Calibre Operations Pty Ltd

Carmichael Coal Mine & Rail Project
Adani Client's Engineer – Rail

Hydrology and Hydraulics Design Criteria

CARP12033-SPE-C-001

MASTER COPY

Rev	Description	Author	Checked	Approved	Authorised	Date
0	Issued for Use	Dr. Sravan	D. Ting	S. Lowden	P. Williams	September 2012
B	Issued for Client Review	Dr. Sravan	J. Chapman	S. Lowden		August 2012
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CONTENTS

1.0 INTRODUCTION

This document forms part of a suite of specifications which form the complete Project Design Criteria. It will be used by the team while undertaking the role of Adani's Client's Engineer – Rail (the Project). This document should be read in conjunction with the other documents in this suite as listed in Table 1.1, with specific reference to the Design Criteria Summary (CARP-12033-SPE-G-001).

Table 1.1: Project Design Criteria documents

Document Title	Document Number
Design Criteria Summary	CARP12033-SPE-G-001
Hydrology & Hydraulic Design Criteria	CARP12033-SPE-C-001
Earthworks Design Criteria	CARP12033-SPE-C-002
Roads and Pavements Design Criteria	CARP12033-SPE-C-003
Rail Alignment Design Criteria	CARP12033-SPE-C-004
Trackwork Design Criteria	CARP12033-SPE-L-003
Signalling & Communications Design Criteria	CARP12033-SPE-N-001
Bridge Design Criteria - Road & Rail	CARP12033-SPE-S-001
Level Crossing Design Criteria	CARP12033-SPE-S-002
Operations and Rollingstock Design Criteria	CARP12033-SPE-Z-001

The PDC is considered as a live document, able to be refined as the design progresses. The criteria will set out the performance requirements of the design and will be used to measure compliance during the design and construct (D&C) stage.

1.1 Background

Adani is proposing to develop a new coal mine in the Galilee Basin, approximately 190 km west of Moranbah and 160 km north-west of Clermont. The mine will comprise both open cut and underground mining from within EPC 1690 and EPC 1080. The thermal coal mine is expected to produce 60 million tonnes per annum (Mtpa) at peak production over a potential mine life of 90 years. Export coal will predominately service the Indian domestic power market, with first coal targeted for mid-2015.

A new non-electrified heavy haul railway is proposed to connect Carmichael Mine to both the QR National 'narrow gauge' network and the North-South 'standard gauge' corridor, providing high capacity access to Abbot Point Coal Terminal (APCT). Dual gauge track is proposed from the mine through to the junction of the standard gauge line.

