8 BEERWAH TO CALOUNDRA

8.1 Introduction

This Chapter considers the environmental and social effects of the proposed scheme between the North Coast Rail line north of Beerwah rail station to Caloundra Road east of Caloundra Aerodrome. This section of the route is approximately 19km in length and would traverse for the most part State and privately owned (pine forest) land. West of Pelican Waters where the alignment passes through regionally significant wetland areas it would be constructed (for 2.2km) on viaduct. Two stations are proposed in this section, one at Pelican Waters and the other east of the Aerodrome south of Caloundra Road. The Caloundra Road station is proposed to cater for commuters and would incorporate adequate parking facilities.

Significance criteria have been applied to subject areas within these Chapters and used to describe the assessment of effects. For details relating to the derivation of these criteria the reader is referred to Part A, section 4.6.

8.2 Land Use Planning

From Beerwah east, the corridor is contained within land zoned Special Uses for state forest purposes, which the forward planning for the area intends would remain. This provides a low intensity land use planning context on which the CAMCOS route would not have substantive impacts.

As the corridor departs from the existing north coast line immediately north of the station in Beerwah, it provides significant opportunities to build transit supportive development on the traditional railway town of Beerwah township. This would provide significant opportunities to intensify this township character in Beerwah.

From the Bruce Highway east to Bells Creek, the corridor is within land contained in the Rural zone, and avoids the Environment Protection zoned land associated with the south branch of Bells Creek.

The private forestry land in this location is in the ownership of the Caloundra Downs Joint Venture (CDJV). This is a 3,200 hectare parcel of land from which the pines will be harvested in 2003. CDJV is currently undertaking an “informal land use investigation” into this property for a “range of land uses meeting a range of public and commercial objectives”. A more intensive use of this site would contravene Caloundra City Council’s strategic planning intentions for the land (which are for rural and state forest purposes), and have subregional and regional implications. For these reasons, this informal investigation process is intended to consult with all relevant parties to investigate potential land uses in the area.

The future development prospects for this land are outside the CAMCOS investigation process. However, should any further urban development occur within the Caloundra Downs landholding, there is a significant opportunity for the planning of this area to be based on transit supportive development principles around an additional potential station location within that landholding.

Further east, the corridor is contained within areas designated for open space in Council planning, and it is inevitable that route selection would impact on locations with high environmental values in this area (see remaining sections in this Chapter for more details).

The route is located west of current developments at Pelican Waters and within their landholding. It follows the alignment of the proposed Bells Creek Arterial, which is designated in the Development Control Plan for Pelican Waters. Further significant urban residential development is planned at Pelican Waters. This provides opportunities for the planning of that area to be reoriented towards the future station location.

Near Caloundra Road the corridor is located immediately to the east of the Caloundra Aerodrome landholding, crosses Rotary Park and is to the west of a former Caloundra City landfill site.

The proposed station south of Caloundra Road is the most central to existing commercial, industrial and residential development in the Caloundra area. It represents a strategic node for which future development opportunities exist, depending on the future of the aerodrome and the potential to upgrade existing land zoned and utilised for the landfill and recreational activities.

Overall, this section of the proposed corridor does not cause significant detrimental impacts on the current land use and planning for the area. It does however offer significant potential for future transit supportive development planning in key locations at Beerwah, Pelican Waters and Caloundra.

8.3 Local Transport Issues

8.3.1 Beerwah

Traffic patterns in and around Beerwah have varied significantly over the last couple of decades. This variation has resulted initially from strong traffic growth along Glass House Mountains Road, which until the mid 1980’s, was a part of the Bruce Highway and National Route 1. During the early 1980’s, travel along this section of the old Highway was characterised by long delays and numerous accidents and breakdowns.
on long weekends and during holiday periods. This section of road returned to a relatively lightly trafficked scenic alternative with the opening and then duplication of the new Bruce Highway through the pine plantations, several kilometres to the east.

Even today, Beerwah is somewhat sheltered from the much higher growth occurring along the coastal strip, but it has been identified by Caloundra City Council as the key District Centre on the north coast line. This designation along with the development changes that will follow as a result of implementing the CAMCOS corridor, will increase traffic flows generally in and around the town. In addition, its location as the junction between the proposed CAMCOS corridor and the north coast line will increasingly see more traffic focussed on this location.

A commuter car park catering for park and ride users from the surrounding areas already exists at Beerwah. However, it is expected that when the CAMCOS corridor is constructed, a large number of services will stop at Beerwah as it will then be at the confluence of two rail lines. Therefore, it is anticipated that the town centre and the commuter car park will see far greater usage, as users of the facility will be attracted from the surrounding areas, including Landsborough and Nambour.

Cyclist and pedestrian routes will be largely unaffected by the proposed public transport alignment. Any future upgrade works at Beerwah station should make greater allowances for these travellers through the provision of safe storage facilities for bicycles. Walkways and a supportive network of bikeways should be encouraged around the town centre to ensure that these modes provide access to the facility for the greater community.

The transport network around Beerwah can be expected to remain largely unaffected by the eventual construction works for the new corridor. This is because most of the new alignment traverses uninhabited areas. There will however, be some local delays in the vicinity of the crossing of Glass House Mountains Road for haulage and construction traffic and during the necessary diversion works for the new overpass crossing. These delays are likely to be localised and manageable if normal DMR construction practices are observed.

8.3.2 Pelican Waters

Pelican Waters and Golden Beach are prime residential and tourist accommodation locations at the southern end of the Sunshine Coast. It is anticipated that the Pelican Waters station (see Figure 8.3.2) will be used by local residents and tourists travelling to other attractions along the Sunshine Coast, and for commuters travelling to Brisbane. Therefore, some local traffic around the station will be a result of local feeder buses and taxis servicing the area, plus some private vehicles using the kiss and ride facility. It is expected that with proper planning, much of the demand to/from the station will be serviced by walk-in and cycle-in users. Use of this station will also be influenced by the location of the proposed eco-tourism development to the west of the transport corridor. Such a development could be well served by the public transport station and a grade separated pedestrian and cyclist crossing associated with the station complex.

Local traffic in and around Pelican Waters is also set to experience significant change in the coming years as the major elements of the estate are completed. These would include the golf course and resort facilities, the retail centre and the balance of the residential housing. The future of the proposed Bells Creek arterial is yet to be finally resolved but recent planning by the consultants, based upon alternative access arrangements being put forward by Pelican Waters, has resulted in alternatives that could negate the future need to construct this road through the wetlands. However, it is understood from DMR that the need for this road will be determined by the Caloundra Downs Informal Land Use Investigation. Local traffic planning still has some way to go in this area but there are a number of opportunities to satisfactorily address both the local and regional arterial needs.

8.3.3 Caloundra Station

This site on the old refuse dump is well located to capitalise on the future relocation of the Aerodrome. Options for the Aerodrome site are broad ranging in terms of type and scale and will need to be carefully considered by Caloundra City Council and included in Council’s Planning Scheme. The site comprises some 130 hectares of prime developable land and therefore has the potential to impact on, and compete with, the traditional town centre in and around Bulcock Street.

The Caloundra station (see Figure 8.3.2) is planned to be one of the three major stations along the CAMCOS corridor that will have a park and ride facility. Caloundra is recognised as a major employment attractor for the Sunshine Coast, as well as an origin and destination for commuters using the CAMCOS corridor. The Australian Bureau of Statistics Journey to Work survey revealed that in 1991, 5% of Sunshine Coast residents were destined for the Brisbane Statistical Division (greater Brisbane including Caboolture) for work purposes. Therefore, this station is expected to attract a large number of long distance commuters.

As Maroochydore is designated as the key regional centre, there will also be significant demand at Caloundra station for journeys to and from Maroochydore. Demand forecasts undertaken with the CAMCOS transport model, estimates that approximately one third of the demand on the service will be long distance trips to and from Caboolture and
Brisbane, while two thirds will be internal suburban commuter trips. Further, visitor travel within the Sunshine Coast region is approximately 10-15% of total travel. Whilst some of this demand will be captive to visitors travelling by car, there is still significant potential to capture some of this travel market.

An assessment of the line demand at Caloundra indicates that approximately 21% of users are destined for Maroochydore, 13% for Kawana, 5% for Nambour, 6% for Beerwah/Landsborough, 7% for Parrearra and 10% for southern destinations including Brisbane. All other destinations make up the remainder.

It is important that proper planning measures ensure that appropriate transit oriented development, walk links and cyclist / pedestrian facilities associated with this station site are incorporated. Council’s bikeway strategy should be modified and enhanced to implement a network of bike paths that provide links to the station. Appropriate walkways should also link the town centre and surrounding residential areas with the station to minimise car access to the station.

Included within this development should also be the provision of a well planned bus interchange to cater for the large number of local bus services that will be required to bring passengers to and from the station from the surrounding area. The layout sketches included in the Transport/Land Use Strategy illustrate an indicative solution.

### 8.4 Residential, Business & Community Issues

#### 8.4.1 Future Without Scheme

Beerwah will experience residential growth in the future as outlined in the Caloundra City Strategic Plan. This may in turn produce a need for additional community facilities to be located within the town.

The Pelican Waters development will continue to grow as outlined in the Pelican Waters Master Plan and the Development Control Plan for the area. This will include further residential development, a Golf Course, resort, a school and marina.

The proposed Bells Creek Arterial may be constructed to alleviate congestion on the existing north south routes through Golden Beach, altering the access patterns not only in Golden Beach and Pelican Waters, but traffic from the entire Sunshine Coast. As Pelican Waters grows it is recognised that additional access routes would be required as vehicular traffic increases. It is also recognised that there would be an increase in demand for community resources with the increase in population in this area.

The Caloundra City Council is currently undertaking a feasibility study for the use of surplus aerodrome land, and is currently allowing new leases to occur and renewing current leases, but none of the leases are to extend beyond the year 2014.

### 8.4.2 Effects of the Scheme

This section focuses on the direct and indirect impacts on property, community facilities, access etc. The effects on residential amenity (including noise and visual implications) have been assessed elsewhere in this chapter and are not repeated here.

This section should be read in conjunction with Table 8.4.2, which provides details of all affected properties and the proportion of those properties likely to be affected by the scheme. Figures 5.5.1a & b provide the reader with the location of those affected properties.

