South Batemans Bay Link Road

Water quality, drainage and flooding assessment

Transport for NSW | April 2020

Prepared by Cardno (NSW/ACT) Pty Ltd and Transport for NSW

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1 Introduction

1.1 Proposal identification

Transport for NSW is proposing to connect the Princes Highway with the existing South Batemans Bay Link Road at Glenella Road (the proposal). The proposal would include a new roundabout on the Princes Highway south of Batemans Bay and a new two-lane road (one lane in each direction) between the roundabout and Glenella Road. The proposal would generally follow the current alignment of Glenella Road (formally known as The Ridge Road) between Heron Road and the Princes Highway to complete the South Batemans Bay Link Road project.

This report supports the environmental assessment for the proposal. The proposal is subject to assessment by a review of environmental factors (REF) under Division 5.1 of Environmental Planning and Assessment Act 1979 (EP&A Act).

1.2 Proposal location

The proposal is located within the Eurobodalla Local Government Area (LGA) about 2.5 kilometres south of Batemans Bay, adjacent to the Princes Highway, about 300 kilometres south of Sydney and 150 kilometres east of Canberra (Figure 1-1). Batemans Bay is the main commercial centre of the Eurobodalla Shire. The Central Business District (CBD) has a mix of commercial, tourist, recreational and residential land uses. There are further urban residential and future employment lands located along the coastal villages south of Batemans Bay. The area is a popular tourist destination, particularly for Australian Capital Territory (ACT) residents and the Batemans Bay population increases substantially during holiday periods.

1.2.1 Key features of the proposal

Key features of the proposal include:

- A new roundabout on the Princes Highway, including:
  - two southbound lanes through the roundabout
  - a single northbound right turn lane through the roundabout to Glenella Road
  - a northbound bypass lane on the Princes Highway
  - single lane entry and exit to and from the Glenella Road
- A new two-lane road (one lane in each direction), about one kilometre in length, between the new roundabout on the Princes Highway and Heron Road
- A new T-intersection at the junction of The Ridge Road and Glenella Road
- Utility adjustments including for telecommunication, electrical and water infrastructure
- Earthworks including cuttings, embankments and retaining walls
- Establishment and use of temporary ancillary facilities during construction, including site offices, access tracks, plant laydown areas, stockpile sites, water quality controls and vehicle turning bays
- Drainage and stormwater management infrastructure along the road corridor
- Site rehabilitation and landscaping work.
The proposal would allow for land use development and increase freight access and productivity in the Batemans Bay CBD, southern coastal villages and proposed Surf Beach employment lands. The proposal would also provide a safe and efficient alternative access to the southern coastal villages that would help ease current and future congestion in the Batemans Bay CBD, particularly along Beach Road.

The proposal is shown in Figure 1-2.

1.2.2 Proposal background

The Princes Highway is an important connection for regional motorists and is a key route for heavy vehicle, commuter and tourist traffic movements. The traffic volume on the Princes Highway just south of Batemans Bay is around 8,800 vehicles per day with 8.3 per cent heavy vehicles and a growth rate of around 1.2 per cent per year. Beach Road is a regional road and a major sub-arterial road through the Batemans Bay CBD linking the Princes Highway, just south of the Batemans Bay Bridge, to the various residential areas and beaches south of the CBD, from Catalina to Surf Beach and further south along George Bass Drive.

In June 2014, the NSW Government announced $10 million for the South Batemans Bay Link Road project to improve traffic flow through Batemans Bay and support future growth in the region. In early 2019, Eurobodalla Shire Council completed construction of the first stage of the South Batemans Bay Link Road between George Bass Drive and Heron Road, east of the Princes Highway. The completed section of the South Batemans Bay Link Road is known as Glenella Road. As part of these works, the section of The Ridge Road from the Princes Highway to Glenella Road was renamed to Glenella Road. This was undertaken by Council to define the connection of the sub arterial road (Glenella Road) through to the Princes Highway.

In January 2019, the NSW Government announced funding of $30 million for Transport for NSW to finalise planning and build the connection of the South Batemans Bay Link Road to the Princes Highway.

Transport for NSW proposes to build a link road connection between the Princes Highway and the South Batemans Bay Link Road along the existing alignment of Glenella Road. The proposal would reduce pressure on the existing Beach Road/Princes Highway, ease congestion in the Batemans Bay CBD and accommodate for future traffic growth.

The main objective of the proposal is to provide a safe and efficient connection between the Princes Highway and the South Batemans Bay Link Road.

Other objectives of the proposal are to:

- Facilitate land use development in the Batemans Bay CBD and southern coastal villages to support residential property and employment growth
- Increase freight productivity for heavy vehicles accessing the southern coastal villages and the proposed Surf Beach employment lands
- Improve traffic amenity in the Batemans Bay CBD.
Figure 1-1: Location of the proposal
South Batemans Bay Link Road
Water quality drainage and flooding assessment
1.3 Purpose of the report

This water quality, drainage and flooding assessment has been prepared by Cardno (ACT/NSW) Pty Ltd on behalf of Transport for NSW. For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1 of the EP&A Act.

