Erosion and pollution

During construction, erosion potential would be minimised by staging works and minimising the extent of disturbed areas, not clearing areas until needed, as well as undertaking progressive restoration and revegetation. Erosion would be further minimised by retaining remaining vegetation cover, wherever possible, and by managing stormwater flows to reduce flow rates as much as possible. Following construction, erosion control would be achieved by implementing appropriate bank stabilisation measures, for example through the use of jute matting incorporating sterile seeds (e.g. millet) to provide stability. Native species would be planted in these areas.

Potential contaminants would not be stored in or in proximity to natural waterways; refuelling of machinery would similarly be undertaken at least 30 metres from natural waterways in clearly marked designated areas that are designed to contain spills and leaks. Chemical spill kits would be readily available and accessible to construction workers and all hazardous materials spills and leaks would be reported to site managers. All appropriate spill containment measures would be adopted and incorporated into the CEMP.

Monitoring

The Project will impact threatened biodiversity including *Pultenaea parviflora*, *Grevillea juniperina* subsp. *juniperina*, Shale Gravel Transition Forest, River-flat Eucalypt Forest and Cumberland Plain Woodland. Mitigation measures will be implemented to minimise the impacts and monitoring would be undertaken to measure the effectiveness of the proposed mitigation measures. Monitoring and reporting of the outcomes of management and mitigation actions is important in ensuring the effectiveness of the monitoring. This would feed back to the management plans in an adaptive manner.

Offsets

All native vegetation proposed to be cleared occurs within the NWGC biodiversity certified area, and as such no project-specific offsets are required under State legislation. Overall compensation for loss of habitat is provided under the biodiversity certification as part of the Growth Centres SEPP. Biodiversity certification will provide $530 million to purchase areas of high conservation value or to enter into private conservation agreements, both within and outside the Growth Centres.

8.7 Water quality and hydrology

8.7.1 Construction impacts

Water quality

The potential effect of the Project on water quality would primarily relate to potential pollution of stormwater run-off with sediments, fuels and other hazardous materials from construction sites. As discussed in Section 9.3.1, the widening of fill embankments, cuttings, excavations and clearing of vegetated land could result in increased erosion and subsequent sediment delivery to local waterways.

The potential impacts associated with increased sediment loading include increased turbidity and an increased potential for the transport of contaminants bound to sediment particles. The mobilisation of contaminants within stormwater run-off is of particular concern in areas that have been identified as moderately to highly likely to contain contaminated materials that may be uncovered during construction (refer Section 3.11). The transportation of

contaminated soil from construction sites could also affect waterways outside of the project area if the contaminants are allowed to escape containment measures. Further discussion relating to soil erosion management issues are provided in Section 9.3.1. Similarly, contaminated land issues are further discussed in Section 9.4.

Water quality impacts associated with erosion and sedimentation would be greatest where construction works are undertaken adjacent to existing waterways (including stormwater drains traversing beneath the rail corridor) and where existing culverts are required to be replaced or extended (refer Section 3.7.1).

Chemical spills and leaks associated with the transportation, use and storage of hazardous materials could contaminate stormwater run-off from the construction site. Spillage of diesel, lubricating oils or other chemicals could occur during refuelling and/or maintenance of construction vehicles, while leakage of fuels or oils could occur from poorly maintained construction vehicles. Any on-site chemical spill or leak could adversely affect the water quality within Eastern Creek and its tributaries. Water quality outside of the project area could also be affected during the transportation of hazardous materials to and from construction sites. Management of chemical spills is further discussed in Section 9.7.

The uncovering of saline and/or contaminated groundwater, and its subsequent disposal, could also affect water quality in Eastern Creek and its tributaries. As discussed in Section 3.7.2, the water table is expected to be high in the project area, particularly between 300 and 900 metres north of Quakers Hill Station (Maunsell 2006a). In areas where the water table is high, groundwater may be encountered during excavation, requiring disposal during construction. It is likely that saline groundwater conditions could exist within the Project area due to the moderate to high salinity potential in the area. There is also the potential for contaminants to be present within groundwater, particularly in areas identified as having moderate to high potential for presence of contaminated materials (refer Section 3.11).

Surface water

There could be temporary impacts to local surface water system behaviour during the construction of the Project. These impacts could include temporary loss of floodplain storage and temporary redistribution of flood flows as a result of material stockpiles and works within flowpaths and at culvert crossings. These impacts would be temporary and would be dependent on the occurrence of a flood event during the construction. To reduce the potential impacts to surface water systems, no stockpiles would be located within the high/medium flood risk areas or adjacent to existing culverts.

Where culverts are to be extended or augmented, water flows and drainage systems would be maintained at all times. A number of measures would be implemented to control water quality and hydrologic impacts during the construction of the Quakers Hill to Vineyard Duplication Project. The measures would be consistent with the principles and practises detailed in Landcom's *Managing Urban Stormwater: Soils and Construction* (Landcom 2004).