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Category</th>
<th>Description</th>
<th>Total Area (ha)</th>
<th>% Affected</th>
<th>Affected by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G</td>
<td>Industry</td>
<td>State Forest</td>
<td>914</td>
<td>4.2%</td>
<td>Corridor</td>
</tr>
<tr>
<td>2</td>
<td>G</td>
<td>Reserve (conservation or open space)</td>
<td>Crown Land</td>
<td>20.7</td>
<td>2.2%</td>
<td>Corridor</td>
</tr>
<tr>
<td>3</td>
<td>G</td>
<td>Industry</td>
<td>State Forest</td>
<td>508</td>
<td>1.3%</td>
<td>Corridor</td>
</tr>
<tr>
<td>4</td>
<td>G</td>
<td>Industry</td>
<td>State Forest</td>
<td>1356</td>
<td>1.7%</td>
<td>Corridor</td>
</tr>
<tr>
<td>5</td>
<td>C</td>
<td>No existing buildings or structures, land take only</td>
<td>Caloundra Downs</td>
<td>1334</td>
<td>1.5%</td>
<td>Corridor</td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>No existing buildings or structures, land take only</td>
<td>Caloundra Downs</td>
<td>962.4</td>
<td>0.3%</td>
<td>Corridor</td>
</tr>
<tr>
<td>7</td>
<td>C</td>
<td>No existing buildings or structures, land take only</td>
<td>Pelican Waters</td>
<td>153.3</td>
<td>1.9%</td>
<td>Corridor</td>
</tr>
<tr>
<td>8</td>
<td>C</td>
<td>No existing buildings or structures, land take only</td>
<td>Pelican Waters</td>
<td>77.2</td>
<td>9.1%</td>
<td>Corridor and Station</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>Reserve (Conservation or open space)</td>
<td>Portion 480</td>
<td>227.6</td>
<td>1.1%</td>
<td>Corridor</td>
</tr>
<tr>
<td>10</td>
<td>G</td>
<td>Reserve (uncommitted, drainage or buffer)</td>
<td>Former Land Fill Site</td>
<td>11</td>
<td>5.7%</td>
<td>Corridor</td>
</tr>
<tr>
<td>11</td>
<td>G</td>
<td>Reserve (uncommitted, drainage or buffer)</td>
<td>Former Land Fill Site</td>
<td>8</td>
<td>54.3%</td>
<td>Corridor</td>
</tr>
</tbody>
</table>
Table 8.4.2: Property Effects – Beerwah to Caloundra Road

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Category</th>
<th>Description</th>
<th>Total Area (ha)</th>
<th>% Affected</th>
<th>Affected by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G</td>
<td>Reserve (conservation or open</td>
<td>Rotary Park</td>
<td>4.7</td>
<td>9.3%</td>
<td>Corridor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>space)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of properties affected = 12  
Total number of individual land owners affected = 5

Key: G = Government  C = Commercial  P = Private

8.4.2.1 Community Facilities and Severance

With respect to community facilities, none would be directly affected by the route within the Beerwah area.

At the Caloundra Road end of this section, the western portion of Rotary Park would be directly affected.

In terms of severance effects, the Glasshouse Mountains Road would be temporarily affected during construction, affecting access north to Landsborough, and access from Fraser Road south. Access to Beerwah High School from the recognised catchment areas of Caloundra and Buderim may benefit from the scheme (once operational), with a more direct rail link from these areas to Beerwah.

No severance issues have been identified in the Pelican Waters/Golden Beach area, as the corridor alignment is located on the western side of existing development, and would be on the western edge of all future development.

8.4.2.2 Private Residential and Commercial Properties

No residential or rural residential properties would be directly affected by the scheme in this section of the route.

Four commercially owned properties would be affected including 2 lots belonging to Pelican Waters, upon which future developments are proposed, and 2 large lots owned by Caloundra Downs, which are currently used for private plantation forest (see section 8.13). No existing commercial buildings would be affected by the scheme in this section of the corridor.

8.4.2.3 Government Owned or Leased Properties

Nine government owned lots would be affected by the scheme through this section. This number includes 3 properties within the State forest, 2 local government reserves (the former landfill site) and 2 parcels of Crown land (including Portion 480, a proposed National Park). As stated in Chapter 7, Lot 480 is unallocated land that may have Native Title implications.

8.4.3 Mitigation

8.4.3.1 Introduction

Many of the impacts associated with acquiring land for the corridor would be deemed to have been satisfactorily mitigated through the provision of compensation.

Requests to acquire designated land under hardship can be made under the Integrated Planning Act 1997 once the Minister for Transport Designates the corridor.

8.4.3.2 Community Facilities and Severance

The mitigation of effects on Rotary Park would involve the reinstatement of existing park facilities either at the same location or another location agreed with Council. This would include reinstatement of recreational facilities, including playground equipment, amenities, bikeways, and educational facilities.

Glass House Mountains Road at Beerwah would need to be realigned and regraded over the railway during construction. This would involve temporary sidetracking, maintaining traffic flow, but at a slower speed during the construction phase.

No severance issues require mitigation in the Pelican Waters / Golden Beach area. The newly constructed bike paths within Rotary Park would need to be reinstated after construction of the Station.

8.4.3.3 Privately Owned Residential and Commercial Properties

No privately owned residential properties are affected.

It is intended that the CAMCOS Scheme including the station would be incorporated into the future subdivision and development plans for Pelican Waters.

The future of the Caloundra Downs property is currently uncertain. It is assumed from preliminary discussions with Caloundra Downs that any future development proposals in this site would incorporate the CAMCOS proposals. Compensation issues would be dealt with following the outcome of the Informal Land Use Study.
8.4.3.4 Government Owned or Leased Properties

The mitigation of impacts on the State Forest is covered in section 8.13.

The loss of small sections of portion 480 would be mitigated through the implementation of the compensatory habitat policy, as discussed in section 8.6.3 and through negotiations with QT and the EPA.

8.4.4 Assessment

In accordance with the definition of significance criteria provided in section 4.6 the effects on Rotary Park are considered to be minor adverse.

The effect of severance at Beerwah would be a temporary one during construction and is considered not significant.

Given that appropriate levels of compensation are provided and the mitigation measures outlined in section 8.4.3 are implemented, the effect on commercially owned properties in this section of the route is considered to be minor adverse.

The significance of impacts on the State Forest have been dealt with in section 8.13 and the impacts on Portion 480 in section 8.6.

8.5 Groundwater

8.5.1 Introduction

The following section outlines the impacts of the proposed alignment in the Bells and Lamerough Creek wetland areas on groundwater.

8.5.2 Water Balance

The pre-development water balance surrounding the transportation corridor has already been greatly impacted by the establishment of pine forest, excavation of drains and the canal and lake developments of Golden Beach and Pelican Waters. However, within the undisturbed wetlands area, the water balance has not significantly changed, being somewhat isolated from surrounding impacts. The isolation is due to the flat nature of the topography, preventing significant runoff and the dominance of rainfall and evapotranspiration over minor groundwater flow.

The proposed rail alignment is likely to modify the groundwater balance through the clearing of vegetation along the route. This would have the effect of decreasing evapotranspiration tending to maintain a groundwater level close to, or above the surface.

8.5.3 Interruption to Flow

Horizontal groundwater flow is considered to be minor due to the flat topographic surface and consequential lack of groundwater gradients. Therefore, the construction of a railway embankment is likely to have a negligible impact on groundwater flow, even though some compaction of soft sub-surface layers may occur.

8.5.4 Surface Water Interaction

Groundwater levels in the vicinity of Portion 480 are close to or at the surface. Any modifications to the limited surface water drainage would have an impact on the groundwater. Where significant ponding of water occurs, there is likely to be a higher groundwater level through a longer period of the year. Conversely, where drainage works are constructed, groundwater levels may be lower than currently experienced.

8.5.5 Contamination

The most serious threat to groundwater quality is through the interaction of groundwater and surface water where potential acid sulphate conditions are present. It is unlikely that drainage works associated with a railway embankment would lead to acid water generation, as drainage will mainly affect surface water flow. Of a much greater threat is the excavation of canals and lakes associated with adjacent residential and other developments. Formation of acid conditions in these bodies of water from groundwater released from acid sulphate soils may occur. This could then interact with the groundwater along the margins of Portion 480 through interchange of water.

A potential for groundwater contamination would always be present from the rail operation. This would include spillage of lubricants from construction equipment, trains and service equipment, as well as leakage from sewerage and waste water at the railway stations. In the event of a railway accident, larger spillages of lubricants could occur. It is understood that the railway would only operate passenger trains and therefore there would be no risk of more serious contamination from spillages from goods trains. The use of herbicides to control weeds along the railway line could allow contaminants to enter the groundwater system.

8.5.6 Conclusion

The groundwater system in the Portion 480 area is not used for potable or irrigation use. No existing groundwater users south of Bells Creek or in the Golden Beach and Pelican Waters residential areas would be impacted by the railway corridor due to the hydraulic isolation of groundwater by Bells Creek, Lamerough Creek and proposed lakes at Pelican Waters.
Groundwater in the aquifer comprising shallow alluvial, estuarine and swamp deposits over weathered sandstone basement is considered an essential element in maintaining the integrity of the wetland environment as the water table is close to, or at the surface for much of the year. There is little lateral groundwater flow due to the flat nature of the landscape and therefore the water balance is dominated by rainfall, surface flows and evapotranspiration.

Major modifications to the water balance have already occurred or are planned in the surrounds, with the construction of drainage in the pine forest and excavation of canals and lakes at Golden Beach and Pelican Waters.

Clearing of a strip of wetlands for a railway would reduce evapotranspiration and generate more runoff. This would tend to cause more surface waterlogging unless provision is made for drainage. However, excess drainage runs the risk of lowering the groundwater table and causing generation of acid sulphate affected water. Sections 8.8 and 8.9 of this Chapter provide details of the hydraulics and wetland hydrology of this area. The mitigation measures in relation to drainage that are proposed to ameliorate construction of the rail alignment are also given in these sections.

The proposed installation of piles for viaduct construction through this area is not considered likely to interconnect groundwater of varying quality or pressures.

8.6 Terrestrial Ecology

8.6.1 Future Without the Scheme

The following activities may occur in this section in the next 10-15 years and may or may not have an effect on the ecology of the area:

- In the Beerwah State Forest, forestry activities will continue, DPI would have no intention to vary the land use on any of the sites.
- The pine plantation on the Caloundra Downs property east of the Bruce Highway will be cleared in 2003 regardless of what happens with CAMCOS. The future use of the land after this activity is still unknown and is dependent on the Informal Land Use Investigation currently being undertaken for the site by Lensworth;
- It is anticipated that the proposed National Park (portion 480) would be designated by 2011;
- Pelican Waters development will be completed;
- Bells Creek Arterial could potentially be constructed to Pelican Waters if CAMCOS didn’t go ahead. The timing of this would be dependent on traffic volumes on certain roads in the area exceeding set traffic volumes;
- Caloundra City Council will be reviewing options for Caloundra Aerodrome with current leases due to expire in 2014.

8.6.2 Effects of the Scheme

8.6.2.1 National Parks

The railway alignment runs to the south of proposed National Park (NP) Lot 480, and passes close to the south-eastern corner before curving up to the north. The line itself would not be within the NP at that point, but the 20m minimum clearing area along the line would extend approximately 4m over that corner. Very little clearing would be likely to be required in that area and direct impacts should be negligible.

Some 800m of line would pass through the north-eastern corner of Lot 480, leaving the Pelican Waters site at the location of the proposed Bells Creek Arterial Road, and veering to the north-east off Lot 480, towards the old Caloundra landfill site. The original alignment of this northern section was further to the west, nearer to Caloundra Aerodrome, but the preferred alignment results in slightly lesser impacts upon the ecological values identified in this area, as more of it lies within the Caloundra landfill site and less in the heathland and eucalypt forest areas to the west.

The section of the preferred alignment through the melaleuca forest would be on viaduct so as to minimise the construction footprint and clearing around the line should be limited to a 20m wide band. This clearing would involve an area of some 0.8ha of the melaleuca forest. The alignment would not be of viaduct construction through the eucalypt forest between the melaleuca forest and the former Caloundra City landfill site, so the clearing would be extended to a 40m wide band, and would involve the disturbance of some 1.6ha of the forest.

