HANCOCK COAL PTY LTD

Calibre Rail
Alpha Coal Project - Rail
Phase 1B

Detailed Floodplain Study
Miclere Creek / Piebald Creek

HC-CRL-24100-RPT-0136
CJVP10007-REP-C-014

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CONTENTS

1.0 PURPOSE

The purpose of this report is to analyse and assess the impact of the Alpha Coal Project (ACP) railway line as it traverses the Miclere Creek and Piebald Creek floodplain system. The analysis provides recommendations of the cross-drainage infrastructure required to minimise impacts to existing flowpaths and to meet the conditions set in the Environmental Impact Study (EIS) and the Supplementary Environmental Impact Study (SEIS).

This report provides details of the floodplain analysis undertaken for the Miclere Creek and Piebald Creek systems. It details the pre- and post-development inundation extents for the 5, 50 and 100 year Average Recurrence Interval (ARI) events. The results for depths of flow, velocity fields and afflux from the development of the railway have been assessed for the approved design criteria of the 50 year ARI event.

2.0 PROJECT BACKGROUND

Hancock Coal Infrastructure Pty Ltd (HCIPL) are undertaking an investigation into the development of a 30Mtpa open pit, thermal coal mine within the Galilee Basin 50km north of the Alpha township in central Queensland. This project is known as the Alpha Coal Project (ACP). A project overview can be seen in Figure 1.

As part of this project, a 500km standard gauge rail alignment and associated infrastructure is required to transport the coal from the mine, at Alpha, to the port at Abbot Point, north of Bowen. Calibre has recently completed a Bankable Feasibility Study (BFS) for the rail alignment and is continuing to progress the identified critical path detail design activities.

Subsequent to this, an EIS has been prepared and corresponding SEIS compiled to clearly define design parameters to be adhered to in any further investigations, and eventually, design.

Part of the stakeholder response to the EIS identified specific concerns that were raised in relation to the drainage criteria approved by Hancock Coal in the BFS. The SEIS has taken into account these concerns and the drainage criteria updated to address the issues raised in the EIS. This Detail Floodplain Study takes into account these changes in the drainage criteria developed for the SEIS.

Figure 1: Proposed Alpha Coal Project railway alignment

3.0 REFERENCES, CODES AND STANDARDS

The following reports and codes were used as part of the floodplain modelling:

- BFS Drainage Engineering Report (CVJP10007-REP-C-001 / HC-CRL-24100-RPT-0022);
- Queensland Government Climate Change Guidelines: Increasing Queensland's resilience to inland flooding in a changing climate (2010);
- Australian Rainfall and Runoff (AR&R);
- C&R land holder consultation;
- EIS and SEIS.

The following data sources were used for the hydrologic and hydraulic modelling:

- Department of Environment and Resource management (DERM) blended topographic survey data (Shuttle Radar Topography Mission (SRTM) and combined contour data);
- LiDAR data for current alignment (600m wide corridor with a vertical accuracy of ±100mm) provided by HCIPL;
- LiDAR data flown for BFS alignment (approximate 4000m wide corridor with a vertical accuracy of ±500mm) provided by HCIPL;
- DERM stream-gauge historical data;
- Bureau of Meteorology (BoM) Intensity-Frequency-Duration (IFD) regional data.

4.0 ABBREVIATIONS

ACP	Alpha Coal Project
AEP	Average Exceedance Probability
AR&R	Australian Rainfall and Runoff
ARI	Average Recurrence Interval
BFS	Bankable Feasibility Study
BoM	Bureau of Meteorology
C&R	C&R Consulting Pty Ltd
CatchmentSIM	Hydrologic catchment delineation program
CSP	Corrugated Steel Pipe
DERM	Department of Environment and Resource Management
EIS	Environmental Impact Statement
FFA	Flood Frequency Analysis
HCPL	Hancock Coal Pty Ltd
HCIPL	Hancock Coal Infrastructure Pty Ltd
IFD	Intensity-Frequency-Duration
LiDAR	Light Detection and Ranging
RORB	Rainfall and runoff routing program
SEIS	Supplementary Environmental Impact Statement
SRTM	Shuttle Radar Topography Mission
TOF	Top of Formation

5.0 INTRODUCTION

The proposed rail alignment for the ACP currently crosses the Miclere Creek and Piebald Creek floodplain. The analysis was conducted for this system during the BFS and identified that further detailed hydraulic analysis was required due to the possible complex floodplain interaction that exists between the two systems. More accurate LiDAR along the alignment and Landholder consultation were incorporated into this study.

The primary output of the Detailed Floodplain Study was to provide detailed mapping of the pre- and post-development flood extents, inundation durations, flow velocities and afflux predictions for the Miclere Creek and Piebald Creek system. A focus of this study is to assess the impacts that the proposed rail alignment would have on the landscape and surrounding properties.

5.1 Floodplain Location and Description

The combined Miclere Creek and Piebald Creek systems have a catchment area of approximately 1400km^2, and is a significant portion of the Suttor Sub-Basin (18,000km^2) in the Burdekin River Catchment. The terrain is predominantly very flat with significant low-land floodplains and the land-use is dominated by grazing on natural pastures. The landscape is semi-arid with predominantly ephemeral streams (typically flow each year during the wet season between December and April).

A locality plan of the affected catchments that interface with the Alpha Coal Railway is illustrated in Figure 2 below.

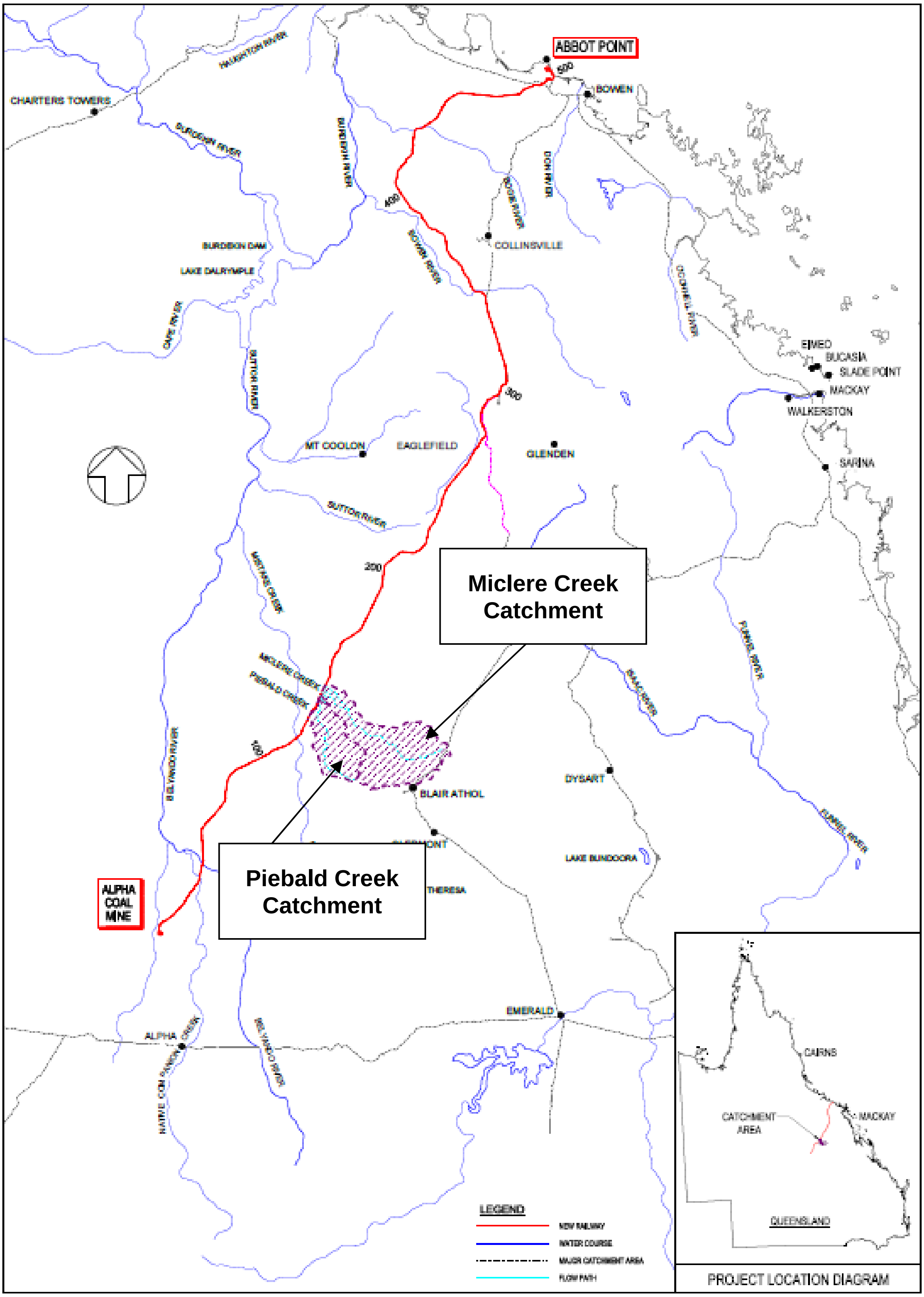


Figure 2: Catchment boundary and location

5.2 Miclere Creek

The catchment area for Miclere Creek at the proposed ACP rail alignment (Rail Chainage 141,478m) is approximately 996.6km^2. The catchment is undeveloped and consists of predominantly pastoral land. The main low flow channel is braided and undefined. As such, during significant flow events there is a complex interaction between the main flow channel and the floodplain upstream of the proposed railway alignment.

5.3 Piebald Creek

Piebald Creek has a contributing catchment area of approximately 379km^2 at the proposed ACP rail alignment interface (Rail Chainage 134,638m). The catchment is predominantly undeveloped and consists of mostly agricultural land. The main channel consists of many braids and does not have a major defined flow path. As such, during flood events a complex interaction between the channel and floodplain flows occurs.

The confluence of Piebald Creek with Miclere Creek occurs approximately 4km downstream of the proposed ACP rail alignment.

6.0 COMMUNITY CONSULTATION

As part of the Detailed Floodplain Study, community consultation was undertaken to correlate the current modelling to the historical knowledge of stakeholders in relation to individual floodplains. The feedback received has been incorporated into the modelling where appropriate.

7.0 BANKABLE FEASIBILITY STUDY (BFS)

Prior to this detailed floodplain analysis, Calibre undertook a BFS level design of all drainage structures on the proposed ACP rail alignment, details of which are summarised in the BFS Drainage Engineering Report (CJVP10007-REP-C-001/ HC-CRL-24100-RPT-0022). The design proposed in the BFS report was used as the basis for the analysis detailed in this study.

7.1 Design Criteria

The adopted drainage design criteria for the BFS are specified in Tables 1 and 2.

Table 1: General drainage design criteria

Design Aspect	Design Criteria
Culvert Classification	Major culverts: culvert locations with a 50 years ARI design flow ≥ 50m^3/sec. Minor culverts: culvert locations with a 50 year ARI design flow < 50m^3/sec.
Design Flood	Minor culverts shall pass the 20 year ARI design event flow. Major culverts shall pass the 50 year ARI design event flow.
Freeboard	Min. 300mm to the formation surface for design event.

Design Aspect	Design Criteria
Headwater	Max. headwater to be 1.5 x culvert diameter.
Max. Outlet Velocity	5.0m/sec for design event with appropriate scour protection.
Scour Protection	Capable of passing 20 years ARI design flood without damage. Rock sizing to be designed in accordance with AUSTROADS Waterway Design, 1994.
Culvert Type & Size	CSP (galvanised corrugated steel pipes). CSP Culverts shall be provided with minimum 600mm earthwork cover. Min. diameter to be 900mm for engineering culverts.
Diversion drains	Unlined diversion drains shall be used to divert catchment flows from one catchment to another, where culverts cannot be used through the rail formation. These should cater for the 20 year ARI design flood without overtopping or scour. Drain design should minimise drain scour for the design event.
Cut off drains	Unlined cut off drains (with a minimum 20 year ARI design flow capacity) should be provided on the upstream side of the railway in cuttings to prevent surface water runoff entering the cuttings and causing scour and washouts.
Levees	Designed to ensure that there is 100mm freeboard above the culvert headwater design level

Table 2: Bridge hydraulic design criteria

Design Aspect	Design Criteria
Design Flood	Bridges shall pass the 50 year ARI design event flow.
Freeboard	Min. 500mm to bridge soffit for 50 year ARI design flow. Min. 300mm to TOF (embankments and guide banks) for 50 year ARI design flow.
Max Velocity	3.8m/s to enable to adopt a practical limit of 1 tonne rock class protection for economy.
Scour Protection	Provide rock protection to cater for 50 year ARI design flow velocities. Rock sizing to be designed in accordance with AUSTROADS Waterway Design, 1994.
Maximum backwater	1.5m with reduction at sensitive locations.
Guide banks	To be designed in accordance with AUSTROADS Waterway Design, 1994.

7.2 Design Process

Hydrologic and hydraulic modelling was completed for all drainage structures along the ACP alignment during the BFS. For major crossings, design flows were estimated using either the rational method, a preliminary hydrologic model (CatchmentSIM and RORB) or a Flood Frequency Analysis (FFA) where stream-gauge data was available. Design flows were then selected based on the best information available at the time of the study and the method considered most appropriate for the level of analysis required for the BFS.

These flows were then hydraulically modelled depending upon the proposed structure type:

- Culverts were analysed using HY-8 (a 1-D modelling program design for culvert analysis) and sizes were determined to ensure afflux was less than 1.5m or the equivalent to the upstream bridge water levels determined from bridge modelling.
- Bridges were assessed using Afflux (a 1-D bridge hydraulic modelling program) to determine span widths that allowed less than 1.5m of afflux (as per the original design criteria). Supplementary culverts for the bridge were sized if the proposed bridge structure was not able to pass flows within the allowable afflux limits.

