

5. Construction impact assessment

5.1. Flood impact during construction

The following activities may be potential sources of flood impacts during construction of the project:

- Ancillary facilities
- Soft soil sites
- Interim construction of the road embankment.

About 90 potential ancillary sites are identified either within or adjacent to the project boundary. These sites provide opportunities to locate facilities for construction eg construction compounds, stockpile sites and batch plants. These sites could be in use for a period of around three years. Many sites are located outside of the floodplain or in an area not affected by the flood events assessed as part of this study. These sites would not be expected to cause upstream impacts due to a flood event during construction.

Around 49 sites are situated on floodplains or in an area below the 20 year ARI event. As such, these sites would need to be built up (on embankments) to provide sufficient flood immunity. These sites are discussed in Section 5.2.

In addition, the project would require construction of sections of embankment in advance of the road construction to accelerate the settlement of soft soils. These works are referred to as 'soft soil sites' in the project. The source of fill for the construction of these sections of road embankments would come from nearby sections of cut for the project. Impacts from these sites are discussed in Section 5.3.

Construction of the road embankment will also incur flood impacts along the project in areas that cross watercourses and their associated floodplains. These embankments would not exceed the height of the operational condition (apart from soft soil sites, as discussed). As a result, impacts from the interim road embankment during the construction phase would be considered less than or equal to those impacts addressed in Chapter 6 and are not addressed in detail here.

5.2. Flood impacts of ancillary facilities

A preliminary assessment of the potential for flood impacts resulting from all ancillary sites is presented in Appendix E.

Almost half (41) of the ancillary facility sites are currently located outside the floodplain and therefore would not be impacted by flooding. Around 15 sites are located, or partially located, in areas of low velocity backwater. These sites are expected to incur a minor loss of flood storage and have minor or negligible impacts on flooding within that particular catchment. Around 10 sites are co-located along the project inside the floodplain in areas that experience low velocity flows and conveyance. As these sites are situated a sufficient distance from culverts and bridge structures, they are likely to incur impacts which are consistent with the project operational impacts.

Around 24 sites are currently located in areas, which may incur moderate or significant flood impacts. These sites have been presented in Table 5-1. Measures proposed to mitigate potential flood impacts for these ancillary facilities are identified in Table 8-8.

Table 5-1 Predicted impacts of ancillary facilities

Section No.	Site No.	Predicted Impact
3	2	Site completely blocks waterway of a small catchment. Would cause substantial flood impacts without sufficient drainage through site.
3	5	Site immediately adjacent to main channel of the small unnamed creek near Mitchell Road, and currently partially blocking a future bridge, and therefore a main flow path. Site likely to experience flooding, particularly during large events.
4	2	Site located on Shark Creek floodplain. Would incur limited impact to regional flooding but considerable impact to drainage as the site is currently blocking cane drains. Would incur some loss of flood storage.
4	6	Site immediately adjacent to Clarence River South Arm channel. In an area of potentially high flood conveyance and likely to incur flood impacts during 20 year ARI flood event.
4	7a	Site is in area of relatively low velocity backwater flooding. However, due to proximity to low point in Shark Creek embankment, experiences higher conveyance and drainage of the Shark Creek catchment during flooding than surrounding areas and therefore may incur some impacts to drainage and duration of inundation of the Shark Creek catchment during large floods.
4	7b	Site is in area of relatively low velocity backwater flooding. However, due to proximity to low point in Shark Creek embankment, experiences higher conveyance and drainage of the Shark Creek catchment during flooding than surrounding areas and therefore may incur some impacts to drainage and duration of inundation of the Shark Creek catchment during large floods.
5	2a	Site is adjacent to the southern bank of the main Clarence River channel in an area of high conveyance and moderate flow velocities during 20 year ARI floods and larger. May incur some flood impacts during large events.
5	2b	Site would be blocking the southern end of the Clarence River bridge upgrade adjacent to the main channel. It is in an area of high conveyance and moderate flow velocities during 20 year ARI floods and larger. Likely to incur considerable flood impacts if a large flood event was to occur during construction.
5	2d	Site is adjacent to the southern bank of the main Clarence River channel in an area of high conveyance and moderate flow velocities during 20 year ARI floods and larger. Site would be blocking southern end of future Clarence River Bridge upgrade. Likely to incur considerable flood impacts during large events.
5	3a	Site is adjacent to the northern bank of the main Clarence River channel in an area of high conveyance and moderate flow velocities during 20 year ARI floods and