8.6.2.2 Rare & Threatened Species

Flora

At least seven species of rare, threatened or otherwise significant flora are known or likely to occur within habitat affected by this section of the alignment. The required clearing in SA24 would result in the removal of an area of suitable habitat for *E. conglomerata* and *P. spinulos*, while in the Bells/Lamerough Creeks area, clearing would include areas of habitat for *B. grandiflora*, *A. attenuata*, *A. baueri*, and *S. scabripes*. It is unknown for certain whether specimens of each of these species would be directly affected by the clearing for the rail alignment, but it is considered likely that some could be affected.
Fauna

Eleven species of rare, threatened or otherwise significant fauna are known or likely to occur within habitat affected by this section of the rail alignment. Clearing for track, access and safety requirements would result in the removal of suitable habitat for Wallum Rocketfrog (Limnodynastes freycineti), Wallum Sedgefrog (Litoria olongburensis), Wallum Frogllet (Crinia tinnula), Eastern Tiger Snake (Notechis scutatus), Elf Skink (Erotoscincus graciloides), Black-necked Stork (Ephippiorhynchus asiaticus), Grey Goshawk (Accipiter novaehollandiae), Lewin’s Rail (Rallus pectoralis), Swamp Crayfish (Tenuibranchiurus glypticus), Sword-grass Brown (Tisiphone abeona rawnsleyi) and the Painted Skipper (Hesperilla picta).

Suitable habitat areas for Elf Skink, Eastern Tiger Snake, Sword-grass Brown and the Painted Skipper are highly restricted in extent and distribution within the area (west of the Bruce Highway). Removal of limited habitat associated with railway development may significantly increase their vulnerability to local extinction. Acid frogs, particularly the Wallum Sedgefrog, are sensitive to changes to habitat and water quality.

The degree of impact to the remaining suitable wetland habitat between Bells (north branch) and Lamerough Creeks would be largely dependent on minimising the potential to alter local surface water hydrology and quality. A mounded construction through this area (Bells Creek north branch to the dam west of Pelican Waters Estate; wetlands south of Lamerough Creek to Caloundra landfill site) would have been likely to result in a longer term adverse impact on the health and vigour of these wetland habitats and conditions for rare and threatened species than would viaducting this section of the alignment. Construction of the railway line on viaducts through this area is predicted (Lawson & Treloar, pers comm. 1999) to have no significant effect on either the peak water levels or the average water levels in the wetlands associated with Bells and Lamerough Creeks, and overall impacts to hydrology in these areas are therefore expected to be minimal. This is the construction method, which would be used from Bells Creek to the Pelican Waters dam/borrow pit, and again across Lamerough Creek and its associated wetland areas.

Areas of wetland habitat would be separated from the main wetland area by the railway line in the Bells Creek area (south of the line) and the Lamerough Creek area (east of the line). Viaduct construction through these areas should also help to minimise disturbance to the connectivity of habitat between the main wetland area and those portions to the south and east.

Direct impacts to the habitat areas discussed above would be principally related to the clearing of some 4.9ha and 1.6ha (respectively) of vegetation from the Bells and Lamerough Creek wetland areas.

8.6.2.3 Marine Plants

A small number of mangroves would need to be removed/lopped on sections of Bells Creek, where they currently occur as a scattered fringe. As construction would be on viaducts across these waterways, specimens would be retained where possible during construction, and it is expected that others would be able to grow under the railway line during the operation phase.

The impact on marine plants is therefore expected to be minimal, but a permit would be required from the DPI for the removal/disturbance of any marine plant, prior to construction commencing.

8.6.2.4 Critical Nature Conservation Areas

The alignment passes through approximately 4.1km of the Bells Creek CNCA. As mentioned in section 5.9.1.1, a large portion of this CNCA has been and is being cleared as part of the Pelican Waters site development, but some of the central, northern and western portions of it remain largely undisturbed.

The western 1.5km (approximately - from the western edge to the southern crossing of the Pelican Waters internal waterway) of this would be through melaleuca forest wetland areas. This length would be constructed on viaduct to minimise the impacts (such as clearing) as well as to help maintain the existing hydrological regime across this wetland area. With this construction method, a 20m wide band of vegetation would need to be cleared, requiring the removal of approximately 3ha of melaleuca forest within this section of the CNCA.

Between the southern and northern crossings of the Pelican Waters internal waterway, the alignment passes through lands approved for intensive development on the Pelican Waters site. Much of the native vegetation in this section has already been disturbed by site activities, and it is expected that by the time the rail line is constructed, the rest would have been removed, so the impacts of construction through this section (approximately 1.6km long) are likely to be negligible.

From the northern waterway crossing over Lamerough Creek, some 500m of viaduct would need to be constructed, to minimise the impacts to the crossing itself and the adjacent melaleuca forest wetland areas to the immediate north. This would require the removal of approximately 1.0ha of melaleuca forest vegetation. Beyond that wetland area, the alignment traverses a eucalypt forest area for the final 400m or so to the boundary of the CNCA, at the edge of the old Caloundra landfill site. Approximately 1.6ha of eucalypt forest would need to be cleared to allow construction
and operation of the railway line in this section of the CNCA, as this section would be of embankment construction.

Overall, construction along the rail alignment within the Bells Creek CNCA would require the removal of some 5.6ha of native vegetation - 4.0ha of melaleuca forest and 1.6ha of eucalypt forest.

8.6.2.5 State Forest Scientific Areas

The alignment passes through the north-western corner of SA24 (a length of some 135m). This would require the clearing of an area of approximately 0.5ha along the alignment, and would excise an area of approximately 0.3ha, i.e. the north-west corner of the SA separated from the main area by the railway line.

SA59 lies to the south of the preferred alignment, and would not be directly impacted upon by the construction of the railway line. Some indirect impacts would be expected, however, from the disruption to the narrow link between the SA and the lands associated with Alf's Hill to the north. Construction on viaduct pylons over the vegetated link would help to minimise the disruption and its associated impacts.

8.6.2.6 Endangered and Of Concern Regional Ecosystem Types

The original alignment passed through a patch of tall melaleuca forest (RE 12.3.5) on the southern side of Clifts Break, lining Bellbird Creek. This would have involved the removal of a substantial portion of this forest patch, exposing much of the remainder to edge effects through increased light and weed invasion, and extending the existing disturbance present along Clifts Break.

In order to minimise the disturbance to this RE, the preferred alignment has been located to cross between the two of concern RE remnants at the point of the existing disturbance associated with Clifts Break. While at the same time this alignment minimises the disturbance to SA 24 to the south, and maintains a curve radii through this section which achieves an acceptable (although less than desirable) train speed. An area in the order of 0.2ha of the southern patch of tall melaleuca forest would need to be cleared to construct the railway along the preferred alignment. Some edge effects to the adjacent parts would be expected, but could be minimised by rehabilitation works such as replanting of buffering species along the margin of the cleared area.

The alignment also crosses the eastern tributary of Mellum Creek, which is lined with a narrow band of *E. racemosa* open forest (equivalent to RE 12.5.3), a previously wide-spread vegetation type, much of which has been replaced with pine plantations in this area. The tributary crossing would require the removal of less than 0.3ha of this vegetation type.

8.6.2.7 Significant Wetland Areas

Three identified significant wetland areas would be affected in this section, namely:

- Bells Creek Wetland (140);
- Bells Creek North Wetland (139); and
- Lamerough Creek Wetland (138).

The alignment would impact on each to varying degrees. For Bells Creek Wetland (140), there would be a crossing approximately 65m long over a tributary of the Bells Creek south branch, near the northernmost extremity of this wetland. It would require the removal of approximately 0.1ha of melaleuca forest in this area.

For Bells Creek North Wetland (139) also, the alignment would cross some 65m of wetland, this time over the north branch of Bells Creek, requiring the removal of an additional 0.1ha or so of melaleuca forest.

Lamerough Creek Wetland (138) would be more substantially affected by railway line construction, with the alignment passing through some 2.5km of its area. This would require the removal of approximately 5.1ha of melaleuca forest and 0.7ha of heathland.

8.6.2.8 Riparian Vegetation

The proposed railway alignment would affect riparian vegetation along each of the creeks and tributaries in this section (Bluegum Creek, Bellbird Creek, an unnamed tributary of Bluegum Creek, Mellum Creek, an unnamed tributary of Mellum Creek and the branches and tributaries of Bells Creek). Melaleuca forest was the dominant riparian vegetation type, with some ecotonal forest to be affected along Mellum Creek, and scattered mangroves in the lower estuarine areas along Bells Creek.

A band of vegetation 20m wide at the most would be affected at each creek crossing, with only the construction areas themselves being cleared on the banks, and a safety area cleared on either side to prevent trees falling on the overhead rail lines.

8.6.2.9 Significant Vegetation Types

The key areas of Priority 1 vegetation types in this section are associated with:

- SA24;
- The waterways (Bluegum Creek, etc); and
- The wetlands (Bells Creek and Lamerough Creek).
### 8.6.2.10 Areas of Regional and/or Local Fauna Value

The largest area of native fauna habitat occurs between Bells Creek (north branch) and Caloundra Aerodrome (centred on Lot 480). Characteristics including its size, diversity of habitat types (eg. melaleuca and eucalypt forest, reed swamps & heath) and low level of disturbance provide important habitat for a highly diverse fauna assemblage, including a number of vulnerable, rare and regionally significant fauna species. Potential impacts to this area include loss of habitat, development of new edge environments, impediments to fauna movement, changes to surface hydrology and water quality, and increased access for introduced flora and fauna (including feral predators).

West of the Bruce Highway, a number of small remnants support fauna habitat of highly restricted distribution within the area (eg. dry heath and sclerophyll habitats within SA24, rainforest remnant south of Clifts Break and ecotonal habitat along Mellum Creek). These patches of habitat are likely to support a diverse range of fauna including a number of locally uncommon species and species groups (eg. Tree Skink, rainforest birds, butterflies).

The construction of the rail alignment would result in the following impacts:

- Further fragmentation and size reduction, increased edge habitat and increased access for weeds and feral predators within already small remnants and would increase pressure on their capacity to continue to support a diverse fauna and species with specialised habitat requirements. Remnants of particular concern are the SA24, the melaleuca and rainforest remnant adjacent to Clifts Break;
- Removal of locally uncommon habitat types including dry heath south of Mt Alpha;
- Riparian/wetland habitats associated with Bellbird, Blue Gum and Mellum Creeks which are likely to support diverse reptile and frog fauna including rare regionally uncommon species such as the Lewin’s Rail and Eastern Tiger Snake; and
- Severance of linear habitat features which are likely to create potential barriers to fauna movement between suitable remnants of fauna habitats.

### 8.6.2.11 Bushland/Wildlife Corridors

Whilst the development of the rail alignment may impact directly on fauna by reducing habitat, the resultant cleared and modified environment may also present a potential barrier to fauna movement. The inhibition or prevention of dispersal of fauna may lead to the isolation of populations and potential for local extinctions and a reduction in the value of conservation areas due to a restriction on gene flow between areas. The extent and nature of the so-called “barrier effect” of railway lines and their easements on movement is poorly understood, though it is proposed that the size of an organism and its level of mobility and behavioural flexibility are likely to be the primary determinants of how a species perceives the scale of patchiness in its environment. Thus for larger ground mammals, clearing for construction may represent less of an impediment than for a smaller species. The route would also be fenced creating a barrier to many species, particularly macropods which appear to be common throughout the local area.