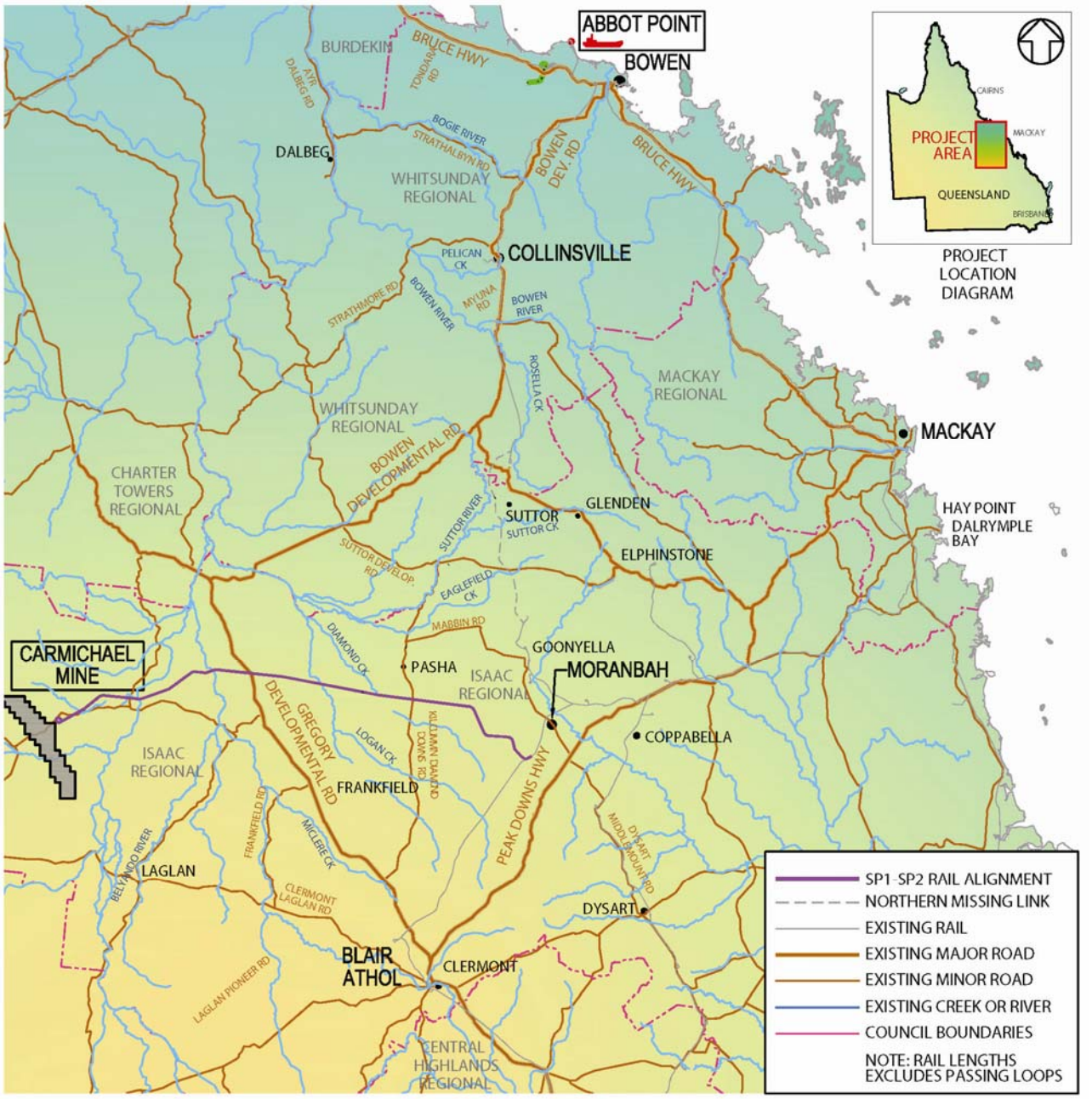

Figure 1.1: Location

1.2 Document Purpose

This document defines the criteria that will be used in the hydrology and hydraulics design for the Project.

1.3 Definitions

SRTM	Shuttle Radar Topography Mission
RCBC	Reinforced Concrete Box Culvert
RCP	Reinforced Concrete Pipe
ARI	Average Recurrence Interval
AFI	Average Frequency Interval
TMR	Department of Transport and Main Roads Queensland

1.4 Codes and Standards

Relevant design criteria to be adopted to the Carmichael Rail Project are identified & referred with in CARP12033-SPE-G-001 for the purpose of this project.

2.0 DESIGN CRITERIA

The following section describes the design criteria for the drainage infrastructure along the proposed rail alignment.

2.1 Flood Immunity

The following flood immunity criteria are to be adhered to for the proposed design:

- Lowest edge of formation level - 50 year ARI flood immunity plus 300mm freeboard;
- Top of rail – 100 year ARI flood immunity;
- Major Road crossings – 50 year ARI flood immunity or as specified by appropriate statutory body; and
- Minor Road crossings – 10 year ARI flood immunity or as specified by appropriate statutory body.

2.2 Cross Drainage Structures

The assessment of hydraulic impacts and design of hydraulic structures will be undertaken using 1-dimensional and 2-dimensional hydraulic modelling software. The choice of hydraulic modelling depends on the complexity of the flow regime and the classification of the waterway. Refer to Table 2.1 below for a summary of waterway classification criteria basis.

Table 2.1 Waterway classification criteria basis

Catchment Flow Characteristic	Cross Drainage Classification
Defined floodplains which are subject to EIS approval	Major Floodplain Structure
Design flow rate Q50 >250 m^3/s	Major Bridge Structure
Design flow rate Q50 >50 m^3/s	Major Drainage Structure
Design flow rate Q50 <50 m^3/s	Minor Drainage Structure

It should be noted that Major Floodplain Structures will be composed of Major Bridge Structures and Major Drainage Structures and will be subject to their respective design criteria as outlined below. Drainage design will also be subject to additional environmental design criteria, as outlined in Table 2.4.

