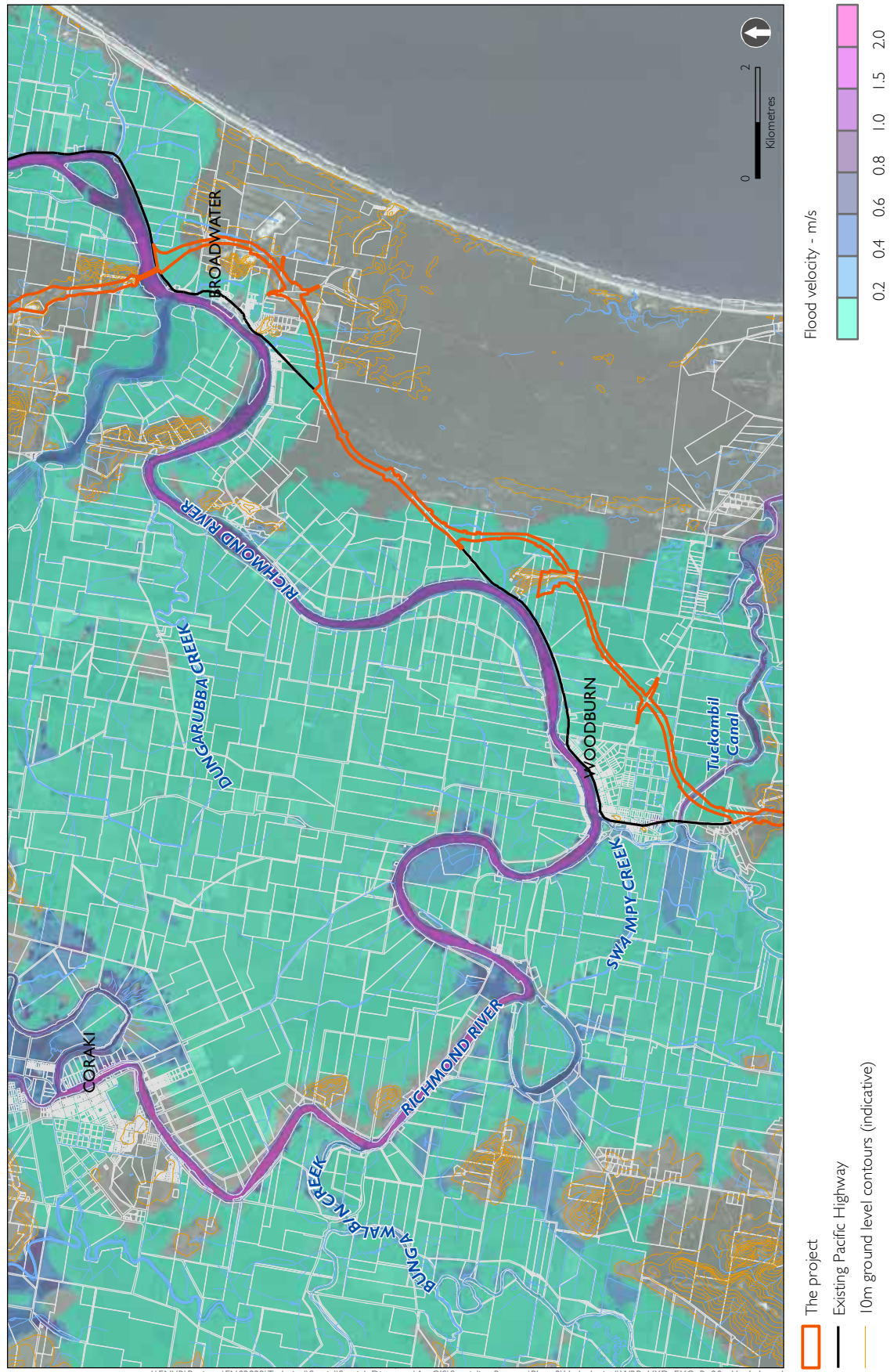


Figure 4-38 Peak 20y ARI flood velocities: Mid Richmond River



I:\ENVR\Projects\EN02829\Technical\Spatial\Spatial\_Directory\ArcGIS\Specialist\_Reports\Phase2\Hydrological\W2B\_HYD\_EXG\_R\_20y\_V\_r1v1.mxd

## 4.15. Lower Richmond River

### 4.15.1. Lower Richmond River catchment description

The Lower Richmond River refers to the most downstream 28 kilometres of the 170 kilometre long Richmond River. Ballina is located on the northern bank of the Richmond River just upstream of the river mouth. Sections 10 and 11 of the project cross through this area.