The purpose of the water quality, drainage and flooding assessment is to describe the proposal, and perform a qualitative desktop assessment to document the likely impacts of the proposal on the environment (in regards to water quality, drainage patterns and flood behaviour), and to recommend mitigation and management measures to be implemented. The objectives of this assessment are as follows:

- Identify changes between the existing and proposed alignment to determine the likely impacts of the proposal on water quality, drainage patterns and flow behaviour
- Determine if existing water quality, drainage pattern and flood behaviour within the catchment would be likely to be impacted by the proposal during construction or the long term operation of the proposal through:
  - Changes between the existing and proposed alignment
  - Increases in impervious areas
  - Modification of the existing topology and catchment flow through earthworks
- Determine if the proposal would adversely impact the flow behaviour within the catchment during construction phase
- Provide recommendations for flow management measures for any additional temporary works.
- Provide recommendations for mitigation measures that can be implemented during construction or operation of the proposal.

1.4 NSW State legislation

1.4.1 NSW Water Management Act 2000

The Water Management Act 2000 (NSW) (WM Act) is administered by the NSW Department of Primary Industries and Environment (DPIE) - Water (formerly NSW Office of Water) and is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. The WM Act is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions. The intent and objectives of the WM Act have been considered as part of this assessment. Provisions of the WM Act require the development of management plans to deal with flooding regimes and the way they are managed in relation to risks to property and life and to ecological impacts. The WM Act also defines approvals required for carrying out works situated near a river or floodplain via flood work approvals or drainage work approvals.

1.4.1.1 Water Sharing Plan for the Clyde River Unregulated and Alluvial Water Sources 2016

The Water Sharing Plan for the Clyde River Unregulated and Alluvial Water Sources (2016), established under Section 50 of the WM Act, aims to further protect, preserve, maintain and enhance the important river flow dependant and high priority groundwater-dependant ecosystems of these water sources. The plan does this by providing provisions and regimes that enable access and use of the local water sources in a fair and manageable manner and further requirements for such use. The plan formalises water sharing arrangements in the Clyde River and provides a consistent approach to managing water across the plan area.

The construction boundary is located within the “Clyde River Extraction Management Unit” of the plan, requiring that the plan be adhered to in the event of any take from the water systems of the area.
In the unlikely event that such interference or water take is to occur, excavation required for the construction of a building, road or infrastructure, by either a roads or transport authority is exempt from access and aquifer interference license requirements (Water Management Regulation 2018, Schedule 4).

1.4.2 NSW Floodplain Development Manual

The Floodplain Development Manual (Department of Infrastructure, Planning and Natural Resources, 2005), the Flood Prone Land Policy and Floodplain Risk Management Guidelines provide guidance to local and NSW Government for managing flood risk.

The main objective of the Flood Prone Land Policy is to reduce the impact of flooding and flood liability on owners and occupiers of flood-prone property and reduce public and private losses. The policy recognises the benefits of use, occupation and development of flood-prone land.

The Floodplain Development Manual supports the policy and guides councils and the NSW Government through the floodplain risk management process. The manual helps councils develop and implement local floodplain risk management plans and outlines the technical assistance provided by the NSW Government. The manual details the roles and responsibilities of various NSW agencies and includes information on the following:

- Preparation of flood studies, floodplain risk management studies and plans
- Floodplain risk management options
- Flood planning levels and areas
- Hydraulic and hazard categorisation; and
- Emergency response planning.

1.5 Other policies and guidelines

Other relevant policies and guidelines include the following:

1.5.1 Soil and Water Management Code – Eurobodalla Shire Council

The Soil and Water Management Code (Eurobodalla Shire Council, 2010) applies to all development that involves site disturbance, excavation or filling and provides guidelines to ensure efficient Soil and Water Management. The objectives of the Code include:

- To prevent the degradation of waterways and water bodies by reducing erosion and minimising the loss of sediment from building sites
- To minimise erosion and sedimentation from building sites that results from disturbance to the soil surface associated with construction activities, the installation of services and infrastructure, and the disposal of stormwater into receiving waters; and
- To ensure prompt, practical and effective stabilisation of disturbed lands through the control of the location, timing, extent and nature of rehabilitation and landscaping.
1.5.2 Water Sensitive Urban Design Guideline

The Water Sensitive Urban Design Guideline (Roads and Maritime Service, 2017) describes the application of Water Sensitive Urban Design (WSUD) principles and techniques which are appropriate to the construction and operation of the NSW transport network.