Provision of suitable access across the route would be essential to allow for ground movements between habitats for such species. Landscape features such as Bellbird, Blue Gum, Mellum, Bells (south and north branches) and Lamerough Creeks and associated native riparian vegetation are likely to provide significant opportunities, possibly the only opportunities, to allow for fauna movement between habitats separated by a cleared and fenced environment. The extent to which ground movement is likely to be impeded would be influenced significantly by the conditions associated with structures employed in the crossing of these areas (eg. ambient light levels, vegetation cover, structure length, width and breadth). Small, dark environments within culvert structures are unlikely to provide favourable conditions for regular ground fauna movements.

The construction of the railway would also result in the severance of a narrow strip of heath which links eucalypt forest at Mt Alpha and a melaleuca/heath mosaic in SA59 to the south. The latter forms part of the upper catchment of Bells Creek (south branch). The continuity of native vegetation cover to the southeast has previously been disturbed by the development of the Bruce Highway.

### 8.6.2.12 Broad Nature Conservation Areas

The majority of lands traversed by the railway within this area have been designated as part of a Broad Nature Conservation Area (BNCA). These are intended to be multiple-use areas, which provide: buffers around Critical Nature Conservation Areas (CNCA); linkages between natural landscape features; and maintain biodiversity. Construction of the rail alignment would, in broad terms, place an added pressure on the capacity to achieve the intended objectives for the area by:

- Increasing the current levels of native habitat fragmentation, particularly within the area between Bells Creek (north branch) and Caloundra Road;
Increasing potential impediments to fauna movement and further disruption to natural linkages limited to along Bellbird, Blue Gum, Mellum, Bells and Lamerough Creeks; and

Adding to the existing processes, which threaten the values of buffers around the CNCA west of Pelican Waters Estate.

8.6.2.13 Local Council Protected Areas

The alignment would affect Environment Protection lands on Lot 480, and Open Space lands on the old Caloundra landfill site and Rotary Park site.

8.6.3 Response

8.6.3.1 Compensatory Habitat

It is difficult to mitigate the effects of loss of significant ecological areas associated with the construction of the rail alignment. However, a common practice undertaken by transport authorities and other government departments elsewhere in Australia and around the world is to investigate the acquisition of areas outside of the corridor that exhibit at least equal conservation value in compensation. To show commitment to this best practice principle, a compensatory habitat policy of was investigated for significant ecological areas affected as a result of this study. The wording of the policy (taken from the project Terms of Reference in Appendix A) is given below:

“Investigate a no net loss policy for significant ecological areas. This would involve:

- Investigating and identifying areas of at least equal conservation value which could be acquired by Queensland Transport to compensate for the loss and/or degradation (including edge effects) of native remnant vegetation within and adjacent to the transport corridor;
- Demonstrating through the findings of existing studies and/or best practice flora and fauna survey work and ecological assessments, that the area identified for compensation is of at least equal conservation value than the area being cleared/degraded;
- Investigating and identifying areas which could be rehabilitated to an at least equal conservation value than the area to be cleared or degraded as a result of the transport corridor; and
- Investigating options for varying the width of the corridor reserve to protect areas of high conservation significance.”

In consultation with the Environmental Protection Agency (EPA), the implications of this policy for the project and Queensland Transport (QT) have been investigated in detail.

QT received Crown Law advice on this matter in relation to the Department's powers to acquire land for transport purposes under the Transport Planning and Coordination Act 1994 (TPC). This act gives the Department the power to take land for purposes that are collateral or subsidiary to that purpose. For example, land may be taken not only for the corridor but also for stations, car and bus parks and road crossings that may be essential for the construction and operation of a railway line. That is, they are incidental to the primary purpose.

Section 25(3) of the TPC sets out some particular purposes for which land may be acquired. Section 23(3)(c) provides amelioration of negative environmental effects associated with transport infrastructure. Crown Law's advice is that the purpose of this section of the TPC is to enable the Department to acquire land to assist in reducing the direct environmental impact of the corridor. This might involve the construction of a noise barrier or provision of a buffer between the corridor and surrounding residences to reduce the adverse impacts of noise or dust emissions.

Crown Law's advice is that the acquisition areas of compensatory habitat or Critical Nature Conservation Areas (CNCA) is not for a purpose incidental to the corridor as they are not needed for the primary purpose of a corridor and may not be contiguous to or even proximate to the corridor.

In conclusion, based on Crown Law advice received by QT, their interpretation of the legislation is that compensatory habitat areas are not able to be purchased under the Transport Planning and Coordination Act 1994. However, with the co-operation of QT, the Environmental Protection Agency are pursuing this matter further to achieve an outcome that involves a whole of government approach to this issue. It is anticipated that the issue of purchase of land in compensation for loss of significant ecological areas will be resolved prior to the commencement of construction of the CAMCOS project.

8.6.3.2 Other Issues

Minimising clearing within the required “safety clearing zone” along the railway lines is recommended. This zone is the area either side of the railway lines which would be required to be maintained free of trees and/or other objects likely to be able to fall on or otherwise damage the power lines associated with the train lines, or the train lines themselves. This is recommended to minimise the disturbance to the existing native vegetation in this section and the subsequent degradation to habitat and other ecological values of the area.
Avoidance of fencing waterway/riparian areas. If fencing is required within areas of remnant vegetation, mitigation strategies should include:

- Lopping of trees within the clearing zone, in preference to completely removing them;
- Retaining the low-growing vegetation layers (shrub-layer and ground-layers) except for areas where further clearing is absolutely essential; and
- Where clearing must occur during the construction phase, avoiding bulldozing (or otherwise clearing completely to ground level) - at most, slashing of existing vegetation layers should be undertaken, so that the diversity of native plant species retained is maximised, and that maintenance slashings be as infrequent as possible, to maximise the habitat value of those areas.

In areas where the alignment passes through relatively intact areas of disturbance-sensitive vegetation types, such as melaleuca forest and rainforest/ecotonal forest areas, buffer plantings along the exposed forest edges is recommended, to minimise edge-effect impacts to the remaining forest areas. Such plantings should include appropriate native understorey species such as those present within the remaining forest area itself. They should be planted at the forest edges at a level of density, which would provide adequate protection to the forest environment in terms of shading, weed inhibition and microclimate control in general.

Fencing of the rail easement within wetland/riparian areas should be avoided in order to reduce disruption to fauna movement. If fencing is required within areas of remnant vegetation, mitigation strategies should include:

- Avoidance of fencing waterway/riparian areas. If fencing is a requirement in these areas, it should be installed on the outer top-side of the bridging structure and not at ground level; and
- Provision of small breaks in the fence (eg. minimum 600mm) at intervals of up to 200m may lessen impact on larger mobile species such as macropods.

At creek crossings the riparian zone, clearing would be restricted where possible to lopping of taller trees, with complete-to-ground clearing avoided. Separate crossings for access tracks would not be constructed, as access would be able to be gained to the crossing area from both sides of all creeks. Additional crossings for access tracks at each viaduct crossing site would be considered to be an unnecessary additional disturbance to the fragile riparian systems.

The design of the rail alignment to date has been such that it has incorporated specific design features to aid in the mitigation of both direct and indirect effects on ecological features. These features include provision of the following.

- A total of 2.2km of viaduct though the regionally significant wetlands associated with Bells and Lamerough Creek; and
- Increased length of nearly all waterway crossings in this section to allow for movement of fauna.

Waterway crossings and wetland areas would be viaducted to reduce impacts on wetland/riparian habitats (eg. melaleuca remnant south of Clifts Break, Bellbird, Blue Gum, Mellum & Bells and Lamerough Creeks) and be long enough to incorporate a dry land riparian component to allow movement of non-aquatic fauna. They would also be designed to minimise the construction footprint on habitat for significant species (eg. melaleuca remnant south of Clifts Break) and reduce disruption to habitat connectivity (eg. waterway/riparian habitats). These structures should support an ambient light environment underneath which can sustain a healthy ground cover of native vegetation. Areas immediately adjacent to either side of a bridge should be maintained so as to support both native ground and shrub cover.

The development of waterway crossings also creates a high potential for on-going impacts on downstream aquatic/riparian fauna habitats resulting from the erosion of disturbed and unconsolidated soils, the subsequent transportation downstream, and sedimentation of aquatic/riparian fauna habitats. The period of greatest potential impact is likely to coincide with heavy summer rainfall events (eg. November-January) which are typically the optimum breeding opportunities for the majority of frog fauna, including all rare or threatened species known or likely to occur in affected aquatic/riparian/wetland habitats. In order to minimise potential impacts, implementation and maintenance of rigorous soil and water management strategies must ensure that environmental flows, quantity and quality of water exiting the crossing site is sufficient to protect downstream fauna habitat values.

Access of introduced fauna into larger remnant areas such as Lot 480 may be facilitated by easement clearings. Minimising access of introduced fauna is problematic. Maintenance of dense ground cover vegetation, minimising vehicle access tracks and periodic maintenance of these with a slashed ground cover rather than hard surfacing may assist. An ongoing feral animal trapping program should be undertaken within the rail easement lands, which adjoin sensitive areas such as Lots 480. The dumping of rubbish within natural areas is often associated with unrestricted vehicle access. In order to reduce the incidence and extent of rubbish disposal and the introduction of weeds, access to vehicles should be restricted via locked gates.
8.6.4 Assessment of Effects

The following table describes the assessment of effects of the scheme (with proposed mitigation) on terrestrial ecology on this section of the route.

<table>
<thead>
<tr>
<th>Area</th>
<th>Significance of Impact</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Severe</td>
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<tr>
<td>SA 24</td>
<td></td>
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<tr>
<td>Bellbird Ck</td>
<td>Major</td>
</tr>
<tr>
<td>Bluegum Ck tributary.</td>
<td></td>
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<tr>
<td>Mellum Ck</td>
<td></td>
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<tr>
<td>Mellum Ck tributary.</td>
<td>Major</td>
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<tr>
<td>Dam</td>
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<tr>
<td>Mt Alpha/Alf’s hill</td>
<td></td>
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<td>SA59</td>
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<tr>
<td>Bells Ck Sth. Branch</td>
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<tr>
<td>Bells Ck N Branch tributary</td>
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<td>Bells Ck wetlands</td>
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<td>Lamerough Ck wetlands</td>
<td></td>
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<tr>
<td>Caloundra Aerodrome</td>
<td></td>
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<tr>
<td>Rotary Park - Caloundra landfill site</td>
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</tbody>
</table>

8.7 Aquatic Ecology

8.7.1 Effects of the Scheme

Potential impacts associated with this section of the proposed route with respect to aquatic fauna relate to the crossings of Coochin, Mellum, Bells and Lamerough Creek systems. As noted in the section 5.9.2, these creeks are known, or likely, to contain all of the fish species listed as having conservation status recorded during the preparation of this report.

The proposed waterway crossing methodology would result in the loss of some riparian vegetation associated with the development of the railway (see section 8.6). This loss has the potential to impact aquatic communities by altering the macro-environment at the vicinity of the crossing (eg shading, alteration of stream flow characteristics).

There is a significant potential for system wide impacts during the construction of the railway infrastructure due to the disturbance and subsequent transportation of sediments in and about the route construction area. These sediments may enter the respective waterways in surface runoff, resulting in increased sediment loadings to the waterways and subsequent deterioration in water quality.