This level of analysis was sufficient for the purposes of the BFS and was used as a basis for the Detailed Floodplain Study.

8.0 FLOODPLAIN MODELLING DESIGN CRITERIA

A Supplementary Environmental Impact Statement (SEIS) was prepared after the conclusion of the BFS and this resulted in certain design criteria (from Tables 1 and 2) being modified to meet stakeholder requirements. Table 3 shows the modified drainage design criteria adopted for the Detailed Floodplain Modelling.

Table 3: SEIS Modified Drainage Design Criteria

Design Aspect	Design Criteria
Inundation Extent	Acceptable increases in inundation extent (above the existing conditions for a given return period to the 50 year ARI event) will be proposed where such an increase will not alter rural land use and result in significant impacts.
Inundation Duration	Inundation duration not more than 3 days on valued pasture land that had previously been inundated for 3 days or less for similar rainfall events.
Max Velocity	Bridge outlet velocity = maximum of 1.2 x existing velocity at a distance equal to the bridge span downstream of bridge. Culverts outlet velocity: = 1.5m/s where erodible soils are present. = 2.5m/s for normal soils (with no erosion control).
Maximum afflux	Maximum 0.5m – normally (unless justifiable). Maximum 0.2m – around critical infrastructure. Maximum 0.1m – around dwellings.

Unless specified in Table 3, the design criteria used for the detailed floodplain analysis are identified in Tables 1 and 2.

9.0 DETAILED FLOODPLAIN ANALYSIS

9.1 Introduction

In order to assess the impacts that the proposed ACP rail will have on the Miclere Creek and Piebald Creek systems, a detailed floodplain analysis was conducted. This detailed analysis was then used to assess the adequacy of the proposed cross-drainage structures determined from the BFS.

A detailed hydrologic analysis was completed for both systems and a combined hydraulic model that covers the area of interest, within the floodplain, was developed. The modelling results were then used to assess impacts on inundation extents, time of inundation, afflux and velocities as a result of the ACP railway. From the results of the hydraulic modelling, detailed flood mapping has been produced.

The following sections outline the methodology used to derive the required outputs for the Detailed Floodplain study.

9.1.1 Hydrology

9.1.1.1 Previous Hydrology

During the BFS, peak design discharges were estimated for both Miclere and Piebald Creeks respectively. No stream-gauge data was available for either of the systems and no calibration was undertaken.

For full details on the BFS analysis, refer to the BFS Drainage Engineering Report (CJVP10007-REP-C-001/ HC-CRL-24100-RPT-0022).

9.1.1.2 Additional Information

As a result of the additional flooding information that was obtained from Landholder consultation and a floodplain field investigation (undertaken by C&R consulting), a more holistic and representative modelling approach for the floodplain system was able to be generated.

This information contained more accurate details regarding the hydrologic parameters and existing system flooding behaviour. More accurate LiDAR survey along the rail corridor was also obtained for the detailed analysis. These data sets were all incorporated as additional design inputs.

The following additional data sets were made available for the Detailed Floodplain Study:

Additional Survey

Additional LiDAR was flown along the proposed rail alignment in a 600m wide corridor with a vertical accuracy of ±100mm.

9.1.1.3 RORB Analysis

The contributing catchment areas for both Miclere Creek and Piebald Creek were delineated using the GIS based terrain analysis software, CatchmentSim. A visual check was performed against the BFS delineated catchments and SRTM contours to ensure the CatchmentSim delineation was accurate.

Both systems were delineated in CatchmentSim using the DERM SRTM survey data as this was deemed to have sufficient accuracy for the purposes of hydrologic analyses. Catchments were generated for both systems and exported into the rainfall-runoff routing program, RORB.

A summary of the catchment analysis for Miclere Creek and Piebald Creek are shown below in Table 4 and Table 5.

Table 4: Miclere Creek catchment properties

Item	Value
Catchment area	997km^2
d_{av}	49.15km

Table 5: Piebald Creek catchment properties

Item	Value
Catchment area	379km^2
d_{av}	27.39km

Parameters

RORB model parameters were initially set to those recommended by AR&R for Queensland. As no stream-gauge calibration was available for the Miclere and Piebald systems, if catchment characteristics showed similarities between adjacent calibrated catchments, these calibrated parameters were adopted.

Piebald Creek has similar catchment parameters to the neighbouring Mistake Creek catchment. Mistake Creek has a stream-gauge where an FFA was performed to allow for hydrologic calibration. The Detailed Floodplain Study conducted for Mistake Creek (CJVP10007-REP-C-015 / HC-CRL-24100-RPT-0137) had calibrated RORB parameters as shown in Table 6 and Table 7.

Table 6: Mistake Creek calibrated RORB parameters

Item	Value
k_c (calibrated)	150
m	0.847

Table 7: Mistake Creek calibrated losses

Event ARI (years)	Initial loss (mm)	Continuing loss (mm/hr)
100	25	2.5
50	25	2.5
20	30	2.5
10	30	2.5
5	35	2.5

The initial parameters for the RORB model were set using the formulae outlined in AR&R guidelines for Queensland. These are shown below:

$k_c = 0.88\ A^{0.53}$ (Equation 9.1)
where A is the catchment area in square kilometres

$(k_c/d_{ave}) = -13.5\ m^3 + 45.8\ m^2 - 53\ m + 21.2$ (Equation 9.2)
where d_{ave} is the average stream length from sub-catchment centroids to the catchment outlet

The RORB manual suggests that the k_c parameter is better estimated using the following formula:

$k_c = 2.2\ (A^{0/5})\ (Q_p/2)^{(0.8-m)}$ (Equation 9.3)
where Q_p is the predicted peak discharge

Using the above formula (equation 9.2) as recommended by AR&R and adopting the 'm' value from the Calibrated Mistake Creek Catchment, initial catchment parameters for Piebald Creek and Miclere Creek were calculated and are shown in Table 8 and Table 9.

Table 8: Miclere Creek initial RORB parameters

Item	Value
k_c	47.3
m	0.847

Table 9: Piebald Creek initial RORB parameters

Item	Value
k_c	26.4
m	0.847

Calibration

No calibration was undertaken for either Miclere or Piebald Creeks due to the absence of stream-gauge data.

Adopted parameters

The calibrated RORB parameter (m) for Mistake Creek was used for both the Piebald Creek and Miclere Creek models. The calibrated 'k_c' from Mistake Creek was unable to be adopted for these catchments as it was assessed that the predicted peak flows were unrealistic for the catchment characteristics. From previous floodplain calibrations it was observed that calibrated parameters lowered the predicted peak discharge when compared to the values produced when using the parameters suggested in equations 9.2 and 9.3. As such, it was conservative to use equations 9.2 and 9.3 (where appropriate) to estimate k_c to produce a more realistic representation of the catchment characteristics and predicted peak discharges.

Final adopted hydrologic parameters are shown in Table 10 and Table 11.

Table 10: Piebald Creek adopted RORB parameters

Item	Value
k_c	26.4
m	0.847

Table 11: Miclere Creek adopted RORB parameters

Item	Value
k_c	47.3
m	0.847

Results

The results extracted from the hydrologic modelling for Miclere Creek and Piebald Creek systems at the ACP rail interface are shown below in Table 12, 13 and 14. As Miclere Creek was the dominant catchment, peak storm durations have been adopted from Table 13 for both Miclere and Piebald Creek.

Table 12: Peak storm durations

Event ARI (years)	Peak discharge storm duration (hours)
100	18
50	18
5	18

Table 13: Miclere Creek predicted peak discharges

Event ARI (years)	Peak predicted discharge (m^3/s)
100	1392
50	1136
5	430

Table 14: Piebald Creek predicted peak discharges

Event ARI (years)	Peak predicted discharge (m^3/s)
100	669
50	554
5	222

Full hydrographs have been extracted from the RORB model for the 5, 50 and 100 year ARI events are provided in Appendix A. The predicted peak discharges for both systems were then used as inflows into the Miclere Creek and Piebald Creek floodplain hydraulic model as described in Section 9.1.2.

9.1.2 Hydraulic Modelling

It had been identified during the BFS that the Piebald Creek and Miclere Creek systems required additional modelling due to a possible complex floodplain interaction that occurred upstream of the proposed ACP rail alignment. In order to accurately assess this interaction, a full hydrodynamic 2-D model was generated using the software package MIKE Flood. The advantage of using MIKE Flood is the program's ability to model large grid-scale features such as complex floodplains, while also allowing sub grid-scale features such as culverts and bridges to be modelled with a greater degree of accuracy.

The following section outlines the process used to generate the 2-D model, sensitivity analysis conducted and modelling results.

9.1.2.1 MIKE Flood Model

Bathymetry

The hydraulic model required a significant model domain in order to adequately capture the possible floodplain interaction between the Miclere Creek and Piebald Creek systems and be sufficiently downstream to minimise the effects of the downstream boundary. This resulted in a bathymetry of 1013 x 922 cells at a grid cell size of 15m x 15m (model area of 210km^2). The final bathymetry used for the pre- and post-development rail cases is shown below in Figure 3. The post-development bathymetry used the proposed current railway alignment.

A portion of the bathymetry has been based on a combination of LiDAR sources (BFS LiDAR and current alignment LiDAR) and covers all of the area downstream of the railway and a minimum of approximately 1.2km upstream of the rail (varying dependent on location as per the "Approximate SRTM/LiDAR interface" shown in Figure 3). At the time of the Detailed Floodplain Study, the only available survey data outside of these extents was the SRTM survey. Due to the significant accuracy reduction of the SRTM in comparison to the LiDAR, it was assessed that some manipulation of the relative levels of the SRTM was needed to ensure boundary levels matched the LiDAR data at stream inverts. After initial modelling, it was determined that there was no interaction between the two creek systems.

For this model, the SRTM tiles were raised independently after initial modelling results were processed. It was found that the systems remained as individual systems until downstream of the proposed railway. As such, the SRTM was spliced and manipulated accordingly for each system. Miclere Creek SRTM was lowered by 1.8m and Piebald Creek SRTM was lowered by 4.2m, with both systems utilising a variable interpreted transition that was generated between the SRTM and LiDAR boundary to provide a smoothed surface between the two data sets. The preference was to ensure that the SRTM surface at stream centrelines was above the LiDAR data to ensure flows were able to pass over the interface.

This bathymetry manipulation was considered appropriate for the purposes of the assessment of impacts from the proposed ACP rail alignment and utilised the best data available at the time of this Detailed Floodplain Study.

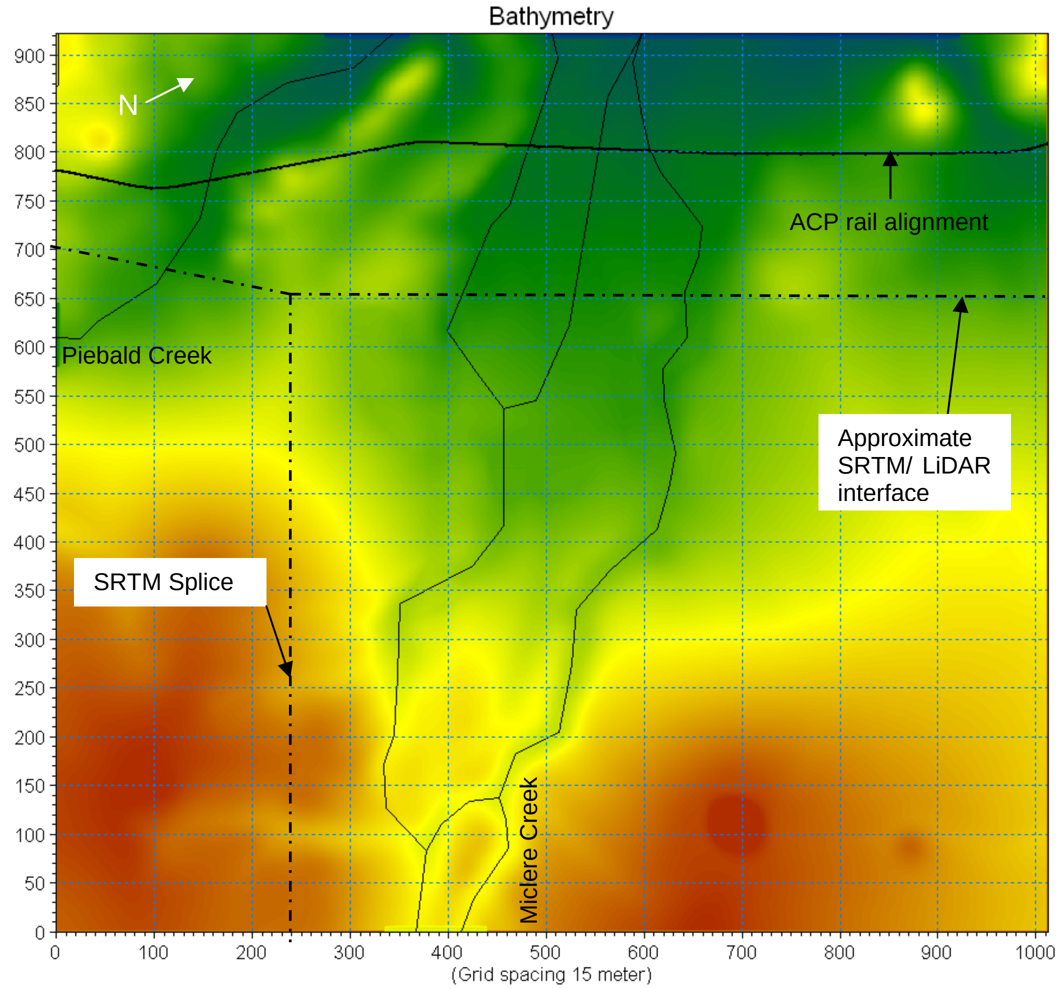


Figure 3: Hydraulic model extent

Boundary conditions

Miclere Creek and Piebald Creek inflow hydrographs were input into the model over an appropriate width to ensure minimal dispersion of flows laterally during peak hydrograph inflows. The downstream boundary conditions were set using the respective system peak flow values and a rating curve (discharge-height relationship) generated from the downstream cross section and average stream slope.

