6.2 Hydrology and flooding

Hydrological and hydraulic studies were completed to identify design requirements to mitigate the changes in potential flooding risks and to address the requirements of the proposal. Refer to the *Great Western Highway Upgrade – Medlow Bath Hydrology and Hydraulic Impact Assessments* (Mott MacDonald, 2021a) in Appendix E.

6.2.1 Methodology

The hydrological performance of key features of the stormwater drainage system comprising pipes, culverts, open channels and head walls has been assessed through DRAINS model. The assessment approach included:

- hydrologic and hydraulic analysis of existing cross drainage structures
- hydraulic analysis to identify culvert upgrades required for the works
- development of a high-level strategy for discharging runoff from the new pavement drainage system
- impact assessment of the proposed works during construction and operation
- design for mitigation to reduce the impacts of the proposal in terms of water quality and quality of run off.

Data sources

The assessment was completed based on draft masterplans for Medlow Bath Park, digital survey, utility and environmental GIS data, and road design information as detailed in Appendix E.

Existing cross drainage structures

A schedule of the existing cross drainage structures along the Great Western Highway that provide capture and conveyance of upstream runoff are listed below, with information on these culverts obtained through a detailed survey.

- CX3480 - CH3480, 1no. 375 millimetre diameter pipe
- CX3770 - CH3770, 1no. 450 millimetre diameter pipe
- CX3960 - CH3960, 1no. 450 millimetre diameter pipe
- CX4200 - CH4200, 1no. 450 millimetre diameter pipe
- CX4220 - CH4220, 1no. 375 millimetre diameter pipe.

Performance for existing structures:

Due to the small and urban nature of the upstream catchments, the flow regime reflecting the critical storm conditions are consistently short and flashy events with high intensity rainfall. Assumptions were made on the size of cross drainage structures downstream of CX3770, CX3960, CX4200 in the rail corridor as this information is not embedded into the Digital Sending Software digital utility information on the drainage features within the corridor.

The identified drainage standards of existing drainage structures were:

- CX3480 at 2 per cent Annual Exceedance Probability (AEP), discharges freely
- CX3770 at 1 per cent AEP, assumes unblocked rail cross drainage downstream. Rail hydraulic standard less than 1 per cent AEP
- CX3960 at 10 per cent AEP, assumes unblocked rail cross drainage downstream. Rail hydraulic standard less than 1 per cent AEP
- CX4200 at 20 per cent AEP, constrained by downstream rail cross drainage

- CX4220 at 20 per cent AEP, Constrained by downstream rail cross drainage.

A range of rainfall intensities were then selected to assess the existing cross drainage performance, including 1 per cent, 2 per cent, 5 per cent, 10 per cent and 20 per cent AEP storm events and the details are summarised below.

- At 1 per cent AEP, the existing cross drainage structures CX3480, CX3960, CX4200, CX4220 showed overflow results
- At 2 per cent AEP, the existing cross drainage structures CX3960, CX4200, CX4220 showed overflow results
- At 5 per cent AEP, the existing cross drainage structures CX3960, CX4200, CX4220 showed overflow results
- At 10 per cent AEP, the existing cross drainage structures CX4200 and CX4220 showed overflow results
- At 20 per cent AEP, the existing cross drainage structures showed no overflow results.

Design assumptions

The study recognises future upgrade considerations due to the potential impact on peak flows of future development and climate change. TfNSW design criteria for blockage of cross drainage structures has not been considered in the capacity assessment below but would form part of the design criteria for the cross drainage structures in detailed design.

Uplift in rainfall intensities as a result of temperature increases under the latest climate projections in the Australian Rainfall and Runoff 2019 (ARR 2019) have also been incorporated into design infrastructure. The cross drainage capacity for the proposal would be upgraded to 1 per cent AEP inclusive of climate change uplift for the RCP 8.5 in line with the ARR 2019. (The RCP refers to the ‘Representative Concentration Pathway that takes into account emissions of greenhouse gases, aerosols and other chemically active gases, and land use and cover. An RCP of 8.5 represents a scenario at the higher end of likely temperature increases.)