Section No.	Site No.	Predicted Impact
		larger. Site would be partially buffered by the existing highway, but would be obstructing the northern end of the current and Clarence River Bridge upgrade. Likely to incur substantial flood impacts during large events.
5	4a	Site completely obstructs 16-cell culvert on Chatsworth Island (corresponding culverts for Section 5 – Site 4b). Likely to incur moderate flood impacts during large events in comparison to project operational impacts.
5	4b	Site completely obstructs 16-cell culvert on Chatsworth Island (corresponding culverts for Section 5 – Site 4a). Likely to incur moderate flood impacts during large events in comparison to project operational impacts.
5	3b	Site would incur total obstruction of bridge at station 87.3, immediately north of the Clarence River Bridge. Would experience unacceptable and substantial upstream impacts during large events.
5	5c	Site located is small however incurs total obstruction of a small bridge on Chatsworth Island and would incur significant upstream impacts during large flood events.
5	6	Site located on breakout channel during large floods in Mororo Creek catchment. Would incur substantial impacts to caneland to the north of the site.
6	3a	Outer regions of site located in Tabbimoble Creek floodplain with complete obstruction of culverts across the project. Would incur substantial flood impact without mitigation.
6	3b	Site partially located in Tabbimoble Creek floodplain with total obstruction of existing bridge. Would incur substantial flood impacts upstream.
8	1	Located in Lower Richmond river floodplain. Would incur some loss of flood storage and minor obstruction to Tuckombil Canal floodplain flow.
8	2a	Site located in Lower Richmond floodplain. Location would incur blockage of culverts across the project. Would incur substantial upstream flood impacts.
8	2b	Site located in Lower Richmond floodplain. Location would incur blockage of culverts across the project. Would incur substantial upstream flood impacts.
8	2c	Site located in Lower Richmond floodplain. Location would incur partial blockage of culverts across the project.
9	1	Site located in Lower Richmond floodplain. Site would incur some removal of flood storage and minor flood impacts.
10	1a	This site is currently located on the floodplain immediately adjacent to the Richmond River channel. The site is blocking the southern underpass of the Richmond River Bridge, causing a major obstruction to flows during 20 and 50 year ARI floods.
11	2	This site is currently located in front of a major drainage section of the highway, consisting of several large multicell culverts. The location is considered unable to accommodate a construction site without unacceptable impacts to flooding.

5.3. Flood impacts of soft soil sites

5.3.1. Proposed soft soil sites on floodplains

Table 5-2 details the location of soft soil fill locations.

Table 5-2 Summary of soft soil treatment sites

Section number	Site number	Approximate location	Approximate length (m)	Approximate height (m)
4	SS-01	South of Shark Creek	1870	5 – 6
4	SS-02	North of McIntyres Lane Bridge	490	5 – 15
4	SS-03	North and south of Edwards Creek	2470	4 – 9
5	SS-04	South of Hardwood Bridge	1325	3 – 4
5	SS-05	North of Hardwood Bridge	650	4 – 6
5	SS-06	South of Serpentine Creek	475	3 – 4
5	SS-07	South of Carols Lane overpass	800	3
8	SS-08	North and south of Tuckombil Canal	830	4 – 6
11	SS-09	North of Whytes Lane and south of Duck Creek	4200	1 – 3

The fill locations for the soft soil areas are shown with the prefix of SS on the label. The fill locations are confined to the Clarence River and Richmond River floodplains. This section documents the predicted impacts on flooding behaviour of the soft soil fill locations (SS-01 to SS-09).

The fill embankments may be above the 100 year ARI flood level for a temporary period, depending on the technique used to accelerate settlement. Following adequate settlement of the soft soils, excess fill would be removed to reduce the embankment to final design level prior to construction of the roadway. Hence, it has been assumed in these flood impact assessments that the fill sites would be filled above the 100 year ARI flood levels.

