaken to confirm the extent of temporary and/or permanent impacts at the following locations:</p> <ul style="list-style-type: none"> • Areas associated with the informal school bus stop at the intersection of Coramba Road and Spagnolos Road • Englands Road • Oz Group Packhouse at Isles Drive. • The results will be used to determine the need for alternative arrangements, where reasonable and feasible. 	TfNSW	Detailed design
Strategy for pedestrians and cyclists	n/a	TT10	<i>Consultation with CHCC will be undertaken during detailed design regarding the operational strategy for pedestrians and cyclists particularly where there is potential interaction with CHCC's existing proposed pedestrian and cycle network and where location-specific wayfinding plans are required.</i>	TfNSW	Detailed design
Confirmation of assessed impacts	TT11		A review of operational network performance will be undertaken <i>within 12 months from</i> after the <i>opening completion</i> of the project to confirm the operational traffic and transport impacts of the project on the surrounding road network, in particular at intersection/interchange locations, <i>Isles Drive</i>	TfNSW	Operation

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			and Coramba Road. The assessment will be based on updated traffic surveys at the time and the methodology used will be comparable with that used in Appendix F, Traffic and transport assessment of the EIS and Appendix A, <i>Supplementary traffic and transport assessment of the Amendment Report</i> . Where required, additional mitigation measures will be identified in consultation with CHCC to manage any additional traffic performance impacts.		
Old Coast Road design investigation	n/a	TT12	<i>Design and road safety investigation of the Korora Basin Road and Old Coast Road intersection including Old Coast Road Bridge No. 2, will be carried out during detailed design to determine if any reconfiguration or upgrade is needed. The design and road safety investigation will be carried out in consultation with CHCC.</i>	TfNSW	<i>Detailed design</i>
Access arrangements for properties on existing Pacific Highway	n/a	TT13	<i>Alternative access arrangements for Boambee Palms and Holiday Park, Lindsay Transport and other properties with access to the existing Pacific Highway between Englands Road and Sawtell Road will be investigated during detailed design. The investigation will be carried out in consultation with CHCC and affected property owners to determine reasonable and feasible design solutions that address the safety concerns described in Section 4.7.7 of the Submissions Report. Any decision to proceed with a design solution will be subject to funding availability and consideration of environmental constraints, project objectives and value for money.</i>	TfNSW	<i>Detailed design</i>
Parking and access at Kororo Public School	n/a	TT14	<i>The new Luke Bowen footbridge will be constructed prior to the removal of the existing bridge where reasonable and feasible with any disruptions to access occurring outside of school terms and in consultation with Kororo Public School and School Infrastructure NSW.</i>	TfNSW/ Contractor	<i>During construction</i>

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Noise and vibration					
Construction noise and vibration management	NV01		<p>A Noise and Vibration Management Plan will be prepared and implemented as part of the CEMP and in accordance with the Construction Noise and Vibration Guideline (Roads and Maritime Services 2016a) <i>and the Interim Construction Noise Guidelines (DECC 2009b)</i>. The plan will identify:</p> <ul style="list-style-type: none"> • All potential significant noise and vibration generating activities associated with the activity • Measures to be implemented during construction to minimise noise and vibration impacts, such as restrictions on working hours, respite periods, staging, placement and operation of ancillary facilities, temporary noise barriers, haul road maintenance, and controlling the location and use of vibration generating equipment • A monitoring program to assess performance against relevant noise and vibration criteria • Process for the implementation of respite periods to provide residents with respite from ongoing impact • Arrangements for consultation with affected receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. 	Contractor	Prior to construction and during construction
Construction and vibration impacts	NV02		<p>Prior to commencing construction, the structural integrity of Old Coast Road Bridge No. 1 and Old Coast Road Bridge No. 2 will be confirmed by a suitably qualified structural engineer. The results from inspection will be documented and used to verify the applicable vibration criteria, construction vehicle restrictions and any feasible and reasonable mitigation measures to be implemented. A copy of the report will be provided to CHCC.</p>	Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	NV03		<p>Building condition surveys will be conducted for buildings and other structures within 50 m of vibration generating activities before commencement of construction. A copy of the building condition survey report will be provided to the relevant property owner.</p>	Contractor	Prior to construction
	NV03		<p><i>Building condition surveys will be undertaken for buildings and other structures within the following distances from the main vibration generating activities:</i></p> <ul style="list-style-type: none">• <i>Blasting operations – within 500 m</i>• <i>Pile driving – within 250 m</i>• <i>Excavating by hammering or ripping – within 100 m</i>• <i>Vibrating compaction > 7 tonne plant – within 50 m</i>• <i>Vibrating compaction < 7 tonne plant – within 25 m</i>• <i>Demolition of structures – within 50 m.</i> <p><i>A copy of the building condition survey report will be provided to the property owner.</i></p>	Contractor	<i>Prior to construction</i>
	NV04		Where vibration generating activities will be carried out within minimum working distances for cosmetic damage, vibration monitoring will be carried out. Where monitoring indicates cosmetic damage criteria are exceeded, alternative low-vibration work practices will be investigated and implemented.	Contractor	During construction
	NV05		Consultation with the Boambee Equestrian Centre will be carried out during detailed design following further consideration of construction methodologies and further geotechnical conditions to ensure appropriate work practices are implemented to minimise the risk of vibration impacts.	Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Impacts from out of hours works	NV06		<p>An Out of Hours Work Procedure will be included as part of the Noise and Vibration Management Plan to manage any variations to the standard construction hours. The procedure will follow the approach in Construction Noise and Vibration Guideline (Roads and Maritime Services 2016a) <i>and the Interim Construction Noise Guideline (DECC 2009b)</i>. The procedure will include, but not be limited to:</p> <ul style="list-style-type: none"> • Scheduling of noise intensive or high noise impact work to evening periods where feasible • Use of alternative plant and equipment and/or construction techniques to minimise noise • Notification and consultation requirements including preparation of a six-month 'look ahead' program for likely out of hours work • Use of temporary noise barriers • Acoustic sheds will be included around tunnel portals to shield noise from within the tunnel during evening and night periods • Respite periods • Representative noise monitoring • Offers of reasonable and temporary alternative accommodation or an act of good will • Use of negotiated agreements. 	Contractor	During construction
	NV07		<p>At-property operational noise mitigation measures will be implemented during the pre-construction phase <i>and early construction phases</i> of the project, where reasonable and feasible, to assist in reducing noise impacts associated with construction (including out of hours work). <i>At-property treatments will be prioritised for those properties likely to be most affected by construction noise impacts.</i></p>	TfNSW / Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Construction noise impacts from ancillary facilities	NV08		Ancillary facilities will be designed to ensure that primary noise sources are at a maximum distance from residences (where reasonable and feasible), with solid structures (sheds, containers, etc.) placed between residences and noise sources (and as close to the noise sources as is practical).	Contractor	During construction
Construction traffic noise impacts	NV09		<p>Management of construction related traffic noise will include the following considerations:</p> <ul style="list-style-type: none"> • Scheduling of vehicle movements during less sensitive time periods where possible • Training/inductions to address driver behaviour and avoidance of the use of engine compression brakes • Vehicle maintenance. 	Contractor	During construction
Blasting	NV10		<p>A Blast Management Strategy will be prepared as part of the Noise and Vibration Management Plan. The strategy will aim 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 residences and sensitive receivers. The Blast Management Strategy will address:</p> <ul style="list-style-type: none"> • Details of blasting to be performed, including location, method and justification of the need to blast • Identification of any potentially affected noise and vibration sensitive sites and structures • Establishment of appropriate criteria for blast overpressure and ground vibration levels at each category of noise sensitive site • Details of the storage and handling arrangements for explosive materials and the proposed transport of those materials to the construction site 	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<ul style="list-style-type: none"> • Identification of 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 • Determination of potential noise and vibration and risk impacts from blasting and appropriate best management practices • Community consultation procedures. 		
Operational noise impacts	NV11		<p>The operational noise mitigation measures, including noise barriers and/or at-property treatments, will be confirmed during detailed design. The treatments will be provided as early as practicable in the construction program to reduce potential noise impacts associated with construction. This will also include consideration of industrial noise exceedances associated with the Kororo Public School bus interchange.</p>	TfNSW / Contractor	Detailed design
Operational noise impacts	NV12		<p>An operational noise review will be carried out 12 months after the opening of the project to confirm the operational noise impacts. The review will be based on updated traffic surveys at the time (and once traffic flows have stabilised) and will be in accordance with the Noise Mitigation Guideline (Roads and Maritime Services 2015a) and Practice Note viii of Environmental Noise Management Manual (RTA 2001b). The review will:</p> <ul style="list-style-type: none"> • Assess actual noise performance compared to predicted noise performance • Assess the performance and effectiveness of noise and vibration mitigation measures • Where deficiencies in performance are identified, provide recommendations for additional feasible and reasonable measures. 	TfNSW	Operation

