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Carmichael Coal Line and Rail Project Rail Inundation Mapping

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RAIL INUNDATION MAPPING**

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PROJECT 301001-01788 - CARMICHAEL COAL LINE AND RAIL PROJECT

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1 INTRODUCTION

WorleyParsons has been commissioned to undertake additional inundation mapping based on flood modelling results produced for the Carmichael Rail FEED Design. Two cases were assessed, the existing pre-construction case and the post-construction case (the model representing the inclusion of the Carmichael rail alignment in the topography of the model). The 20, 50, 100 and 1000 years Average Recurrence Interval (ARI) flood events were simulated.

The purpose of this assessment is to develop inundation duration maps to provide:

- Duration mapping for the six waterways that were the subject of previous 2D Modelling work, Belyando River, North Creek, Mistake Creek, Diamond Creek, Grosvenor Creek and Logan Creek. These are presented in Figure 1.
- Property specific duration maps for the properties impacted by flooding within the model areas of the six waterways (as above). There are 14 properties affected by flooding within the bounds of the six existing waterway models.

The mapping was developed for the catchments and selected properties for three flood events, the 20, 50 and 100 years ARI.

The mapping produced will be utilised for landholder consultation, and to demonstrate compliance with the Hydrology and Hydraulics Design Criteria. The design criteria states:

“The total duration of inundation for the 50 year ARI event shall not exceed 72 hours or 20% (whichever is greater) of the existing inundation durations. The inundation duration of more than 72 hours may have some effect on growth of local grasses. Unless under specific circumstances where inundation durations for post-development can be tolerated in conjunction with landholder agreement.

The inundation durations shall be calculated by drawing a horizontal line on the flood hydrograph at the level when the flood depth is 300mm and measuring the time for which the flood level is above this level.”

The following sections present the methodology and results of this inundation mapping assessment.



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2 METHODOLGY

The inundation mapping utilised the results produced from the previously established modelling of the Carmichael Rail that had been undertaken as part of the Carmichael Rail Line FEED process, where two dimensional (2D) modelling approaches were applied. The 2D models produce outputs required to undertake the duration analysis. The catchments which were modelled as 2D models, and therefore were mapped for this assessment are:

SP1 Rail Branch

- North Creek (170.3km)
- Mistake Creek (~120km)
- Belyando River (~148km)
- Logan Creek (82.6km)

SP2 Rail Branch

- Diamond Creek (62.6km)
- Grosvenor Creek (18.5km).

Various hydraulic model and result files were provided by Adani (Proponent for the project) for use in this assessment. The following methodology was applied depending on the information provided:

- Result files, where provided and suitable for the mapping, were utilised for the assessment, without change.
- Where result files were not included in the data package (i.e. for SP2), the models were re-simulated to produce the required result files. Where the models had more than 30,000 cells, minor modifications were made to allow simulation with the WorleyParsons model licence. The models results were compared visually to the 50 year ARI afflux maps as presented in the FEED Report (CARP12033-REP-G-100_Rev0_FEED Report - Rail - Volume 4 Drawings), to ensure the results were replicated and were consistent with the FEED Study.
- In some instances the previously established pre and post models were simulated for different lengths of time. Where this occurred the longer results were trimmed by WorleyParsons to normalize the simulation times for the purposes of this additional inundation mapping.

Table 2-1 provides a summary of the models and the methodology as described above that was applied.



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Table 2-1 Model Summary

| | Pre Event | | | Post Event | | |
|----------------|--|---|--|--|---|---|
| | Q20 | Q50 | Q100 | Q20 | Q50 | Q100 |
| Belyando River | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files trimmed to match duration of Pre Q100 event (1008hrs trimmed to 959hrs) |
| Logan Creek | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping |
| Mistake Creek | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. |
| North Creek | Supplied result files used for flood mapping | Supplied result files were trimmed to duration of 95 hours to match the durations of the Q20 and Q100 result files. | Supplied result files used for flood mapping | Supplied result files used for flood mapping | Supplied result files were trimmed to duration of 95 hours to match the durations of the Q20 and Q100 result files. | Supplied result files used for flood mapping |



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| | Pre Event | | | Post Event | | |
|-----------------|---|---|---|---|---|---|
| | Q20 | Q50 | Q100 | Q20 | Q50 | Q100 |
| Diamond Creek | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. |
| Grosvenor Creek | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. | Result files not available. Simulated by WP to produce results. |



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2.1 Assessment of Inundation Duration

The depth result files for the six waterway models were utilised for the assessment of the duration of inundation. Analysis was undertaken using WorleyParsons proprietary software, WaterRIDE™.