The lower sections of Chilcotts Creek, Maguires Creek, Duck Creek, Emigrant Creek and North Creek are also included. These catchments run along the north-western edge of the lower Richmond River floodplain and are bounded at their upper reaches by the coastal escarpment.

#### Richmond River

The main features of the Richmond River floodplain within Sections 10 and 11 of the project include:

- The floodplain is naturally constrained just downstream of Broadwater by the Blackwall Range to the north and remnant coastal dunes to the south.
- The coastal dunes form a natural barrier to flow along the shore. Flood flows for the entire catchment can only enter the ocean through the defined Richmond River mouth.
- Sugar cane cultivation is the dominant agricultural industry in the coastal zone, particularly between Ballina and Coraki. Cattle grazing is the major land use in inland areas with forestry on steeper slopes.

#### Emigrant Creek, Duck Creek and other tributaries

Emigrant Creek and its sub-catchments consist of a series of elevated ridges that run along the coastal escarpment at the boundary of the Alstonville Plateau and the Richmond River (North Creek) floodplain. They are dominated by rolling topography and hills with slopes ranging from five per cent to 30 per cent. The majority of the catchment areas have been cleared for agricultural purposes.

Emigrant Creek has a long narrow catchment of southerly orientation. The catchment area to the bridge at Tintenbar is 28 square kilometres. Within this catchment is Emigrant Creek Dam, which has a full supply volume of 819 megalitres and contributes to Ballina's water supply.

Duck Creek is the southern-most tributary of Emigrant Creek. It is located south of Alstonville with the Bruxner Highway generally aligned along its northern boundary. It is a relatively small sub-catchment with a catchment area of 14.2 square kilometres. The creek flows in a general west to east direction before joining Emigrant Creek very close to the junction of the Bruxner and Pacific highways.

Chilcotts Creek is a minor sub-catchment of Emigrant Creek with a catchment area of 8.5 square kilometres. It is located between Duck Creek and Maguires Creek.

Maguires Creek has a catchment area of 48 square kilometres to the bridge at Teven. The catchment includes the town of Alstonville. The only major tributary of Maguires Creek is Houghlahans Creek.

Sandy Flat Creek (formerly Palmers Creek, circa 1970) flows south-west and is a tidally influenced tributary of Emigrant Creek. Its point of confluence is about one kilometre south-east of Tintenbar which is located at the northern end of the project. The existing Pacific Highway crosses Sandy Flat Creek just upstream of the point of confluence with Emigrant Creek.

#### 4.15.2. Flood modelling

The flood model developed for the Ballina Bypass Pacific Highway upgrade project was used for assessing the concept design.

Two event durations have been modelled, the 72 hour and 12 hour events. The 72 hour event has been used for assessing flooding in the Richmond River and the 12 hour event is the critical flood event for local catchment flooding. Further information regarding details of the model development is provided in BMT WBM (2008a).

#### 4.15.3. Base case flooding behaviour

The flooding behaviour of this area has been assessed through hydrological and hydraulic flood modelling. The type of models used in this catchment are summarised in Table 2-4.

The base case for this study is the base case used for the Ballina Bypass project. The base case is a representation of the floodplain as it was in 1998. This allowed this study to consider the cumulative impacts of the Ballina Bypass and the Woolgoolga to Ballina project compared to the 1998 base case.

Peak base case flood levels and depths in the Ballina area for the 100 year ARI events are shown in Figure 4-39 and Figure 4-40. Existing peak velocities are presented in Figure 4-41. These results are discussed below from north to south.

These figures show that flood flow depths vary considerably across the floodplain, with some areas of greater than 1.75 metre peak depth in the 20 year ARI flood.

Some key observations of base case flood behaviour (prior to the construction of the Ballina Bypass) are:

- The existing Pacific Highway is a barrier to flow from the Emigrant Creek catchments in the 100 year ARI event. Flood level differences upstream (west) of the highway are up to 300 millimetres higher than levels on the eastern side
- The highway is generally less of a barrier in the 20 year ARI flood event, particularly where the highway runs east-west from the Bruxner Highway junction to Ballina. However, south of the Bruxner Highway junction where the Pacific Highway runs north-south, it does hold flood levels up to 300 millimetres higher on the western side compared to the eastern