6.2.2 Existing environment

Regional context

The proposal is in the vicinity of multiple tributaries comprising ephemeral streams that feed into the larger river systems of the Coxs River and Grose River. These catchments predominantly comprise of native vegetation with small portions of urban development located adjacent the transport corridor of the Great Western Highway and adjacent rail corridor.

The study area for the hydrology assessment covers 10.58 hectares including Medlow Bath Station and interchange, as well as Medlow Bath Park to the east and downstream of the major sag location and cross drainage structures for the transport corridor. This major sag just south of the existing railway station collects runoff from the majority of the study area and directs the flow to the receiving Adams Creek to the west. Smaller portions of the study area drain to the remaining watercourses.

Climate

Average monthly rainfall for the nearest rainfall station at Katoomba (063039, Murri Street) indicates the area experiences larger summer rainfalls than during the winter months. This is indicated in the Figure 6-3 average monthly plot, with the annual average rainfall at 1,400 millimetres across the 134 year record.

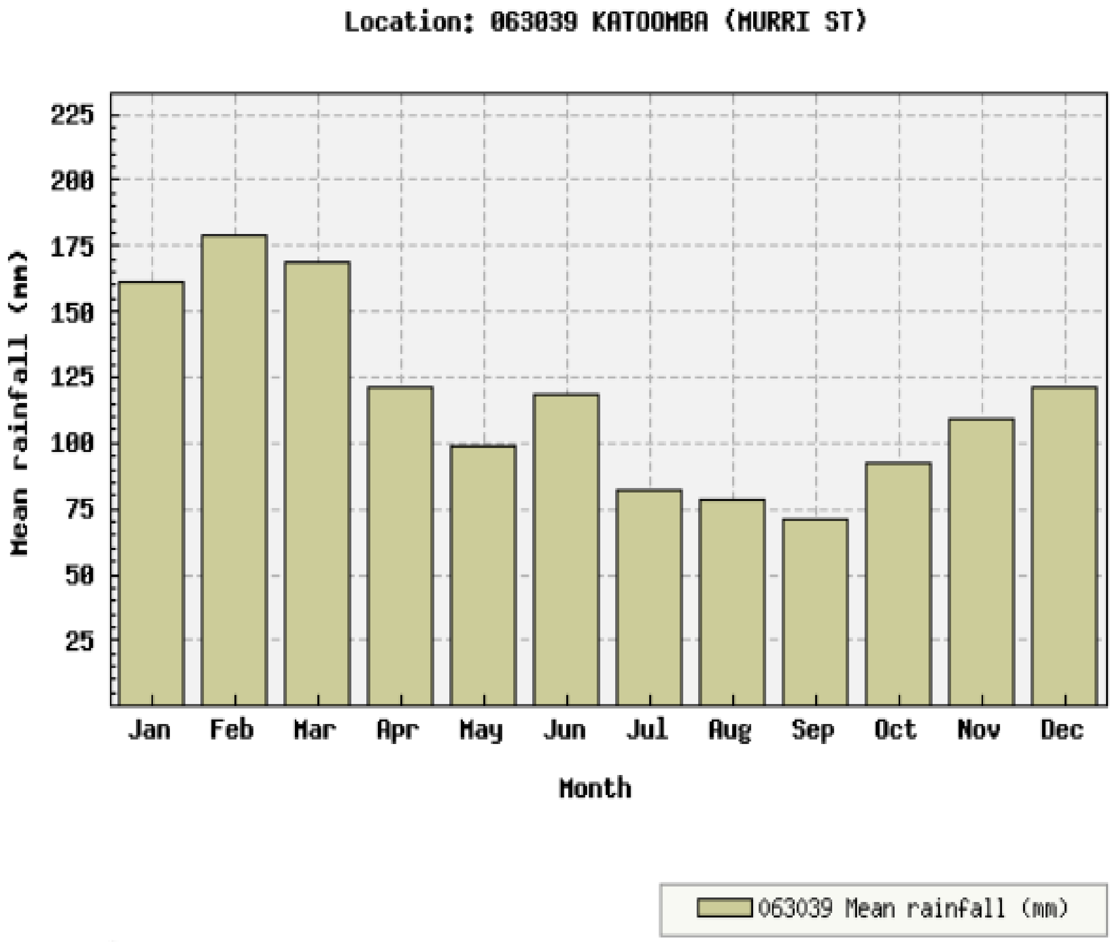

Figure 6-3: Average monthly rainfall data (Source: Bureau of Meteorology)