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Biodiversity					
Removal of threatened fauna habitat	FF01		The Threatened Species Management Plan (<i>Appendix D, Updated threatened species management plan of the Amendment Report</i>) will be reviewed and updated as required during detailed design and prior to operation construction . The purpose of the review will be to address any detailed design and/or construction refinements and to comply with relevant project approval requirements. The Plan will operate in conjunction with the Flora and Fauna Management Plan.	Contractor	Detailed design and prior to operation construction
	FF02		The Flora and Fauna Management Plan will be prepared in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and implemented a part of the CEMP. The Flora and Fauna Management Plan will build upon the strategies outlined in the Threatened Species Management Plan <i>prepared in accordance with FF01</i> and identify detailed site-specific and species-specific mitigation measures and management protocols to be implemented before, during and after all construction activities to further avoid or reduce impacts on threatened biodiversity.	Contractor	Prior to construction
	FF03		Native vegetation and fauna habitat removal will be minimised through detailed design where reasonable and feasible. Particular focus will be given to avoiding and minimising the removal of: <ul style="list-style-type: none"> • Hollow bearing trees • Native vegetation in riparian zones • Native vegetation from known fauna connectivity corridors and near proposed fauna crossing structures. 	Contractor	Detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	FF04		<i>Where reasonable and feasible, habitat will be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a). This approach can be extended to salvaging some habitat logs such as root balls and providing them for re-use to CHCC and other organisations where they have the capacity to accept this material.</i>	Contractor	During construction
	FF05		Protection and enhancement of vegetated riparian zones will be undertaken to improve opportunities for fauna movement (including spotted-tailed quoll and pale-vented bush hen).	Contractor	During construction
	FF06		Opportunities for providing roosting habitat for microbats in new bridge structures adjacent areas of known microbat habitat will be investigated <i>where reasonable and feasible and where future maintenance issues will not be compromised.</i>	Contractor	Detailed design
	FF07		A Nest Box Management Plan will be prepared and implemented as part of the Flora and Fauna Management Plan in accordance with Guide 8: Nest Boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a). The Plan will include requirements for monitoring and maintenance.	Contractor	Prior to construction
Removal / clearing of native vegetation (including riparian vegetation)	FF08		Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Contractor	Prior to construction
	FF09		The limits of clearing within the construction footprint will be delineated using appropriate signage and barriers, identified on site construction drawings and communicated to construction staff during induction. Vegetation and habitat	Contractor	During construction

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			features to be retained, such as hollow-bearing trees, will be clearly identified and protected by suitable fencing, signage and/or markings.		
	FF10		Vegetation clearing will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Contractor	During construction
	FF11		Native vegetation consisting of suitable species from locally indigenous vegetation communities of the study area will be progressively re-established in accordance with Guide 3: Re-establishment of native vegetation of the Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Contractor	During construction
	FF12		An unexpected species find procedure will be prepared and implemented in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Contractor	During construction
Removal of threatened flora	FF13		A <i>Rusty Plum</i> Salvage and Re-establishment Plan for southern swamp orchid individual(s) and <i>rusty plum</i> will be prepared prior to construction, outlining detailed procedures for the preparation of the re-establishment and receiving sites, plant movement, pre- and post- care of target individuals as well as detailing the objectives, monitoring procedures and contingency measures.	TfNSW	Prior to construction
Removal of threatened species habitat	n/a	FF14	<i>Threatened species habitat will not be cleared for the purposes of ancillary facilities. These areas will be identified and limits of clearing delineated before construction in accordance with FF09.</i>	Contractor	Prior to construction
Fragmentation of identified biodiversity links	FF14	FF15	Fauna connectivity structures will be designed and constructed to facilitate safe fauna passage across the project in accordance with the locations and design principles detailed in Appendix H, Biodiversity assessment report	Contractor	Detailed design and during construction

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
and habitat corridors			<i>Appendix D, Updated threatened species management plan of the Amendment Report.</i>		
	FF15	FF16	Permanent fauna fencing, including specific fencing for koala and giant barred frog areas of known habitat, will be progressively installed as fauna connectivity structures become operational in consultation with a suitably qualified and experienced ecologist.	Contractor	Detailed design and during construction
	FF16	FF17	Temporary fauna fencing will be installed if existing fauna fence at the southern end of the project on the Pacific Highway is removed during construction period.	Contractor	During construction
Edge effects on adjacent native vegetation and habitat	FF17	FF18	Exclusion zones will be set up at the limit of clearing in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Contractor	During construction
Injury and mortality of fauna	FF18	FF19	Any fauna encountered during construction will be managed in accordance with Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Contractor	During construction
	FF19	FF20	A native stingless bee rescue protocol will be developed and implemented to guide relocation of any native bee hives within the construction footprint.	Contractor	During construction
Invasion and spread of weeds	FF20	FF21	Biosecurity risk and weed species will be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and Guide 7: Pathogen Management (RTA 2011a). Specific protocols will be prepared and implemented to manage, Chytrid fungus, Phytophthora and Myrtle Rust.	Contractor	During construction
Noise, light and vibration	FF24	FF22	Shading and artificial light impacts on areas of retained native vegetation will be minimised through detailed design where reasonable and feasible.	Contractor	Detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	FF22	FF23	Exclusion measures for microbats will be investigated for culverts identified as having high and medium habitat potential in consultation with a suitable qualified and experienced ecologist. Where required, timing for exclusion measures will be undertaken outside of breeding and winter torpor periods.	Contractor	Prior to and during construction
Impacts to aquatic habitat and changed hydrological regimes	FF23	FF24	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and Guidelines for Fish Habitat Conservation and Management Update 2013 (DPI 2013) and with reference to Guidelines for Controlled Activities on Waterfront Land – Riparian corridors (DPI 2012d).	Contractor	During construction
	N/A	FF25	<i>In the event that water is required to be extracted from local waterways, water levels and construction activities will be managed to ensure key fish habitat/aquatic ecosystems are protected (eg during periods of low and/or no flow, extraction from local waterways will not occur).</i>	Contractor	During construction
	FF24	FF26	Any machinery used during instream works should be verified as clean and free of potential weeds and pathogens to avoid biosecurity risk.	Contractor	During construction
	FF25	FF27	Waterway crossings will be designed and constructed in accordance with Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003) and will include maintaining existing nominal flow velocity where possible or at less than 0.3 m/sec to prevent damage to aquatic habitats.	Contractor	Detailed design and during construction
	FF26	FF28	Coffer dams will be used during work undertaken within or immediately adjacent to waterways where reasonable and feasible to prevent or minimise increased turbidity. In the event that coffer dams are not reasonable and feasible, silt curtains would be used.	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	FF27	FF29	Changes to existing hydrological regimes within known and potential coastal petaltail dragonfly habitats will be minimised during detailed design. Bridges and/or culverts will be located and designed to maintain existing hydrological regimes where reasonable and feasible and will consider the potential for scour impacts on downstream habitats.	Contractor	Detailed design
Urban design, landscape and visual amenity					
Landscape and visual impacts	UD01		<p>An Urban Design and Landscape Plan will be prepared <i>in consultation with CHCC</i> to support the detailed design of the project. The plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The plan will include:</p> <ul style="list-style-type: none"> • Location and identification of existing vegetation and proposed landscaped areas, including species to be used • Built elements including retaining walls, bridges and noise barriers (using mounds as a priority where feasible, walls to supplement where required) • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Fixtures such as lighting, fencing and signs • Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage • Procedures for monitoring and maintaining landscaped or rehabilitated areas • Water sensitive urban design solutions • <i>Consideration of a detailed CPTED assessment of the project.</i> 	Contractor	Detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<p>The plan will be prepared in accordance with TfNSW urban design policy guidelines including:</p> <ul style="list-style-type: none"> • Beyond the Pavement – urban design policy, procedures and design principles (Roads and Maritime Services 2014b) • Landscape design guidelines: Design guideline to improve the quality safety and cost effectiveness of green infrastructure in road corridors (Roads and Maritime Services 2017b) • Bridge Aesthetics: Design Guidelines to improve appearance of bridges in NSW (Roads and Maritime Services 2019) • Tunnel urban design guideline: Design guideline to improve the customer and community experience of road tunnels (Roads and Maritime Services 2017c) • Noise Wall Design Guideline: Design guidelines to improve the appearance of noise walls in NSW (Roads and Maritime Services 2016b) • Shotcrete Design Guideline: Design guidelines to avoid, minimise and improve the appearance of shotcrete in NSW (Roads and Maritime Services 2016d) • Water sensitive urban design guideline (Roads and Maritime Services 2017d) • <i>Guidelines for Controlled Activities for Works on Waterfront Land – Vegetation Management Plan (DPI 2012e)</i> • <i>Crime prevention and the assessment of development applications – guidelines under section 79C of the Environmental Planning and Assessment Act 1979 (NSW Department of Urban Affairs and Planning 2001)</i>. 		