While these fill sites would form part of the final project, there is potential for higher flood impacts than that associated with the final project due to the temporarily higher embankment levels. The fill embankments do not cross major rivers. They would not include any major cross-drainage culverts, however, flow through local waterway and agricultural drains would be maintained through temporary culverts.

5.3.2. Existing flooding and hydrology of soft soil sites

SS-01 is located on the Clarence River floodplain and more specifically on the Shark Creek basin part of that floodplain (south of Shark Creek). The area is subject to inundation in Clarence River flood events, Shark Creek flood events and local runoff. The first two types of flooding mentioned can result in very deep, slow moving flows. The local runoff from the cane lands is generally shallow faster flow.

The area around SS-01 generally drains in a south-easterly direction towards the main cane drain north of Byrons Lane. This drain then flows westerly towards the Clarence River South Arm to drain the low parts of the floodplain. The drain has flood gates installed near the entrance to the river to prevent back-flow from high tides or flood flows.

SS-02 is also located on the Clarence River floodplain in a small catchment with an area of just over one square kilometre. The flatter parts of this catchment are drained by a small cane drain (approximately 1.2 kilometres in length) that drains to the Clarence River South Arm.

SS-03 is also located on the Clarence River floodplain on an area known as the Chaselings Basin. This area is subject to inundation in Clarence River flood events and local runoff. The Clarence River flood events result in very deep, slow moving flows. The local runoff from the cane lands is generally shallow faster flow.

The whole Chaselings Basin drains generally eastward towards a network of cane drains. These ultimately all drain into Edwards Creek which is a highly modified creek / cane drain. Edwards Creek then flows westerly towards the Clarence River South Arm to drain the low parts of the Chaselings Basin. The drain has flood gates installed near the entrance to the river to prevent back-flow from high tides or flood flows.

SS-04 is located on the Clarence River floodplain just south of the main arm of the river near the current Yamba Road interchange. This area includes James Creek which conveys tidal flows to and from the river on the eastern side of SS-04. The western side of SS-04 is a freshwater system with the existing highway forming a barrier between the estuarine areas to the east.

SS-05, SS-06 and SS-07 are all located on the Clarence River floodplain and more specifically, the Chatsworth and Harwood islands area. These areas have a number of cane drains crossing the existing highway route which is in close proximity to the embankments.

SS-08 is located on the Richmond River floodplain on either side of the Tuckombil Canal. The canal provides an important conveyance path for floodwaters from the Richmond River floodplain towards the Evans River and ultimately the ocean at Evans Head. The canal has a levee constructed on either side and floodplain flows on the land immediately north and south of the levee are not significant.

SS-09 is located on the Richmond River floodplain south of Ballina. The area is a cane farming area with a network of cane drains conveying local runoff to the river and Duck Creek.

5.3.3. Flood management objectives

Land use near the soft soil fill locations is predominantly open flood plain and cane farm land, with some other rural and agricultural areas. There are a few houses that are within the 100 year ARI flood extent.

As discussed, the soft soil sites have the potential to be temporarily higher than the project embankments during construction. As a result, the flood impacts of the soft soil sites were assessed against the flood management objectives of the project in consideration of their temporary nature. The flood management objectives relevant to this catchment are:

- Less than 50 millimetres increase in flood heights at houses for any assessed flood event less than and equal to 100 year ARI event
- Less than 50 millimetres increase in flood heights on cane farm land for any assessed flood event less than and equal to 100 year ARI event

- No more than five per cent increase in the flood duration on cane farm land and ten per cent increase in flood duration for other rural areas.
- Velocities to remain below one metre per second where currently below this figure based on erosion on bare soils. An increase of not more than 20 per cent where existing velocity is above one metre per second.
- Velocity-depth products for houses, commercial premises and urban areas remain in low hazard category (for children)
- No change to the direction of watercourses or the direction of flood flows except for constriction into and expansion out of discrete openings (culverts and bridges).

These objectives are detailed in Section 2.1.