8.7.2 Operation impacts

Water quality impacts

Potential exists for stormwater run-off to become contaminated with sediments, fuels, oils and/or other materials, which may be washed into the stormwater system from stations, car parks, the rail corridor and exposed surfaces. Potential contaminants are listed in Table 8-39. Contaminated stormwater could adversely impact the water quality in Eastern Creek and its tributaries.

Run-off from the new car parks and bus interchange facilities at Schofields and Vineyard could be contaminated with fuel, oil and/or other chemicals from leaking cars and buses using these facilities. Chemical spills and leakage during the operational maintenance could also reach local waterways via the stormwater network. Chemical spill and leakage is discussed in Section 9.7.

As the NWGC becomes increasingly urbanised, the area of paved and other impermeable surfaces will also greatly increase. This is expected to lead to an increase in stormwater runoff quantity and volume of pollutants that would be likely to affect the quality of receiving waters. The increase in volume of stormwater runoff and increased volume of pollutants that would result from the Project would be minor in comparison to that resulting from the development of the NWGC.

Table 8-39 Runoff constituents and sources

Pollutant	Description	Examples of primary sources
Gross pollutants	Litter, debris, organic matter	Station forecourts, car parks, vegetated areas
Sediment	Particulate	Pavement wear, car parks, land surface erosion, atmospheric deposition, maintenance, spills
Nutrient	Nitrogen, phosphorous	Atmospheric deposition, fertiliser application, organic matter (grass, leaves), animal faeces
Metal (toxicants)	Lead	Car parks (tyre wear), motor oil, grease
	Iron	Car parks (auto rust), moving engine parts
	Copper	Metal plating, bearing and brushing wear, moving engine parts, brake lining wear, fungicides and insecticides
	Cadmium	Car parks (tyre wear, catalytic converters), insecticides
	Chromium	Metal plating, moving parts, brake lining wear
	Nickel	Diesel fuel and petrol exhaust, lubricating oil, metal plating, brushing wear, brake lining wear, asphalt paving
	Manganese	Moving engine parts
	Sulfate	Fuels
	Zinc	Car park (tyre wear)
	Mercury	Diesel fuel exhaust
Oil and grease	Visible oils	Asphalt pavements, leaks from motor vehicles, organic matter

Pollutant	Description	Examples of primary sources
Hydrocarbons	Petroleum	Spills, leaks or blow-by of motor lubricants, anti-freeze and hydraulic fluids, asphalt surface leakage
	Polychlorinated biphenyls (PCB)s	Background atmospheric deposition, PCB catalyst in synthetic tyres

Source: Adapted from RTA 2003

Surface water

The changes to the surface water system include a change to the hydrologic processes and the hydraulic behaviour of both the local system and the wider catchment. Both local and catchment impacts are considered in the following sections. The wider catchment impacts are considered in the context of flooding impacts.

Local surface water systems

At the local scale, the changes to culvert crossings would have the largest impact to the local surface water system. If not properly considered as part of the detailed design process, the Project has the potential to exacerbate local flooding impacts by:

- increasing run-off flow and volume from the additional impervious surfaces
- affecting the ability of the of existing culverts to deal with the increased run-off and causing water to pond to higher levels behind the rail embankment
- changing the behaviour of existing culverts and impacting on informal detention systems that may currently assist in attenuating flood peaks within Eastern Creek
- changing the downstream velocities, and therefore, increasing erosion potential due to the extension of culverts.

Specific examples of these changes could occur at the new stations and car parks and following the demolition of the existing Schofields and Vineyard stations. Changes to the local flow regime and behaviour would also change erosion and sedimentation behaviour, which may be the result of increased run-off from newly sealed surfaces (such as the new stations and car parking spaces) onto poorly vegetated natural surfaces and/or as a result of an increase in exposed surfaces (such as unsealed access tracks, or following demolition of the existing Schofields and Vineyard stations).

The new Schofields Station is proposed to be built at the top of a topographical high point. There is the potential for impacts to the existing longitudinal drainage and existing downstream cross-drainage system as a result of increased surface run-off due to additional hard surfaces. This would change the local hydrologic regime, with less infiltration and sheet flow, and a tendency for an increased volume of runoff and channelised flow. These issues would need to be considered further during detailed design.

With respect to these local changes, Figure 8-12 indicates the location of the proposed culverts for the Project and indicates the freeboard available in the 50 and 100 year average recurrence interval (ARI) events. At each of the culverts, the flood risk category is also identified. These flood risk categories indicate the potential magnitude of the impact as a result of changes to the culvert. An assessment of flood impact at these culverts was completed by Maunsell (2007) based on preliminary concept proposed culvert sizes. A summary of this assessment is provided in Table 8-40.