Many of the fish species recorded from the waterways, including those of conservation status are known to be susceptible to increased suspended sediment loadings (McDowall 1996). Impacts to the species can result as a direct effect (eg. reduction in gill efficiency) or as a secondary effect by altering habitat suitability (eg. smothering of food resources, removal of aquatic vegetation).

The impacts on water quality have the highest potential to directly effect areas downstream of the crossing location. The records of species occurrence obtained for this study do not provide specific location details. As such, prior to construction phase, it may be prudent to determine the location of the species of conservation significance, either based on field surveys or habitat preferences. This information can then be used to determine the relative sensitivity of areas with respect to stream flow direction and potential impacts, thus providing a basis for the rigour of the EMP’s prepared (see Part C, Chapter 12).

During the construction of the railway, it would be necessary to construct bridge pylons and supporting foundations. As such some works within the waterway channels will be required. This has the potential to restrict the movement of aquatic fauna by the placement of construction materials across waterways.

As discussed in the section 5.9.2, utilisation of the waterways within this section of the proposed route by
traditional and/or recreational fishers would be very limited due to the size and access difficulties associated with the creeks. Additionally, commercial operations are not permitted in these areas. It is unlikely that access would be improved by the development during the construction and/or operational phases due to the restricted access to the corridor. Existing access will remain. As such the impact of the proposal to the fishing sectors is considered not significant.

8.7.2 Response

Environmental Management Plans (see Part C Chapter 12) in design and construction phases have been developed for the clearing of vegetation. The clearing of the corridor, and in-stream construction activities would be kept to a minimum in order to mitigate potential ecological impacts.

Due to the relatively narrow waterway channels at the proposed crossing locations, it may be necessary to construct fishways around the construction site to maintain both a waterway for the passage of aquatic fauna and flow to downstream areas. The adherence to the measures contained in the associated EMP should ensure that the impact of restriction to fauna movement is mitigated. Adherence to these EMP’s should minimise the potential for any significant near field (ie. crossing location) ecological impacts.

8.7.3 Assessment

Given the corridor width at the crossing locations (maximum 20m), and the recommendations contained in the terrestrial ecology assessment (see section 8.6), the impacts at these locations are likely to be restricted to the immediate vicinity of the crossing location (ie 20m maximum section). As such, the impact upon the creek system is likely to be minimal.

The loss of sediments into waterways associated with this section of the route is to be minimised and carefully monitored, as outlined in the associated EMP. The assessment of the water quality impacts has indicated that whilst potential does exist for the project to have an impact upon water quality, standard site practices are available to minimise these effects.

The assessment of water quality impacts indicates that the impact of the operation of the railway will be minor adverse. Additionally, the vegetation and hydrological assessments indicate that the alterations to the existing environment will be minor. As such, the impact of the development upon aquatic fauna within these highly significant waterways (due to the presence of conservation status species and protected areas), which is primarily dependant upon these factors, is likely to be minor.

Overall, assuming the recommended mitigation measures are implemented and adequately maintained, the impact to the aquatic ecology during the construction phase would be minor adverse.

8.8 Hydraulics

8.8.1 Introduction

Mellum Creek, Bells Creek, and Lamerough Creek, and many smaller creeks and gullies that are tributaries of these major creeks are crossed by the route between Beerwah and Caloundra. The locations at which drainage structures are required are shown in Figures 4.7.6a-f and 100 year ARI flood levels and discharges, and structure sizes are given in Table 8.8.1.

8.8.2 Mellum Creek

The Mellum Creek crossing is identified as BC4 on Figure 4.7.6a along with four other creek crossings in the vicinity; Bellbird Creek (BC2); Bluegum Creek (BC1); and a tributary (BC5) of Mellum Ck. Bellbird Creek is a tributary of Bluegum Creek which itself is a tributary of Mellum Creek, but the confluences of the creeks are downstream of the route.

There are no known flood studies in this area so it was necessary to establish a RORB hydrological model to determine the 100 year ARI discharges at the route and at the Bruce Highway 4km downstream. It was not possible to establish a hydraulic model along this section because only 5m contours were available and hence approximate methods were used to determine flood heights.

There was no data available to allow calibration of the RORB model. Therefore, the following parameters recommended in Australian Rainfall and Runoff (IEAust, 1987) were adopted:

- $k_0 = 0.88 \ A^{0.53}$
- $IL = 0 \ mm$
- $CL = 2.5 \ mm/hr$
- $m = 0.8$

The 100 year ARI discharges are given in Table 8.8.1.

The following approximate methods were used to estimate the 100 year ARI flood levels.

- 100 year ARI flood levels were calculated along the north coast railway line using the ground surface elevation on railway plans and assuming a hydraulic gradient based on the 5m contours. These flood levels were then translated to the route using the same hydraulic gradient. The discharges from the RORB model were used in this calculation.
- The recorded 1893 flood level on north coast rail line was translated to the route using the same hydraulic gradient as above.
The 100 year ARI flood level was calculated at Bruce Highway using the hydraulic gradient adopted by Main Roads to calculate the 50 year ARI flood level. The flood level was translated 4km upstream of the route using separately for comparison, the Main Roads hydraulic gradient and a hydraulic gradient based on 5m contours. The discharges from the RORB model were used in this calculation.

These different methods gave a large variation in flood levels at each of the creek crossings, although the lower values appeared to be too low compared with the 5m contours. The highest flood level at each crossing was adopted and rounded to the nearest metre.

Structure sizes were calculated assuming 150 mm of afflux.

It is considered that the discharges calculated using RORB are reasonable and hence the waterway areas are a reasonable estimate, but an uncertainty of no less than ±1.5 m can be assumed for the flood levels. The waterway areas in the existing north coast rail line are considerably less than calculated here possibly indicating that the structures were sized using a considerably larger allowable afflux and/or for a lower return period flood, or the RORB model is overestimating discharges. The discharges calculated using RORB are consistent with discharges obtained using calibrated RORB models on similar size catchments in Queensland so it is considered that the discharges and recommended waterway areas are reasonable. However it is recommend that this matter be considered further when more detailed modelling is undertaken.

Consideration would be given at the detailed design stage as to the extent upstream of any increase in flood levels and the likely impact. This comment is more pertinent to Bluegum Creek and less so to Bellbird Creek. Upstream of the route are residential and commercial developments and the Glass House Mountains Road and the North Coast Rail. It is considered that for a 100 year event any issues that may evolve could be overcome.

However, as stated in section 4.7.5 if the waterway openings are designed to pass the 100 year discharge with an afflux of say 150mm, but the rail level is set above the 100 year flood level, then floods of larger magnitude than the 100 year would cause increases in flood levels of greater than 150mm at the crossing and may increase scour in the channel downstream.

The CAMCOS route would not significantly alter the hydrology or hydraulics of the Mellum Creek system of watercourses in floods up to the 100 year event.

### 8.8.3 Bells Creek

The route passes to the north of the Bells Creek south branch but crosses the northern branch which only becomes a defined channel in the vicinity of the route. Upstream of the channel the creek system is a series of drains through State Forest and wetlands. The South Branch, like the North Branch, drains State Forest and small wetland areas. The South Branch itself does not cross the route, rather there are numerous small catchments which drain across the route (BC6 to BC10) into the wetlands and the channel itself.

Hydrologic and hydraulic information for the North Branch was obtained from the Pelican Waters EIS (Cardno & Davies, 1998). Cardno and Davies modelled a proposed arterial road (known as the Bells Creek Arterial) from Caloundra Road to approximately Bells Creek on an alignment similar to the CAMCOS route. A RORB model was used for the hydrologic modelling and RUBICON for the hydraulic modelling. Cardno & Davies advised verbally that the RUBICON model has been converted to a MIKE11 model. The flood levels at Bells Creek and Lamerough Creek at the route are from the latest modelling and differ slightly from those quoted in the Pelican Waters EIS.

A bridge length of 45m (76m²) and culvert area of 8.3m² are recommended in the Pelican Waters EIS for the main channel (BC11) and overflow (BC12) of the North Branch respectively. It is stated in the report that structures were sized assuming 150mm afflux, but the velocity through the bridge would be approximately 3m/s which is high for 150mm afflux or alternatively as the unrestricted stream velocity. Similarly the culvert area appears to be too small to limit the afflux to 150mm. Therefore the waterway areas recommended in this report are larger than in the Pelican Waters EIS.

The Rational method was used to estimate the 100 year peak discharges from the small catchments which drain across the route into the South Branch of Bells Creek. A runoff coefficient of 0.8 was adopted which allows for future development of the catchment. The time of concentration (t_c) was calculated using the equation recommended in Australian Rainfall and Runoff (ARR) for eastern New South Wales, this equation was adopted for this study because it allows for a quick estimation of t_c and of an accuracy acceptable for an IAS.

The CAMCOS route would not significantly alter the hydrology or hydraulics of the Bells Creek system of watercourses in floods up to the 100 year ARI event.

### 8.8.4 Bells Creek to Lamerough Creek (BC13)

In this region, there is a wetlands area on the upstream side of the route. In the 100 year flood event, Cardno and Davies found that there will be flow out of the...
wetlands into the channel and lake system which is part of the Pelican Waters stormwater management system.

The Pelican Waters EIS recommends the provision of 65m$^2$ of waterway area between Bells Creek and Lamerough Creek to maintain the existing flow regime across the floodplain. The culverts should be spaced across the floodplain to minimise the concentration of flows. The route would cross a channel created for the treatment of stormwater runoff from Pelican Waters. Cardno & Davies’ preliminary estimate of the waterway area of this crossing is 18 m$^2$. On the basis of this information the recommended waterway area for BC13 has been rounded to 85 m$^2$.

Based on the 100 year discharge provided by Cardno and Davies, 65m$^2$ would be adequate to ensure that flows are not concentrated into the Bells Creek or Lamerough Creek crossing of the route. It is recommended that further modelling be undertaken at the detailed design stage as the existing modelling was done using limited survey information. Careful attention should be paid to ensure that the location of culverts corresponds to existing flow paths.

The CAMCOS route would not significantly alter the hydrology or hydraulics of the Bells Creek to Lamerough Creek floodplain in the 100 year ARI flood. Additional comments on the impact of the route on low flows through the wetlands are provided in section 8.9.

### 8.8.5 Lamerough Creek (BC14)

Like Bells Creek, Lamerough Creek drains a wetland to the west of the route. In larger floods the Bells Creek and Lamerough Creek floodplains would interact upstream of the route with the modelling indicating a flow to the north from Bells Creek to Lamerough Creek. Flood levels and discharges for the Lamerough Creek crossing were obtained from the Pelican Waters EIS. A waterway area of 55m$^2$ was recommended in the EIS for this crossing. However, this would result in a velocity of approximately 4.5 m/s which would cause severe scouring of the creek, and a significant increase in the upstream flood level. A larger waterway area calculated using an allowable afflux of 150mm is recommended in Table 8.8.1 for this crossing.

The CAMCOS route would not significantly alter the hydrology or hydraulics of the Lamerough Creek system of watercourses in the 100 year ARI flood.