The purpose of the Guideline is to provide guidance to project managers, civil designers, urban designers, landscape architects, stormwater engineers and planners on how to best apply WSUD to Transport for NSW projects. This guideline does not mandate the use of WSUD techniques, but provides a range of industry-standard elements that can be practically incorporated into Transport for NSW projects and describes what situations are appropriate for each. It also considers broader design issues including construction cost, safety and maintenance requirements.

This guideline also provides a process to ensure that broader infrastructure design aspects are considered in the adoption of WSUD including:

- Opportunities based on site conditions, e.g. slope and available land
- Maintenance requirements; and
- User and community safety.

1.5.3 Infrastructure Design Standard - Eurobodalla Shire Council

The Infrastructure Design Standard (Eurobodalla Shire Council) details the requirements for the design of infrastructure undertaken on Council, Crown or private land within the Eurobodalla LGA, to ensure that the quality of the assets received and subsequently maintained by Council meet a minimum design standard. The Standard is to be used in conjunction with AUS-SPEC and Austroads design guidelines. The objectives of the Guideline include:

- That new and upgraded infrastructure is of consistent standard within the Council area and generally consistent with neighbouring local government areas
- That minimum design standards are achieved and that works meet Council's legislative obligations
- That community amenity will be improved through development
- That environmental, public and employee risk during and after development is considered
- That maintenance requirements are considered at the planning and design stages; and
- All relevant statutory authorities/stakeholders have been consulted and their requirements have been considered in the design.
2 Methodology

This section outlines the methodology adopted to assess the impacts of the proposal on water quality, drainage and flooding. The scope of work consists of the preparation of a working paper for the proposal that includes a review of the existing environment at the site, identifies potential impacts that could result from the proposal, and describes mitigation measures to address any potential impacts.

2.1 Data collection

The following data was used in the assessment of impacts on water quality, drainage and flooding:

- The 20 per cent concept design was used to identify the key drainage approaches and elements along the alignment. The 20 per cent concept design included the major cross drainage elements, design contours, structural elements and pavement drainage features.
- Detailed ground survey of the proposed alignment by Transport for NSW dated 06 January 2020 was used to characterise the existing Glenella Road and identify existing drainage features.
- Aerial Laser Survey (ALS) tiles were used to examine existing contours and determine catchment areas.
- A site visit was conducted on 15 October 2019 to visually identify the key areas of the project and characterise likely impacts of the proposal on flood and drainage patterns, and water quality.
- Previous water quality reporting conducted for nearby Joes Creek prepared by WBM Oceanics Australia (2004).
- Previous flood study for Joes Creek prepared by Willing & Partners Pty Ltd (1989).

2.2 Site modelling

All modelling and assessment of the site conducted as part of this report was qualitative in nature, with the goal of identifying areas of concern and any further detailed assessment that may be required.

The proposed environment and construction works were compared to the existing environment of the site in consideration of water quality impacts from the site. The scale of the proposed works and the sensitivity of downstream environments was also considered in this regard to identify potential areas of concern.

Drainage catchments were determined using 1 metre site contours provided in the ALS survey tiles. The sub catchments upstream of the proposed Glenella Road were also delineated with this methodology to assess minimum drainage requirements of the road.

An approximate estimate of the 1 per cent annual exceedance probability AEP flow at each transverse drainage location has been estimated using XPRafts (Ver 11.0, Innovyze, 2018) and combined with guidelines in the Australian Rainfall and Runoff – A Guide to Flood Estimation (ARR)(Geoscience Australia, 2019). Rainfall losses were adopted from the Willing & Partners (1989) study.

A hydraulic model was not considered necessary as the proposed alignments are located within the upper reaches of the catchment area, significantly elevated above any nearby watercourses and historically recorded flood levels. It has been established that a qualitative model would be sufficient to determine impacts on drainage and flood behaviour within the construction boundary. Analysis of topographical data in comparison to previous flood studies was used to determine flood risk at the site.
2.3 Limitations

As identified above, this assessment is qualitative in nature, with no quantitative assessments of water quality, drainage or flooding of the construction boundary. The assessments undertaken for this study are based on data from comparable locations in the near vicinity of the proposal. No detailed analysis of any changes in the drainage patterns including flood levels, behaviour and extents within the construction boundary will be presented in this report.
3 Existing environment

The construction boundary is dominated by steep forested slopes with the exception of the Princes Highway and various dirt tracks including the existing Glenella Road. The following sections of the report detail key features of the existing environment that would influence the impact of the proposal on water quality, drainage and flooding.

3.1 Catchment overview

The proposal lies upon a ridgeline east of Round Hill and traverses the north-eastern slopes of Round Hill, with different elements of the construction boundary draining into three different creeks (Figure 3-1, Figure 3-2). These three creeks are Hanging Rock Creek, McLeod’s Creek and Deep Creek. Both McLeod’s Creek and Deep Creek form part of the Clyde River Catchment. The Clyde River catchment is approximately 1723 km² (DPIE, 2020) and is largely undeveloped. The contributing creeks within this catchment discharge into the Clyde River, which connects to the sea outfall at Batemans Bay. Hanging Rock Creek forms its own catchment draining east towards Batemans Bay. The Joes Creek catchment, which captures flows from the existing Glenella Road beyond the construction boundary extent, lies immediately south of the Hanging Rock Creek catchment.