Initial water surface levels from the downstream boundary condition were projected back upstream to account for the loss of storage due to tailwater affects. The selection of downstream boundary levels was subject to sensitivity testing as outlined in Section 9.1.3.

Roughness coefficients

The Miclere Creek and Piebald Creek systems have two distinct types of roughness: a relatively smooth and well defined flow path for the main conveyance channels; and a rough, low velocity, low water depth floodplain. As such, two Manning's values were adopted for this Detailed Floodplain Study:

- Channel: n = 0.04
- Floodplain: n = 0.1

In an initial approach to easily and accurately define the two separate roughness areas, 5 year ARI event flows were halved and input into the hydraulic model (to simulate a bank-full stream event). Where depths exceeded 0.2m and velocities above approximately 0.15m/s, a roughness value attributed to a channel was assigned. The remaining model domain was set to a roughness equivalent to floodplain.

After Landholder feedback was received on several neighbouring floodplain systems, it was identified that a more accurate representation of the two separate roughness areas was to assign a channel roughness to the main stream flow paths only (delineated by contour maps) and a roughness value equivalent to a floodplain for the remaining model domain. The adopted values are shown in Figure 4. The selection of roughness values was subject to sensitivity testing as outlined in Section 9.1.3.

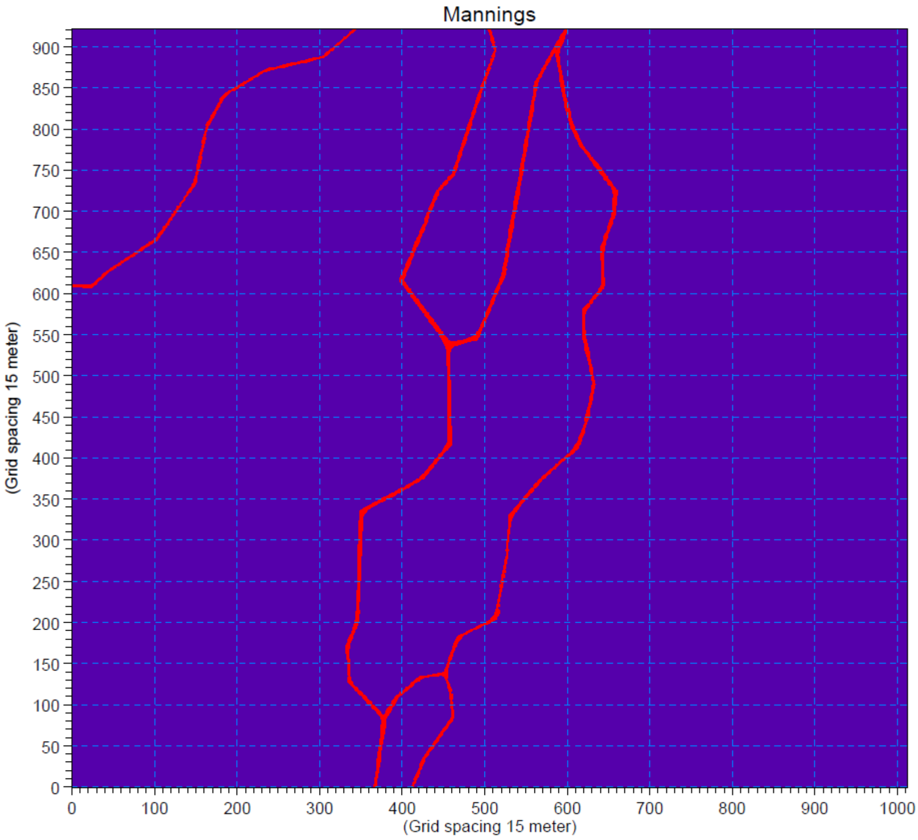


Figure 4: Manning's roughness

MIKE Flood coupling

The MIKE Flood modelling package allows for the input of 1-D modelling elements (MIKE11) within the 2-D model domain (MIKE21). These links are known as 'couples'. For this Detailed Floodplain Study, bridges and culverts have been input into the model as 1-D elements to accurately assess the headloss through cross-drainage structures. All structures have been modelled implicitly with standard MIKE11 variables. Coupled locations are shown in Figure 5.

In order to maintain inundation extents post-development and as specified in the SEIS, floodplain relief culverts are proposed for the Miclere Creek and Piebald Creek system at (maximum) 50m spacing. These relief culverts consist of 900mm diameter Corrugated Steel Pipes (CSP). Through sensitivity testing it was determined that in order to minimise geometric grid-scale problems and minimising the required number of couples within the model, it was feasible to group 5 floodplain relief culverts from adjacent 2-D grid cells. This resulted in a grouping a 5/900mm CSP every 250m within the model.

Flows through the floodplain relief culverts in MIKE Flood was verified against a 1-D model of a single 900mm diameter CSP using the HY-8 modelling package.

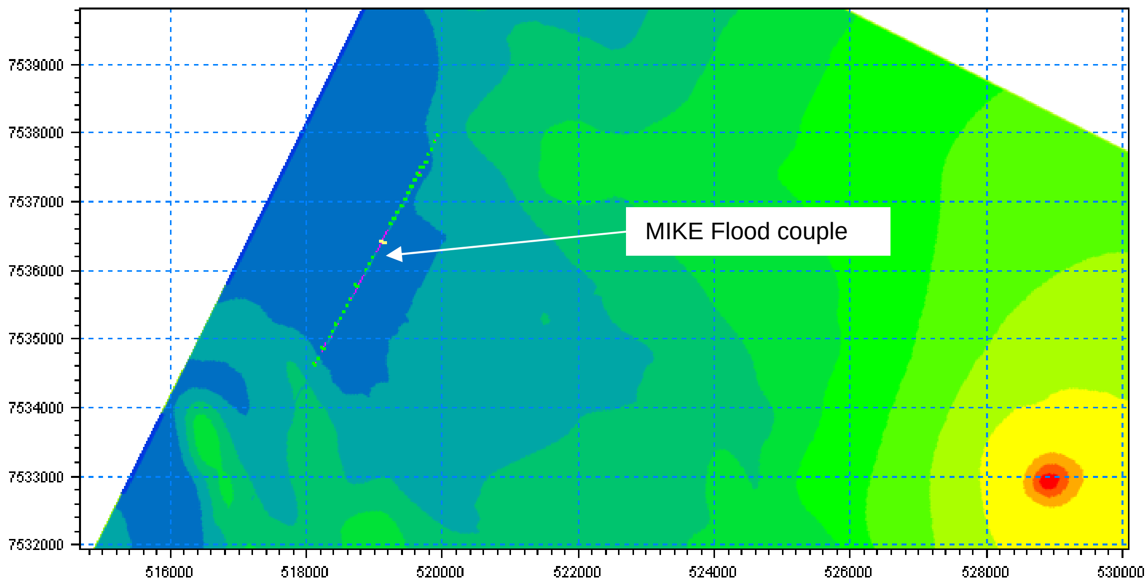


Figure 5: MIKE Flood couple locations

In addition to the floodplain relief culverts, the BFS proposed a bank of 52/ 3000mm CSP culverts for Miclere Creek and a bank of 37/ 2700mm CSP culverts for Piebald Creek. These were also inserted as couples into the MIKE Flood model.

9.1.3 Sensitivity Testing

Due to the lack of anecdotal evidence available to calibrate the hydraulic model, a sensitivity range of ± 30% on roughness values, inflow hydrographs and downstream boundary water levels was tested. Sensitivity testing was undertaken for the 50 year ARI event and for the pre-development case only at the locations shown in Figure 6.

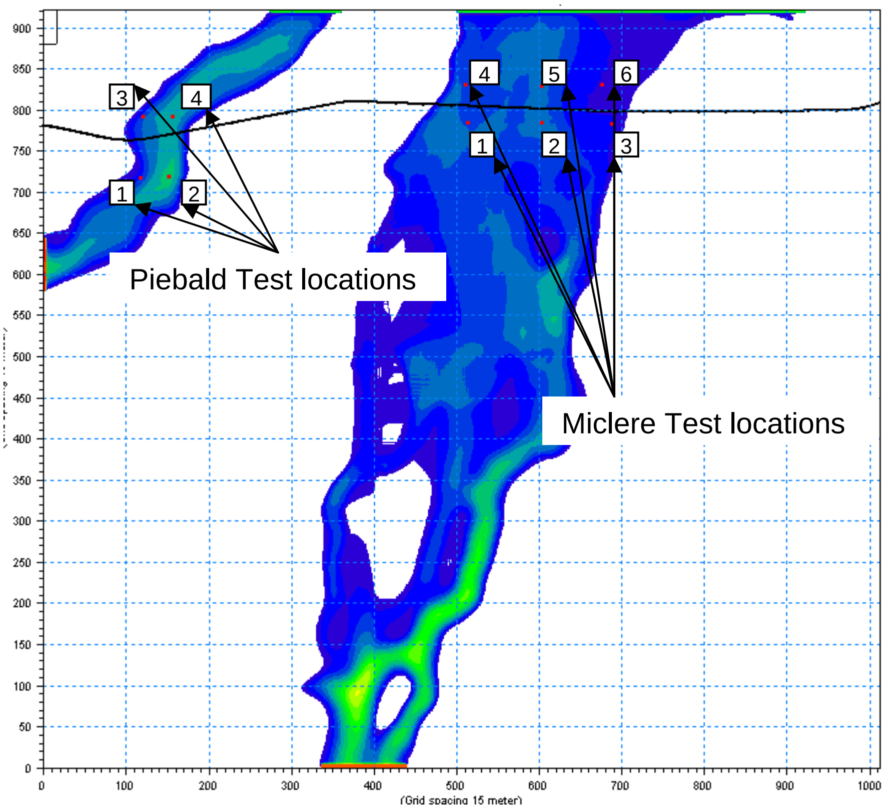


Figure 6: Sensitivity testing locations

Ten locations were selected both upstream and downstream of the proposed railway alignment and included main channel and floodplain locations in order to assess the sensitivity of certain parameters on the predicted water levels and velocities.

Manning's values

The value of Manning's 'M' (M=1/n) was adjusted by ±30% to assess the impacts of this parameter on the predicted maximum inundation depths and velocities at the locations shown in Figure 6. The sensitivity of the Manning's 'M' value is shown in Table 15 and 16.

Table 15: Piebald Manning's 'M' value sensitivity (depth)

Location	Adopted value (m)	+30% value	Change (m)	-30% value	Change (m)
1	0.697	0.487	-0.21	1.020	0.323
2	2.147	1.933	-0.214	2.478	0.331
3	0.889	0.682	-0.207	1.212	0.323
4	1.722	1.519	-0.203	2.042	0.32

Table 16: Miclere Manning's 'M' value sensitivity (depth)

Location	Adopted value (m)	+30% value	Change (m)	-30% value	Change (m)
1	1.109	0.943	-0.166	1.369	0.26
2	1.284	1.141	-0.143	1.511	0.227
3	0.446	0.369	-0.077	0.582	0.136
4	1.158	1.007	-0.151	1.397	0.239
5	1.396	1.264	-0.132	1.628	0.232
6	0.388	0.296	-0.092	0.556	0.168

The Manning's value has an impact ranging from -220mm to +340mm on the predicted water surface level. This has an equivalent inundation extent impact of -5.6% and +5.5%, which is a relatively minor impact on the predicted extents.

At the same testing locations, the peak velocities were also extracted. From Table 17 and 18, it can be seen that there is an equivalent change in velocity as per the change in Manning's percentage. However, the flow velocity change is small and remains in the same order of magnitude as the adopted existing case.

Table 17: Piebald Manning's 'M' value sensitivity (velocity)

Location	Adopted value (m)	+30% value	Change (%)	-30% value	Change (%)
1	0.340	0.352	3.5	0.301	-11.5
2	0.450	0.531	18.0	0.354	-21.3
3	0.193	0.205	6.2	0.172	-10.9
4	0.496	0.590	19.0	0.392	-21.0

Table 18: Miclere Manning's 'M' value sensitivity (velocity)

Location	Adopted value (m/s)	+30% value	Change (%)	-30% value	Change (%)
1	0.280	0.317	13.2	0.235	-16.1
2	0.374	0.445	19.0	0.296	-20.9
3	0.203	0.228	12.3	0.174	-14.3
4	0.430	0.505	17.4	0.344	-20.0
5	0.469	0.573	22.2	0.361	-23.0
6	0.215	0.236	9.8	0.188	-12.6

Inflow hydrographs

The inflow values were adjusted by ±30% to assess the impacts of this parameter on the predicted maximum inundation depths at the locations shown in Table 19 and 20.

Table 19: Piebald Inflow hydrograph sensitivity

Location	Adopted value (m)	+30% value	Change (m)	-30% value	Change (m)
1	0.697	0.933	0.236	0.418	-0.279
2	2.147	2.396	0.249	1.849	-0.298
3	0.889	1.136	0.247	0.598	-0.291
4	1.722	1.962	0.240	1.441	-0.281

Table 20: Miclere Inflow hydrograph sensitivity

Location	Adopted value (m)	+30% value	Change (m)	-30% value	Change (m)
1	1.109	1.312	0.203	0.861	-0.248
2	1.284	1.461	0.177	1.078	-0.206
3	0.446	0.547	0.101	0.342	-0.104
4	1.158	1.343	0.185	0.936	-0.222
5	1.396	1.576	0.180	1.183	-0.213
6	0.388	0.514	0.126	0.266	-0.122

The inflow values have an impact ranging from -300mm to +250mm on the predicted water surface level. This has an equivalent inundation extent impact of -8.2% and +4.4%, which is a relatively minor impact on the predicted extents.