- During large flood events, when the Richmond River is in flood and Emigrant Creek is backwater affected, floodwaters from Emigrant Creek breakout across the Pacific Highway and Sandy Flat to flow into Deadmans Creek, part of the North Creek catchment, to the east. Much of Sandy Flat appears to act as a flood storage area. Levels need to build up to a significant depth to overtop the Sandy Flat Road ridge to the east
- The Sandy Flat basin does not fill sufficiently in a 20 year ARI flood to breakout across the north-south portion of Sandy Flat Road to discharge into the Deadmans Creek catchment. There is some inter-catchment transfer in the 100 year ARI flood
- There are shallower depths downstream than upstream of Gallans Road Reserve between Thursday Plantation and Ballina Heights
- The floodplain between Teven Road and Barlows Road, upstream of the old railway reserve, also exhibits large peak flood depths
- The section of Teven Road from the dual bridges to Wellers Road acts as a levee to breakout flows from Maguires Creek in flood events up to the 20 year ARI flood
- New subdivisions north and south of the existing Pacific Highway at West Ballina are predominantly dry in the 100 year ARI flood whilst the highway itself is overtopped almost along its entire length west of West Ballina and south to Whytes Lane in these larger flood events
- Rural properties on Smith Drive are inundated in a 20 year ARI event
- Flows from Duck Creek break out to the south-east of the intersection between Uralba Road and Uralba Cutting Road. The flow path runs parallel to Duck Creek on the northern side of Uralba Road, reconnecting to Duck Creek immediately upstream from where Duck Creek meets the Bruxner Highway.

### **Flood immunity of the existing highway**

An assessment was undertaken to determine the flood immunity of the existing Pacific Highway within the Richmond River floodplain. The following flood immunities were estimated for this length of the highway:

- From Broadwater to Wardell, the most flood prone area is between Broadwater and the intersection with Boundary Creek Road, where the highway overtops during a 5 year ARI event. Through Broadwater, the highway would overtop during an event with an ARI of slightly less than 20 years.
- From Wardell to the Ballina bypass tie-in, the existing highway would not overtop in a 20 year ARI event.

### Property inundation on the Lower Richmond River floodplain

The township of Ballina and surrounding area is particularly flood prone with many properties experiencing flooding along Maguires Creek, Duck Creek, Emigrant Creek and the Lower Richmond River. Impacts would be experienced in the township of Ballina as well as surrounding areas. Properties identified as being inundated in impacted areas for the 20 and 100 year ARI floods are summarised in Table 4-8.

**Table 4-8 Flooded properties in the impacted parts of Ballina and surrounds**

Flood event	Level of flooding (depth above floor level)	Commercial properties	Fully detached			Multi-unit	
			Single story	High-set	Double storey	Single storey	Double storey
20 year ARI	0.5 m +	2	0	7	1	0	0
	0-0.5 m	50	73	14	26	1	3
100 year ARI	0.5 m +	4	7	22	6	0	0
	0-0.5 m	68	187	39	49	5	14

#### 4.15.4. Geomorphic characteristics

A high level and preliminary geomorphic assessment has been conducted for these waterways based on aerial photography and soil maps.

Although the project does not cross the Richmond River in the Lower Richmond River floodplain area, it does cross several of its tributaries, including Duck Creek and Randles Creek.

#### Duck Creek

Duck Creek is a meandering alluvial medium stream and a major tributary of the Lower Richmond River. The waterway has a vegetated riparian area with a good cover of native trees and shrubs.

The creek has the potential to actively meander, and is unconfined within the floodplain. The land comprises both alluvial floodplain, and forested floodplains. The alluvial floodplain is utilised for productive farming and cropping enterprises.

Duck Creek has well-vegetated banks. To instigate a change in channel form or for considerable erosion to occur in Duck Creek, the following events would need to occur:

- Major flooding of the order 5 year ARI or greater
- Bank slumping due to floodplain saturation

Plate 4-30 shows Duck Creek at the existing Pacific Highway crossing – the same location as the project crossing.



**Plate 4-30 Duck Creek at the project crossing**

### **Randles Creek**

Randles Creek is a minor waterway which becomes Saltwater Creek immediately downstream of the project crossing. The creek is a small tributary of the Richmond River. The adjacent land generally comprises forested valley floors and flats, and alluvial flood plain.

The waterway is well-vegetated with good stands of native trees and shrubs growing along the edges and vicinity, which contributes to river health and the stability of banks.

This stream will likely engage with the floodplain in relatively small flow events.

To instigate a change in channel form or for considerable erosion to occur in Randles Creek, flooding in the order of two year ARI event or greater would need to occur.

Plate 4-31 shows Randles Creek within 250 metres of the project crossing.



**Plate 4-31 Randles Creek looking upstream**

Upgrading the Pacific Highway - Woolgoolga to Ballina Upgrade

Figure 4-39 Peak 20 year ARI flood levels: Lower Richmond River and Ballina