The existing Princes Highway primarily drains west into McLeod’s Creek, with small portions draining east into Hanging Rock creek via surface runoff and table drains. Should the Princes Highway require any widening for additional merge lanes or median strips, these additional impervious areas would flow into McLeod’s Creek. The proposed alignment of Glenella Road and its interface with the Princes Highway would drain entirely into Hanging Rock Creek. A small portion of the south-western temporary ancillary site would drain south into Deep Creek. Inflows from upslope catchment areas onto the current Princes Highway are minor as the road alignment approximately follows the ridgeline between the two catchments. A total of four culverts currently traverses the Princes Highway road alignment at an east to west direction.

Glenella Road currently has minimal formalised drainage infrastructure, with a majority of the upslope catchment flows traversing the road into the Hanging Rock Creek. Four pipe culverts of 375mm diameter are spaced (approximately) evenly along the existing Glenella Road within the construction boundary, three of which are within the proposed Glenella Road alignment.

The three proposed temporary ancillary sites have no formalised drainage infrastructure. The locations and dimensions of the surveyed culverts discussed above can be found in Figure 3-2.

Groundwater data within the construction boundary is limited. Eight boreholes along the proposed road alignment were created as part of the geotechnical investigations conducted by Transport for NSW as part of the preliminary investigations for the proposal. The boreholes reached typical depths between 0.2 – 1.2 metres before refusal on underlying sandstone. No boreholes encountered any groundwater along the alignment indicating a deep water table within the construction boundary. This is in line with the site features and location, which is characterised by steep slopes and is at the top of the catchment. No other boreholes within 500 metres are known to exist within comparable locations to the construction boundary.

The lower extents of both McLeod’s Creek and Deep Creek, located approximately 700 metres and 1.2 kilometres away from the construction boundary respectively, and are identified as Coastal Wetlands under the State Environmental Planning Policy (Coastal Management) 2018.

The extents of the Princes Highway which flow west into McLeod’s Creek are likely to be widened as part of design refinements being undertaken, to allow for longer merge lanes and a median, and may increase the impervious area. The temporary ancillary facility proposed on Lattas Point Road also drains toward McLeod’s Creek. As a precautionary measure, this assessment considers potential impacts from these areas in the event that future design changes result in the additional road widening of the Princes Highway within the construction boundary.
The majority of the proposed works are within the Hanging Rock Creek catchment and are close to the headwaters of that catchment. The Hanging Rock Creek and its associated catchment continue east before flowing into Batemans Bay, which forms the direct junction with the South Pacific Ocean. Hanging Rock Creek flows in a south to north direction to the east of the proposal and the Batemans Bay CBD. The upper reaches of the catchment are defined by steep slopes and forested bushland, whilst residential lots, a small industrial estate and a large golf course dominate the downstream catchment.

### 3.2 Water quality

As identified in above, the proposed alignment and the majority of the temporary ancillary facilities would drain into Hanging Rock Creek, highlighting Hanging Rock Creek and its surrounding catchment to be of primary concern for the development. The proposed alignment would not traverse or obstruct any surrounding watercourses or existing drainage lines. However, the current access tracks proposed for use during the construction phase would run parallel to a small portion of Hanging Rock Creek and crosses two minor creek lines of Hanging Rock Creek (refer Figure 3-2). Hanging Rock Creek does not have any permanent water or defined channel within the construction boundary.

No specific water quality data or modelling for Hanging Rock Creek was available during the assessment. A report prepared by WBM Oceanics Australia (2004) found that Joes Creek, which is largely forested, appears to have generally good water quality and does not appear to suffer widespread anoxic conditions. The report did, however, identify occasions of die-off of filamentous algae in the creek which enables anoxic conditions to establish.

The upper extents of the Hanging rock creek and Joes creek are in close proximity to each other and share very similar topography and forested conditions. In the absence of directly relevant information, Hanging Rock Creek can also be expected to have generally good water quality in the upper extents of the creek and catchment. As the proposed road alignment is in this upstream area, this comparison is considered suitable for the purposes of this report.

Downstream water quality in Hanging Rock Creek is likely to be of worse condition, due to the immediately adjacent golf course and industrial park. The potential for contaminated runoff from the industrial park and high nutrient flows from the manicured golf course are high.
3.3 Flooding

All proposed works are contained within the upper-most reaches of their relevant catchment areas, upon a steep ridgeline and slope with grades varying between 10 and 40 per cent. These topographical characteristics as well as the lack of historical flooding in the near vicinity of the proposal indicate a low probability of any flooding occurring at the project site. As there are no changes in the road extent within the Clyde River catchment, the flooding impact assessment focused on the Hanging Rock Catchment.