Table 8-40 Summary of flood risk assessment

Culvert	50 year ARI freeboard (m)	100 year ARI freeboard (m)	Flood risk category	Change in 50 year ARI headwater level	Change in 100 year ARI headwater level	Potential impacts
2	0.77	0.71	High	-1.01	-1.31	Reduction in flood extent for local event
3,4,5	0.87	0.87	High	-1.77	-2.12	Reduction in flood extent for local event
6	0.79	0.76	High	-0.79	-1.18	Reduction in flood extent for local event
7[2]	1.27	0.98	Low	n/a[1]	n/a[1]	Anticipated negligible increase in flood impact based on preliminary concept design
10	0.85	0.93	High	-0.06	n/a[1]	
11	1.21	0.93	Medium	-0.99	-1.47	Reduction in flood extent for local event
12	1.31	1.37	Medium	-1.19	n/a[1]	
13	0.35	0.14	Medium	-0.14	-0.16	Reduction in flood extent for local event
14	nil	Nil	High	No change	No change	No change, downstream flood depending
16	nil	Ni	High	No change	No change	No change, downstream flood depending
17	nil	nil	High	No change	No change	No change, downstream flood depending

Source: Culvert Flood Assessment Report (Maunsell, June 2007).

Note 1: n/a = No existing headwater level is available for comparison.

Note 2: Culvert 7 has been remodelled and preliminary analysis indicates there will be no significant increase in flood levels. This will be further investigated during detailed design.

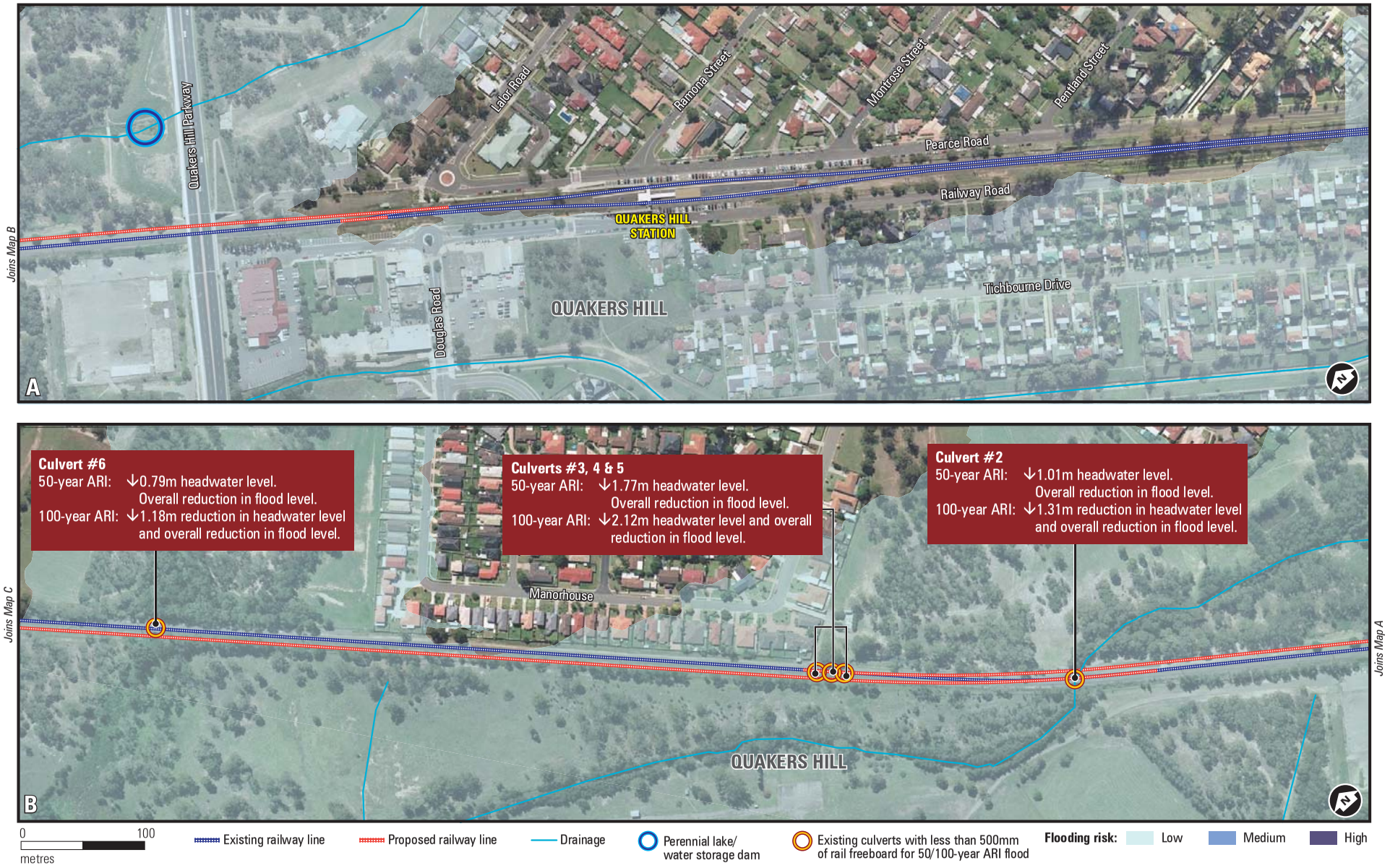

Figure 8-12a Location of the proposed culvert works and indicative flood level for 50- and 100-year ARI event

Note: Project detail shown is indicative only, subject to detailed design.