Downstream boundary

The downstream boundary water surface levels were adjusted by ±30% to assess the impacts of this parameter on the predicted maximum inundation depths at the locations shown in Table 21 and 22.

Table 21: Piebald downstream boundary sensitivity

Location	Adopted value (m)	+30% value	Change (m)	-30% value	Change (m)
1	0.697	0.697	0.000	0.697	-0.000
2	2.147	2.147	0.000	2.147	-0.000
3	0.889	0.889	0.000	0.889	-0.000
4	1.722	1.722	0.000	1.722	-0.000

Table 22: Miclere downstream boundary sensitivity

Location	Adopted value (m)	+30% value	Change (m)	-30% value	Change (m)
1	1.109	1.109	0.000	1.109	-0.000
2	1.284	1.285	0.001	1.284	-0.000
3	0.446	0.446	0.000	0.446	-0.000
4	1.158	1.159	0.006	1.158	-0.000
5	1.396	1.404	0.006	1.396	-0.000
6	0.388	0.391	0.003	0.388	-0.000

The downstream boundary level has a negligible impact on the predicted water surface level. This has an equivalent inundation extent impact of -0.2 % and +2.0 %, which has minimal impact on the predicted extents.

The sensitivity analysis has shown that the magnitude of the hydraulic model inflows has the most significant impact on the predicted water surface levels within the 2-D model. Although the relative change in level is high when compared to the predicted water depth, the change in inundation extent is minimal.

Conservative values for all variables have been adopted as part of this study. It is considered that the outcomes of the study are adequate without hydraulic model calibration and are conservative in nature.

9.2 Floodplain Drainage Structure Recommendations

As discussed in previous sections, with the additional data received and incorporated as part of the Detailed Floodplain Study, additional analysis was required on the proposed BFS cross-drainage infrastructure in order to demonstrate that the impacts of the proposed ACP rail alignment could be mitigated to levels that comply with the EIS and SEIS. This has resulted in a significant increase in cross-drainage infrastructure.

The following additional cross-drainage structures are proposed to meet the EIS, SEIS and stakeholder requirements for the system.

For Miclere Creek, the following additional cross-drainage infrastructure is recommended in order to minimise the impacts of the railway:

- 72/ 3000mm diameter CSPs at the proposed crossing location (northern branch);
- 105/ 2700mm diameter CSPs on the centreline branch of Miclere;
- 50/ 2700mm diameter CSPs on the northern side branch of Miclere;
- 83/ 1500mm diameter CSPs supplementary culverts on the northern side of the floodplain.

The approximate locations for the proposed Miclere Creek Culverts are shown below in Figure 7.

Piebald Creek required an additional 78/ 2700mm diameter supplementary CSPs, and 900mm diameter floodplain relief CSP culverts at 25m spacings.

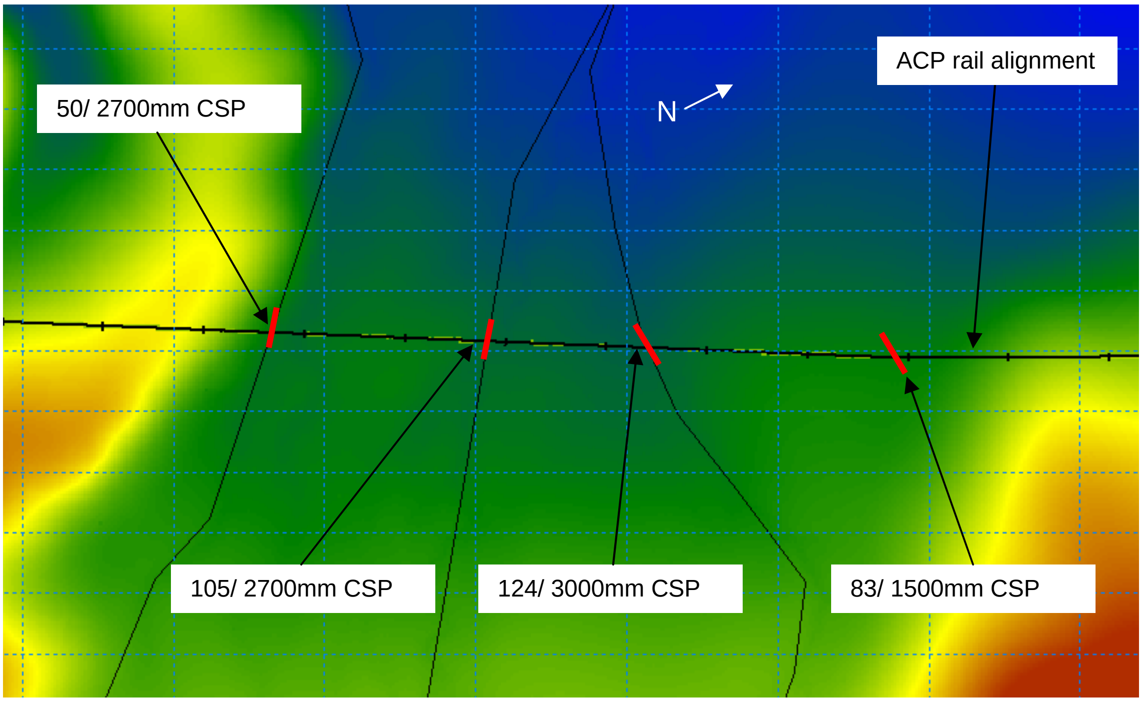


Figure 7: Miclere Creek proposed culvert locations and total quantities

9.3 Results

Following the collation of information received from Landholders during the consultation process, the findings from this Detailed Floodplain Study have been presented to specific Landholders who have an interest in and/or are influenced by the proposed Alpha Coal rail alignment and its impact on the Miclere Creek / Piebald Creek floodplain system.

Feedback from Landholders through continued consultation has shown the pre-development flood modelling correlates well with what has been observed on-site during major flood events. The post-development models utilise the same hydrologic parameters and same hydraulic modelling methods as the pre-development models to ensure consistency. Preliminary drainage structures have been modelled in the post-development case to conform to the SEIS requirements.

Peak floodplain inundation depths, water surface elevations, velocities and inundation extents have all been plotted and are shown in Appendix B.

Drawings include:

- Inundation extents:
  - 5, 50 and 100 year ARI events pre - and post-development.
- Inundation depths:
  - 50 year ARI event post-development.
- Water surface elevations:
  - 50 year ARI event post-development.

- Velocity profiles:
  - 50 year ARI event post-development.
- Afflux:
  - 50 year ARI event.

A summary of the findings from the Detailed Floodplain Study compared to the SEIS drainage criteria is shown in Table 23.

Table 23: Results Summary

Design Aspect	SEIS Design Criteria	Result Summary
Inundation Extent	Acceptable increases in inundation extent (above the existing conditions for a given return period to the 50 year ARI event) will be proposed where such an increase will not alter rural land use and result in significant impacts.	Conforms to SEIS requirements. There is an overall decrease of 0.001% in inundation extent of the modelled area during the design flood event.
Inundation Duration	Inundation duration not more than 3 days on valued pasture land that had previously been inundated for 3 days or less for similar rainfall events.	Conforms to SEIS requirements.
Max Velocity	Bridge outlet velocity = maximum of 1.2 x existing velocity at a distance equal to the bridge span downstream of bridge. Culverts outlet velocity: = 1.5m/s where erodible soils are present. = 2.5m/s for normal soils (with no erosion control).	Conforms to SEIS requirements. Refer Velocity drawing in Appendix B for details.
Maximum afflux	Maximum 0.5m – normally (unless justifiable). Maximum 0.2m – around critical infrastructure. Maximum 0.1m – around dwellings.	Conforms to SEIS requirements. Refer Afflux drawing in Appendix B for details.

Further to the above table, results show that there is a minimal change in overall inundation extents due to the current alignment and proposed floodplain drainage structures. This is shown below in Table 24.

Table 24: Change in inundation extents

Event ARI (years)	% change in "wet" cells	Change in area (ha)
5	-1.2	-49.8
50	-0.001	-0.1

With the inclusion of additional cross-drainage structures, the proposed ACP rail alignment will meet the afflux limits specified in the SEIS with the exception of minor localised areas. These areas are very small in extent, localised to areas adjacent to the alignment and currently have no impact to existing infrastructure, inundation times, velocities and minimal increase in inundation extents. Afflux and velocity results for the nominated design criteria post-development meet the requirements of the SEIS and stakeholder requirements. Results are shown in Appendix B.

Inundation Duration

One of the primary concerns of Landholders from the EIS and during the consultation process is related to the change in duration of inundation due to the development of the Alpha Coal rail alignment.

Detailed 2-D modelling with time-step analysis on areas of interest reports that inundation duration has been maintained across the floodplain to the requirements of the SEIS ie; inundation duration of not more than 3 days on valued pasture land that had previously been inundated for 3 days or less for similar rainfall events.

10.0 CONCLUSION

Detailed hydrologic and hydraulic modelling has been completed for Miclere and Piebald Creeks at the proposed ACP rail alignment. It has been shown that the proposed railway can mitigate its hydraulic impacts to an acceptable level with small, localised areas that exceed the limits placed on the project by the SEIS. The recommended cross-drainage structures for Miclere and Piebald Creek are shown in Tables 25 to 28. Alternative drainage structures may be utilised providing equivalent hydraulic performance is maintained or improved.

Table 25: Miclere Creek

Item	Value
Proposed cross-drainage infrastructure	124/ 3000mm diameter supplementary CSPs 155/ 2700mm diameter supplementary CSPs 83/ 1500mm diameter supplementary CSPs

Table 26: Piebald Creek

Item	Value
Proposed cross-drainage infrastructure	115/ 2700mm diameter supplementary CSPs

Table 27: Floodplain relief culverts - Piebald Creek

Item	Value
Proposed cross-drainage infrastructure	900mm diameter CSPs at 25m in the floodplain

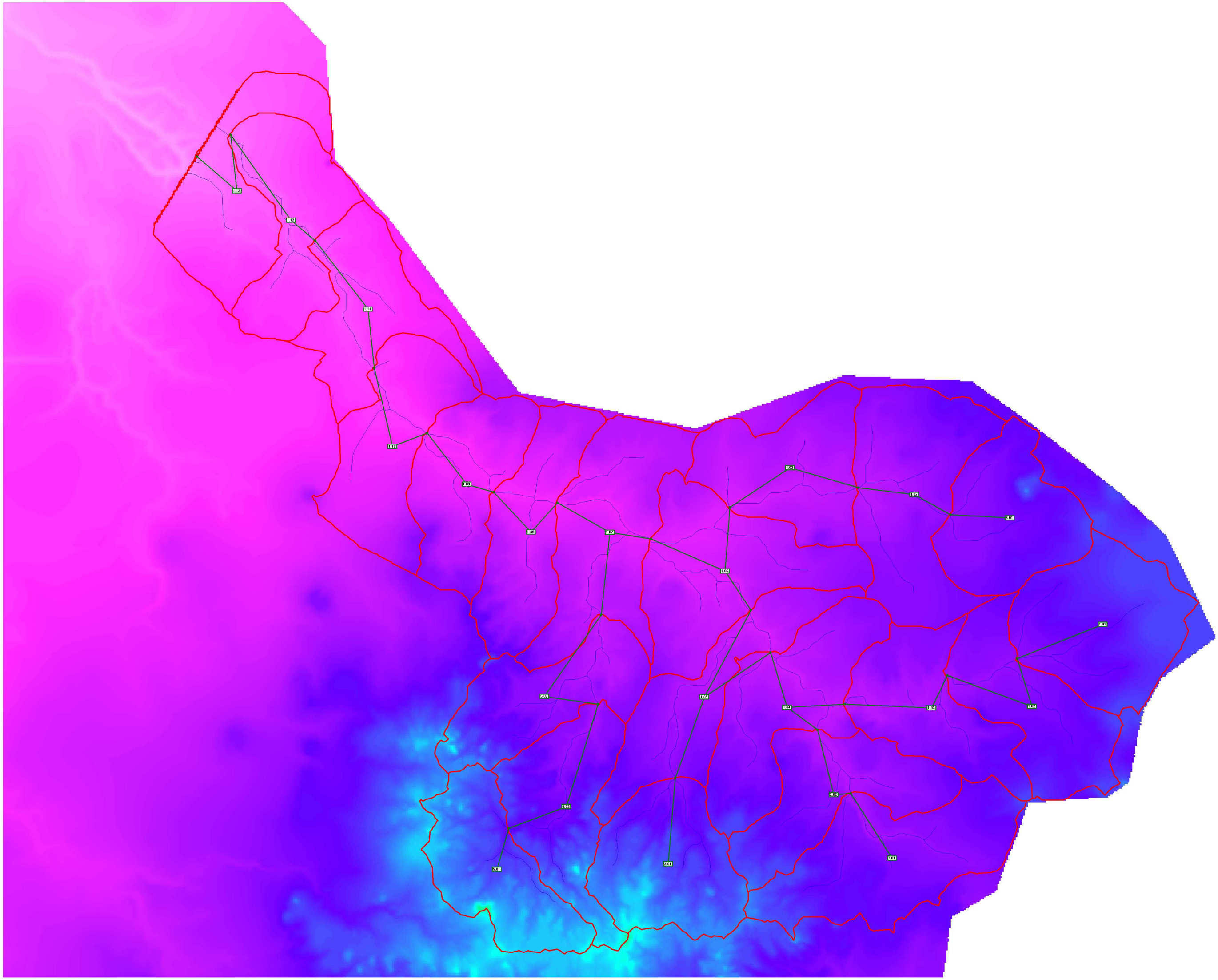
Table 28: Floodplain relief culverts - Miclere Creek

Item	Value
Proposed cross-drainage infrastructure	900mm diameter CSPs at 50m in the floodplain