No hydrological or hydraulic modelling specifically focussing on the proposal area or the whole of the Hanging Rock Creek catchment were available at the time of assessment. The following reports and studies include limited analysis of the lower reaches of the Hanging Rock Creek and nearby Joes Creek (refer Figure 3-1 for creek locations):

- A report by Webb, McKeown and Associates (2001) – The report stated that “runoff from the Hanging Rock Creek catchment also has the capacity to cause local flooding above Beach Road, particularly along Hanging Rock Creek and the golf course”. The report also noted significant flooding risks in the Hanging Rock subdivision in the lower parts of the catchment where grades are less steep.

- A stormwater drainage and flooding assessment by MIEngineers (2018) – The report cited previous flood studies within the vicinity of Beach Road in 2006 and 2011 by Cardno, noting that one of the mechanisms of flooding at Beach Road was due to overbank flooding from Hanging Rock Creek. The report further identified that properties in the Hanging Rock urban area, approximately 1.2 km from the construction boundary, are reported to have a history of flooding.

- The Joes Creek Flood Study (Willing & Partners, 1989) - The study modelled and reported peak flows and flood levels for various Average Recurrence Interval (ARI) events at various locations within the adjacent Joes Creek catchment. This modelling also determined that minor flooding could occur at the northern end of George Bass Drive (approximately 2 km east of the proposal) in the lower extents of the catchment with high rainfall (1 in100 Annual Exceedance Probability (AEP)) and tidal conditions (0.94m high water solstice level).

As identified in these studies, flooding can occur in the lower reaches of these catchments, particularly in the vicinity of constructed creek crossings and foreshore development. Such flooding however is far removed from the project site, occurs at elevations between 1 to 3m AHD with grades below 3 per cent and where tidal influence can occur. The differences in elevation, grade, and upstream catchment vastly differ from the construction boundary implying that flooding is unlikely to occur within the construction boundary.

The ancillary facilitates are also not considered to be at risk of flooding due to similarly characterised locations. The lowest extents of the access tracks near Hanging Rock Creek vary in elevation between 10 and 20 metres. Minor localised inundation at the bottom of these tracks may be possible in extreme weather events.
4 Proposed works

As discussed above, the proposal lies upon a ridgeline north of Round Hill, with different elements of the proposal draining into three different creeks and two different catchments. However, the proposed changes to the road extent all occur within the upper extent of the Hanging Rock Creek Catchment. These changes primarily include the new roundabout on the Princes Highway and the upgrade of Glenella Road. The proposed alignment of Glenella Road would follow the existing unsealed road from where Stage 1 (completed by Eurobodalla Shire Council in 2019) terminates in the south east of the construction boundary, to within approximately 50 metres upstream of the current intersection with the Princes Highway. Here, the proposal would deviate from the existing alignment and continue approximately 200 metres further north before joining the Princes Highway via the new roundabout. This assessment was based upon the 20 per cent concept design. However, widening of the Princes Highway to accommodate additional merge lanes extending up to 350 metres north of the proposed roundabout intersection have also been considered.

As the proposal alignment does not directly impact on any watercourses or creeks, the key features of the proposal that would directly affect the catchment primarily involve the increases in impervious road surface area and supporting earthworks. A marginal length across the Glenella Road alignment comes within close proximity to several minor creek lines that discharge into the main Hanging Rock Creek arm. The proposal would not alter the flow conveyance within Hanging Rock Creek and would still be located away from any direct contact with both minor and major creek lines.

The access tracks that would be used to assist construction intersect several minor creek lines that connect to the main Hanging Rock Creek. These access tracks are existing tracks within the construction boundary and may require minor upgrades and widening as part of the proposed construction works to ensure safe access and movement within the construction boundary.

Beyond the new roundabout and associated interface with the Princes Highway, no permanent changes were proposed to the Princes Highway as part of the 20 per cent concept design. However, further development of the concept design includes widening of the Princes Highway for up to 350 metres north of the intersection.

The proposed road alignment does not cross any defined watercourses but does intersect several existing drainage lines within the upper reaches of the Hanging Rock Creek catchment. A total of three 375mm diameter culverts located across Glenella Road and one 450mm diameter culvert across the Princes Highway would be intersected by the proposed road alignment. As per the 20 per cent concept design, 10 new pipes and culverts have been proposed to replace and upgrade the existing infrastructure to ensure flow connectivity and drainage pattern within the catchment is maintained. The current design indicates transverse pipes are to be of a minimum 450mm diameter, a significant increase over the current drainage infrastructure. The concept design plan in Figure 3-2 shows the indicative transverse drainage pipes proposed across the new Glenella Road alignment. These new drainage features have catchment areas ranging from 0.3 to 4 hectares.
5 Potential impacts

5.1 Water quality

5.1.1 Construction phase

There is a risk of impact to surrounding water bodies and systems at any construction site where raw materials are stockpiled, hardstand areas are created, or where natural surfaces are excavated and exposed. In particular, the steep topography associated with this site increases the risk of erosion and subsequent sediment loading of runoff should any uncontrolled activities occur at the site. Consideration must also be given to the materials, equipment and machinery kept on site during the construction phase and whether any protection measures are required to ensure they do not contaminate the natural water system via potential spills or their associated use.