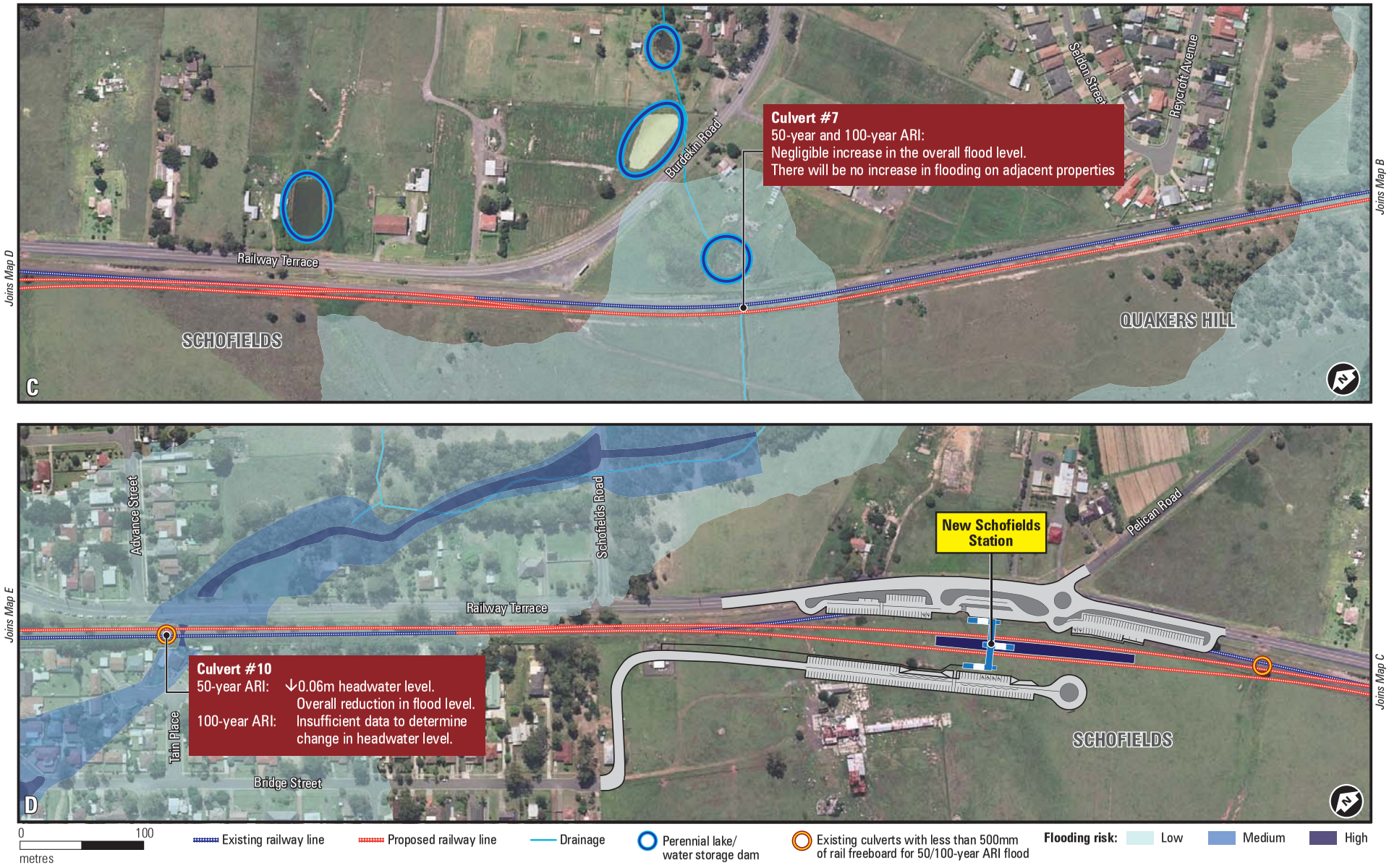

Figure 8-12b Location of the proposed culvert works and indicative flood level for 50- and 100-year ARI event

Note: Project detail shown is indicative only, subject to detailed design.