5.3.4. Clarence River flood impacts

Design

The soft soil sites on the Clarence River floodplain would be in two general locations:

- Shark Creek to Maclean interchange (sites SS-01, SS-02 and SS-03)
- Just south of the Clarence River and Chatsworth and Harwood Islands (sites SS-04, SS-05, SS-06 and SS-07).

The predicted impacts on flooding behaviour due to the construction of these embankments were assessed using the same hydraulic flood model used in assessment of the project, as detailed in Section 2.2.5.

The soft soil sites on the Shark Creek floodplain and Chaselings Basin area cross a number of major cane drains that drain toward Clarence River South Arm, including the main drain to the river (Edwards Creek).

It is important that these drains remain operational throughout the duration of construction. The project would include temporary drainage culverts that would convey local runoff towards the flood-gated culverts and the Clarence River South Arm. These temporary drainage culverts would be sized during detailed construction. However, for the purposes of the flood impact assessment for Clarence River flood events, it was conservatively assumed that these temporary drainage crossings would not convey floodwaters.

One of the most important flood elements on the Chaselings Basin area is the Goodwood Street underpass. In times of Clarence River flood events, floodwaters break the river banks near Ferry Park and cross Cameron Street. Floodwaters then pass under the existing Pacific Highway via the Goodwood Street underpass and fill the large Chaselings Basin area. In the early stages of a Clarence River flood, this is the first (and for some time only) flowpath into the Chaselings Basin area. During construction, an equivalent gap (eg culverts or an underpass) would need to be maintained over the flood season (from December to July) to preserve the existing flood regime.

Within the Chatsworth and Harwood islands area, the embankments would result in partial blockage of the floodplain. However, this blockage would only represent 33 per cent of the flow width across the Chatsworth and Harwood Islands floodplain. As discussed in Section 6.11.3, the Chatsworth and Harwood islands floodplain conveys only six per cent of the total flow in the river system. The large majority of flow (over 90 per cent) is conveyed by the main arm and North Arm of the river.

A gap of 180 metres would be included in embankment SS-07 on Chatsworth Island to allow a flow path through the embankment to reduce the impact it would otherwise have on the surrounding flood levels.

Flood level impacts

The impacts associated with proposed construction embankments (with a gap for Goodwood Street and on the Chatsworth Island floodplain) are presented in Figure 5-1 to Figure 5-6. These figures show that the predicted impacts of the embankments on the Clarence River floodplain would meet the stated impact objectives for this area, even without culverts across local drainage waterways. The impacts actually experienced with the culverts in place would be less than those shown here.

Flood inundation duration impacts

Flow into the Chaselings Basin would be similar to the existing case up to the time when the river bank is overtopped. This would result in a faster rate of floodwater rise on the western side of SS-03. Despite the change to the rate of floodwater rise, the increase in inundation is less than five per cent. This complies with the flood management objective for cane requiring less than five per cent increases to the time of inundation.