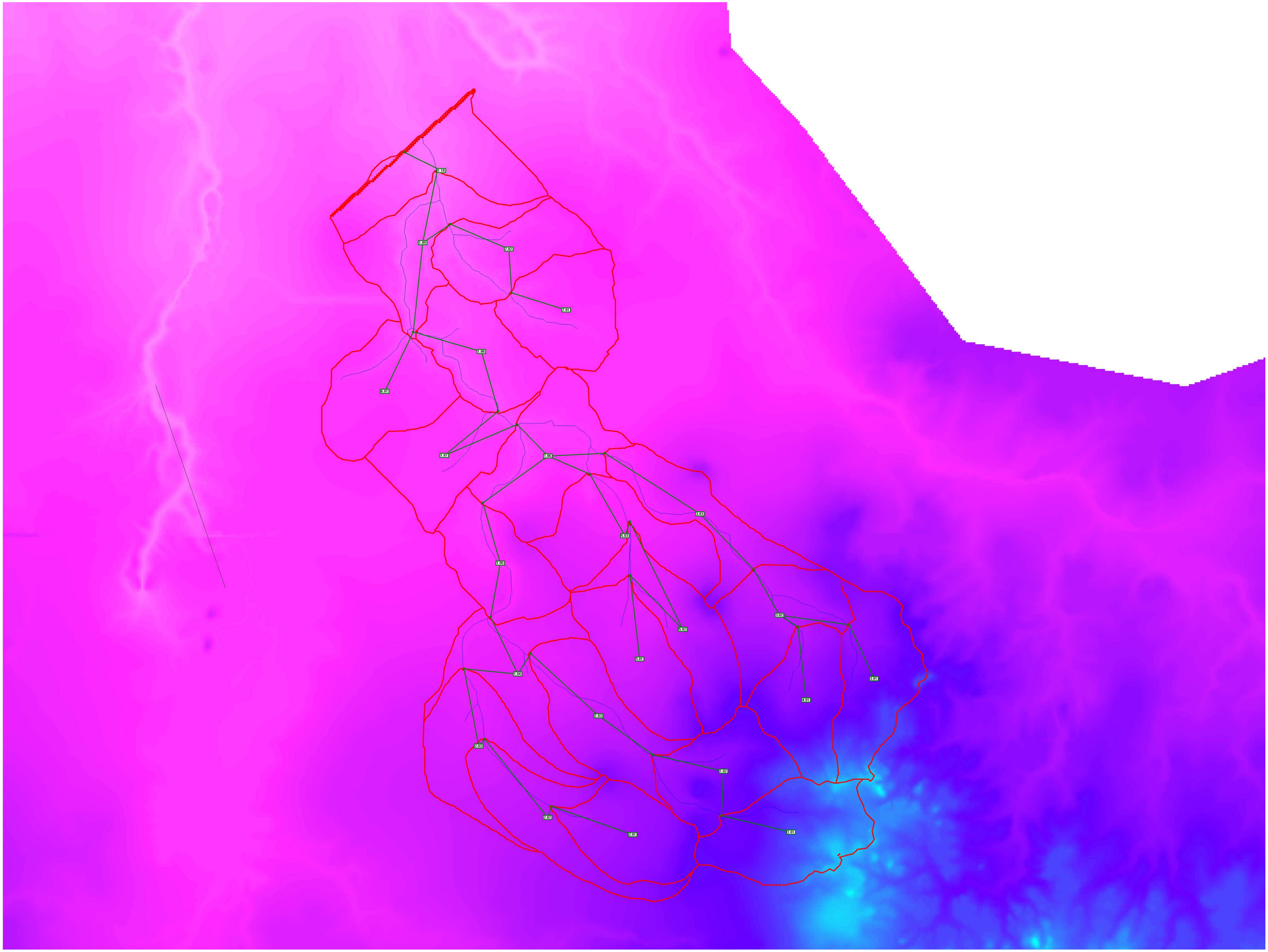
The findings can be further optimised when further hydraulic analysis is undertaken during the Detailed Design phase of the project.

APPENDIX A
RORB RESULTS

Miclere Creek Catchment Deliniation



Piebald Creek Catchment Deliniation



Kc and m parameters - Miclere creek

Miclere Creek

ARR Book 5

Catchment area	996.6	km^2	
d_{av}	49.15	km	(from RORB model)
K_c (Weeks, QLD)	34.17		

adjusted K_c	47.3373	
m	0.847	for 0.6<m<1.2

LHS	RHS (goal seek to LHS by changing m)
0.963119	0.963119

RORB manual	**Iteration1**	
K_c	51.41739	
Q_p	1200	m^3/s
m_1	0.847	

Kc and m parameters - Piebald creek

Piebald Creek

ARR Book 5

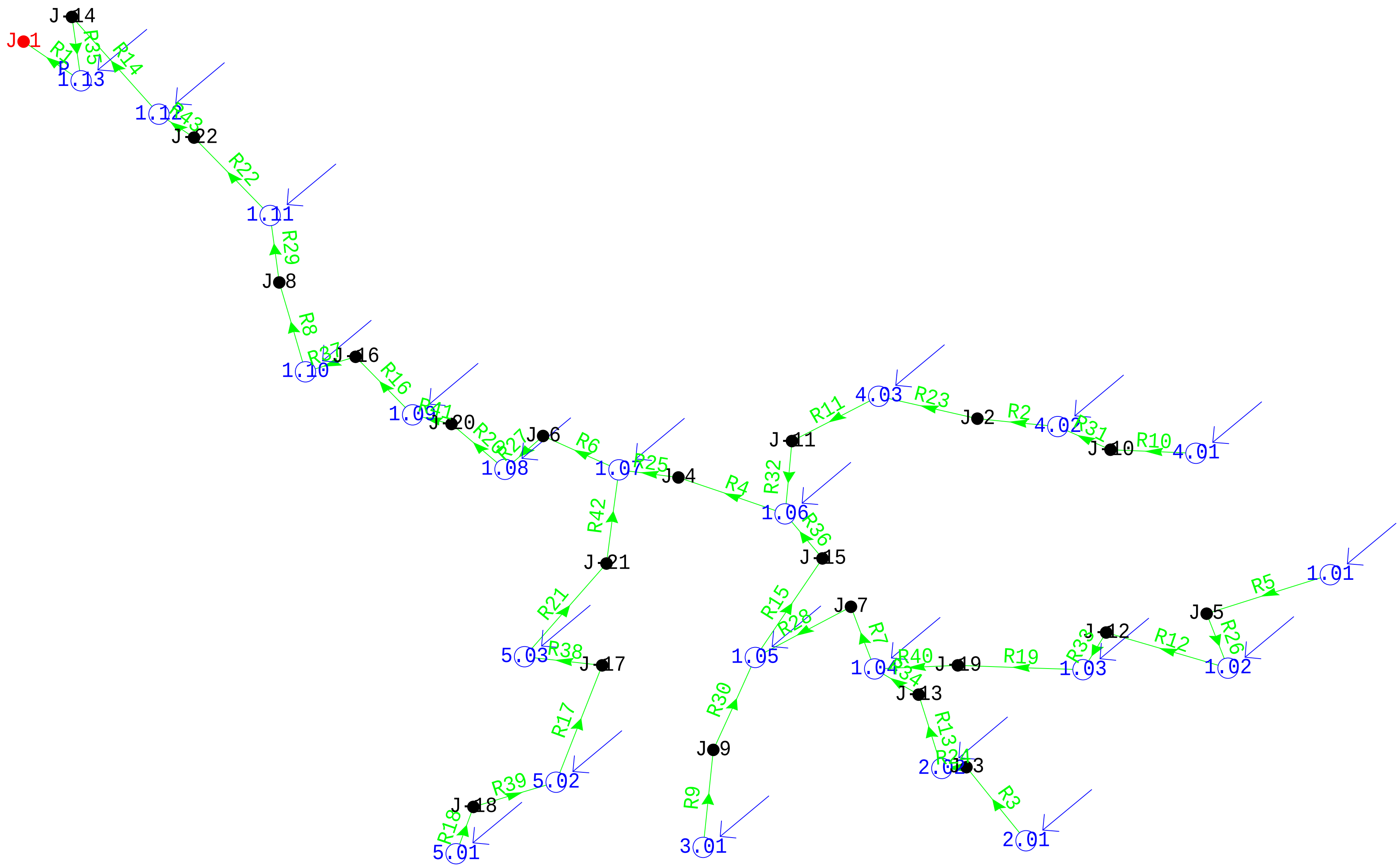
Catchment area	379.4	km^2	
d_{av}	27.39	km	(from RORB model)
K_c (Weeks, QLD)	20.48		

adjusted K_c	26.37983	
m	0.847	for 0.6<m<1.2

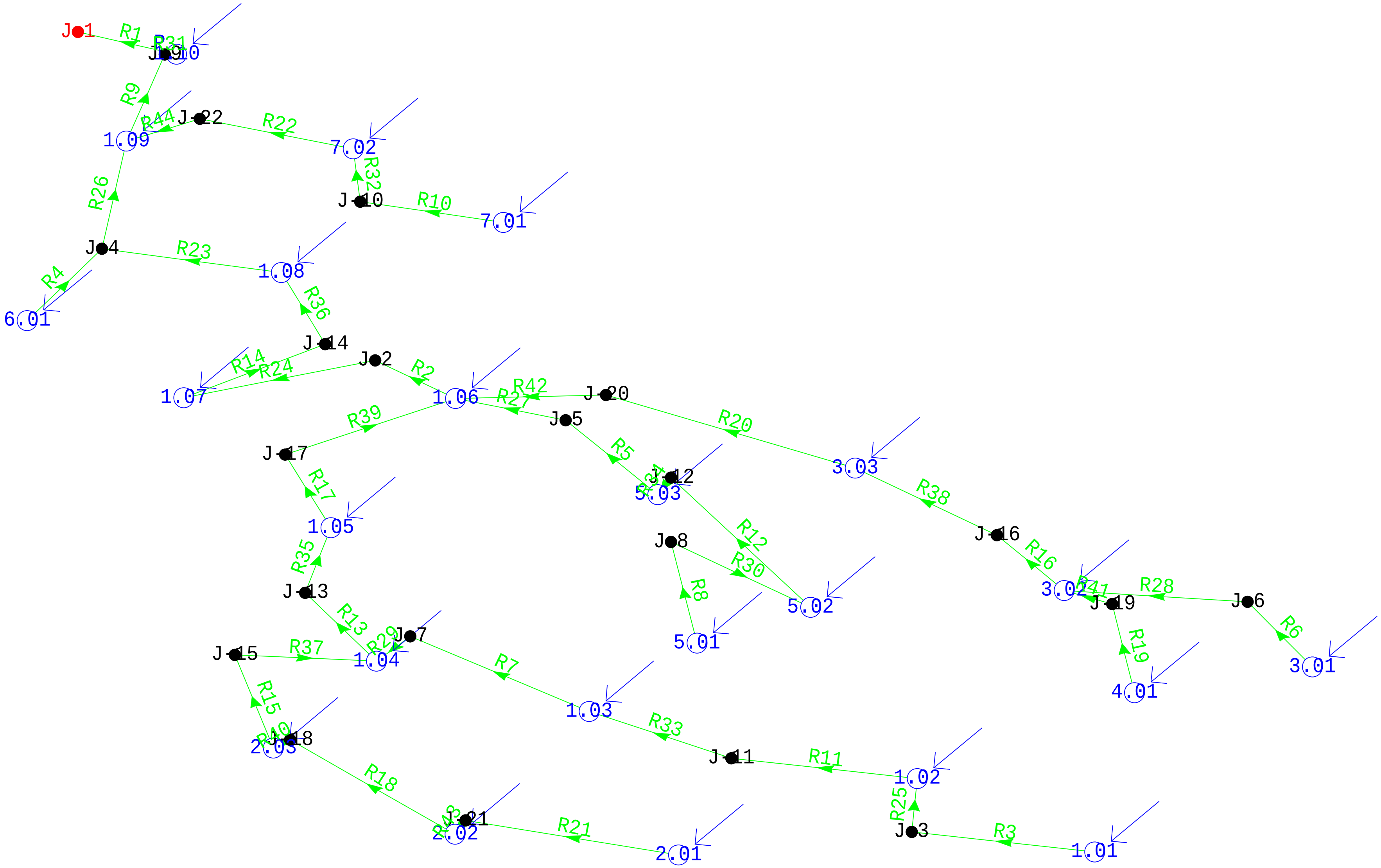
LHS	RHS (goal seek to LHS by changing m)
0.963119	0.963119

RORB manual	**Iteration1**	
K_c	32.33512	
Q_p	800	m^3/s
m_1	0.847	

Miclere Creek RORB



Piebald Creek RORB



```
                              Miclere Creek_18h50y
 RORBWin Output File
 *******************

 Program version 6.15 (last updated 30th March 2010)
 Copyright Monash University and Sinclair Knight Merz

 Date run: 07 Oct 2011 14:41

 Vector file       : S:\PRO-Projects\2011\CARP11064 HCPL Alpha FEED\06
Engineering\6.4 Hydrology\Miclere Creek\RORB\Miclere Creek.catg
 Storm file        : S:\PRO-Projects\2011\CARP11064 HCPL Alpha FEED\06
Engineering\6.4 Hydrology\Mistake Creek\RORB\Miclere Creek_18h50y.stm
 Output information: Flows & all input data


 Data checks:
 ************
 Next data to be read & checked:

 Catchment name & reach type flag
 Control vector & storage data
 Code no.  51     7.0 Location read as  Subcatchment: 1.13
 Sub-area areas
 Impervious flag
 Initial storm data
 Rainfall burst times
 Pluviograph 1
 Sub-area rainfalls

 Data check completed



 Data:
 ****

 Miclere Creek


 Time data, in increments from initial time
 Miclere Creek: 18 hour 50 year Design Storm
 Time increment (hours)=  1.00

                  Start   Finish
 Rainfall times:     0       18


 End of hyeto/hydrographs:   18
 Duration of calculations:  100



 Pluviograph data (time in incs, rainfall in mm, in
                  increment following time shown)

        1:Temporal pattern (% of depth
   Time     1
     0     3.4
     1    21.5
     2     3.9
     3     2.6
     4     4.5
     5    11.1
     6     1.9
     7     1.2
     8     8.8
     9     7.1
    10     2.2
```