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Water sensitive urban design	UD02		Temporary and permanent drainage infrastructure will be designed to incorporate water sensitive urban design principles where possible in accordance with Water sensitive urban design guideline (Roads and Maritime 2017d). This could include replacing concrete lined longitudinal catch drains with vegetated swales and the operational water quality control measures.	Contractor	Detailed design
Construction visual impacts	UD03		Temporary site lighting will be installed and operated in accordance with AS 4282:1997 Control of the Obtrusive Effect of Outdoor Lighting (Standards Australia 1997).	Contractor	During construction
	UD04		Project work sites, including construction areas and supporting facilities (such as ancillary sites) will be managed to minimise visual impacts, including appropriate storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials.	Contractor	During construction
	n/a	UD05	<i>Boundary fencing that incorporates screening will be installed around all ancillary sites that are adjacent to residential areas for the duration of site establishment and construction. The boundary fencing (and screening) will be designed to minimise visual impacts on nearby sensitive receivers.</i>	Contractor	During construction
Potential overshadowing	UD05	UD06	Where noise walls cause overshadowing, consideration will be given during detailed design to the use of transparent panels within the noise wall design in consultation with potentially affected property owners.	Contractor	Detailed design
Potential glare impacts	UD06	UD07	A reflectivity study will be undertaken during detailed design to identify adverse reflective glare from the use of transparent panels in noise walls on road users and adjacent residential properties. An appropriate glazing design will be considered where issues are identified. The reflectivity study will also investigate the potential for glare impacts on road users associated with the morning sun for Shephards Lane and Gatelys Road tunnel.	Contractor	Detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Visual impacts at Fern Tree Place	n/a	UD08	<i>An arborist will be engaged to determine whether trees within the construction footprint could be trimmed rather than cleared for the construction of the Kororo Public School bus interchange adjacent Fern Tree Close. Any trimming will be carried out by or under direction of the arborist. Retained trees will be protected to ensure construction does not detrimentally affect tree health.</i>	Contractor	During construction
	n/a	UD09	<i>Consultation with Fern Tree Place property owners located adjacent to the Kororo Public School bus interchange will be carried out prior to construction to determine whether additional tree planting beyond the indicative road corridor could be undertaken to assist in screening impacts.</i>	TfNSW / Contractor	Prior to construction
Visual impacts at Coachmans Close	n/a	UD10	<i>An arborist will be engaged to determine whether trees within the construction footprint could be trimmed rather than cleared for the construction of the project along Coachmans Close. Any trimming will be carried out by or under direction of the arborist. Retained trees will be protected to ensure construction does not detrimentally affect tree health.</i>	Contractor	During construction
Land use and property					
Future land use	LUP01		Consultation with CHCC will be undertaken during detailed design regarding the West Coffs Investigation Area to ensure appropriate consideration of the project is provided in any future masterplanning.	TfNSW	Detailed design
Property impacts	LUP02		Property acquisition will be carried out in accordance with the Land Acquisition Information Guide (Roads and Maritime Services 2014a), Fact sheet: Property acquisition of subsurface lands (Roads and Maritime Services 2015c) and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .	TfNSW	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Management of residual land	LUP03		Ancillary sites will be rehabilitated to their pre-construction condition (where reasonable and feasible) and managed in accordance with Appendix B of Appendix J, Urban design, landscape character and visual impact assessment of the EIS.	TfNSW / Contractor	During and post construction
Management of utilities adjustment and/or relocation	LUP04		<p>The following strategy for managing utilities will be implemented prior to construction in consultation with the relevant utility providers:</p> <ul style="list-style-type: none"> • Further detailed utility investigations (revised ‘Dial before you Dig’ queries and/or potholing will be carried to confirm location of buried services) • Detailed utility design be undertaken in accordance with the relevant utility providers requirements • Relocation or protection work will be undertaken in a manner that minimises environmental impacts and addresses the relevant utility service providers requirements and construction methods. 	TfNSW / Contractor	Prior to construction
Agriculture					
Partial property acquisition	AG01		Where a property is not subject to a total acquisition, a specialist agricultural consultant will be engaged at the request of affected property owners whose properties are seriously or critically impacted by the project to assist in assessing, but not limited to, considering opportunities for agricultural diversification and/or revised farm management practices.	TfNSW	Prior to construction
Impact on irrigation water source	AG02		Impacted irrigation water sources and/or infrastructure will be restored, replaced, relocated or compensated for in consultation with affected property owners.	TfNSW / Contractor	Prior to construction
Impact on agricultural structures	AG03		Impacted structures, eg packing sheds and cropping structures, etc, will be replaced or reconfigured in consultation with affected property owners where feasible.	TfNSW / Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Impact on property access	AG04		Internal farm access impacted by the project will be reconfigured in consultation with affected property owners where reasonable and feasible.	TfNSW / Contractor	Prior to construction
	AG05		Existing property accesses will be maintained during construction. Where this is not feasible or reasonable, temporary alternative access arrangements will be provided following consultation with the affected property owners with consideration to existing farming practices.	Contractor	Prior to and during construction
Dust impacts	AG06		Real time dust monitoring will be carried out at representative locations of dust sensitive agricultural receivers along the project alignment to allow for the timely management of dust generation on-site and to minimise potential impacts. The representative locations of dust sensitive agricultural receivers will be determined during detailed design and will include the Oz Group Packhouse. Monitoring will be carried out in accordance with the Approved Methods for the sampling and analysis for air pollutants in NSW (EPA 2017a) where applicable.	Contractor	Prior to and during construction
Wind and microclimate impacts	AG07		An Automatic Weather Station will be established at a representative location to confirm the outcomes of the wind flow and microclimate investigations. The Automatic Weather Station will be established in accordance with the Bureau of Meteorology's Observation Specification No. 2013.1: Guidelines for siting and exposure of meteorological instruments and observing facilities.	TfNSW	Prior to, during and post construction
Managing the spread of Panama disease	AG08		A Panama Disease Control Management Plan will be prepared and implemented during construction in consultation with Regions, Industry, Agriculture & Resources, DPIE and representatives of the Banana Growers Association of Coffs Harbour & District. The plan will be prepared in accordance with relevant Queensland's Department of Agriculture and Fisheries guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (2015) and Panama disease tropical race 4:	TfNSW / Contractor	Prior to and during construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<p>Decontamination guide (2016). Specific management measures and controls will address the following as a minimum for all existing and former banana plantations within the construction footprint:</p> <ul style="list-style-type: none"> • Cleaning and washdown procedures for construction plant, vehicles and equipment and personnel • Clearing and grubbing practices • Stockpile management procedures for topsoil and other materials • Procedures for the management and/ or disposal of contaminated and/ or potentially contaminated Panama disease soils including its identification as such to prevent accidental spread of the disease by others • Erosion and sediment control requirements • Dust management controls • The movement of construction plant, vehicles and equipment and personnel both within the project and externally, including where construction plant and equipment may have previously worked in other affected areas such as north east Queensland • Revegetation and rehabilitation practices. 		
Socio-economic					
Impacts to residents the community and businesses (including those related to property, amenity, and access impacts)	SE01		<p>Consultation will be undertaken with potentially affected residences prior to the commencement of and during work in accordance with Community Liaison Implementation Plan. The Plan will be based on the draft Community consultation framework in Appendix D of the EIS and will be implemented prior to construction.</p> <p>The Plan will provide specific information in relation to community involvement during construction and will include, but not be limited to:</p> <ul style="list-style-type: none"> • A map of impacted properties 	TfNSW / Contractor	Prior to and during construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<ul style="list-style-type: none"> • A register of impacted residential properties and businesses • A register of potential construction impacts and timings • A risk assessment and management plan to minimise impacts on stakeholders • A procedure for managing and responding to enquiries and complaints • Procedures for notifying the community of upcoming work and impacts • Procedures for communicating the details of design and construction • <i>Procedures for consulting with property owners prior to any site establishment activities at ancillary sites</i> • <i>Procedures for coordinating with CHCC regarding special events held at the Coffs Coast Sport and Leisure Park precinct to minimise impacts to the community and precinct users.</i> 		
Minimise loss of passing trade	SE02		A Directional Signage Plan will be developed in accordance with TfNSW and Destination NSW signage guidelines to ensure effective and appropriate signposting for key locations along the project. The plan will identify the range of services that Coffs Harbour provides and will be prepared in consultation with CHCC, Coffs Harbour Chamber of Commerce and the NSW Government's Tourist Attraction Signposting Assessment Committee (TASAC).	TfNSW	Prior to operation
Minimising impacts and community values	SE03		<i>Design investigation of the property access road south of the Coramba Road interchange and property owner consultation will be undertaken to develop reasonable and feasible options with the aim to avoid potential impacts on the tree planted as a memorial to a family member where feasible. This may include but may not be limited to realignment of the property access road or translocation of the tree.</i>	Contractor	Detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	SE04		Management of the gravestone of Herbert Frazer Simpson at the intersection of the existing Pacific Highway and James Small Drive will be undertaken in accordance with the Roadside Tributes Factsheet (Road and Maritime Services 2016f). Every effort will be made to contact the family, if known, and work with them to develop an appropriate strategy for reinstallation, relocation or removal. If the family is unknown or cannot be contacted, TfNSW would store the gravestone off-site for future recovery if necessary.	TfNSW	Prior to construction
	SE05		Seed collection and salvage of representative species within the planted rainforest impacted by the project near Mackays Road will be undertaken prior to construction where reasonable and feasible. The purpose of the seed collection and salvage is to re-establish a portion of the rainforest within adjacent landscaping associated with the project. Where possible, the location would allow for access from the realigned Mackays Road/new local access roads.	TfNSW	Prior to construction
Impacts to local businesses	SE06		Consultation with CHCC will be carried out prior to construction regarding impacts to the Coffs Coast Resource Recovery Park and the businesses which operate from the park. Consultation will aim to identify opportunities to reduce the extent of property acquisition, temporary construction impacts and any other associated impacts to facilities which are important to the ongoing operations of the park.	TfNSW	Prior to construction
Impacts to local businesses	n/a	SE06	<i>Ongoing consultation with CHCC will be undertaken to identify opportunities to reduce temporary construction impacts on the operation of Coffs Coast Resource Recovery Park.</i>	TfNSW	<i>Prior to construction and during construction</i>