Whilst the construction phase is temporary, if uncontrolled, the significant amounts of disturbance associated with this phase could cause harm upon surrounding ecosystems.

An investigation and assessment of environmental impacts upon water quality in the area as a result of construction has been undertaken in the Erosion and Sediment Management Report in Appendix G of the REF (SEEC, December 2019). This assessment considers all temporary facilities as well as the proposed road footprint.

5.1.2 Operational phase

During operation, potential impacts on water quality would primarily originate from vehicles utilising the new road infrastructure. This may result in:

- Pollutants such as heavy metals, hydrocarbons, gross pollutants and nutrients accumulating on the new road surface from passing traffic, atmospheric deposition and wind deposition. These pollutants may get washed off by stormwater runoff and transported to the downstream riverine system and into the bay; and
- Large spills of hazardous substances from traffic incidents on the new road involving vehicles carrying hazardous substances. The spilt substances can enter the drainage system or the creek and find their way into the bay.

The proposed alignment of Glenella Road would be sealed as opposed to the existing road in the same location, which is an unsealed road. As such, sediment load in stormwater runoff from the proposed road is likely to be less than the current situation.

As discussed in Section 3.2, the lower extents of both McLeod’s Creek and Deep Creek, located approximately 700 m and 1.2 km away from the construction boundary respectively, are identified as Coastal Wetlands under the State Environmental Planning Policy (Coastal Management) 2018. Due to the sensitive nature of these receiving waterbodies, management measures have been considered as recommended in Section 6.1 to ensure suitable water quality goals are achieved prior to water discharging to these locations.
5.2 Drainage

5.2.1 Construction phase
As identified in Section 5.1.1 above, uncontrolled drainage from the site during the construction phase poses a risk to surrounding water systems. As the site is developed, changes in topography due to earthworks may lead to alterations in drainage patterns from the site, especially before final form is achieved. This combined with the gradual increase in impervious areas as the construction progresses can result in temporary re-distribution and/or re-routing of the existing drainage flows and subsequent issues at the proposal. Drainage from the site must be accounted for and managed appropriately. An investigation and assessment of drainage in the area during construction has been undertaken in the Erosion and Sediment Management Report in Appendix G of the REF (SEEC, December 2019).

Construction of the new alignment would require the removal of existing pipe culverts. Removal of these culverts could exacerbate any drainage issues both on and off site should a storm event occur prior to the installation of proposed drainage infrastructure.

Existing access tracks in the vicinity of the site, as identified in Figure 3-2, would also be utilised during construction. These tracks would be widened as required by up to 7 metres from the centreline to ensure safe and effective access across the site. The alignments of the tracks would not change, minimising any alteration of drainage patterns and flood behaviour within the catchment. As identified in Figure 3-2, these access tracks cross Hanging Rock Creek and are within close proximity of the upstream flow path lines of Hanging Rock Creek. As such, widening and intensified use of these tracks could impact upon the upper flow paths of Hanging Rock Creek. Review of historical aerial imagery and site inspections indicate that Hanging Rock Creek does not have any permanent water or clearly defined channel within the construction boundary, however, adequate drainage and stability of tracks would need to be ensured in these locations during their use.

The existing tracks, once suitably repaired and widened, are deemed sufficient for contractors to gain access during the construction of the new road alignment and no additional access tracks have been identified within this proposal. Adequate drainage across any access tracks would be required if additional access tracks are proposed at later stages of the design development.

5.2.2 Operational phase
During operation, the key environmental impact as a result of drainage at the site originates from the increase in impervious area from the proposal. Increases in impervious area result in an increase in stormwater runoff frequency, flow rate, flow volume and flow velocity. The proposed road drainage is likely to concentrate stormwater flows to specific discharge locations along the road alignment. Whilst these increases are likely to be insignificant compared to the overall catchment flows, they could have impacts on localised erosion and sedimentation, water quality and flooding. The steep inclines associated with the site also exacerbate the risk of accelerating flows and causing erosion along drainage pathways.

The 20 per cent concept design (including a potential widening of Highway) would result in an approximately 13,800 m² increase of sealed road impervious area. Approximately 7,800 m² of this area would be due to the new roundabout and merge lanes within the Princes Highway, with the remaining increase due to the proposed sealing of Glenella Road. This would result in an overall increase of less than 0.3 per cent of impervious area for their respective catchment areas.