Table 2.2 and Table 2.3 below summarise the design criteria for bridge structures and drainage structures.

Table 2.2 Major Bridge Structure design criteria

Design Aspect	Design Criteria
Bridge Classification	Locations with a 50 year ARI design flow ≥ 250 m^3/s
Design ARI event	Bridge structure must pass the 50 year ARI design flow
Freeboard	Minimum 500mm to the soffit for the design event
Maximum velocity	3.8m/s for the design event with appropriate scour protection
Scour protection	Rock Protection or rock mattress as per Austroads Waterway Design

Table 2.3 Major and Minor Drainage Structure design criteria

Design Aspect	Design Criteria
Culvert classification	Major culverts: culvert locations with a 50 year ARI design flow ≥50 m^3/s Minor culverts: culvert locations with a 50 year ARI design flow <50 m^3/s
Design ARI event	Major culverts and isolated minor culverts: 50 year ARI design flow Minor culverts: 20 year ARI design flow (flow above Q20 is diverted to other drainage structures)
Freeboard	Minimum 300mm to top of formation level for the design event
Headwater	Maximum headwater to be 1.5 x culvert diameter or box height
Culvert type	Reinforced Concrete Pipes (RCP's) and Reinforced Concrete Box Culverts (RCBC's) depending on location Minimum diameter for engineered culverts to be 900mm
Cover requirements	Cover design must ensure adequate provision made for train loading
Maximum culvert outlet velocity	2.5m/s for the design event with appropriate scour protection
Scour protection	Rock Protection as per Austroads Waterway Design

Table 2.4: Major Floodplain additional environmental design criteria

Design Aspect	Design Criteria (Subject To Landholder Discussions)
Critical Infrastructure	0.2m maximum
Housing Areas	0.1m maximum
Other Areas	Limited to 0.3m where practicable
Non-critical infrastructure/ housing or uninhabited areas	0.5m maximum

2.3 Longitudinal Drainage

The following section describes the design criteria for longitudinal drainage infrastructure along the proposed rail alignment. The design criteria are outlined below in Table 2.5.

Table 2.5 Longitudinal Drainage design criteria

Design Aspect	Design Criteria
Design ARI event	Longitudinal drainage – 20 year ARI design flow Diversion drainage – 50 year ARI design flow
Maximum velocity	3.5m/s for the design event with appropriate scour protection
Scour protection	Rock Protection as per Austroads Waterway Design (if required)

2.4 Inundation Duration

Any increase in duration (modelled) of flooding inundation is not to exceed an average across the modelled extent of 72 hours or 20% (whichever is greater) of existing inundation durations during the 50 year ARI event. This is unless specific circumstances where inundation durations post-development can be tolerated in conjunction with landholder agreement. Inundation durations shall be measured from when the water depth is greater than 300mm on the rising limb of the hydrograph to when the water depth is equal to 300mm on the falling limb of the hydrograph.

3.0 DESIGN STANDARDS

The design will be undertaken according to the following Design Standards:

- Australian Rainfall and Runoff Manual (AR&R) (1987);
- Waterway Design – A Guide to the Hydraulic Design of Bridges - AUSTROADS;
- Queensland Urban Drainage Manual (2007); and
- Transport and Main Roads - Road Drainage Manual (2010).

4.0 DURABILITY OF DESIGN

Regular maintenance of drainage infrastructure is necessary in order for any drainage infrastructure to work as designed for the required design life of the project. The design life and durability of drainage infrastructure are detailed below:

- Inaccessible and in ground drainage elements – 100 years;
- Drainage elements that are accessible for refurbishment and maintenance - 50 years; and
- Scour protection at hydraulic structures that is accessible for refurbishment and maintenance – 50 years.

For further details on durability of design and design life of all design components, refer to CARP12033-SPE-G-001.

5.0 SAFETY IN DESIGN

The design will be undertaken with safety in mind, covering the full life of the structures including construction, operation, maintenance, possible future upgrading, and eventual demolition. Examples of safety aspects on which the design team may have a significant influence include: the location of drainage structures, and provisions for safe access for inspection and maintenance. Refer to CARP12033-SPE-G-001 for further details.