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	n/a	SE07	<i>Temporary signage including use of variable message signs will be used to identify any revised access changes to tourism businesses. The temporary signage will be installed in consultation with affected tourism businesses and in accordance with Traffic Control at Work Sites Manual (Roads and Maritime Services 2018c).</i>	TfNSW	Prior to construction and during construction
Aboriginal cultural heritage					
Impacts on known Aboriginal sites or places	AH01		<p>An Aboriginal Heritage Management Plan will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The plan will be prepared in consultation with the RAPs. The plan will give effect to any management measures contained in the Aboriginal cultural heritage assessment carried out for the project and include:</p> <ul style="list-style-type: none"> • Details of investigations completed or planned to be carried out and any associated approvals required • Mapping of areas of Aboriginal heritage value and identification of protection measures to be applied during construction • Procedures to be implemented if previously unidentified Aboriginal objects, including skeletal remains, are discovered during construction • An induction program for construction personnel on the management of Aboriginal heritage values and cultural awareness. • Opportunities for on-going Aboriginal community engagement in the project. 	Contractor	Prior to construction
	AH02		Before any construction activity (including pre-construction activities of minimal environmental impact), a heritage site map will be prepared identifying Aboriginal sites to be excavated and avoided (for all sites in proximity to the construction footprint) and included in relevant induction training.	Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Archaeological salvage	AH03		Archaeological salvage excavation as detailed in Table 15-7 must be carried out in accordance with the methodology specified in Appendix L, Aboriginal cultural heritage assessment report.	TfNSW/ Contractor	Prior to construction
	n/a	AH03	<i>Collection of surface artefacts and archaeological salvage excavation must be carried out in accordance with the methodology specified in Section 9 and Appendix E of Appendix G, Updated Aboriginal cultural heritage assessment of the Amendment Report.</i>	TfNSW/ Contractor	Prior to construction
	AH04		Where archaeological salvage excavation, cultural salvage or surface collection has been nominated for impacted sites, no construction activities (including pre-construction activities of minimal environmental impact) can occur on the land to be investigated until the relevant archaeological excavations at the nominated site have been completed.	TfNSW/ Contractor	Prior to construction
	n/a	AH05	<i>Cultural salvage must be carried out in accordance with the methodology specified in Section 9 and Appendix F of Appendix G, Updated Aboriginal cultural heritage assessment of the Amendment Report.</i>	TfNSW/ Contractor	Prior to construction
Unexpected finds of Aboriginal objects	AH05	AH06	The Unexpected Heritage Items: Heritage Procedure 02 (Roads and Maritime Services 2015e) will be used in the event of uncovering an unexpected archaeological find during construction.	Contractor	During construction
Unexpected finds of human remains	AH06	AH07	In the event that construction activity reveals possible human skeletal material (remains), all work is to halt at that location immediately and the steps outlined in the Unexpected Heritage Item: Heritage Procedure 02 (Roads and Maritime Services 2015e) will be followed. Identified knowledge holders will be notified within 24 hours of any confirmed discovery of Aboriginal skeletal remains.	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Impacts to intangible cultural values associated with impacted cultural sites	AH07	AH08	Rehabilitation and revegetation of the construction footprint will occur with local indigenous plant species progressively during construction. The identification of the plant species will be carried out in consultation with the identified knowledge holders and the RAPs. Opportunities will be given to local Aboriginal organisations for involvement and potential engagement in the revegetation process.	TfNSW / Contractor	During construction
	AH08	AH09	A booklet (in a format appropriate for local publication) will be prepared by a cultural heritage specialist on the cultural values and historical records of the cultural sites. As part of the process, the visual documentation of the cultural landscape will occur before construction. The report will be full colour and distributed to local libraries and educational institutions. The final content of the booklet will be developed in consultation with identified Aboriginal knowledge holders <i>and the RAPs</i> .	TfNSW	Prior to and during construction
	AH09	AH10	Interpretative signage relevant to the cultural sites will be prepared in consultation with identified knowledge holders. Consultation with the knowledge holders and RAPs will occur in regard to potential locations for the placement of the signage. The final location(s) for interpretative signage will be subject to property owner agreement.	TfNSW	During and post construction
Non-Aboriginal cultural heritage					
Construction impacts to known non-Aboriginal heritage items	NAH01		A Non-Aboriginal Heritage Management Plan will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage. The plan will include: <ul style="list-style-type: none"> • Details of investigations completed or planned to be carried out and any associated approvals required 	Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<ul style="list-style-type: none"> • Mapping of areas of non-Aboriginal heritage value and identification of protection measures to be applied during construction • Procedures to be implemented if previously unidentified non-Aboriginal relics or heritage items are discovered during construction • An induction program for construction personnel on the management of non-Aboriginal heritage values. 		
	NAH02		Consideration will be given to minimising impacts to elevated vantage points across the Coffs Harbour Banana Plantation Landscape during the preparation of the Urban Design and Landscape Plan. This will include, but not be limited to, investigating opportunities to maintain views to, from and within the landscape.	Contractor	Detailed design
	NAH03		<p>Archival recording will be prepared for the Coffs Harbour Banana Plantation Landscape, former Coffs Heights Post Office, the North Coast Railway <i>including the dry argillite retaining wall</i>, the Old Coast Road Bridge No.1, Old Coast Bridge No.2 and the marked tree stumps. The archival records should record the process of development and alterations to heritage values. A program of archival recording should be completed prior to construction. Archival recording will be completed in accordance with How to Prepare Archival Records for Heritage Items (NSW Heritage Office 1998) and Photographic Recording of Heritage Items Using Film or Digital Capture (NSW Heritage Office 2006).</p>	TfNSW/ Contractor	Prior to construction
	NAH04		The North Coast Railway <i>including the dry argillite retaining wall</i> , Old Coast Road Bridge No.1 and Old Coast Road Bridge No.2 will be marked on sensitive area maps to identify their heritage values. These areas will be marked as 'no-go' areas which are established at an appropriate distance (ie on the curtilage boundary of the item) to protect the heritage values. Where construction is to occur within 50 m of the North Coast Railway and the timber	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			beam bridges, the use of physical fencing will be considered to further protect the heritage values but allow construction (including access) to proceed unhindered. The use of sensitive area maps and 'no go' areas will be incorporated into the induction program as part of the Non-Aboriginal Heritage Management Plan.		
	n/a	NAH05	<i>The extent of dry argillite retaining wall impacted will be minimised during detailed design where reasonable and feasible. Where impacts cannot be avoided, the structural integrity of the dry argillite wall will be confirmed by a suitably qualified structural engineer. The results from inspection will be documented and used to confirm any stabilisation works required (eg reinforcing the front of the wall during construction), verify the applicable vibration criteria, and develop any other feasible and reasonable mitigation measures to be implemented to minimise impacts. A copy of report documenting the structural integrity of the dry argillite wall and a description of any stabilisation works if required will be provided to the Australian Rail Track Corporation.</i>	Contractor	<i>During detailed design and during construction</i>
Discovery of unexpected non-Aboriginal objects	NAH05	NAH06	Should any heritage items, archaeological remains or potential relics of non-Aboriginal origin be encountered, then construction work that might affect or damage the material will cease and notification provided in accordance with the Unexpected Heritage Items: Heritage Procedure 02 (Roads and Maritime Services 2015e). Work will only re-start once the requirements of that Procedure have been satisfied.	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Flooding and hydrology					
Impacts on flood behaviour during construction	FH01		<p>A Construction Flood Management Plan will be prepared and implemented before construction to manage the impact of a 5% AEP flood event or greater on the operation of ancillary facilities. The plan will form part of the CEMP and will detail:</p> <ul style="list-style-type: none"> • The impacts on hydrology and flooding from the construction phase • Control measures and procedures for construction activities to avoid, minimise or manage potential adverse impacts to construction works in the event of a flood within or adjacent to the project • <i>Management responses for ancillary sites provided in Table 17-5 of the EIS and Table 5.10-2 of the Amendment Report</i> • Flood monitoring to forecast large rainfall and flood events and notification measures • Emergency response and evacuation procedures in the event of a flood during the construction phase • Suitable evacuation routes and procedures for evacuation of site personnel • A register of all materials stored in work areas prone to flooding • Control measures for stockpiling within the floodplain to minimise loss of material in flood events. • Protocols for equipment and materials that can be removed from the subject area during a flood event where reasonable and feasible • Consultation and coordination with local residents, CHCC and other relevant stakeholders • Induction of all construction site staff and visitors to familiarise with the emergency response procedures. 	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	FH02		If the detailed construction plan requires staging of additional earthworks within floodplain(s) crossed by the project, revised flood modelling will be carried out as part of the detailed design to determine the potential for changed flooding impacts and any required mitigation and/or management response.	Contractor	During detailed design
Impacts on flood behaviour during construction from temporary waterway crossings	FH03		<p>Temporary waterway crossings will be designed, constructed and maintained in accordance with the following requirements:</p> <ul style="list-style-type: none"> • Low-flow conditions will be maintained • No additional flooding impacts will occur greater than those assessed for the operational phase • Fish passage will be maintained in accordance with the relevant waterway classification and DPIE guideline, Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003) • Material used in temporary waterway crossings will be selected to minimise risk of fine sediment material entering the waterway • Include erosion and sediment controls in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) • Any material used in the temporary creek crossing will be removed following construction and the site rehabilitated to its existing condition where reasonable and feasible. <p><i>The above requirements will be supplemented by learnings from the Woolgoolga to Ballina Pacific Highway upgrade project, specifically the requirements of the Technical Briefing Note: Temporary Waterway Crossings Minimum Standards (Pacific Complete 2017) developed in consultation with EPA and other relevant government agencies.</i></p>	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Hydrology impacts from creek realignments	FH04		<p>Creek realignments and/or adjustments will be designed to behave in a similar hydrologic and geomorphic manner as existing conditions and will consider the requirements of the Policy and Guidelines for Fish Habitat Conservation and Management (DPI 2013). Revegetation and adequate scour protection will be provided so there are no hydraulic impacts on bed and bank stability, erosion, sedimentation or riparian vegetation in accordance with the Controlled Activities for Works on Waterfront Land – In-stream Works (DPI 2012c).</p> <p>Detailed design of waterway realignments and adjustments will be developed in consultation with Regions, Industry, Agriculture and Resources, DPIE and will consider:</p> <ul style="list-style-type: none"> • Investigation of opportunities to reduce or avoid waterway realignments to maintain existing creek alignments including locating piers outside of the waterway • Retention of existing riparian vegetation where possible, including retention of tree stumps where trees are removed • Maintaining existing waterway lengths, velocities and hydraulic grades • Use of soft engineering approaches to scour protection where landscaping is provided over the rock scour • Maintaining fish passage in accordance with the waterway classification and Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003). 	Contractor	Detailed design and during construction
	FH05		<p>During the initial establishment and operation period of realigned or adjusted waterways, regular inspections will be carried out to ensure effective design of the realignment. An inspection program will be documented in the Soil and Water Management Plan. The inspections will assess implementation and success of the controls and identify any maintenance actions required.</p>	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Minimise scour potential	FH06		Scour protection for bridges and culverts will be designed in accordance with Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003) and Guidelines for Controlled Activities for Works on Waterfront Land – Outlet Structures (DPI 2012b).	Minimise scour potential	During detailed design
Construction impacts on flood evacuation routes	FH07		NSW State Emergency Services will be notified of any partial or total road closures during construction because of the project. The Construction Flood Management Plan should detail any impacts on existing flood conditions in relation to flood evacuation routes.	Contractor	During construction
Managing residual flood impacts	FH08		<p>Consultation with CHCC will be carried out during detailed design regarding any residual flood impacts. This will include, but not be limited to:</p> <ul style="list-style-type: none"> • A whole of government approach will be investigated which considers the relationship between the project and North Boambee Valley (West) URA and what reasonable and feasible options could be implemented to assist in managing potential flood impacts • Modifications to the Bennetts Road detention basin. 	TfNSW	During detailed design
	FH08		<i>A whole of government approach will be investigated with CHCC which considers the relationship between the project and North Boambee Valley (West) Urban Release Area and what reasonable and feasible options could be implemented to assist in managing potential flood impacts.</i>	TfNSW	During detailed design
	FH09		Consultation with the proponent of Pacific Bay Eastern Lands development will be carried out during detailed design to develop a reasonable and feasible design solution to mitigate flood impacts on the approved residential areas. Consultation will also consider future proposals that are being investigated.	TfNSW	During detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	FH10	FH09	Proposed mitigation measures for the North Boambee Valley catchment as described in <i>Table 17 of Appendix H, Updated flooding and hydrology assessment of the Amendment Report. EIS, Chapter 17, Flooding and hydrology Table 17-10</i> . The final design solution may involve combinations of the described mitigation options and the design response developed as part of the concept design and will be subject to further flood modelling and consultation with CHCC, Environment, Energy and Science Group, DPIE and adjacent property owners.	TfNSW / Contractor	During detailed design
	FH11	FH10	Proposed mitigation measures for the Coffs Creek catchment as described in <i>Table 20 of Appendix H, Updated flooding and hydrology assessment of the Amendment Report. Chapter 17, Flooding and hydrology Table 17-13</i> of the EIS will be investigated during detailed design. The final design solution may involve combinations of the described mitigation options and the design response developed as part of the concept design and will be subject to further flood modelling and consultation with CHCC, Environment, Energy and Science Group, DPIE and adjacent property owners.	TfNSW / Contractor	During detailed design
	FH12	FH11	Proposed mitigation measures for the Northern creeks catchment as described in <i>Table 23 of Appendix H, Updated flooding and hydrology assessment of the Amendment Report Chapter 17, Flooding and hydrology Table 17-16</i> of the EIS will be investigated during detailed design. The final design solution may involve combinations of the described mitigation options and the design response developed as part of the concept design and will be subject to further flood modelling and consultation with CHCC, Environment, Energy and Science Group, DPIE and adjacent property owners.	TfNSW / Contractor	During detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Project impacts on flood evacuation routes	FH13	FH12	Consultation with NSW State Emergency Services and CHCC will be carried out during detailed design if there are any changes to the existing flood evacuation routes or associated roads which may be impacted during operation.	TfNSW	During operation
Consideration of dam safety	n/a	FH13	<i>Consultation will be undertaken with Dams Safety NSW during detailed design regarding the potential for parts of the project to be Declared Dams under the Dams Safety Act 2015.</i>	TfNSW	<i>During detailed design</i>
Soils and contamination					
Contaminated soil	SC01		<p>Phase 2 contamination investigations will be undertaken in areas of potential contamination identified during the preliminary site investigation (RCA 2016). The investigation will be carried out in accordance with the Guideline for the Management of Contamination (Roads and Maritime Services 2013d). This will include soil sampling from targeted areas including:</p> <ul style="list-style-type: none"> • Banana plantations within proposed cuttings (analysed for arsenic, lead and organochlorin pesticides including DDT, Aldrin and Dieldrin) • Incremental soil sampling along construction footprint at existing Pacific Highway where there is a history of truck accidents to assess potential lead and hydrocarbon contamination • Targeted soil sampling at locations with dumped materials, fill materials and other agricultural uses • Areas of PASS within construction footprint to determine oxidised pH level. 	TfNSW	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Contaminated land disturbance	SC02		<p>A Contaminated Land Management Plan will be prepared and implemented as part of the CEMP for any areas of existing contaminated land or to address land contamination likely to be caused by the activity. The plan will be prepared in accordance with relevant requirements of the Guideline for the Management of Contamination (Roads and Maritime Services 2013d). As a minimum the plan will address the following matters:</p> <ul style="list-style-type: none"> • Control measures to divert surface runoff away from the contaminated land • Capture and manage of any surface runoff contaminated by exposure to the contaminated land • Further investigations required to determine the extent, concentration and type of contamination, as identified in the Phase 2 contamination investigations • Manage the remediation and subsequent validation any certification land, including any certification required • Measures to ensure the safety of site personnel and local communities during construction • Procedures to identify and manage any unexpected contamination finds during construction. 	Contractor	During detailed design
Remediation of contamination	SC03		If site contamination investigations indicate that construction works will impact contaminant that are present on site in concentrations above the intended land use criteria, then a Remedial Action Plan will be developed, and remediation works carried out in consultation with the EPA and in accordance with the Guideline for the Management of Contamination (Roads and Maritime Services 2013d).	Remediation of contamination	During detailed design
Soil, surface water and groundwater quality	SC04		A Soil and Water Management Plan will be prepared in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and Erosion and Sediment Management Report: Coffs Harbour Bypass	Contractor	During detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<p>(SEEC-2019) Appendix B, <i>Updated erosion and sediment management report of the Submissions Report</i> and implemented as part of the CEMP. The plan will identify all reasonably foreseeable risks relating to soil erosion and water pollution associated with carrying out the activity and describe how these risks will be managed and minimised during construction. The plan will include arrangements for managing pollution risks associated with spillage or contamination on the site and adjoining areas.</p>		
Soil erosion and sedimentation	SC05		<p>A primary Erosion and Sediment Control Plan will be prepared and implemented as part of the Soil and Water Management Plan. The plan will identify detailed measures and controls to be applied to minimise erosion and sediment control risks including:</p> <ul style="list-style-type: none"> • Runoff, diversion and drainage points • Sediment basins and sumps • Scour protection • Stabilising disturbed areas as soon as possible, check dams, fencing and swales • The need for site-specific plans to address staged implementation arrangements. <p>The plan will also include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.</p>	Contractor	Prior to and during construction
Erosion and sedimentation management	SC06		<p>A suitably qualified and experienced soil conservationist will be engaged during construction of the project to advise and review the implementation and management of erosion and sediment controls.</p>	Contractor	During detailed design and construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Soil erosion and bank stability risk	SC07		Batters will be designed and constructed to minimise risk or exposure, instability and erosion, and to support long term, ongoing best practice management, in accordance with the Guideline for Batter Stabilisation Using Vegetation (Roads and Maritime Services 2015f). <i>In considering the application of best practice management, the combination of mulch and topsoil, in establishing vegetation on batters will also be investigated.</i>	Contractor	During detailed design and construction
Spill management during construction	SC08		A site-specific emergency spill response procedure will be developed as part of the Soil and Water Management Plan and include spill management measures in accordance with the Roads and Maritime Code of Practice for Water Management and relevant EPA guidelines. The procedure will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities.	Contractor	During detailed design
Disturbance of acid sulfate materials	SC09		An Acid Sulfate Soils Management Plan will be prepared and implemented as part of the Soil and Water Management Plan. The plan will be prepared in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005).	Contractor	During detailed design
Surface water quality					
Water quality monitoring program	SW01		A Water Quality Monitoring Program will be prepared and implemented prior to and during construction and operation to identify whether the project is resulting in adverse impacts on water quality and assess compliance with statutory requirements and project targets. Monitoring will continue for a period of three years following construction, or before if it can be proved that no impact has occurred. The monitoring program will be prepared in accordance with the Guideline for Construction Water Quality Monitoring (RTA n.d.) and details provided in Chapter 19, Surface water quality of the EIS.	TfNSW	Prior to and during construction and operation