Miclere Creek_18h50y

```
  11     1.5
  12     5.2
  13    14.8
  14     6.1
  15     3.0
  16     0.8
  17     0.4

 Total 100.0
```

DESIGN run control vector

```
Step  Code             Description
  1    1     Add sub-area 'A' inflow & route thru normal storage    1
  2    5     Route hydrograph thru normal storage    2
  3    2     Add sub-area 'B' inflow & route thru normal storage    3
  4    5     Route hydrograph thru normal storage    4
  5    2     Add sub-area 'C' inflow & route thru normal storage    5
  6    5     Route hydrograph thru normal storage    6
  7    3     Store hydrograph from step    6; reset hydrograph to zero
  8    1     Add sub-area 'D' inflow & route thru normal storage    7
  9    5     Route hydrograph thru normal storage    8
 10    2     Add sub-area 'E' inflow & route thru normal storage    9
 11    5     Route hydrograph thru normal storage   10
 12    4     Add h-graph ex step    7 to h-graph ex step   11
 13    2     Add sub-area 'F' inflow & route thru normal storage   11
 14    5     Route hydrograph thru normal storage   12
 15    3     Store hydrograph from step   14; reset hydrograph to zero
 16    1     Add sub-area 'G' inflow & route thru normal storage   13
 17    5     Route hydrograph thru normal storage   14
 18    4     Add h-graph ex step   15 to h-graph ex step   17
 19    2     Add sub-area 'H' inflow & route thru normal storage   15
 20    5     Route hydrograph thru normal storage   16
 21    3     Store hydrograph from step   20; reset hydrograph to zero
 22    1     Add sub-area 'I' inflow & route thru normal storage   17
 23    5     Route hydrograph thru normal storage   18
 24    2     Add sub-area 'J' inflow & route thru normal storage   19
 25    5     Route hydrograph thru normal storage   20
 26    2     Add sub-area 'K' inflow & route thru normal storage   21
 27    5     Route hydrograph thru normal storage   22
 28    4     Add h-graph ex step   21 to h-graph ex step   27
 29    2     Add sub-area 'L' inflow & route thru normal storage   23
 30    5     Route hydrograph thru normal storage   24
 31    3     Store hydrograph from step   30; reset hydrograph to zero
 32    1     Add sub-area 'M' inflow & route thru normal storage   25
 33    5     Route hydrograph thru normal storage   26
 34    2     Add sub-area 'N' inflow & route thru normal storage   27
 35    5     Route hydrograph thru normal storage   28
 36    2     Add sub-area 'O' inflow & route thru normal storage   29
 37    5     Route hydrograph thru normal storage   30
 38    4     Add h-graph ex step   31 to h-graph ex step   37
 39    2     Add sub-area 'P' inflow & route thru normal storage   31
 40    5     Route hydrograph thru normal storage   32
 41    2     Add sub-area 'Q' inflow & route thru normal storage   33
 42    5     Route hydrograph thru normal storage   34
 43    2     Add sub-area 'R' inflow & route thru normal storage   35
 44    5     Route hydrograph thru normal storage   36
 45    2     Add sub-area 'S' inflow & route thru normal storage   37
 46    5     Route hydrograph thru normal storage   38
 47    2     Add sub-area 'T' inflow & route thru normal storage   39
 48    5     Route hydrograph thru normal storage   40
 49    2     Add sub-area 'U' inflow & route thru normal storage   41
 50    5     Route hydrograph thru normal storage   42
 51    7.0   Print hydrograph,  Subcatchment: 1.13
 52    2     Add sub-area 'V' inflow & route thru normal storage   43
```

Miclere Creek_18h50y
53 0 **********End of control vector**********

Sub-area data

Sub-area	Area km²	Dist. km*
A	5.37E+01	7.86E+01
B	4.16E+01	6.99E+01
C	4.01E+01	6.39E+01
D	5.74E+01	7.23E+01
E	4.15E+01	6.27E+01
F	4.96E+01	5.72E+01
G	4.51E+01	5.96E+01
H	4.08E+01	5.26E+01
I	4.31E+01	7.03E+01
J	5.84E+01	6.24E+01
K	4.30E+01	5.51E+01
L	5.68E+01	4.68E+01
M	4.03E+01	6.46E+01
N	4.04E+01	5.39E+01
O	4.00E+01	4.54E+01
P	5.36E+01	3.92E+01
Q	4.01E+01	3.39E+01
R	4.07E+01	2.90E+01
S	4.56E+01	2.31E+01
T	4.00E+01	1.54E+01
U	4.12E+01	5.82E+00
V	4.37E+01	5.48E-01

Total 9.966E+02

For whole catchment ; Av. Dist., km* = 49.15
For interstation area 1; Av. Dist., km* = 49.15; ISA Factor = 1.000

* or other function of reach properties related to travel time

Normal storage data

Storage no.	Length km*	Rel. delay time	Type	Slope percent
1	6.2	0.127	Natural	
2	2.4	0.049	Natural	
3	2.4	0.049	Natural	
4	3.6	0.073	Natural	
5	3.6	0.073	Natural	
6	3.1	0.063	Natural	
7	7.2	0.147	Natural	
8	2.4	0.048	Natural	
9	2.4	0.048	Natural	
10	3.1	0.063	Natural	
11	3.1	0.063	Natural	
12	1.5	0.031	Natural	
13	5.5	0.112	Natural	
14	1.5	0.031	Natural	
15	1.5	0.031	Natural	
16	4.2	0.086	Natural	
17	4.8	0.098	Natural	
18	3.1	0.063	Natural	
19	3.1	0.063	Natural	
20	4.1	0.084	Natural	
21	4.1	0.084	Natural	
22	4.2	0.086	Natural	
23	4.2	0.086	Natural	
24	3.4	0.070	Natural	

25	4.9	0.100	Natural
26	5.8	0.117	Natural
27	5.8	0.117	Natural
28	2.8	0.057	Natural
29	2.8	0.057	Natural
30	3.4	0.070	Natural
31	3.4	0.070	Natural
32	1.8	0.037	Natural
33	1.8	0.037	Natural
34	3.1	0.063	Natural
35	3.1	0.063	Natural
36	2.9	0.058	Natural
37	2.9	0.058	Natural
38	4.8	0.098	Natural
39	4.8	0.098	Natural
40	4.7	0.096	Natural
41	4.7	0.096	Natural
42	0.5	0.011	Natural
43	0.5	0.011	Natural

* or other function of reach properties related to travel time

Input of parameters:
****

Miclere Creek
DESIGN Run
Miclere Creek: 18 hour 50 year Design Storm
Time increment = 1.00 hours

Constant loss model selected

Rainfall, mm, in time inc. following time shown

Time Incs	Catchment	Sub-Area A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
0	5.7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
1	36.0	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
2	6.5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
3	4.4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
4	7.5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
5	18.6	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
6	3.2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
7	2.0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
8	14.7	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
9	11.9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
10	3.7	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
11	2.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
12	8.7	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
13	24.8	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	

Miclere Creek_18h50y

25

14	10.2	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
15	5.0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
16	1.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tot.	167.4	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167
Pluvi. ref. no.		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Time Incs	Catch ment	Sub-Area Q	R	S	T	U	V
0	5.7	6	6	6	6	6	6
1	36.0	36	36	36	36	36	36
2	6.5	7	7	7	7	7	7
3	4.4	4	4	4	4	4	4
4	7.5	8	8	8	8	8	8
5	18.6	19	19	19	19	19	19
6	3.2	3	3	3	3	3	3
7	2.0	2	2	2	2	2	2
8	14.7	15	15	15	15	15	15
9	11.9	12	12	12	12	12	12
10	3.7	4	4	4	4	4	4
11	2.5	3	3	3	3	3	3
12	8.7	9	9	9	9	9	9
13	24.8	25	25	25	25	25	25
14	10.2	10	10	10	10	10	10
15	5.0	5	5	5	5	5	5
16	1.3	1	1	1	1	1	1
17	0.7	1	1	1	1	1	1
Tot.	167.4	167	167	167	167	167	167
Pluvi. ref. no.		1	1	1	1	1	1

Rainfall-excess, mm, in time inc. following time shown

Time Incs	Catch ment	Sub-Area A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	24.2	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
2	4.0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3	1.9	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4	5.0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
5	16.1	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
6	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	12.2	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

Miclere Creek_18h50y

9	9.4	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
10	1.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	6.2	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
13	22.3	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
14	7.7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
15	2.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
16	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tot.	113.4	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113

Time Incs	Catchment	Sub-Area Q	R	S	T	U	V
0	0.0	0	0	0	0	0	0
1	24.2	24	24	24	24	24	24
2	4.0	4	4	4	4	4	4
3	1.9	2	2	2	2	2	2
4	5.0	5	5	5	5	5	5
5	16.1	16	16	16	16	16	16
6	0.7	1	1	1	1	1	1
7	0.0	0	0	0	0	0	0
8	12.2	12	12	12	12	12	12
9	9.4	9	9	9	9	9	9
10	1.2	1	1	1	1	1	1
11	0.0	0	0	0	0	0	0
12	6.2	6	6	6	6	6	6
13	22.3	22	22	22	22	22	22
14	7.7	8	8	8	8	8	8
15	2.5	3	3	3	3	3	3
16	0.0	0	0	0	0	0	0
17	0.0	0	0	0	0	0	0
Tot.	113.4	113	113	113	113	113	113

Routing results:
****
Miclere Creek
Miclere Creek: 18 hour 50 year Design Storm
DESIGN run no. 1

Parameters: kc = 58.76 m = 0.80

Loss parameters	Initial loss (mm)	Cont. loss (mm/h)
	15.00	2.50

*** Calculated hydrograph, Subcatchment: 1.13

	Hydrograph Calc.
Peak discharge,m³/s	1319.

Miclere Creek_18h50y

Time to peak,h	22.0
Volume,m³	1.08E+08
Time to centroid,h	26.3
Lag (c.m. to c.m.),h	18.3
Lag to peak,h	14.0

Hydrograph summary
****

Site	Description
01	Calculated hydrograph, Subcatchment: 1.13

Inc	Time	Hyd0001
1	1.00	0.00
2	2.00	0.00
3	3.00	26.02
4	4.00	86.82
5	5.00	95.84
6	6.00	90.31
7	7.00	136.35
8	8.00	183.36
9	9.00	189.22
10	10.00	224.79
11	11.00	311.16
12	12.00	372.00
13	13.00	412.53
14	14.00	488.79
15	15.00	647.65
16	16.00	828.71
17	17.00	940.23
18	18.00	1033.98
19	19.00	1129.95
20	20.00	1208.79
21	21.00	1269.03
22	22.00	1303.93
23	23.00	1318.62
24	24.00	1314.09
25	25.00	1294.04
26	26.00	1259.50
27	27.00	1212.12
28	28.00	1153.05
29	29.00	1084.46
30	30.00	1008.92
31	31.00	929.46
32	32.00	848.98
33	33.00	769.97
34	34.00	694.35
35	35.00	623.41
36	36.00	557.90
37	37.00	498.14
38	38.00	444.13
39	39.00	395.68
40	40.00	352.42
41	41.00	313.95
42	42.00	279.84
43	43.00	249.63
44	44.00	222.92
45	45.00	199.30
46	46.00	178.42
47	47.00	159.96
48	48.00	143.62
49	49.00	129.15
50	50.00	116.32
51	51.00	104.93
52	52.00	94.81
53	53.00	85.80
54	54.00	77.77

55	55.00	70.61
56	56.00	64.20
57	57.00	58.46
58	58.00	53.32
59	59.00	48.70
60	60.00	44.55
61	61.00	40.81
62	62.00	37.43
63	63.00	34.38
64	64.00	31.62
65	65.00	29.12
66	66.00	26.85
67	67.00	24.79
68	68.00	22.91
69	69.00	21.20
70	70.00	19.64
71	71.00	18.22
72	72.00	16.92
73	73.00	15.72
74	74.00	14.63
75	75.00	13.62
76	76.00	12.70
77	77.00	11.85
78	78.00	11.07
79	79.00	10.35
80	80.00	9.68
81	81.00	9.07
82	82.00	8.50
83	83.00	7.97
84	84.00	7.49
85	85.00	7.03
86	86.00	6.61
87	87.00	6.22
88	88.00	5.86
89	89.00	5.52
90	90.00	5.21
91	91.00	4.91
92	92.00	4.64
93	93.00	4.38
94	94.00	4.14
95	95.00	3.92
96	96.00	3.71
97	97.00	3.51
98	98.00	3.33
99	99.00	3.16
100	100.00	3.00
101	101.00	2.84

```
                              Piebald Creek_18h50y
 RORBWin Output File
 *******************

 Program version 6.15 (last updated 30th March 2010)
 Copyright Monash University and Sinclair Knight Merz

 Date run: 08 Oct 2011 15:24

 Vector file       : S:\PRO-Projects\2011\CARP11064 HCPL Alpha FEED\06
Engineering\6.4 Hydrology\Piebald Creek\RORB\Piebald Creek.catg
 Storm file        : S:\PRO-Projects\2011\CARP11064 HCPL Alpha FEED\06
Engineering\6.4 Hydrology\Piebald Creek\RORB\Piebald Creek_18h50y.stm
 Output information: Flows & all input data


 Data checks:
 ************
 Next data to be read & checked:

 Catchment name & reach type flag
 Control vector & storage data
 Code no.  56     7.0 Location read as  Subcatchment: 1.10
 Sub-area areas
 Impervious flag
 Initial storm data
 Rainfall burst times
 Pluviograph 1
 Sub-area rainfalls

 Data check completed



 Data:
 ****

 Piebald Creek


 Time data, in increments from initial time
 Piebald Creek: 18 hour 50 year Design Storm
 Time increment (hours)=  1.00

                  Start   Finish
 Rainfall times:     0       18


 End of hyeto/hydrographs:   18
 Duration of calculations:  120



 Pluviograph data (time in incs, rainfall in mm, in
                  increment following time shown)

         1:Temporal pattern (% of depth
   Time     1
     0     3.4
     1    21.5
     2     3.9
     3     2.6
     4     4.5
     5    11.1
     6     1.9
     7     1.2
     8     8.8
     9     7.1
    10     2.2
```