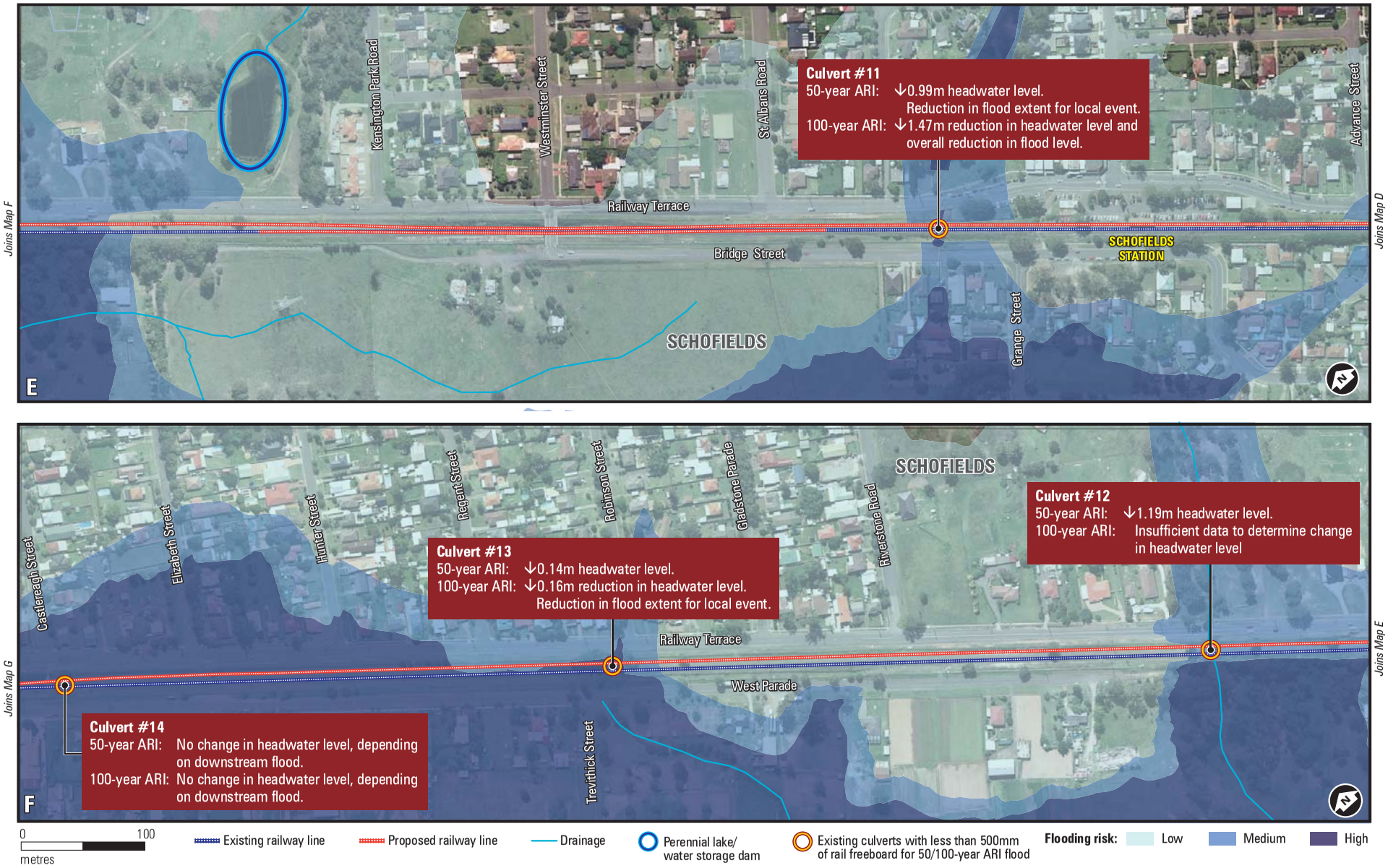

Figure 8-12c Location of the proposed culvert works and indicative flood level for 50- and 100-year ARI event

Note: Project detail shown is indicative only, subject to detailed design.