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<p>The monitoring program will include requirements for:</p> <ul style="list-style-type: none"> • Identification of monitoring locations which are representative of the potential impacts • Collection of baseline information prior to construction • Consideration of the identified sensitive environments • Water quality objectives to assess potential impacts against • Contingency and ameliorative measures in the event that adverse impacts are experienced • Reporting of the monitoring results. 		
Water quality impacts from dewatering existing storages	SW02		Dewatering of existing storages (eg dams) will occur overland in vegetated areas or will be used for dust suppression activities and not discharged directly into waterways to minimise release of high levels of nutrients and or contaminates directly into the waterways.	Contractor	During construction
Water quality impacts from dewatering during construction	SW03		Any dewatering activities will be undertaken in accordance with the Technical Guideline: Environmental Management of Construction Site Dewatering (RTA 2011b), in a manner that prevents pollution of waters.	Contractor	During construction
Works within or adjacent to waterways	SW04		<p>A detailed Environmental Work Method Statement will be prepared and implemented for all works undertaken within or immediately adjacent to waterways. The Environmental Work Method Statement will detail measures to avoid or minimise risks from erosion and sedimentation to water quality and biodiversity. It will be prepared in accordance with relevant guidelines including, but not limited to consideration of:</p> <ul style="list-style-type: none"> • Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects 	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<ul style="list-style-type: none"> • Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings • <i>Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004)</i>. 		
Managing tannin leachates	SW05		<p>Mulch stockpiles will be managed in accordance with the Roads and Maritime Environmental Direction for the Management of Tannins from Vegetation Mulch (Roads and Maritime 2012b). This would include but not be limited to:</p> <ul style="list-style-type: none"> • Planning and staging vegetation processing activities • Stockpile location and management to minimise the production and release of tannins • Monitoring the stockpiles for the production of tannins • Response to tannin production. 	Contractor	During construction
Managing tannin leachates	SW05		<p>Mulch stockpiles and the potential generation of tannin leachates will be managed through the implementation of a Management of Tannins from Vegetation Mulch Procedure. The procedure will be prepared in accordance with the Environmental Direction for the Management of Tannins from Vegetation Mulch (Roads and Maritime Services 2012). The procedure will include but not be limited to:</p> <ul style="list-style-type: none"> • Planning and staging vegetation processing activities • Management of temporary mulch stockpiles (less than one week) • Stockpile location and management to minimise the production and release of tannins including use of impermeable bunds and sumps to capture tannin leachate • Monitoring the stockpiles for the production of tannin leachate including post-rainfall inspection requirements • Response(s) to tannin leachate production. 	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Inspection and maintenance program	SW06		An inspection and maintenance program as part of the Soil and Water Management Plan will be implemented during construction to ensure effective implementation of all temporary and permanent soil, erosion and water pollution safeguards. The timing and frequency of inspections will be set out in the Soil and Water Management Plan. The inspections will assess implementation and success of the controls, actions required to ensure ongoing effective operation, and compliance with any statutory approvals. A register of inspections will be established.	Contractor	During construction
Operational water quality impacts	SW07		Stormwater and road runoff will be directed towards operational water quality treatment structures that will assist in the removal of pollutants from discharge water to protect ecosystem and human health.	Contractor	During detailed design
	SW08		The type and design of the specific stormwater treatment measures will continue to be refined as part of the detailed design process with the aim of achieving the NSW Water Quality Objectives where reasonable and feasible. This will include review of the proposed stormwater treatment train and consideration of best management practice guidelines including the Water sensitive urban design guideline (Roads and Maritime Services 2017d).	Contractor	During detailed design
Groundwater					
Acid sulfate materials	GW01		Stockpiles containing PASS or ASS treatment areas will be lined and bunded in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005) to prevent leachate contaminating groundwater.	Contractor	During construction
Management of groundwater interception	GW02		Additional groundwater monitoring standpipes will be included for Type A cuts for alluvial aquifers along the project and in the areas around the major embankments to supplement existing data.	TfNSW	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
	n/a	GW03	<i>Captured groundwater from tunneling will be treated using temporary water treatment plants and transferred to storage dams for reuse during construction as a source of non-potable water.</i>	Contractor	<i>During construction</i>
	GW03	GW04	<i>Unless used as a source of non-potable water for the project, groundwater captured by cuttings and tunnels will be returned into the aquifer down gradient and within the same catchment from where it was intercepted where reasonable and feasible.</i>	Contractor	During construction
	GW04	GW05	Engineering measures for long-term management of groundwater inflow to cuttings and tunnels will be designed and constructed to ensure groundwater is recharged downgradient of the cutting or tunnel from where it is captured and within the same catchment where reasonable and feasible. This will be facilitated by, but not limited to, absorption trenches, infiltration galleries/pits, sediment basins and grassed swales.	Contractor	During detailed design
	GW05	GW06	Where groundwater recharge downgradient of the cutting or tunnel is not reasonable and feasible, measures will be designed and implemented that transfer seepage water downstream via water quality basins before being discharged into a downstream drainage channel or creek, within the same catchment.	Contractor	During detailed design and during construction
	n/a	GW07	<i>Additional geotechnical and hydrogeological investigations and modelling will be carried out for the Gatelys Road tunnel during detailed design to improve predictions of likely groundwater inflows, inform construction methodologies and develop engineering measures to reduce groundwater ingress where inflow rates are still anticipated to exceed 1 L/s per kilometre. Investigations and modelling will be undertaken in consultation with Water Group, DPIE.</i>	Contractor	<i>During detailed design</i>