### 8.8.6 Caloundra Airport Catchment (BC15)

The Caloundra Airport and the catchment to the north-west up to Caloundra Road drain across the route approximately at the location identified as BC15 in Figure 4.7.6a. The peak 100 year discharge was calculated using the Rational Method. A runoff coefficient of 0.95 was assumed on the basis that the catchment will be fully developed. The time of concentration was estimated using a standard inlet time and times for pipe and channel flow given in QUDM. This method was considered to be of sufficient accuracy for the purposes of this study. The discharge and culvert area are given in Table 8.8.1. The culvert area was calculated assuming an allowable afflux of 150mm. It was not possible to estimate a flood level in this region because there is insufficient topographical information.

The CAMCOS route would not significantly alter the hydrology or hydraulics of this catchment in events up to the 100 year.

### 8.8.7 Duck Holes Creek (BC16)

Duck Holes Creek would pass under the route to the South and downstream of Caloundra Road. It has as its catchment a mainly industrial area to the North of Caloundra Road. There was no recent hydraulic or hydrologic information available for this catchment. Therefore the Rational Method was used to estimate the peak 100 year discharge. A runoff coefficient of 0.95 was assumed on the basis that the catchment will in time be fully developed. The time of concentration was estimated using a standard inlet time and times for pipe and channel flow given in QUDM. The method was considered to be of sufficient accuracy for the purposes of this study. Because of the proximity of Caloundra Road and the industrial sites upstream of the route, the waterway area was sized assuming an allowable afflux of 100mm. It was not possible to estimate a flood level in this region because there is insufficient topographical information.

The CAMCOS route would not significantly alter the hydrology or hydraulics of the Duck Holes Creek system of watercourses in floods up to the 100 year ARI event.

### Table 8.8.1: 100 Year ARI Structure Sizes - Beerwah to Caloundra Road

<table>
<thead>
<tr>
<th>Waterway Identification</th>
<th>100 Year ARI Discharge (m$^3$/s)</th>
<th>100 Year ARI Upstream Flood Level (mAHD)</th>
<th>Structure Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC1</td>
<td>85</td>
<td>27.0</td>
<td>65m$^2$</td>
</tr>
<tr>
<td>BC2</td>
<td>55</td>
<td>29.0</td>
<td>45m$^2$</td>
</tr>
<tr>
<td>BC3</td>
<td>55</td>
<td>23.0</td>
<td>45m$^2$</td>
</tr>
<tr>
<td>BC4</td>
<td>255</td>
<td>23.0</td>
<td>200m$^2$</td>
</tr>
</tbody>
</table>
Table 8.8.1: 100 Year ARI Flood Levels & Structure Sizes - Beerwah to Caloundra Road

<table>
<thead>
<tr>
<th>Waterway Identification</th>
<th>100 Year ARI Discharge (m³/s)</th>
<th>100 Year ARI Upstream Flood Level (mAHD)</th>
<th>Structure Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC5</td>
<td>55</td>
<td>23.0</td>
<td>45m²</td>
</tr>
<tr>
<td>BC6A</td>
<td>23</td>
<td>17.1</td>
<td>18m²</td>
</tr>
<tr>
<td>BC6B</td>
<td>4</td>
<td>11.5</td>
<td>3m²</td>
</tr>
<tr>
<td>BC7</td>
<td>31</td>
<td>7.2</td>
<td>24m²</td>
</tr>
<tr>
<td>BC8</td>
<td>13</td>
<td>5.2</td>
<td>10m²</td>
</tr>
<tr>
<td>BC9</td>
<td>22</td>
<td>4.2</td>
<td>17m²</td>
</tr>
<tr>
<td>BC10</td>
<td>39</td>
<td>3.1</td>
<td>30m²</td>
</tr>
<tr>
<td>BC11</td>
<td>225</td>
<td>3.11</td>
<td>45m (76m²)*</td>
</tr>
<tr>
<td>BC12</td>
<td>15</td>
<td>2.75</td>
<td>11.5m²</td>
</tr>
<tr>
<td>BC13</td>
<td>-</td>
<td>-</td>
<td>85m²</td>
</tr>
<tr>
<td>BC14</td>
<td>250</td>
<td>3.0</td>
<td>190m²</td>
</tr>
<tr>
<td>BC15</td>
<td>40</td>
<td>-</td>
<td>30m²</td>
</tr>
<tr>
<td>BC16</td>
<td>100</td>
<td>-</td>
<td>100 m²</td>
</tr>
</tbody>
</table>

*Refer comment in text relating to Bells Creek bridge.

8.9 Wetland Hydrology

8.9.1 Modelling Results

The fully developed case includes the proposed CAMCOS route as well as the fully developed Pelican Waters Development as shown in their development plan.

Two options were investigated:

Option 1 - included only the proposed waterway area for the Bells Creek and Lamerough Creek crossings which were 11.5m² and 190m² respectively. These preliminary waterway requirements arose out of initial flood conveyance sizings as given in section 8.8.

Option 2 - included approximately 1km of viaduct on the Bells Creek portion of the outlet.

The following table details the average 90th percentile (ie 90% of water levels are equal to or below this value) and peak water levels within the wetland for the development scenarios.

Table 8.9.1: Developed Case Statistics – Water Levels

<table>
<thead>
<tr>
<th></th>
<th>Dry Year (m AHD)</th>
<th>Average Year (m AHD)</th>
<th>Wet Year (m AHD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Developed 1</td>
<td>Developed 2</td>
<td>Developed 1</td>
</tr>
<tr>
<td>Average</td>
<td>0.52</td>
<td>0.52</td>
<td>0.53</td>
</tr>
<tr>
<td>90th Percentile</td>
<td>0.57</td>
<td>0.57</td>
<td>0.58</td>
</tr>
<tr>
<td>Peak</td>
<td>0.72</td>
<td>0.72</td>
<td>1.03</td>
</tr>
</tbody>
</table>

From the above results it is clear that the Option 1 waterway area for Bells Creek is not adequate for the larger runoff events (i.e. a peak of 1.48m AHD compared with 1.24m AHD for the existing case). However, the inclusion of the viaduct provides an adequate waterway area, with no significant change in wetland hydrology predicted.

Detailed results are provided in the Appendices.

An area of concern is the future stages proposed for Pelican Waters, in relation to the impact on the critical drainage paths. Drainage has already been significantly modified by the Pelican Waters development, and future stages show further filling around drainage paths, particularly of those to Lamerough Creek.

It is observed in these plots that there is a slight decrease in the peaks for the developed case. This can be attributed to a loss in catchment area by Pelican Waters in the southern portion of the catchment, thus resulting in less runoff from this area into the wetland.
8.9.2 Conclusions

Based on the detailed investigation described in this report, it is concluded that:

- The hydrologic performance and characteristics of the wetland is complex, and depends on long term seasonal rainfall and drainage via restricted outlets;
- The wetland has already been significantly altered by the Pelican Waters development; and
- Waterways sized on peak flood conveyance requirements alone have the potential to significantly alter the hydrologic performance of the wetland, hence, larger openings are recommended.

Additional long term monitoring of wetland water levels is required to better understand its complex characteristics.

8.10 Water Quality

8.10.1 Effects of the Scheme

As outlined in section 7.4, the potential impacts to water quality from the route would be highest during the construction phase. Areas exposed from the earthworks phase could contribute a high sediment load to receiving waters, unless mitigated. Increased sediment loads to the receiving waters (ultimately Pumicestone Passage for this section of the route), would be undesirable due to the numerous adverse ecological impacts which could occur. This could include decreasing light penetration (which has implications for photosynthetic and respiration processes), reducing the suitable habitat for some aquatic species which cannot tolerate such turbid conditions and reducing the aesthetic appeal of waterways. Siltation of the waterways may also occur, which can smother aquatic submerged macrophytes (which stabilise creek banks) and benthic fauna.

A smaller potential impact to water quality arises from accidental spillages of materials associated with rail construction (eg. fuel, lubricants etc.) during the construction phase. These materials could cause water quality degradation in downstream waterways, if not prevented from entering waterways.

During the operational phases, potential water quality impacts from the railway line are smaller than during the construction phase, with railways having only a minor potential for water quality impacts. Some increase in pollutant loads from the railway track may result, including some oils and greases and possibly herbicides (used to keep the tracks weed free). The potential for large hydrocarbon or pollutant spillages during the operational phase would also be small, as the railway would be electric and no large quantities of fuel or freight would be conveyed along the route.

During the operational phase of the railway, pollutants may accumulate on the carparking areas during dry periods and be washed into downstream waterways during subsequent runoff events. Depending on the pollutants accumulated, water quality degradation and adverse impacts to aquatic flora and fauna may result. Section 7.4.2 details the runoff characteristics anticipated from carparking areas, with increased heavy metal and hydrocarbon loads likely, unless mitigation measures are installed. Such impacts have the potential to affect the water quality of the immediate receiving waters and ultimately Pumicestone Passage. As detailed previously, Pumicestone Passage contains a Fish Habitat Area and currently receives unsustainable pollutant loads (Willing and Partners et al., 1993).

8.10.2 Response

The potential water quality impacts from the railway construction and operation would include the following measures.

8.10.2.1 Best Practice Sediment and Erosion Control Measures

Providing best practice sediment and erosion control measures are implemented and maintained during the entire construction phase, the potential impacts to water quality would be minimised. Such best practice sediment and erosion control measures would include the provision of sedimentation basins, flocculation of basin discharges, minimising exposed soil areas and diverting upstream runoff from exposed areas. More detail on the sediment and erosion control measures recommended for the construction phase of the railway would be determined at the design stage of the project. It has been recommended that sediment and erosion control measures be designed to effectively treat events up to a one in one year average recurrence interval, which is the largest event which can be practically treated with best management measures.

8.10.2.2 Treatment of Track Runoff by Vegetated Swales

It has been recommended that runoff from the railway and access tracks be directed into vegetated swales to filter runoff prior to it flowing into vegetated areas and/or waterways. Natural topography and drainage features would be utilised to direct runoff into the vegetated swales, and native vegetation would be retained for this purpose, where possible.

8.10.2.3 Minimise and Manage Herbicide Application

It is recommended that the application practices of any herbicides are carefully controlled, with no excess herbicide applied. Herbicides which have been designed to minimise potential water quality and faunal impacts, by degrading rapidly to harmless by-products are recommended.
8.10.2.4 Treatment of Carpark Runoff

Best practice mitigation measures recommended to reduce the load of pollutants from carparking areas prior to entering receiving waters include:

- Inclusion of sediment removal structures, such as Continuous Deflective System or CDS units, at major stormwater outlet points. Sediment removal units (such as CDS’s) are capable of removing 95% of all gross pollutants (ie litter and coarse sediment) from stormwater (Cargill R., July 1997). These units are also effective for removing hydrocarbons from stormwater runoff;
- Inclusion of vegetated swales, where possible, to filter minor runoff flows prior to discharge from carparking areas;
- Regular sweeping and maintenance of carparking areas to minimise the accumulation of pollutants in carparking areas; and
- Oil interceptors.

8.10.3 Assessment

In the Beerwah to Caloundra Road section of the railway, all waterways crossed are tributaries of Pumicestone Passage, an important waterway which currently receives unsustainable pollutant loads (Willing and Partners et al., 1993).

As the current pollutant load to Pumicestone Passage is unsustainable, further increases to the waterway (and its tributaries) should be prevented, wherever possible. In the context of the proposed railway, best management practices would be adopted to minimise the loss of sediment from construction areas. Such best practice sediment and erosion control measures would include the provision of sedimentation basins, flocculation of basin discharges, minimising exposed soil areas and diverting upstream runoff from exposed areas. More detail on the sediment and erosion control measures recommended for the construction phase of the railway would be determined at the design stage of the project.