New drainage features have been proposed to replace and upgrade the existing infrastructure to ensure flow connectivity and drainage pattern within the catchment is maintained. The concept design plan in Figure 3-2 shows the indicative transverse drainage pipes proposed across the Glenella Road alignment.
Due to the minimal change in footprint at the site and the minor increases in impervious area, impacts upon drainage at the site are anticipated to be minimal. The proposed upgrades to drainage infrastructure along Glenella Road are appropriate for the site.

### 5.3 Flooding

#### 5.3.1 Construction phase

As discussed in Section 3.3 above, flooding is not anticipated to occur at the site due to the steep topography and location at the top of the catchment system. Should flooding occur at the site during the construction phase, damage to uncompleted works could be considerable with potential risk to the safety of equipment and personnel.

Due to the marginal scale of the works involved during construction, the minimal change in road alignment at the site and the temporary nature of the construction phase, no measurable impacts to flooding downstream of the site are anticipated as a result of this proposal during construction.

#### 5.3.2 Operational phase

Following the completion of works, the temporary ancillary facilities would be decommissioned, resulting in no changes to flood risk outside of the Hanging Rock Creek Catchment. Within the Hanging Rock Creek Catchment, the proposal could have minor localised flooding impacts in the immediate surrounds of the road alignment under extreme weather events. These impacts, which would require consideration during design development, could include accumulation of flows at the head of introduced drainage measures, minor pooling on the road and concentrated discharge at the downstream end of drainage measures.

In the wider Hanging Rock Creek catchment, particularly in the lower reaches of the creek where previous flooding has been reported, no measurable impacts on flooding are anticipated as a result of the operation of the proposal.
6 Management recommendations

6.1 Water quality

6.1.1 Construction phase

Control measures utilising a variety of environmental management practices should be in place throughout all stages of construction to manage, erosion and sediment loading. It is recommended that these measures should include, but are not limited to, water diversion bunds, stabilised access points and sediment basins. Hazardous construction materials and fuels should also be stored in a suitable manner to ensure no accidental release. Environmental management during construction is discussed in detail in the Erosion and Sediment Management Report in Appendix G of the REF (SEEC, December 2019). The report details the anticipated construction phase impacts and associated management measures to mitigate these impacts during construction with detailed plans and descriptions. It is recommended that the measures presented in SEEC report be implemented during the construction phase of this project.

Additionally, it is recommended that a suitable spill response plan be implemented by the contractor appointed to ensure any spills that do occur at the site are contained appropriately at the time of the incident.

6.1.2 Operational phase

As discussed above, the potential for accumulated road pollutants to be washed off by stormwater into the creek and bay must be accounted for in the design. Stormwater quality improvement measures to address the expected pollution loading, as a result of the additional proposed road extent, is recommended in accordance with the Roads and Maritime Procedure for Selecting Treatment Strategies to Control Road Runoff (2003). These measures should be modelled appropriately in an operational stormwater assessment during detailed design and incorporated into the detailed design if deemed necessary.

Steep catchment slopes make many treatments such as basins difficult to implement effectively and safely. Bio-filtration swales would likely be a suitable mitigation measure for this scale of development although the grades of the surrounding land would limit the areas where these could be established. The use of a bio-filtration swale would provide improvements on the current drainage arrangement and would provide capacity for spill containment should any spills occur on the road, whilst reducing impacts and ongoing maintenance requirements in comparison to a water quality basin.

Appropriate scour protection measures should also be incorporated into the detailed design to prevent the erosion and subsequent pollutant loading of watercourses and drainage channels.

6.2 Drainage

6.2.1 Construction phase

Control measures utilising a variety of environmental management practices should be in place throughout all stages of construction to manage drainage from the construction boundary, including all temporary ancillary facilities. It is recommended that these measures include, but are not limited to, water diversion bunds, detention basins, stabilised stormwater channels and erosion protection measures. Stormwater management during construction is discussed in detail in the Erosion and Sediment Management Report in Appendix G of the REF (SEEC, December 2019). The report details the anticipated construction phase impacts and associated management measures with detailed plans and descriptions. Construction of
drainage infrastructure should be staged in a manner to ensure minimal downtime between the removal of existing culverts and the installation of proposed upgraded infrastructure.

Any widening of the existing access tracks and intensification of use should not encroach upon the banks of Hanging Rock Creek and any drainage crossings should be adequately maintained to ensure existing drainage from the site is unchanged. Maintenance should ensure access track drainage is in adequate condition upon cease of use.

6.2.2 Operational phase

As above, suitable scour protection and energy dissipation measures should be incorporated into the detailed design to ensure the longevity of drainage infrastructure and prevent erosion. Drainage design should ensure stormwater into and out of drainage system is flowing efficiently and that systems are designed with adequate capacity, with no ponding or pooling at low points. Continued maintenance of drainage infrastructure would be required to ensure flow paths are kept clear and free of blockages.