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Prevention of groundwater impacts from cuttings, tunnels and embankments	GW06	GW08	Monitoring of groundwater levels and quality will be included in the Water Quality Monitoring Program detailed in Chapter 19, Surface water quality SW01.	TfNSW	Prior to and during construction and operation
	GW07	GW09	Monitoring of seepage into cuttings will be carried out and evaluated against the predictions of the numerical modelling undertaken during detailed design.	TfNSW / Contractor	During construction
	GW08	GW10	Major embankments will be designed to enable distributed flow of surface water to prevent ponding.	TfNSW / Contractor	During detailed design
	GW09	GW11	Additional ground truthing and site inspections will be undertaken for potentially impacted groundwater bores/supply wells (including supply well GW068986), springs, Jordans Creek (<i>near Cut 20</i>), and agricultural dams within and immediately surrounding the zone of drawdown. The purpose of the ground truthing and site inspections is to confirm predicted impacts and develop make good provisions where required in consultation with affected property owners.	TfNSW	During detailed design
Prevention of potential impacts on groundwater quality	GW10	GW12	Sites used for stockpiles, washdown areas, refuelling and chemical storage will be located away from areas of shallow groundwater or appropriately lined and bunded to protect groundwater.	Contractor	Prior to and during construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Air quality					
Management of construction impacts	AQ01		<p>An Air Quality Management Plan will be prepared and implemented as part of the CEMP. The plan will identify:</p> <ul style="list-style-type: none"> • Potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction • Identification of all dust sensitive receivers, including banana and blueberry farms, residential dwellings, education institutions, health care facilities, places of worship, childcare facilities and open space • Air quality management objectives and criteria consistent with Approved Methods for the Modelling and Assessment of Air Quality Pollutants in NSW (EPA 2017a) • Mitigation and suppression measures to be implemented, such as using soil binders or covering exposed surfaces, provision of vehicle clean down areas, covering of loads, use of water carts and street cleaning, use of dust screens, maintenance of plant in accordance with manufacturer's instructions, spray bars on crushers • Methods to manage or stop works during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces • When the air quality, suppression and management measures need to be applied and who is responsible • A monitoring program to assess the effectiveness of the applied measures <i>in accordance with Approved Methods for Sampling and Analysis of Air Pollutants in NSW (Department of Environment and Conservation NSW 2007)</i> • Community notification and complaint handling procedures. 	Contractor	Prior to construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Dust generation from building demolition	AQ02		Where buildings and structures are required to be demolished, techniques and practices will be developed to minimise dust generation such as water spraying during demolition as required, and the removal of construction debris along an approved route documented in the Air Quality Management Plan.	Contractor	During construction
Construction vehicle emissions	AQ03		Where practicable, construction vehicles will be fitted with pollution reduction devices and switched off when not in use.	Contractor	During construction
Odour impacts from asphalt batch plants	AQ04		<p>Asphalt batch plants established for the project will include the following measures to minimise odour generation:</p> <ul style="list-style-type: none"> • Bitumen products will be maintained at the minimum temperature possible to minimise odorous emissions • Particulate extraction equipment will be installed, operated and maintained for efficiency in minimising odour impacts • Filters and burners will be adequately maintained to minimise odour impacts • Commission testing will be carried out prior to full operation to ensure that best practice industry standards are met during the operation of the batch plant • An assessment of prevailing winds and the location and direction of receivers when selecting an appropriate asphalt batch plant site. 	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Waste					
Waste management	WM01		<p>A Waste Management Plan will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to support minimising the amount of waste produced and appropriately handle and dispose of unavoidable waste. It will also address the importation of recycled materials to site for use in undertaking the project. The plan will be prepared taking into account the Environmental Procedure – Management of Wastes on Roads and Maritime Services Land (Roads and Maritime Services 2014d). The plan will include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> • Measures to avoid and minimise waste associated with the project • Classification of wastes generated by the project and management options • Classification of wastes received from off-site for use in the project and management options • Identification of any statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting, including any documentation management obligations arising from resource recovery exemptions. 	Contractor	Prior to construction
Management of excess spoil	WM02		<p>Spoil will be beneficially reused as part of the project before alternative spoil disposal options are pursued. Any excess spoil will be managed using the following order of priorities:</p> <ul style="list-style-type: none"> • Review alignment and profile refinements during detailed design • Assess opportunities to reuse excess spoil in works such as landscaping and noise barriers within the construction footprint or in adjacent land 	Contractor	During construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<p>(subject to property owner agreement and/or any project approval or POEO Act requirements)</p> <ul style="list-style-type: none"> • Beneficial reuse within the construction footprint for rehabilitation of ancillary sites used for the project (where it is within the requirements of the project approval) • Transfer to other nearby TfNSW projects for immediate use, where possible, pending construction of other projects or for use on future projects or routine maintenance • Transfer to a TfNSW approved site for reuse on concurrent private/local government projects (with appropriate approvals as required, eg a section 143 notice under section 143(3A) of the POEO Act) • Disposal at an approved materials recycling or licensed waste disposal facility. 		
Waste storage	WM03		<p>Prior to construction, suitable areas within the ancillary sites or in other appropriate areas within the construction footprint will be allocated which provide adequate space and access for:</p> <ul style="list-style-type: none"> • Separated storage of building materials • Separated storage and sorting of construction waste • Removal of construction waste for recycling, reuse or disposal • Separated storage of known previously contaminated materials and contingency for unknown contaminated materials. 	Contractor	Prior to and during construction
Hazardous materials – risk to human health	WM04		A hazardous materials assessment will be carried out of the buildings to be demolished before demolition to identify presence of hazardous materials and ensure appropriate controls are implemented for the demolition, storage and disposal of materials.	TfNSW / Contractor	During detailed design