During the operational phase, runoff from carparking areas at stations would be the largest potential water quality impact, as the railway route itself has potential for only minor effects on water quality. Mitigation measures for the carparking areas (see also section 7.4) would ensure pollutant loads from carparking areas are minimised and only minor increases, if any, in pollutant concentrations would result in receiving waters.

Overall, assuming the recommended mitigation measures are implemented and adequately maintained, the water quality impacts during the construction phase would be moderate adverse (based on the water quality assessment criteria outlined in section 4.6). The potential impacts to the highly significant waterways are able to be successfully mitigated. During the operational phase, the impacts would be minor adverse, based on only a minimal potential for increased pollutant loads to nationally significant waterways.

8.11 Cultural Heritage

8.11.1 Future Situation Without the Scheme

It is a preference among Cultural Heritage consultants and those working with archaeological sites, particularly Aboriginal sites, that such sites be left undisturbed. A number of reasons can be attributed towards this including issues of protection and ownership by Aboriginal groups.

Within the area of the proposed corridor a problem still exists in terms of management of cultural heritage, if the scheme does not go ahead. The area is still zoned to be impacted upon by considerable development well into the next millennia.

As these sites have been identified through the IAS process for CAMCOS, should the scheme not go ahead it is recommended that QT inform the relevant Shire councils as to cultural heritage matters, so that management of these sites can be absorbed back into the responsibility of the Shire.

8.11.2 Effects of the Scheme

Sections of land where cultural heritage is not apparent on the ground surface have been included in the following list of sites and impacts. These are areas where natural parameters such as high points, plus the local geomorphological conditions indicate the increased probability of sites being present in the sub-surface. In addition, areas of high ethno-botanical importance have also been included.

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Site Type</th>
<th>Impact Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Jinkers Tree</td>
<td>No impact, outside of proposed corridor.</td>
</tr>
<tr>
<td>S2</td>
<td>Silcrete flake</td>
<td>One artefact was located north of the proposed scheme, more material is predicted to be associated with this find but it is not likely that the corridor would impact on it as it is located some 200m to the south.</td>
</tr>
<tr>
<td>S3</td>
<td>Flaked piece</td>
<td>A small single silcrete flake was located. It is possible more flakes could be located although an extensive search was undertaken during field work. No impact predicted as the route is over 300m south of this find.</td>
</tr>
</tbody>
</table>
### Site Number | Site Type                  | Impact Assessment                                                                                           |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S4</td>
<td>Quarry site</td>
<td>Historic extractive site located in CSR land. Would not be directly impacted upon by construction activities.</td>
</tr>
<tr>
<td>S5</td>
<td>High Point</td>
<td>Sandy bank along a tributary of Bells Creek would be impacted by the corridor.</td>
</tr>
<tr>
<td>S6</td>
<td>Possible scarred tree</td>
<td>No impact, outside of proposed corridor route</td>
</tr>
<tr>
<td>S7</td>
<td>Scarred tree</td>
<td>No impact, outside of proposed corridor route</td>
</tr>
<tr>
<td>S8</td>
<td>Scarred tree</td>
<td>No impact, outside of proposed corridor route</td>
</tr>
<tr>
<td>S9</td>
<td>Scarred tree</td>
<td>No impact, outside of proposed corridor route</td>
</tr>
<tr>
<td>S10</td>
<td>Scarred tree</td>
<td>No impact, outside of proposed corridor route</td>
</tr>
<tr>
<td>S11</td>
<td>Midden</td>
<td>No impact, outside of proposed corridor route</td>
</tr>
<tr>
<td>S12</td>
<td>Fringe Camp, Duck Holes</td>
<td>Direct impact through western side of Rotary Park.</td>
</tr>
</tbody>
</table>

### 8.11.3 Response

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Site Type</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Jinkers Trees</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S2</td>
<td>Silcrete flake</td>
<td>Monitoring during construction activities.</td>
</tr>
<tr>
<td>S3</td>
<td>Flaked piece</td>
<td>Monitoring during construction activities.</td>
</tr>
<tr>
<td>S4</td>
<td>Quarry site</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S5</td>
<td>High Point</td>
<td>Monitoring during construction activities.</td>
</tr>
<tr>
<td>S6</td>
<td>Possible scarred tree</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S7</td>
<td>Scarred tree</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S8</td>
<td>Scarred tree</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S9</td>
<td>Scarred tree</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S10</td>
<td>Scarred tree</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S11</td>
<td>Midden</td>
<td>No response needed.</td>
</tr>
<tr>
<td>S12</td>
<td>Fringe Camp, Duck Holes</td>
<td>Negotiations with Richard Dalton line as to mitigation plans. Monitoring through the area recommended. Plaque to be erected on site describing the Aboriginal history of the area.</td>
</tr>
</tbody>
</table>

### 8.11.4 Assessment of Effects

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Site Type</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Jinkers Trees</td>
<td>None</td>
</tr>
<tr>
<td>S2</td>
<td>Silcrete flake</td>
<td>None</td>
</tr>
<tr>
<td>S3</td>
<td>Flaked piece</td>
<td>None</td>
</tr>
<tr>
<td>S4</td>
<td>Quarry site</td>
<td>None</td>
</tr>
<tr>
<td>S5</td>
<td>High Point</td>
<td><strong>Minor Adverse</strong></td>
</tr>
<tr>
<td>S6</td>
<td>Possible scarred tree</td>
<td>None</td>
</tr>
<tr>
<td>S7</td>
<td>Scarred tree</td>
<td>None</td>
</tr>
<tr>
<td>S8</td>
<td>Scarred tree</td>
<td>None</td>
</tr>
<tr>
<td>S9</td>
<td>Scarred tree</td>
<td>None</td>
</tr>
<tr>
<td>S10</td>
<td>Scarred tree</td>
<td>None</td>
</tr>
<tr>
<td>S11</td>
<td>Midden</td>
<td>None</td>
</tr>
<tr>
<td>S12</td>
<td>Fringe Camp, Duck Holes</td>
<td><strong>Major Adverse</strong></td>
</tr>
</tbody>
</table>
8.12 Noise and Vibration

8.12.1 Effects of the Scheme

8.12.1.1 Construction Noise and Vibration

The main construction activities on Beerwah to Caloundra Road section of the railway route would be:

- Construction of a viaduct over Glass House Mountains Road, Forestry Road and Bruce Highway;
- Clearance of a corridor through the Beerwah State Forest;
- Construction of a bridge over Mellum Creek;
- Construction of a bridge over Bells Creek;
- Construction of a railway embankment through mainly flat terrain not subject to flooding or controlled by culverts;
- Construction of viaduct over an area near Pelican Waters Development due to potential flooding and areas of ecological significance; and
- Construction of a railway station at Pelican Waters and Caloundra Road.

The main sources of noise during the construction in this section of the route would be the noise from the tree-felling activities (chainsaws, grinders and bulldozers) and earth moving activities (large trucks and embankment compaction equipment). The construction of the viaducts and bridges would produce noise from the use of earth moving equipment, concrete trucks, cranes, compressors, generators, and piling equipment.

Most of the Beerwah to Caloundra Road section of the proposed route is currently free of residential development. The only residential developments in this section of the proposed route are residences in the vicinity of the Beerwah Railway Station and residences at the Golden Beach/Pelican Waters area of Caloundra. Existing noise levels in the Pelican Waters area (see Table 5.13b, section 5.13) indicate a quiet residential area with background noise levels ranging from 34 to 42 dB(A). Levels in Beerwah area were higher, ranging from 41 to 60 dB(A), due mainly to natural noise from the nearby forest, with some local traffic. Construction noise would cause temporary loss of amenity for noise sensitive places with noise levels varying, depending on the type of activities being undertaken and their proximity.

Vibration levels due to construction activities are expected to be generally very low and would typically not be perceptible at the nearest residential locations. The activities which would tend to create the highest levels of vibration would be piling, rock breaking (if required), and vibrating compaction equipment. If this work is expected to occur within 25m of residences then vibration may become perceptible and monitoring would be undertaken in accordance with the EMP to address any concerns residents may have regarding the activities.

8.12.1.2 Operational Noise and Vibration

It has been assumed that the average train speed on the railway section from Beerwah to Caloundra would be 125km/h at the curve on the exit of Beerwah station and 140km/h until just before the Pelican Waters station.

In this section of the proposed railway line the EPP (Noise) planning criteria would be met at a distance of 32m from the centre-line of the track along most of the route where the railway line is likely to be built on a compacted soil embankment. In areas with concrete bridges, the noise would be higher and the noise criteria would be met at a distance of 42 metres from the centre-line of the track (see Figures 8.12.1a &b).

In the area just south of the Pelican Waters Station, the train speed would be reduced to an average of 100 km/h. As a result, the predicted noise level would be lower and the EPP (Noise) planning criteria would be met at a distance of 22m from the centre-line of the track on embankments and at a distance of 27 metres on concrete bridges and viaducts.

In this section of the proposed corridor there are no areas where the EPP (Noise) planning criteria would be exceeded. In spite of this, the operational noise levels would be greater than the Noise Indicator Levels at noise sensitive places in the densely developed areas near Beerwah station (where the nearest property boundaries are 65m from the railway line centre-line). It is of note that the implications of elevating Glasshouse Mountains Road over the CAMCOS route north of Beerwah has not been assessed in detail.

Considering likely future residential development in this section of the route, it is likely that some of the proposed developments in Pelican Waters area may be closer than 200 metres from the centre-line of the proposed railway line. If the noise emissions from the trains used at the time of the construction are the same as the current noise emissions, it is likely that some noise sensitive places in Pelican Waters could experience noise levels higher than the Noise Indicator Levels.

Vibration levels due to electric passenger trains passing residential areas are not expected to be perceptible to building occupants.

In addition to the electric passenger trains, maintenance work forms part of the operational noise associated with the rail lines. Most maintenance vehicles are powered by diesel motors and are fitted with exhaust silencers and in some cases acoustic enclosures are installed around the engines to minimise...
noise. While this will reduce the noise, the primary operations of tamping, grinding, ballast screening and placement are often noisier and are more difficult to treat. These operations are performed only occasionally and hence are not considered to represent a significant noise impact.

Railway stations for this section of the route are proposed at Beerwah, Pelican Waters and Caloundra Road. The two potential sources of noise from the stations are public address (PA) systems used for announcing train information to passengers, and vehicle noise associated with passenger set-down and pick-up and carparks.

Beerwah Station and Caloundra Stations are intended to ultimately have approximately 150-300 and 300-600 car parking spaces respectively. Noise would be generated by car movements in and out of the station and around the car parking areas. Pelican Waters station is only likely to have 20-30 car parking spaces and is not considered to be a significant source of noise.

8.12.2 Response

During construction noise mitigation measures would need to be implemented (as specified in the EMP Chapter 12). Provided such noise mitigation measures are implemented the impacts from the construction activities would be able to be controlled to minimise the levels at noise sensitive places.

Personal Address systems at stations would be designed to minimise noise to neighbours while maintaining speech intelligibility for passengers on the station platform. Design considerations include the use of directional loudspeakers aimed along the platform and spaced close together (eg. 15m) to allow the source level to be reduced. Modern systems also include the use of an automatic gain control circuit to control the level of automatic train announcements.