Transverse drainage is indicated on the concept design and should be designed to convey required maximum flows with an appropriate design blockage and trafficability on the road as part of the detailed design. An aquaplaning risk assessment during detailed design should be conducted to ensure the road surface flows that occurs in larger storm events are below the limits of aquaplaning.

6.3 Flooding

6.3.1 Construction phase

As identified in Section 3.3 and 5.3.1 above, flooding is not anticipated to occur at the site due to the steep topography and location of the site at the top of the catchment system. Irrespective of this, it is recommended that suitable response plans are in place and implemented by the contractor in the event of extreme weather conditions as well as to maintain regular observation of weather forecasts for the area.

6.3.2 Operational phase

The detailed design of the road should ensure efficient flow of stormwater into and out of the drainage system, with adequate capacity and no ponding or pooling at low points to mitigate any potential stormwater inundation at the site. Drainage design should also consider design blockages in accordance with ARR guidelines or similar to minimise the risk of drainage failure. An aquaplaning risk assessment during detailed design should be conducted to ensure minimum harm in the unlikely event that flooding or ponding occurs on the road surface.
7 Conclusion

The report herein has investigated the potential impacts the proposed South Batemans Bay Link Road project would have on water quality, drainage and flooding on the site, and upon downstream locations. The investigation was based on the 20 per cent concept provided by Transport for NSW. No hydrological, hydraulic or water quality modelling for the construction boundary has previously been undertaken.

The assessment has led to the following conclusions in relation to the existing environment:

- The proposal lies within the Clyde River Catchment and Hanging Rock Creek catchment
- Based on the 20 per cent concept design, and potential widening of the Princes Highway to accommodate merge lanes and median strips, the proposal would drain into the Hanging Rock Creek Catchment and McLeods Creek Catchment
- Based on a review of reports available for other catchments discharging to the bay, it has been inferred that the existing water quality in the Hanging Rock Creek and McLeods Creek can be expected to be high without widespread occurrence of anoxic conditions
- Previous reports for other parts of the Hanging Rock Creek catchment have identified some existing flooding issues in the far lower parts of the catchment, however, highlight the unlikelihood of any flooding occurring in the upper reaches of the catchment where the construction boundary is located; and
- The existing Glenella Road, whose alignment the proposal largely follows, has formal drainage infrastructure which would be substantially improved as part of the proposed works.

The following conclusions and recommendations have been drawn in relation to the proposed works:

- Construction phase impacts on water quality and flooding have been covered by the Erosion and Sediment Management report (SEEC, 2019)
- During operation, the proposal could have potential water quality impacts from deposition of accumulated road surface pollutants such as gross pollutants, hydrocarbons, gross pollutants and nutrients, into Hanging Rock Creek, and subsequently Batemans Bay. Detailed design of the proposal should consider the need for environmental safeguards such as WSUD and scour protection measures to mitigate this risk
- An operational stormwater assessment is developed during detailed design in accordance with the Roads and Maritime Procedure for Selecting Treatment Strategies to Control Road Runoff (2003) to determine the need, appropriate size and location of bio-filtration swales
- The proposal could have an impact upon water quality from spills of hazardous substances from both operational traffic incidents and during construction. Suitable management practices and response plans should be put in place to safely manage these incidents if they occur
- The proposal would have insignificant impacts on overall catchment flows
- Concentration in local flows could result in scour and erosion and could impact on water quality. The incorporation of suitable scour protection measures would mitigate this potential impact
- The proposal is likely to have negligible impacts on flood behavior downstream from the site and is unlikely to be effected by known flooding conditions
- Good design practices are required during design development to ensure no localised pooling or drainage blockages occur
- Regular maintenance would be required to ensure the proposal continues to operate as designed.

Should the recommended management measures be adopted, the potential impacts upon water quality, drainage and flooding as a result of the development would be at acceptable levels. Further investigations during the detailed design and construction phases of the project would be required once more detail is available to ensure impacts remain consistent with this assessment.
8 References


MIEngineers (2018). Stormwater Drainage and Flooding Assessment: Proposed Seniors Living Development 49 Beach Road, Batemans Bay.


Roads and Maritime Services NSW (2019 South Batemans Bay Link Road, The Ridge Road, Geotechnical Factual Report
9 Glossary

AEP – Annual Exceedance Probability
ARI – Average Recurrence Interval
CBD – Central Business District
DPIE - NSW Department of Primary Industries and Environment
EP&A Act - Environmental Planning and Assessment Act 1979
LGA – Local Government Area
REF – Review of Environmental Factors
WM Act - Water Management Act 2000 (NSW)
WSUD – Water Sensitive Urban Design