Flood velocity and direction impacts

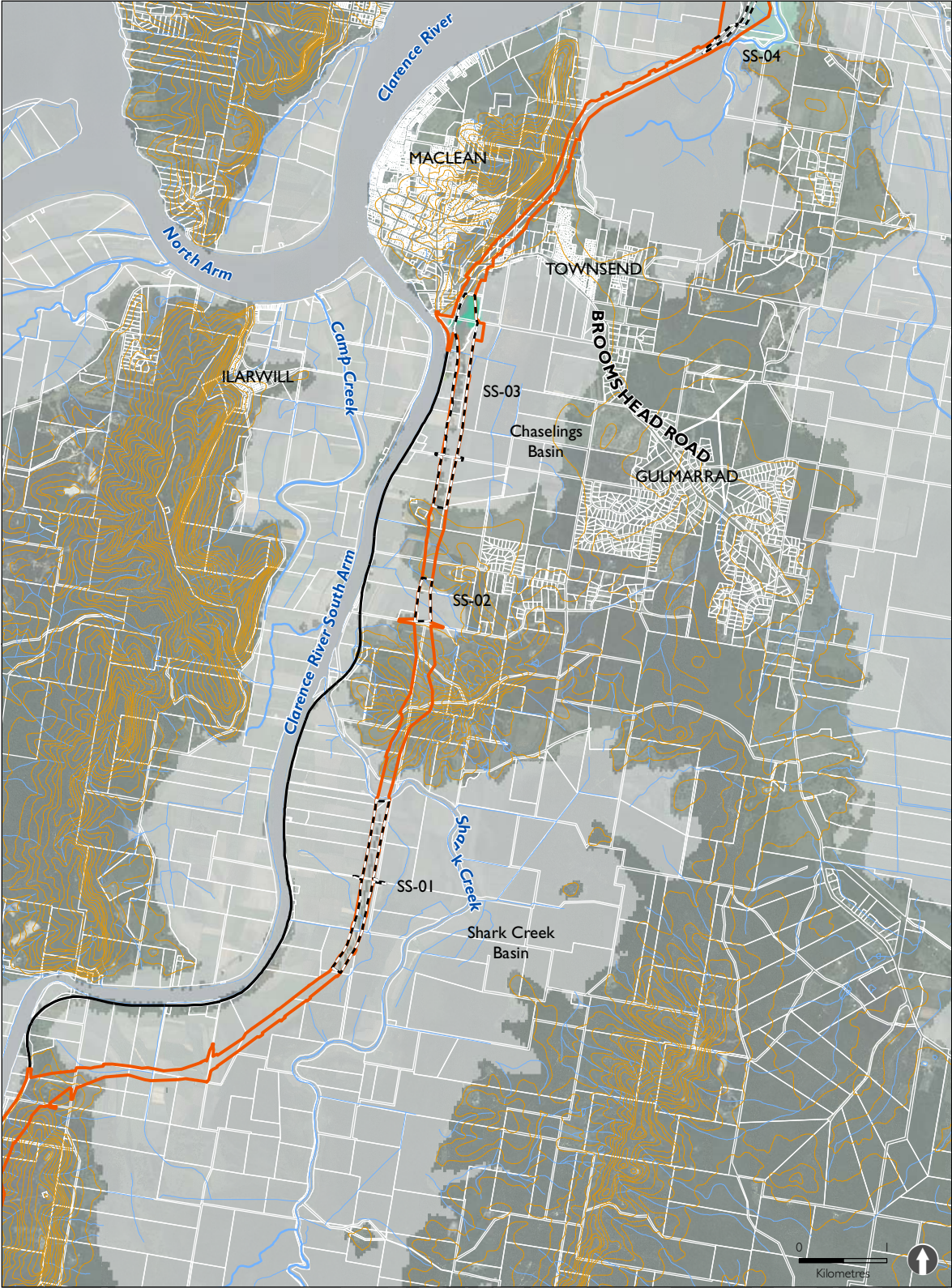
The embankments would result in minor changes to the flooding patterns and rates of floodwater rise and fall on the Clarence River floodplain.

Once the river bank is overtopped, flow from the back-flooding of the Shark Creek basin would pass south along the SS-01 embankment prior to flowing into the broader Shark Creek basin. However, flooding velocities would be low due to the presence of sugar cane on the floodplain and the relatively slow rate of floodwater rise.

General flooding patterns and flow distribution on Chatsworth and Harwood Islands would experience minor changes as Clarence River floodplain flows would pass around sites SS-04, SS-05, SS-06 and SS-07. Rates of floodwater rise and fall would not be significantly affected.

Upgrading the Pacific Highway - Woolgoolga to Ballina Upgrade

Figure 5-1 Soft soil site flood impacts 20 year ARI event: Clarence River at Shark Creek / Maclean



- The project
- Existing Pacific Highway
- 10m ground level contours (indicative)
- Soft soil site

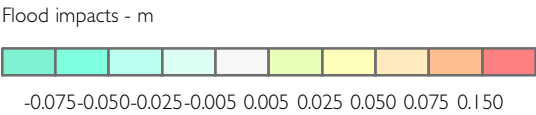


Figure 5-2 Soft soil site flood impacts 50 year ARI event: Clarence River at Shark Creek / Maclean