6.2.3 Potential impacts

The following impacts have been identified based on the concept design and would be reviewed once detailed design is available. During the detailed design phase any additional impact would be identified and added to the project risk assessment for documentation of potential risks and mitigation measures.

Construction

Construction activities would involve earthworks and other ground disturbing activities that would increase the risk of sediment movement off site either through vehicle movements, or wind and water runoff. Impacts from sediment movement are expected to be managed through the implementation of standard erosion and sediment controls and management plans implemented by the contractor.

There is a risk of potential blockages to waterways and drainage lines due to earthworks and other construction activities, which may result in localised flooding upstream and change the ultimate discharge location of overland flows into receiving watercourses. Diversion of drainage lines may also create localised areas of flooding and scour. These impacts are expected to be minor and would be managed through the implementation of standard water management and scour measures.

Operation

Flooding changes

The proposed upgrade includes changes in the road geometry and widening which would create an increase in the paved area, and improve the drainage capacity of the formal drainage infrastructure to current standards. This can change the existing flood behaviour and alter the flood risk to existing sensitive receivers.

The proposal would affect the peak runoff rates from upstream catchments contributing flows to cross drainage structures. The increase in paved areas would result in an estimated 20 per cent increase in the 1 per cent AEP peak flows at the Medlow Bath Park and new cross drainage CD3770 discharge locations. The increased cross drainage capacity removes flood storage from upstream of the rail corridor by allowing higher peak flow rates through the upgraded culverts. These locations are proposed to have attenuation basins for mitigation of the discharge peak flows to no greater than under the existing conditions and to relocate flood storage to within the formal basin structure.

Upstream flooding impacts are caused by increased runoff volumes by the increase in impervious portions of catchments, the increase in catchment size through regrading of the area to create the design pavement profiles, or the redistribution of flows as a result of a change in the formal drainage infrastructure. All three components were found to be influencing the post construction flood impacts in the modelling, however the impacts are generally considered minor given the limitation of vertical alignment changes, maintenance of flow discharge splits to downstream receivers, and general increase in available stormwater storage within the drainage system.

Downstream flooding impacts would be limited through the use of flow control structures including:

- a new detention basin downstream south of the existing cross drainage location (CX3480) where a major flow culvert upgrade across the transport corridor is proposed
- a new detention basin downstream of the existing sag rail cross drainage location (CX4200 and CX4220) where a major flow culvert upgrade across the transport corridor is proposed
- existing intermediate rail cross drainage locations (CX3770 & CX3960) where the highway stormwater system discharges flow to the existing rail cross drainage structures without major flow culvert upgrades.

Scour impacts

Scour potential would be increased with higher velocities and larger flow rates than experienced under existing conditions. With the increase in impervious areas as the road widening is constructed, runoff volumes would increase having the potential for scour events in receiving watercourses. Culvert/channel scour protection to Australian and TfNSW design standards to ensure suitable velocity and peak flow protection would be undertaken during detailed design.

6.2.4 Safeguards and management measures

Table 6-10: Safeguards and management measures – Hydrology and flooding

Impact	Environmental safeguards	Responsibility	Timing	Reference
Blockage causing increased flooding potential	Develop a blockage assessment of the pavement and cross drainage strategy.	Contractor	Detailed design /Pre-construction	Best practice
Overland flows causing localised flooding	Flow diversion bunds and sediment fencing are to be used for redirection of overland flows to dedicated management areas including sediment basins and ultimately to discharge locations.	Contractor	Construction	Best practice