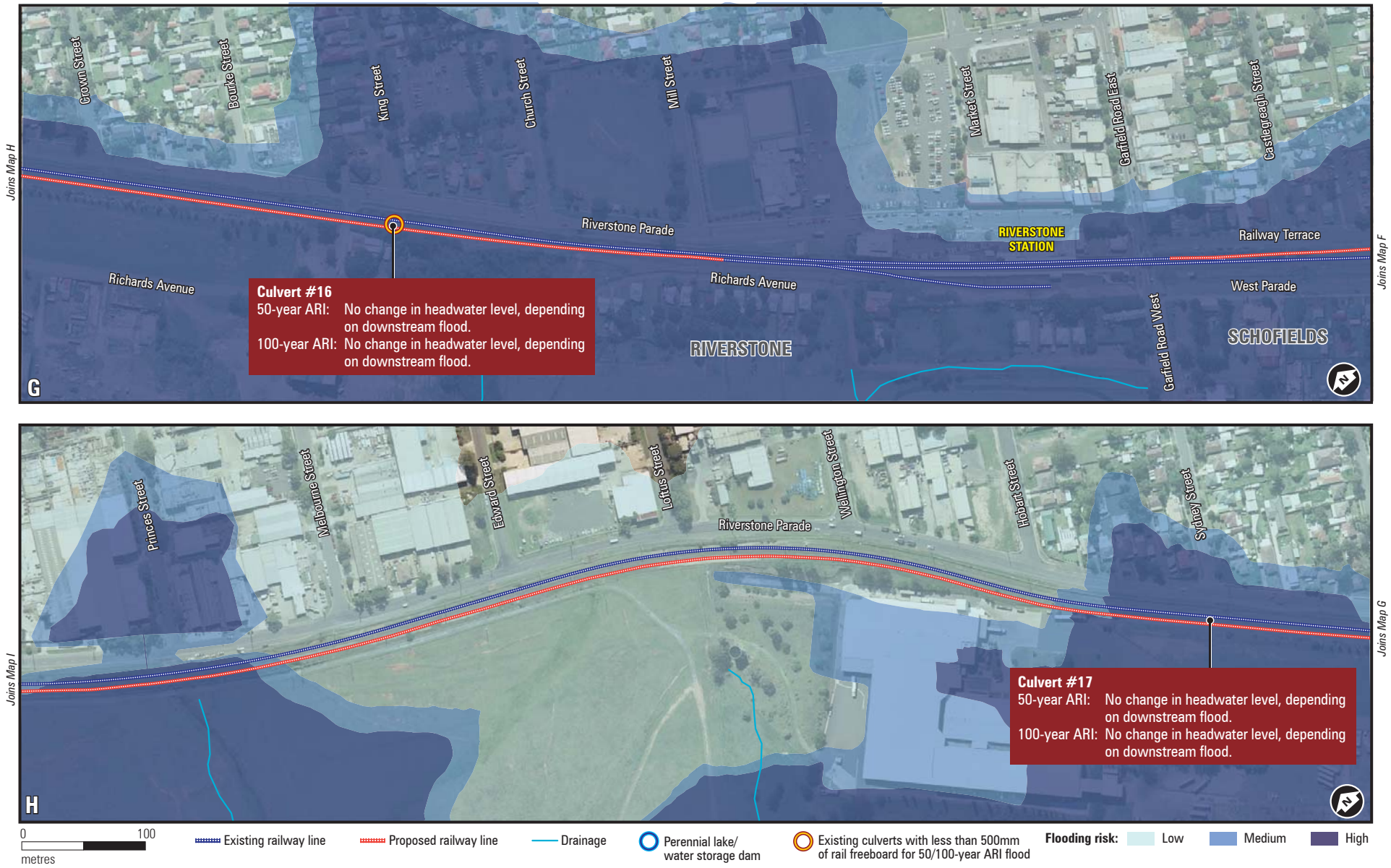

Figure 8-12d Location of the proposed culvert works and indicative flood level for 50- and 100-year ARI event

Note: Project detail shown is indicative only, subject to detailed design.