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Asbestos – risk to human health	WM05		<p>If the hazardous assessment investigations identify asbestos containing materials, an Asbestos Management Plan will be developed and implemented as part of the CEMP. The plan will include:</p> <ul style="list-style-type: none"> • Identification of potential asbestos on site procedures to manage and handle any asbestos, including potential areas where asbestos may be found within soils • Procedures to manage asbestos if encountered during construction • Measures to minimise the total volume of asbestos contaminated material that is generated. These will include separate stockpiling to ensure that asbestos contaminated material is not mixed with clean stockpile material • Procedures for disposal of asbestos in accordance with NSW EPA guidelines, Australian standards and relevant industry codes of practice. 	TfNSW / Contractor	During detailed design
Wastewater	WM06		Where reasonable and feasible, water captured within the construction footprint will be prioritised for reuse as construction water or dust suppression.	Contractor	During construction
Operational waste	WM07		All operational waste will be managed in accordance with the TfNSW waste management procedures and Environmental Management System.	TfNSW	Operation
Sustainability					
Sustainability	S01		<p>A Sustainability Management Plan will be developed to establish governance structures, processes and systems that ensure integration of all sustainability considerations (vision, commitments, principles, objectives and targets), initiatives, monitoring and reporting during the detailed design and construction phases of the project.</p> <p>The plan will include commitments detailed in Chapter 23, Sustainability of the EIS including but not limited to:</p> <ul style="list-style-type: none"> • Key sustainability management roles and responsibilities 	Contractor	During detailed design, construction and operation