Piebald Creek_18h50y

11	1.5
12	5.2
13	14.8
14	6.1
15	3.0
16	0.8
17	0.4
Total	100.0

DESIGN run control vector

Step	Code	Description
1	1	Add sub-area 'A' inflow & route thru normal storage 1
2	5	Route hydrograph thru normal storage 2
3	2	Add sub-area 'B' inflow & route thru normal storage 3
4	5	Route hydrograph thru normal storage 4
5	2	Add sub-area 'C' inflow & route thru normal storage 5
6	5	Route hydrograph thru normal storage 6
7	3	Store hydrograph from step 6; reset hydrograph to zero
8	1	Add sub-area 'D' inflow & route thru normal storage 7
9	5	Route hydrograph thru normal storage 8
10	2	Add sub-area 'E' inflow & route thru normal storage 9
11	5	Route hydrograph thru normal storage 10
12	2	Add sub-area 'F' inflow & route thru normal storage 11
13	5	Route hydrograph thru normal storage 12
14	4	Add h-graph ex step 7 to h-graph ex step 13
15	2	Add sub-area 'G' inflow & route thru normal storage 13
16	5	Route hydrograph thru normal storage 14
17	2	Add sub-area 'H' inflow & route thru normal storage 15
18	5	Route hydrograph thru normal storage 16
19	3	Store hydrograph from step 18; reset hydrograph to zero
20	1	Add sub-area 'I' inflow & route thru normal storage 17
21	5	Route hydrograph thru normal storage 18
22	3	Store hydrograph from step 21; reset hydrograph to zero
23	1	Add sub-area 'J' inflow & route thru normal storage 19
24	5	Route hydrograph thru normal storage 20
25	4	Add h-graph ex step 22 to h-graph ex step 24
26	2	Add sub-area 'K' inflow & route thru normal storage 21
27	5	Route hydrograph thru normal storage 22
28	2	Add sub-area 'L' inflow & route thru normal storage 23
29	5	Route hydrograph thru normal storage 24
30	4	Add h-graph ex step 19 to h-graph ex step 29
31	3	Store hydrograph from step 30; reset hydrograph to zero
32	1	Add sub-area 'M' inflow & route thru normal storage 25
33	5	Route hydrograph thru normal storage 26
34	2	Add sub-area 'N' inflow & route thru normal storage 27
35	5	Route hydrograph thru normal storage 28
36	2	Add sub-area 'O' inflow & route thru normal storage 29
37	5	Route hydrograph thru normal storage 30
38	4	Add h-graph ex step 31 to h-graph ex step 37
39	2	Add sub-area 'P' inflow & route thru normal storage 31
40	5	Route hydrograph thru normal storage 32
41	2	Add sub-area 'Q' inflow & route thru normal storage 33
42	5	Route hydrograph thru normal storage 34
43	2	Add sub-area 'R' inflow & route thru normal storage 35
44	3	Store hydrograph from step 43; reset hydrograph to zero
45	1	Add sub-area 'S' inflow & route thru normal storage 36
46	4	Add h-graph ex step 44 to h-graph ex step 45
47	5	Route hydrograph thru normal storage 37
48	3	Store hydrograph from step 47; reset hydrograph to zero
49	1	Add sub-area 'T' inflow & route thru normal storage 38
50	5	Route hydrograph thru normal storage 39
51	2	Add sub-area 'U' inflow & route thru normal storage 40
52	5	Route hydrograph thru normal storage 41

Piebald Creek_18h50y

53	4	Add h-graph ex step 48 to h-graph ex step 52
54	2	Add sub-area 'V' inflow & route thru normal storage 42
55	5	Route hydrograph thru normal storage 43
56	7.0	Print hydrograph, Subcatchment: 1.10
57	2	Add sub-area 'W' inflow & route thru normal storage 44
58	0	**********End of control vector**********

Sub-area data

Sub-area	Area km²	Dist. km*
A	1.97E+01	4.72E+01
B	1.62E+01	4.15E+01
C	1.76E+01	3.60E+01
D	1.50E+01	4.30E+01
E	1.52E+01	3.78E+01
F	1.53E+01	3.42E+01
G	1.60E+01	3.10E+01
H	1.53E+01	2.62E+01
I	1.77E+01	4.18E+01
J	1.52E+01	4.17E+01
K	1.53E+01	3.53E+01
L	1.50E+01	2.78E+01
M	1.67E+01	3.19E+01
N	1.61E+01	2.66E+01
O	1.79E+01	2.43E+01
P	2.05E+01	2.05E+01
Q	1.58E+01	1.74E+01
R	1.50E+01	1.36E+01
S	1.79E+01	1.46E+01
T	1.65E+01	1.91E+01
U	1.50E+01	1.30E+01
V	1.65E+01	6.14E+00
W	1.79E+01	8.97E-01

Total 3.794E+02

For whole catchment ; Av. Dist., km* = 27.39
For interstation area 1; Av. Dist., km* = 27.39; ISA Factor = 1.000

* or other function of reach properties related to travel time

Normal storage data

Storage no.	Length km*	Rel. delay time	Type	Slope percent
1	3.6	0.132	Natural	
2	2.0	0.075	Natural	
3	2.0	0.075	Natural	
4	3.5	0.128	Natural	
5	3.5	0.128	Natural	
6	1.5	0.056	Natural	
7	3.3	0.120	Natural	
8	1.9	0.070	Natural	
9	1.9	0.070	Natural	
10	1.7	0.061	Natural	
11	1.7	0.061	Natural	
12	1.5	0.056	Natural	
13	1.5	0.056	Natural	
14	3.2	0.117	Natural	
15	3.2	0.117	Natural	
16	2.5	0.091	Natural	
17	3.7	0.137	Natural	
18	2.7	0.099	Natural	

Piebald Creek_18h50y

19	3.6	0.132	Natural
20	2.7	0.099	Natural
21	2.7	0.099	Natural
22	4.8	0.176	Natural
23	4.8	0.176	Natural
24	2.5	0.091	Natural
25	4.2	0.155	Natural
26	1.1	0.039	Natural
27	1.1	0.039	Natural
28	1.3	0.047	Natural
29	1.3	0.047	Natural
30	2.5	0.091	Natural
31	2.5	0.091	Natural
32	0.6	0.022	Natural
33	0.6	0.022	Natural
34	3.2	0.115	Natural
35	3.2	0.115	Natural
36	4.1	0.150	Natural
37	4.3	0.159	Natural
38	3.7	0.133	Natural
39	2.5	0.091	Natural
40	2.5	0.091	Natural
41	4.3	0.159	Natural
42	4.3	0.159	Natural
43	0.9	0.033	Natural
44	0.9	0.033	Natural

* or other function of reach properties related to travel time

Input of parameters:
****

Piebald Creek
DESIGN Run
Piebald Creek: 18 hour 50 year Design Storm
Time increment = 1.00 hours

Constant loss model selected

Rainfall, mm, in time inc. following time shown

Time Incs	Catchment	Sub-Area A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
0	5.7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
1	36.3	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
2	6.6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
3	4.4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
4	7.6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
5	18.7	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
6	3.2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
7	2.0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
8	14.9	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
9	12.0	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

10	3.7	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
11	2.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
12	8.8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
13	25.0	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
14	10.3	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
15	5.1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
16	1.4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	0.7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tot.	168.8	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169
Pluvi. ref. no.		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Time Incs	Catchment	Sub-Area Q	R	S	T	U	V	W
0	5.7	6	6	6	6	6	6	6
1	36.3	36	36	36	36	36	36	36
2	6.6	7	7	7	7	7	7	7
3	4.4	4	4	4	4	4	4	4
4	7.6	8	8	8	8	8	8	8
5	18.7	19	19	19	19	19	19	19
6	3.2	3	3	3	3	3	3	3
7	2.0	2	2	2	2	2	2	2
8	14.9	15	15	15	15	15	15	15
9	12.0	12	12	12	12	12	12	12
10	3.7	4	4	4	4	4	4	4
11	2.5	3	3	3	3	3	3	3
12	8.8	9	9	9	9	9	9	9
13	25.0	25	25	25	25	25	25	25
14	10.3	10	10	10	10	10	10	10
15	5.1	5	5	5	5	5	5	5
16	1.4	1	1	1	1	1	1	1
17	0.7	1	1	1	1	1	1	1
Tot.	168.8	169	169	169	169	169	169	169
Pluvi. ref. no.		1	1	1	1	1	1	1

Rainfall-excess, mm, in time inc. following time shown

Time Incs	Catchment	Sub-Area A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	14.5	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
2	4.1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3	1.9	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4	5.1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
5	16.2	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	

```
                                 Piebald Creek_18h50y
16
   6    0.7           1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
1
   7    0.0           0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
0
   8   12.4          12   12   12   12   12   12   12   12   12   12   12   12   12   12   12
12
   9    9.5           9    9    9    9    9    9    9    9    9    9    9    9    9    9    9
9
  10    1.2           1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
1
  11    0.0           0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
0
  12    6.3           6    6    6    6    6    6    6    6    6    6    6    6    6    6    6
6
  13   22.5          22   22   22   22   22   22   22   22   22   22   22   22   22   22   22
22
  14    7.8           8    8    8    8    8    8    8    8    8    8    8    8    8    8    8
8
  15    2.6           3    3    3    3    3    3    3    3    3    3    3    3    3    3    3
3
  16    0.0           0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
0
  17    0.0           0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
0

 Tot.104.8          105  105  105  105  105  105  105  105  105  105  105  105  105  105  105
105

 Time                Sub-
      Catch          Area
 Incs ment            Q    R    S    T    U    V    W

   0    0.0           0    0    0    0    0    0    0
   1   14.5          15   15   15   15   15   15   15
   2    4.1           4    4    4    4    4    4    4
   3    1.9           2    2    2    2    2    2    2
   4    5.1           5    5    5    5    5    5    5
   5   16.2          16   16   16   16   16   16   16
   6    0.7           1    1    1    1    1    1    1
   7    0.0           0    0    0    0    0    0    0
   8   12.4          12   12   12   12   12   12   12
   9    9.5           9    9    9    9    9    9    9
  10    1.2           1    1    1    1    1    1    1
  11    0.0           0    0    0    0    0    0    0
  12    6.3           6    6    6    6    6    6    6
  13   22.5          22   22   22   22   22   22   22
  14    7.8           8    8    8    8    8    8    8
  15    2.6           3    3    3    3    3    3    3
  16    0.0           0    0    0    0    0    0    0
  17    0.0           0    0    0    0    0    0    0

 Tot.104.8          105  105  105  105  105  105  105


 Routing results:
 ****************
 Piebald Creek
 Piebald Creek: 18 hour 50 year Design Storm
 DESIGN run no.  1


 Parameters:  kc =    26.40    m = 0.85

 Loss parameters      Initial loss (mm)   Cont. loss (mm/h)
                            25.00               2.50
```

Piebald Creek_18h50y

*** Calculated hydrograph, Subcatchment: 1.10

	Hydrograph Calc.
Peak discharge,m³/s	553.9
Time to peak,h	19.0
Volume,m³	3.79E+07
Time to centroid,h	21.6
Lag (c.m. to c.m.),h	13.1
Lag to peak,h	10.4