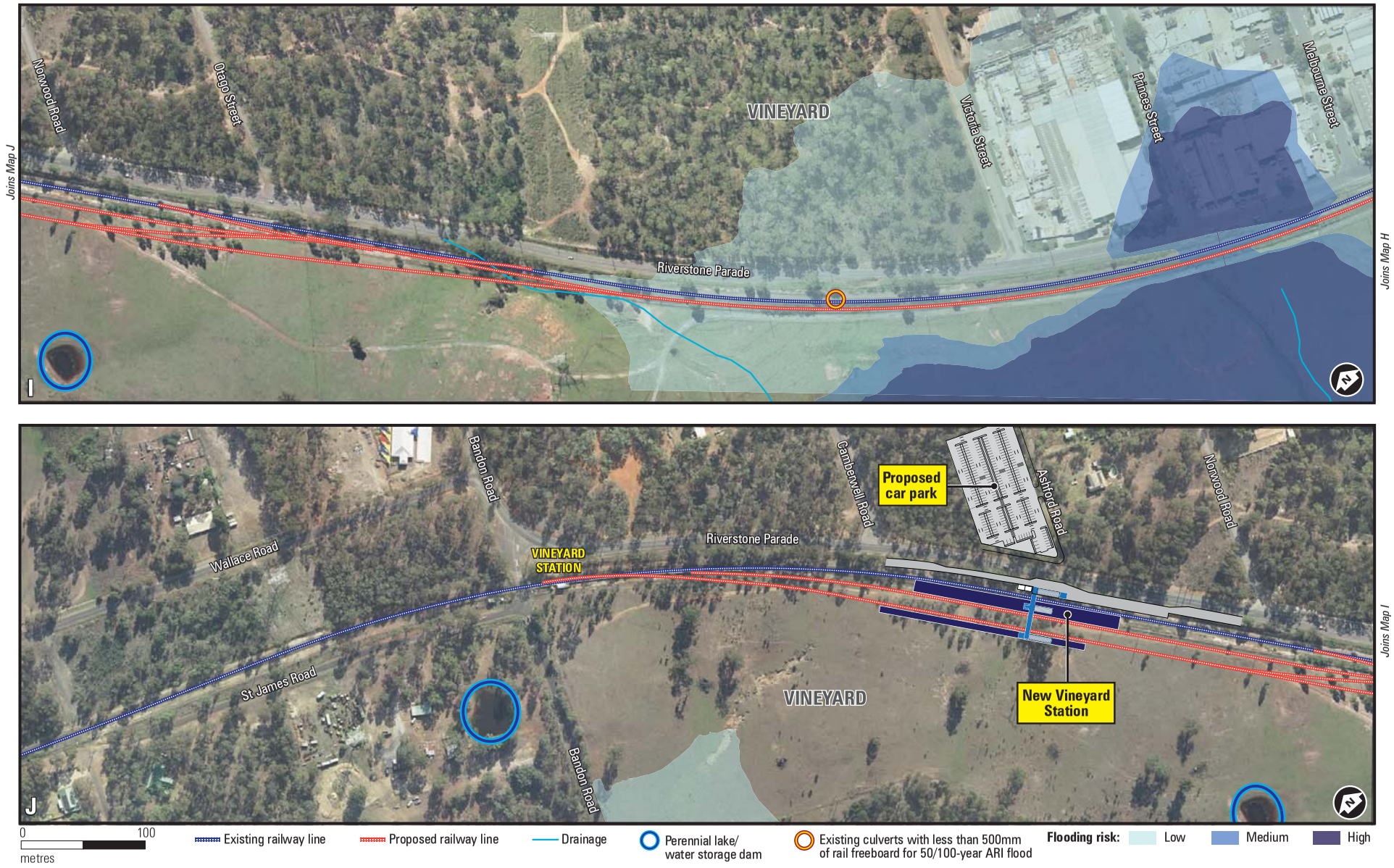

Figure 8-12e Location of the proposed culvert works and indicative flood level for 50- and 100-year ARI event

Note: Project detail shown is indicative only, subject to detailed design.

Flooding

The study area is located in the lower reaches of the Eastern Creek catchment, approximately 10 kilometres from its confluence with the Hawkesbury River. Parts of the study area are located in areas that are prone to low, medium and high risk flooding, as defined by BCC.

BCC has mapped the flood extents of the 100 year ARI and (probable maximum flood) PMF floods for the Hawkesbury Nepean River and the Eastern Creek catchments. This information is presented on Figure 8-12. The local flood impacts have been considered in detail as part of this investigation.

The existing rail line is at an elevation above the Eastern Creek floodplain that is not impacted by local flooding originating within the Eastern Creek catchment for storms up to the 100 year ARI event. However, as detailed in Section 3.7.1, the existing regional Hawkesbury-Nepean flood behaviour of the greater Hawkesbury-Nepean catchment currently results in sections of the existing rail corridor being inundated and overtopped as a result of backwater influences by as much as 2.7 metres for the 100 year ARI storm event.

Significant sections of the duplication of the rail line impinge on the Hawkesbury-Nepean floodplain, which includes the Eastern Creek catchment. The associated embankment that would be built for the Project would impinge into the full range of flood risk categories, high, medium and low, and therefore, may have an impact on the flood behaviour of the Hawkesbury-Nepean floodplain.

This impact would be due to the loss of floodplain storage, and would vary depending on the flood risk classification. For areas of low flood risk, the loss of floodplain storage would not have a significant impact on flood levels or flood extent. For high risk areas, the loss of floodplain storage could potentially have a significant impact on flood extents and levels. For the Project, the volume associated with the embankments is very small compared to the overall volume of floodwaters expected for a Hawkesbury-Nepean catchment-wide flood event. The Project is, therefore, likely to have a minimal impact on the flood levels in the Hawkesbury-Nepean floodplain. These impacts would apply for all events up to and including the PMF.

A preliminary assessment of the PMF event on Eastern Creek and the Hawkesbury-Nepean River has been conducted for this stage of the Project based on PMF levels reported for the Hawkesbury-Nepean River (GHD 2008). The existing PMF flood level, as noted in Section 3.7, is 26.4m AHD which will inundate the rail line for the majority of the length between Quakers Hill and Vineyard. The total fill required for the Project is estimated at 75,030 cubic metres. In comparison to the regional Hawkesbury-Nepean floodplain, this loss in flood storage is insignificant with a resulting impact to PMF flood levels estimated to be in the order of 0% to 0.1% (Richmond Line Alliance 2009). During the detailed design of the Project and culverts, all potential flood impacts will be considered to ensure that potential impacts to PMF levels on Eastern Creek will be minimised and that all local planning and evacuation documents are current such that safe evacuation routes continue to be provided.

The impact of climate change on Sydney's north-west region will potentially effect local weather patterns, storm intensities and potential flooding. An increase in the intensity of rainfall events would mean that the rainfall expected to occur in a 100-year average recurrence interval (ARI) flood event would occur more frequently (on average once every 50 years (CSIRO 2007). The impact of increased flood events as a result of climate change would need to be considered further during the detailed design of rail corridor culvert

crossings and stormwater drainage systems. Section 9.6.2 discusses in further detail the cumulative impact expected for the Project resulting from climate change impacts.

Measures that would be incorporated into the detailed design are discussed in Section 8.7.3.

8.7.3 Management measures

Construction

A number of measures would be implemented to control water quality and hydrologic impacts during the construction of the Quakers Hill to Vineyard Duplication Project. These measures would be detailed in the soil and water quality management plan within the CEMP prior to construction. The measures would be identified in consultation with relevant government agencies and councils, and would be consistent with the principles and practises detailed in Landcom's *Managing Urban Stormwater: Soils and Construction* (Landcom 2004). The existing RailCorp and BCC drainage systems would remain operational throughout the construction of the Project.

Groundwater encountered during the construction of the Project would be managed and disposed of in accordance with DECC requirements, including the *Waste Classification Guidelines* (DECC 2008).

To reduce the potential impacts to surface water systems, no stockpiles of materials would be located within the high/medium flood risk areas or adjacent to the existing culverts.