WaterRIDE™ is a package that allows for the processing of model results from any hydraulic model in one platform.

Utilising waterRIDE™ Flood Manager Analysis tools, results were interrogated for the condition of duration of hours for which the model was inundated above 300mm. Using this approach the inundation durations were calculated by drawing a horizontal line on the flood hydrograph at the level when the flood depth is 300mm and measuring the time for which the flood level is above this level, for every cell in the models. The resulting output is a grid layer of hours.

This assessment was undertaken for all models for all flood events for both the existing case and the post-rail case (36 result files).

Afflux (difference in hours between the post-rail case and existing case) results were developed from the new results files using the 'calculate' function within waterRIDE™. For each catchment model and flood event the existing case was subtracted from the post-rail case to provide the difference between the two cases. 18 result files were generated from this assessment for the mapping.

2.2 Property Inundation

The assessment identified 14 properties that are inundated to varying extents. The properties were identified as inundated where part or all of the property is within a modelled flood extent. It is noted that other properties may be affected outside of the six catchment model extents that have not been captured by this previously completed assessment. No conclusion can be drawn on impacts to duration for those properties that fall outside of the existing model extents. The 14 properties are presented in Figure 1. Of these 14 affected properties, 11 properties are directly traversed by the Carmichael Rail Line and the remaining 3 properties are affected by the waterway systems even though they are not directly traversed by the Rail Line.



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3 RESULTS

Afflux duration maps were developed for the 20, 50, and 100 years ARI flood events for each of the 6 models (18 afflux maps). Maps were produced for the overall catchments and also for the individual properties that are impacted by flooding from the six catchment models (60 maps in total).

The naming convention applied to the mapping is:

waterway.flood event.unique identifier

where

| Waterways = | Flood event = | Unique identifier = |
|-------------|---------------|-----------------------------------|
| Mistake 1 | 1 Q100 | Catchment maps 0 |
| Grosvenor 2 | 2 Q50 | Property maps Lotplan i.e. 2GV248 |
| Diamond 3 | 3 Q20 | |
| North 4 | | |
| Belyando 5 | | |
| Logan 6 | | |

3.1 Result Interpretation

The maps provided in Appendix 1 present the computer modelled differences in duration of flooding, greater than 300mm deep between the existing conditions and following construction of the proposed Carmichael Rail Alignment.

The difference in duration is presented in hours on the maps as different colours. Each colour range corresponds to a different number of hours of duration as follows:

- Areas shaded yellow represent the areas with the smallest amount of change (in duration of flooding between the existing conditions and after the inclusion of the rail alignment).
- Orange shades through to red represent areas where the inclusion of the rail alignment is predicted to increase the amount of time flooding occurs in that area.
- Shades of light green through to blue represent areas where the rail is predicted to reduce the hours of flooding in that area.
- Areas where the change in duration is greater than 72 hours are presented as dark red. Areas where the change in duration is reduced by more than 72 hours are presented as dark blue.

The legend on each map provides the colour shading and corresponding hours.



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3.2 Result Presentation

The results are presented as a series of maps in Appendix 1. In addition, property specific information sheets for each of the 14 properties within the inundation extents have been developed to accompany the property maps. The property sheets are provided in Appendix 2, and include a property specific summary of the 50 years ARI flood event.



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4 QUALIFICATIONS

The following qualifications should be considered when interpreting the results of this assessment:

- The information presented was developed using the most up to date information available at the time of this assessment, as provided by Adani. As revised information becomes available the implications to this assessment should be reviewed.
- The information provided was considered 'fit for purpose' and no additional review of the previously developed models has been undertaken as part of this additional mapping work.
- Some of the previous model durations were normalized to address variation in the model simulation times. The implication of reducing the simulation times has been considered. Generally the impact of reducing the times has a minimal impact on the duration afflux. There are some isolated areas where it is possible the model times need extending. In most instances these areas have predicted increase above 72 hours and therefore the impact of the simulation time is not expected to be significant.
- As a result of the re-simulation of some models by WorleyParsons to obtain model results for this assessment, slight differences may appear when compared to the previous FEED model results. This may be due to differing model versions and modification of grid sizes to meet software licence requirements. It is considered any such changes are minor and will not significantly impact the outcomes of this duration assessment.
- There appears to be a variance between the duration afflux of the Belyando River between the 100 years ARI event and the 20 and 50 years ARIs. The cause of this difference has not been investigated. Based on the change in trend between the events, it is possible that the 100 years ARI Belyando model could benefit from further refinement. As the 50 years ARI is the focus event of this assessment the discrepancy of the 100 years ARI model was not investigated further.



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Appendix 1 Duration Afflux Maps



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Appendix 2 Property Information Sheets