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<ul style="list-style-type: none"> • Targets for diverse and inclusive workforce participation and local employment opportunities • An energy efficiency and greenhouse gas emissions strategy • A sustainable procurement strategy • Water savings initiatives • Monitoring and reporting requirements for sustainability initiatives and performance. 		
Hazard and risk					
Climate change – risk treatments	HZ01		Hydrological and hydraulic assessments undertaken during detailed design will consider the climate change related flood risks to the project and flood impacts from the project. The assessment will confirm the requirements for any additional management measures. The assessment will be undertaken in accordance with the Practical Considerations of Climate Change – Floodplain Risk Management Guideline (DECC 2007).	Contractor	During detailed design
Emergency access	HZ02		Consultation with emergency services, including the NSW Rural Fire Service and Fire and Rescue NSW will be undertaken during construction to ensure emergency access is maintained during and after construction.	Contractor	During detailed design and construction
Bushfire risk	HZ03		<p>A Bushfire Management Plan will be prepared in accordance with the Planning for Bush Fire Protection 2006 (Rural Fire Service 2006) and implemented as part of the CEMP.</p> <p>Measures to be implemented to manage bushfire risk include:</p> <ul style="list-style-type: none"> • Consultation requirements for community notifications in the event of a bushfire • Maintaining equipment in good working order 	Contractor	Prior to and during construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
			<ul style="list-style-type: none"> • Ensuring plant and equipment are fitted with appropriate spark arrestors, where practicable • Ensuring site workers are informed of the site rules including designated smoking areas and putting rubbish in designated bins • Obtaining hot work permits and implementing total fire bans as required • Implementing adequate storage and handling requirements for potentially flammable substances in accordance with the relevant guidelines. 		
Hazardous material storage	HZ04		All fuels, chemicals and other hazardous materials will be stored in a roofed, fire-protected and impervious bunded area at least 50 m from waterways, drainage lines, basins, flood-affected areas or slopes above 10%. Bunding design will comply with relevant Australian Standards and should generally be in accordance with guidelines provided in the EPA Authorised Officers Manual. Appropriate on-site signage will be provided to identify the materials stored.	Contractor	During construction
Spills and accidents	HZ05		Appropriate spill containment equipment will be provided on-site and located at strategic, accessible locations.	Contractor	During construction
Subsidence	HZ06		A Surface Settlement Monitoring Program will be prepared and implemented prior to and during construction to identify whether the project is resulting in adverse subsidence impacts. In the unlikely event that subsidence as a result of the project is deemed to cause building and/or property damage, the damage would be repaired at no cost to the owner.	Contractor	Prior to and during construction

6. Revised environmental management measures

Environmental issue	EIS ID	New ID	Environmental management measures	Responsibility	Timing
Transportation of dangerous goods	HZ07		Consultation with EPA, SafeWork NSW and Fire and Rescue NSW will continue to confirm if the project would be able to accept any classes of dangerous goods during operation. To support the consultation, an absolute risk assessment will be carried out with the purpose to demonstrate that risks have been reduced so far as is reasonably practical. The absolute risk assessment will also consider appropriate infrastructure design and operational management measures to reduce risk and the consequence of any event occurring.	TfNSW	During detailed design
		HZ07	<i>The dangerous goods risk assessment process is ongoing. Further assessment and consultation with relevant authorities and stakeholders will occur as part of this process.</i>	TfNSW	During detailed design
Cumulative impacts					
Cumulative impacts	CI01		Where relevant, consultation would be undertaken with proponents of other nearby developments to increase the overall awareness of project timeframes and impacts.	Contractor	During construction
	CI02		The CEMP will be updated with any revised or new environmental management measure identified from consultation with proponents of other nearby developments, where required.	Contractor	During construction

Chapter 7

Conclusion

7. Conclusion and next steps

TfNSW has amended several aspects of the project in response to consultation with the community and landowners, submissions received on the EIS, consultation with government agencies, and continued development and refinement of the concept design. Design and construction changes are consistent with the outcomes of Ecologically Sustainable Design principles and the objects of the EP&A Act. A number of potential environmental impacts from the project have been avoided or minimised through the amended design. The proposed design changes to the project as described in the EIS are:

- Englands Road interchange
- North Boambee Valley vertical alignment
- Coramba Road bus stop
- Coffs Creek flood mitigation
- Korora Hill interchange
- Kororo Public School bus interchange and Luke Bowen footbridge
- Pine Brush Creek and Williams Creek realignment
- New and revised operational water quality basins.

The proposed construction changes are:

- Additional blasting
- New and revised ancillary sites
- Revised traffic management
- New and revised construction sediment basins.

TfNSW has consulted and engaged with stakeholders and the community on the design changes. Issues raised have been investigated and considered and a significant proportion of feedback has been supportive of the project.

The assessment in **Chapter 5, Additional assessment** has concluded that impacts associated with the proposed design and construction changes are generally consistent with the impacts described in the EIS. As such, the project would still result in some impacts due to noise and vibration, temporary disruptions to traffic flow and access during construction, surface water diversions and engineering controls, the removal of vegetation including some endangered ecological communities, impacts on items and places of Aboriginal heritage significance, socio-economic impacts including business impacts and changes to access and property acquisition.

Compared to the EIS design, the amended design results in some increased impacts for noise and vibration, biodiversity and Aboriginal cultural heritage and overall improvements to flooding and hydrology.

The project has applied the Framework for Biodiversity Assessment (FBA) (OEH 2014a) to quantify the impact to threatened species, populations and communities and developed a Biodiversity Offset Strategy to address the requirements of the TSC Act. A summary of the credits required for the project is provided in **Section 5.4, Biodiversity**. All residual impacts associated with biodiversity will be offset in accordance with the FBA.

7. Conclusion and next steps

Potential impacts will be managed through the implementation of the environmental management measures which have been amended since the EIS to consider the amended design and issues raised during exhibition of the EIS, responded to in the Submissions Report. These are described in **Chapter 6, Revised environmental management measures** of this report.

The project is considered appropriate and justified as the negative impacts are outweighed by the longer term positive impacts of providing improved road safety and travel times for all road users in a region which is expected to experience population growth in coming years and realising the overall benefit of the Pacific Highway upgrade program.

DPIE will consider this Submissions Report and the Amendment Report during its assessment of the project. The Secretary will prepare an environmental assessment report in accordance with section 5.18 of the EP&A Act. The Minister for Planning and Public Spaces will then decide whether or not to approve the project and identify any conditions of approval which will apply.

As the project is being assessed under the Assessment Bilateral Agreement (2015) between the Australian and NSW governments, this only accredits the assessment process under Division 5.2 of the EP&A Act. Accordingly, should the Minister for Planning and Public Spaces approve the project, the Australian Minister for the Environment would then need to issue a separate approval for the project as a controlled action.

If approved by the Australian and NSW governments, TfNSW will continue to consult with community members, government agencies and other stakeholders during the detailed design and construction phases of the project.

Chapter 8

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