Operation

Measures to minimise impacts to water quality and surface water systems during operation of the Project would be determined during detailed design. Some of the options to be considered are outlined below.

Water quality treatment

A number of different stormwater treatment options are available and would be considered during the detailed design phase. Stormwater treatment measures may be grouped into three categories based on their designed level of treatment — primary, secondary or tertiary (refer Table 8-41).

Table 8-41 Levels of stormwater treatment

Level of treatment	Description	Typical retained pollutants[1]	Examples
Primary	Screening of gross pollutants	Gross pollutant	Grates and pits at drainage entrance or exit.
	Sedimentation of coarse particles	Coarse sediment	
Secondary	Sedimentation of finer particles	Fine particles	Vegetation to slow run-off, promote sedimentation of suspended solids and in some cases allow uptake of some soluble pollutants.
	Filtration	Attached pollutants	
Tertiary	Enhanced sedimentation and filtration	Nutrients	Sand filters
	Biological uptake	Heavy metals	
	Adsorption on to sediments	Free oils and greases	

Source: Adapted from RTA 2003

Note: 1: Refer Table 8-40 for further details of typical pollutants

The final selection of the most appropriate treatment measures would be undertaken during detailed design based on likely stormwater quality impacts, however, preliminary measures have been incorporated into the preliminary concept design and are discussed below and in Section 6.3.2.

Where possible, water quality would be maintained using a similar system to that already in use along the rail corridor (refer Section 3.7). Formalised grass swales along the proposed track would be developed, or maintained, and could include check dams and trash racks at culvert crossings as required. Similarly, the principles of water sensitive urban design would be incorporated in to the detailed design of the Project where feasible.

Gross pollutant traps can trap litter, oil, organics and sediment, and where practicable would be at outlet points from the track drainage into BCC's drainage system. Maintenance access would also be provided.

Run-off from unsealed vehicular maintenance access tracks could require silt collector pits installed on Project drainage infrastructure prior to connection points to Council drainage.

The maintenance of the tracks, stations or any other rail infrastructure would be managed through the implementation of RailCorp's operational and maintenance procedures so as to limit operational water quality impacts as far as practicable.

Surface water

Local surface water systems

The detailed design will carefully consider the potential impacts of the Project on the existing local surface water systems and flood regime to meet the following objectives:

- Works associated with the Project will ensure that the resultant flood immunity is at least equal to that of the existing rail line.
- The Project works will not exacerbate existing flood impacts on adjoining properties for all storms up to and including the 100 year ARI event in a manner that will unreasonably impact on the affected properties.
- The project works will ensure all culvert crossings are designed in accordance with *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (NSW Fisheries, January 2003) to ensure minimal impact to fish passage and general aquatic wildlife within the waterways crossed by the rail line.
- The Project works will not exacerbate existing flooding behaviour of key evacuation routes or critical buildings, such as hospitals, emergency services buildings, and buildings that are difficult to evacuate (e.g. nursing homes). Such buildings would not be impacted for all storm events up to and including the PMF.

Flooding

All surface water mitigation measures related to flooding will be developed in accordance with the *NSW Floodplain Development Manual* (DIPNR, 2005). The manual provides guidance for the development of sustainable strategies for managing human occupation and use of floodplain areas. Whilst the manual has been specifically developed for use by local government authorities in the management of flood liable lands, the manual is also of use to other organisations, including NSW Government agencies involved in floodplain risk management.

The manual recognises the Government's Flood Prone Land Policy, the primary objective of which is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, using ecologically positive methods wherever possible. The policy also recognises that:

- flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved.

As sections of the new rail embankment would encroach into the Eastern Creek floodplain, consideration of the potential impacts of the Project with respect to the planning objectives of the *NSW Floodplain Development Manual* is warranted.

A detailed flood impact assessment would be prepared during detailed design of the Project. The assessment would include modelling of potential flood impacts in existing medium to high risk flood areas as a result of the Project, including consideration of embankment widening (filling) activities within the floodplain, and culvert extension/replacement works. The assessment will inform the detailed design process to ensure that the Project works do not exacerbate existing flood impacts at properties adjoining the corridor for storms up to the 100 year ARI event.

As part of the detailed design process, the duplicated track and associated embankment works would not exceed the elevation of the existing rail embankment at any location where overtopping currently occurs.

Any informal detention system that may be impacted by a proposed culvert upgrade would be assessed to determine how that storage loss affects flood flows in Eastern Creek. If required, measures would be incorporated into the design to mitigate the storage loss.

Where reasonable and feasible, stormwater detention shall be provided for new impervious surfaces in consultation with Blacktown LGA.

The detailed design for the Project would include provision for appropriate scour protection upstream and downstream of extended or upgraded culverts, where necessary, to minimise the risk of channel erosion.

Currently, for periods where backwater flooding of the Hawkesbury Nepean floodplain occurs over tracks, trains would cease running temporarily. Partial services may exist depending on the extent of flooding in the area, any damage caused by the flooding or the assessed level of risk to public safety where flooding occurs. Emergency plans for the CityRail network exist and hence, the operation of the duplicated line would follow current RailCorp safety practices associated with flood events.