Noise impacts at Beerwah and Caloundra Road station car parks would be minimised by arranging the carparks to be accessed as directly as possible via busier roads. Where carparks are directly adjacent noise sensitive places, noise barrier fences may need to be erected to reduce intrusion from noise and car headlights. This would be assessed at the detailed design phase.

8.12.3 Assessment of Effects

During operation of the railway between Beerwah and Caloundra no noise sensitive properties would be subject to noise levels exceeding the EEP (Noise) planning criteria. This is considered to be a moderate adverse effect.

8.13 Forestry

8.13.1 Future Without the Scheme

With respect to the DPI Forestry land, if the CAMCOS project did not go ahead, the plantation areas would be used for continuing crops in perpetuity for use in Queensland. DPI F would not vary the land use on any of the sites as the State forest is critical to maintaining timber resources in the region.

The Caloundra Downs Informal Land Use Investigation Assessment Team is fully cognisant of the CAMCOS project and the proposed route alignment. Any future land use scenarios proposed for the area will therefore take the route into consideration.

8.13.2 Assessment of Effects

For harvesting purposes, DPIF requires that trees are logged 1.5 tree lengths from the energised rail line. This means that through the State forest the total area that needs to be cleared is a corridor 100m wide. This clearing distance is also required to:

- Provide a firebreak, which will both reduce the chance of bushfire ignition from the rail line and assist in protecting the rail line from damage from approaching wildfire; and
- Diminish the chance of falling trees at final harvest blocking or damaging rail infrastructure and associated power lines.

The route alignment would result in the isolation of a number of plantation units within the Bluegum Logging area. The following tables describe the amount of productive and non-productive land within the State Forest boundary that would be affected either directly or indirectly by the rail alignment. The information was supplied by DPI F at Beerburrum.

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Site Index</th>
<th>Planted</th>
<th>Area of 1st Rotation (ha)</th>
<th>Area 2nd Rotation (ha)</th>
<th>Other Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegum 202</td>
<td>27.1</td>
<td>03/86</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegum 14a</td>
<td>25.9</td>
<td>06/75</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegum 15</td>
<td>26.4</td>
<td>06/75</td>
<td>4.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegum 16a</td>
<td>27.0</td>
<td>06/75</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegum 208</td>
<td>29.2</td>
<td>09/89</td>
<td>3.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegum 209</td>
<td>30.0</td>
<td>07/89</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegum 210b</td>
<td>26.4</td>
<td>08/87</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DPI F requires that internal roads are all “through roads” for fire management purposes. With respect to access roads within the forestry compartments a number of haul roads would be severed.

8.13.3 Response

Generally the rotation cycle for plantation crops within the State Forest is over a period of 30 years. It is anticipated that at four of the Bluegum logging compartments planted in the early and mid 1970’s (see table above) would be able to be harvested before the rail line was constructed.

In terms of compensation for the early harvesting of parts of other compartments and also for the loss of productive land that can be harvested, DPIF would be seeking an equivalent area of land outside of the State Forest to be purchased. DPIF have already identified parcels of land that are currently on the market and these negotiations would occur between Queensland Transport and DPIF once the project has been approved by the Minister. This land would need to have the same demonstrated productivity as the land lost to CAMCOS to be able to match growth capacities.

A number of haul roads would have to be relocated to allow forestry operations to continue. A road paralleling the north and south side of the corridor is required to allow access to most compartments.

8.13.4 Assessment of Effects

The loss of productive forestry land within the State Forest is not considered to adversely affect overall forestry operations given that the mitigation measures given above are implemented.

8.14 Landscape

8.14.1 Introduction

The landscape analysis has focused on those areas that have been identified by the Consultants and through the public consultation process as being of concern to local residents. Within this section of the route the following locations are assessed.

- Beerwah where CAMCOS leaves the North Coast Rail line and Glasshouse Mountains Road is required to bridge the rail line.
- Crossing the Bruce Highway.
- Bells Creek/Pelican Waters.
- Caloundra Road crossing where the rail line is proposed to be taken over the road on a high viaduct structure.

8.14.2 Effects of the Scheme

8.14.2.1 Glass House Mountains Road Crossing

The crossing at the Glass House Mountains Road would be a grade separated elevated structure (see). The bridge would be viewed primarily from the Figure 8.14.2a road by car occupants as they travel toward the structure. Whilst crossing the bridge (which would be on a bend in the road, people travelling on the road would have an uninhibited view down the length of the cleared corridor through the forest area.

The bridge structure itself is a relatively elegant and slimline form which, despite the grade separation, is positioned below the line of the adjacent tree canopy and therefore would not protrude into the skyline. The alignment and design of the bridge promotes visual absorption of the structure within the surrounding densely vegetated landscape environment.

A visual impact would only be realised when crossing underneath the bridge, when, at this point, the full...
extent of the cleared 100m wide corridor through the State Forest would become apparent.

As the rail corridor passes through the areas of State Forest and private pine plantation it would not be visible to the small number of residential areas in this section.

8.14.2.2 Bruce Highway Crossing

An elevated bridge structure is proposed to cross the Bruce Highway, some 2km from the Bells Creek Road turnoff (see Figure 8.14.2b). The structure is set below the canopy line of the heavily forested surrounding landscape. The main viewpoint for this structure would be from the Bruce Highway.

The area through which the alignment traverses is characterised by a densely vegetated landscape associated with the Beerwah State Forest, which frames the Highway. As a consequence, the slimline form and scale of the elevated structure would be readily absorbed into the surrounds.

8.14.2.3 Bells Creek/ Pelican Waters

Through the Bells and Lamerough Creek wetland areas to the east of the Bruce Highway the rail alignment would be on a viaduct structure. West of Pelican Waters as the alignment turns northwards it would be constructed on an embankment. In this location it would be located some 200m from the nearest residential property and would either not be visible or not an intrusive feature in the landscape. The area surrounding Pelican Waters has already been significantly impacted as a consequence of the development of the residential estate.

8.14.2.4 Caloundra Road

At present the Caloundra Road skyline is dominated by a plethora of signs and overhead wires including lighting poles and telephone wires. The CAMCOS corridor through this area is an elevated bridge structure that would cross the road at a particularly visually cluttered point in the road (see Figure 8.14.2c).

Due to the visual clutter that dominates the urban road environment, the elevated bridge structure would be readily absorbed into the surrounds and barely visible from a distance. The structure itself represents an opportunity to rationalise and tidy up the signage and visual clutter within this precinct. Road signs may be attached to the parapet detail of the structure whilst central mounted signage systems at the ground level may provide greater visual organisation of signage information.

8.14.3 Mitigation

8.14.3.1 Glass House Mountains Road

Mitigation for the Glass House Mountains Road crossing would involve edge planting with lower shrub planting within the corridor to soften the edges so that it blends more with the existing environment.

8.14.3.2 Pelican Waters

At Pelican Waters there would be ample opportunity to mitigate against any adverse views through the creation of a landscape buffer. In fact an area of open space has been designated east of the proposed alignment which could be planted to screen any adverse filtered views from the residential development.

8.14.4 Assessment of Effects

8.14.4.1 Glass House Mountains Road

The slimline form of the Glass House Mountains Road crossing ensures that the road overpass would have only minor adverse effects and a localised visual impact upon the surrounding landscape when viewed from the road corridor.

8.14.4.2 Bruce Highway Crossing

The structure crossing the Bruce Highway would utilise unobtrusive materials and colours and may create a visual relief and reference point along the otherwise uniform landscape along the Bruce Highway. The impact of the crossing is considered to be minor adverse.

8.14.4.3 Bells Creek/Pelican Waters

With the proposed mitigation the visual effect of the alignment at Pelican Waters would be considered to be not significant.

8.14.4.4 Caloundra Road

In visual terms the crossing of the Caloundra Road is not considered to significantly impact on the local environment which is already heavily cluttered and urban in nature. The impact is considered to be minor adverse.

8.15 Overall Effects

The corridor passes on embankment through the State Forest and majority of the Caloundra Downs property. Extensive viaducts are proposed through the regionally significant wetlands of Bells and Lamerough Creeks in order to minimise impacts on these areas.
The route would not cause significant detrimental impacts on current land use planning for the area and it provides significant potential for future transit oriented development opportunities at Beerwah, Pelican Waters and in particular Caloundra Road stations. Only minor adverse effects would be experienced on Rotary Park and commercially owned properties in this section. Much of this section is currently free of residential development. Consequently no noise sensitive properties would be subject to noise levels exceeding the EPP (Noise) planning criteria. Only moderate adverse effects would result from anticipated increases in noise levels in this section.

Minimal traffic disruption can be expected during construction through careful planning and staging of works at the crossings of Glass House Mountains Road and the Bruce Highway.

Additional hydrological and groundwater assessment work was undertaken in the Bells and Lamerough Creek wetland areas to aid in the evaluation of impacts of the rail alignment on the regionally significant wetlands in this area (including the area of the proposed National Park). The results of the groundwater study concluded that the impacts of construction of the rail alignment would be minimal. The hydrological study of the wetlands confirmed that the area had already experienced significant adverse effects due to the development of Pelican Waters and that the inclusion of viaduct structures through these areas would provide an adequate waterway opening area with no significant change in wetland hydrology predicted.

The most significant residual environmental effects associated with the proposed scheme in this section result from impacts on ecological features. Severe adverse effects that are not able to be completely mitigated would be experienced with the construction of the rail alignment through the regionally significant Bells and Lamerough Creek wetland areas located west of Pelican Waters. In addition, construction impacts on Scientific Area 24, Bellbird, Mellum and Bells Creek are considered to result in major adverse effects.

A range of mitigation and offset measures have been incorporated with the scheme to ameliorate these impacts such as:

- Inclusion of a compensatory habitat policy to offset losses of areas of ecological significance that cannot be mitigated. The intent is that areas of at least equal conservation value would be sought which could be acquired and/or rehabilitated to compensate for the loss and/or degradation (including edge effects) of native flora and fauna habitat within the public transport corridor.
- Specific design features to mitigate direct and indirect effects on ecological features including:
  - viaduct structures through wetlands and other areas to minimise direct clearance requirements, allow fauna movement and maintain the hydrological regime; and
  - wider bridge structures than required for purely hydraulic reasons at creek crossings to allow for maintenance of fauna movement.

- Buffer planting along exposed forest edges; and
- Measures to minimise additional clearing outside of that required for safety reasons.

During the operation of the railway minor adverse effects would result based on only a minimal potential for increased pollutant loads into nationally significant waterways such as the Pumicestone Passage. The operational effects on aquatic ecology in this section are considered to be moderate adverse.

Major adverse effects would be associated with the construction of the proposed alignment and part of Caloundra Station on the Aboriginal Fringe camp at Duck Holes Creek. It is understood that these effects would be satisfactorily mitigated through consultation and negotiation with the Undumbi people and the documentation and illustration of the history of this site.

In relation to effects on the existing landscape the key impacts in this section relate to newly proposed bridge crossings north of Beerwah, across the Bruce Highway and across Caloundra Road. In each case, given the local environment and the form of the structures proposed only minor adverse effects are anticipated.

The Environmental Management Plan in Part C, Chapter 12 takes forward all of the mitigation measures proposed in this Part of the IAS report. It provides a detailed description of how those measures are to be implemented to help achieve and maintain acceptable levels of environmental impact during the design, construction and operation of the scheme.