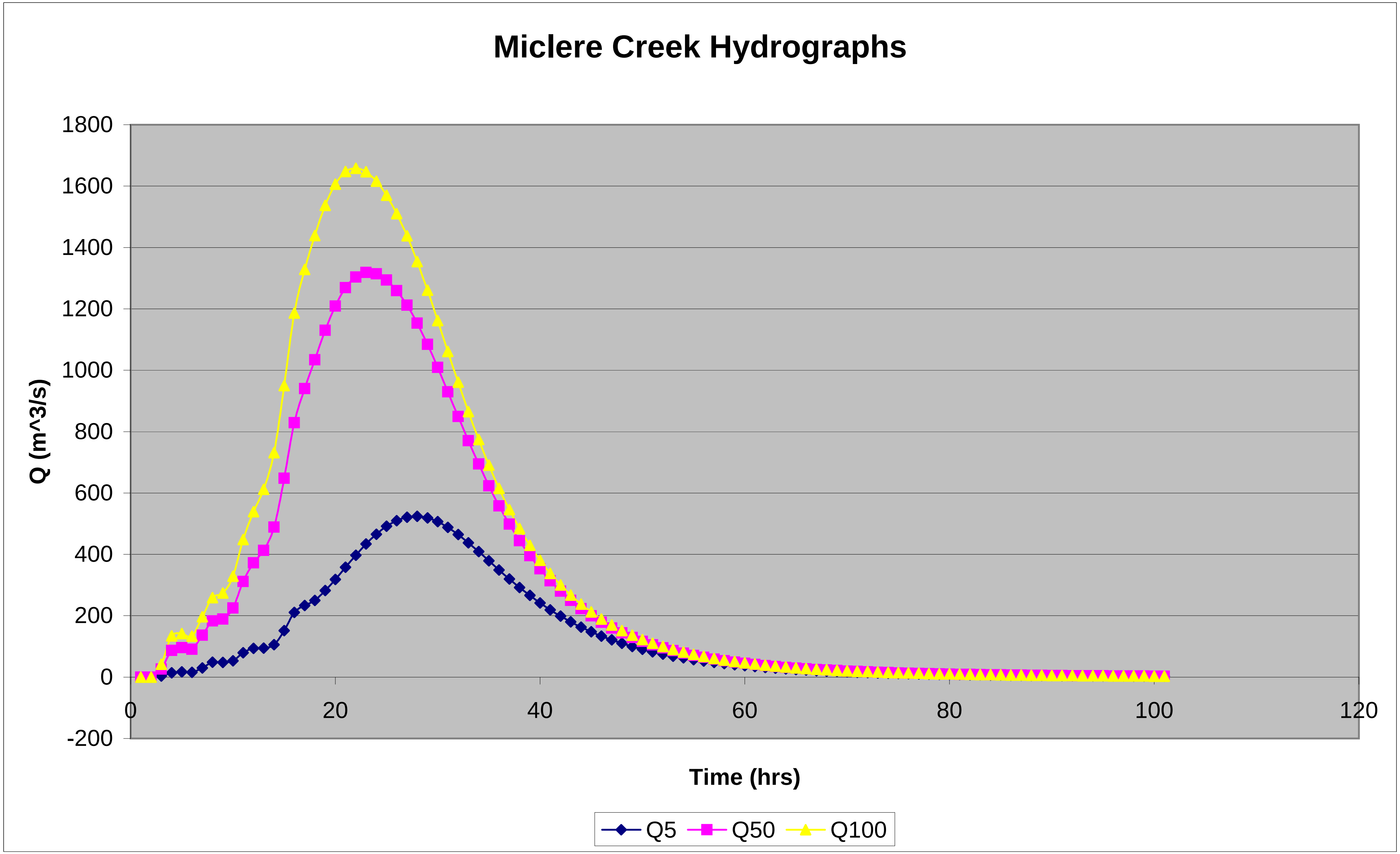
Hydrograph summary
****

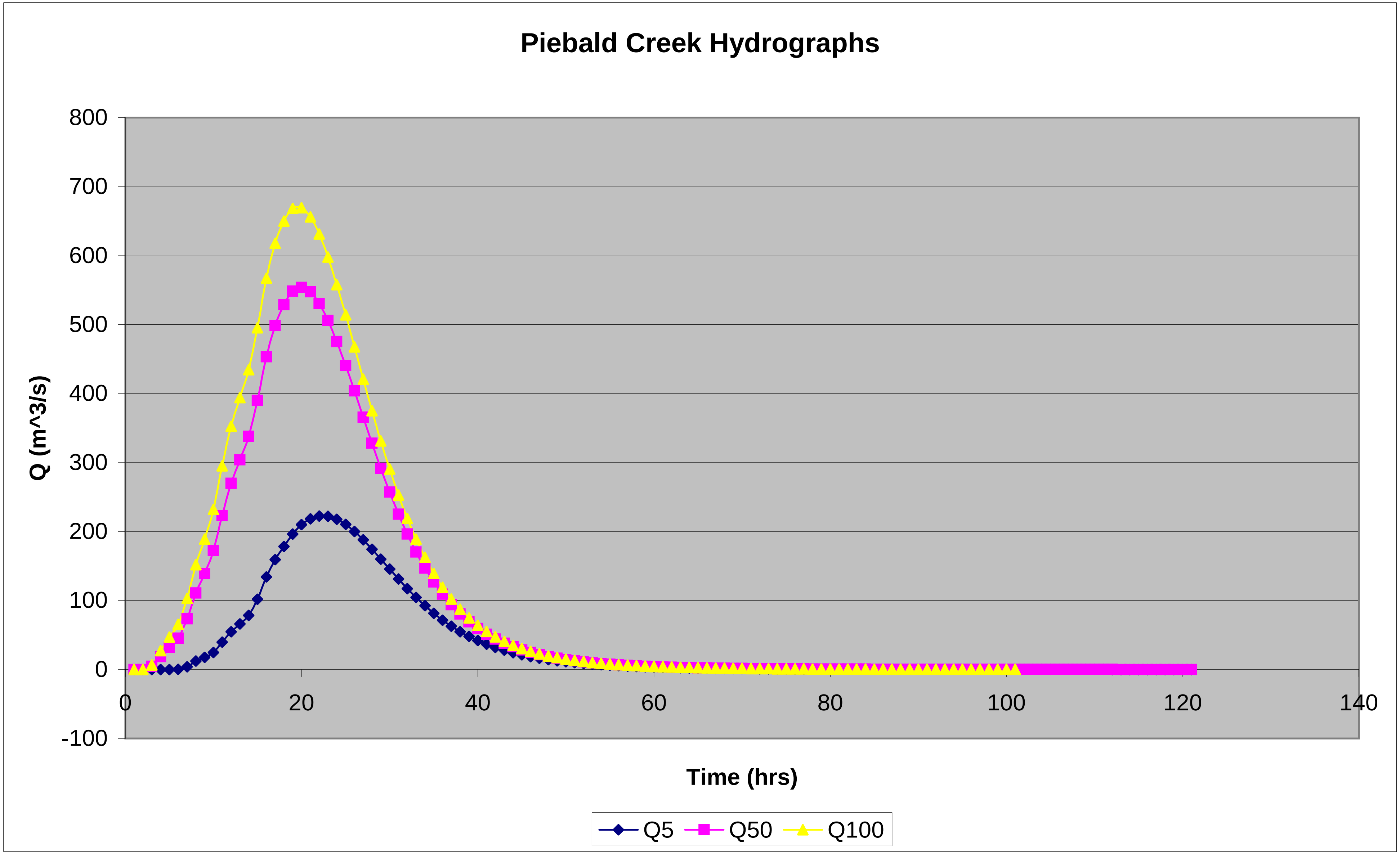
Site	Description
01	Calculated hydrograph, Subcatchment: 1.10

Inc	Time	Hyd0001
1	1.00	0.000
2	2.00	0.000
3	3.00	4.442
4	4.00	18.559
5	5.00	32.432
6	6.00	45.411
7	7.00	73.242
8	8.00	110.648
9	9.00	138.921
10	10.00	172.293
11	11.00	223.090
12	12.00	269.801
13	13.00	303.942
14	14.00	337.903
15	15.00	390.097
16	16.00	453.144
17	17.00	498.668
18	18.00	528.711
19	19.00	548.529
20	20.00	553.941
21	21.00	547.297
22	22.00	530.458
23	23.00	505.850
24	24.00	475.315
25	25.00	440.687
26	26.00	403.641
27	27.00	365.644
28	28.00	327.928
29	29.00	291.486
30	30.00	257.069
31	31.00	225.193
32	32.00	196.166
33	33.00	170.110
34	34.00	146.999
35	35.00	126.701
36	36.00	109.014
37	37.00	93.700
38	38.00	80.503
39	39.00	69.171
40	40.00	59.466
41	41.00	51.168
42	42.00	44.081
43	43.00	38.028
44	44.00	32.859
45	45.00	28.442
46	46.00	24.664
47	47.00	21.429

48	48.00	18.655
49	49.00	16.273
50	50.00	14.224
51	51.00	12.459
52	52.00	10.934
53	53.00	9.616
54	54.00	8.474
55	55.00	7.482
56	56.00	6.619
57	57.00	5.867
58	58.00	5.210
59	59.00	4.636
60	60.00	4.132
61	61.00	3.689
62	62.00	3.300
63	63.00	2.957
64	64.00	2.653
65	65.00	2.385
66	66.00	2.147
67	67.00	1.936
68	68.00	1.749
69	69.00	1.581
70	70.00	1.432
71	71.00	1.299
72	72.00	1.180
73	73.00	1.073
74	74.00	0.977
75	75.00	0.891
76	76.00	0.813
77	77.00	0.743
78	78.00	0.680
79	79.00	0.623
80	80.00	0.571
81	81.00	0.524
82	82.00	0.482
83	83.00	0.443
84	84.00	0.408
85	85.00	0.377
86	86.00	0.347
87	87.00	0.321
88	88.00	0.297
89	89.00	0.275
90	90.00	0.254
91	91.00	0.236
92	92.00	0.219
93	93.00	0.203
94	94.00	0.189
95	95.00	0.176
96	96.00	0.163
97	97.00	0.152
98	98.00	0.142
99	99.00	0.132
100	100.00	0.124
101	101.00	0.115
102	102.00	0.108
103	103.00	0.101
104	104.00	0.095
105	105.00	0.089
106	106.00	0.083
107	107.00	0.078
108	108.00	0.073
109	109.00	0.069
110	110.00	0.065
111	111.00	0.061
112	112.00	0.057
113	113.00	0.054
114	114.00	0.051
115	115.00	0.048

116	116.00	0.045
117	117.00	0.042
118	118.00	0.040
119	119.00	0.038
120	120.00	0.036
121	121.00	0.034

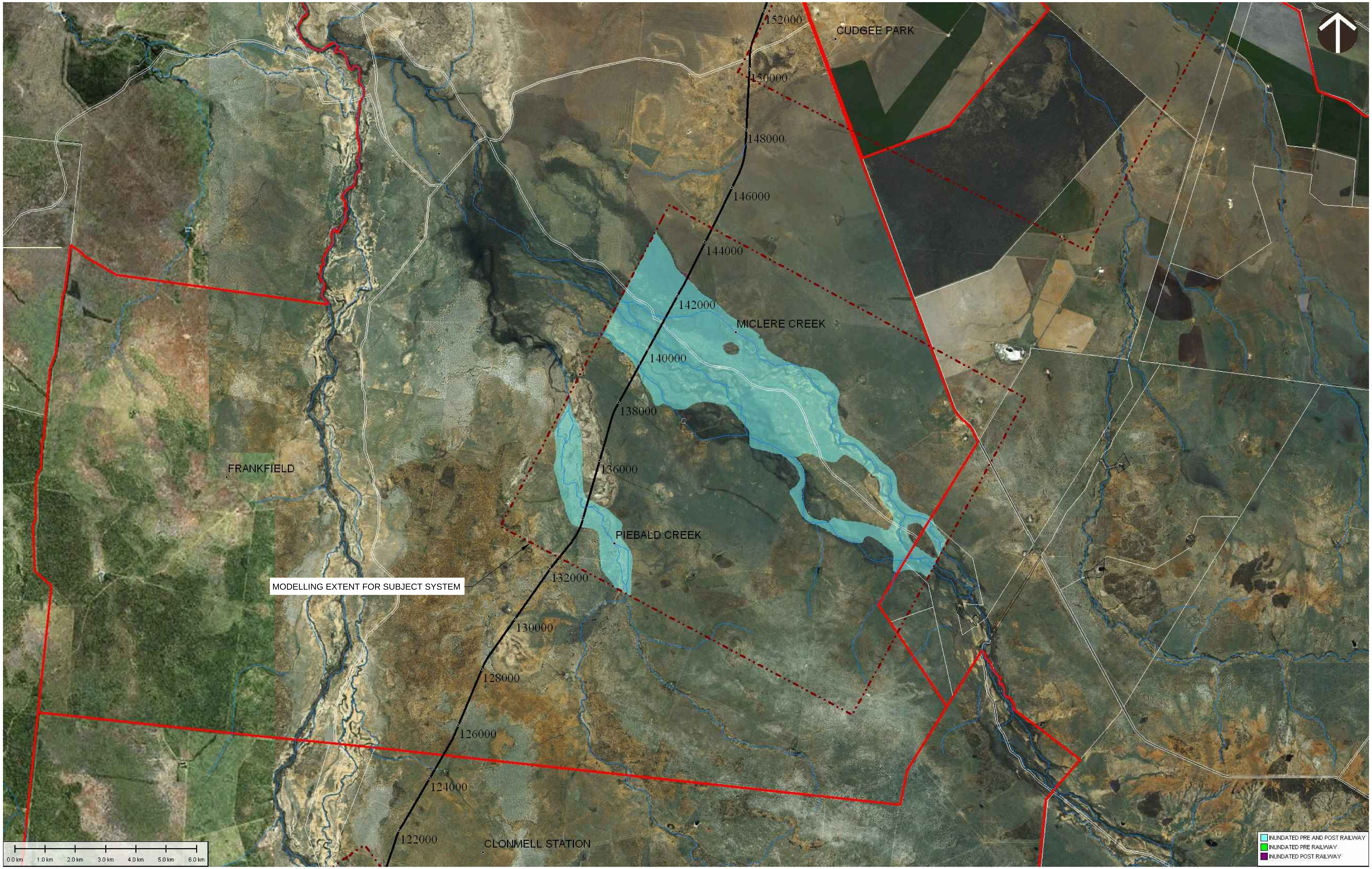

Miclere Creek Hydrographs
Q (m^3/s)
1800
1600
1400
1200
1000
800
600
400
200
0
-200
0
20
40
60
80
100
120
Time (hrs)
Q5
Q50
Q100


Piebald Creek Hydrographs
Q (m^3/s)
800
700
600
500
400
300
200
100
0
-100
0
20
40
60
80
100
120
140
Time (hrs)
Q5
Q50
Q100

APPENDIX B
FLOOD MAPS

NOT TO BE SCALED

NOT TO BE SCALED



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ENG. APPROVED		
ENG. MANAGER		
PROJECT MANAGER		
CLIENT APPROVED		

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HANCOCK COAL PTY LTD

ALPHA COAL PROJECT
RAIL ALIGNMENT - MINE TO ABBOT POINT
FLOOD INUNDATION
MICLERE CREEK / PIEBALD CREEK - Q5

SHEET SIZE A1

PN No CJVP10007

SCALE NTS

CALIBRE DRAWING No. CJVP10007-DWG-G-734

HANCOCK COAL REFERENCE No. HC-CRL-24100-DRG-0666

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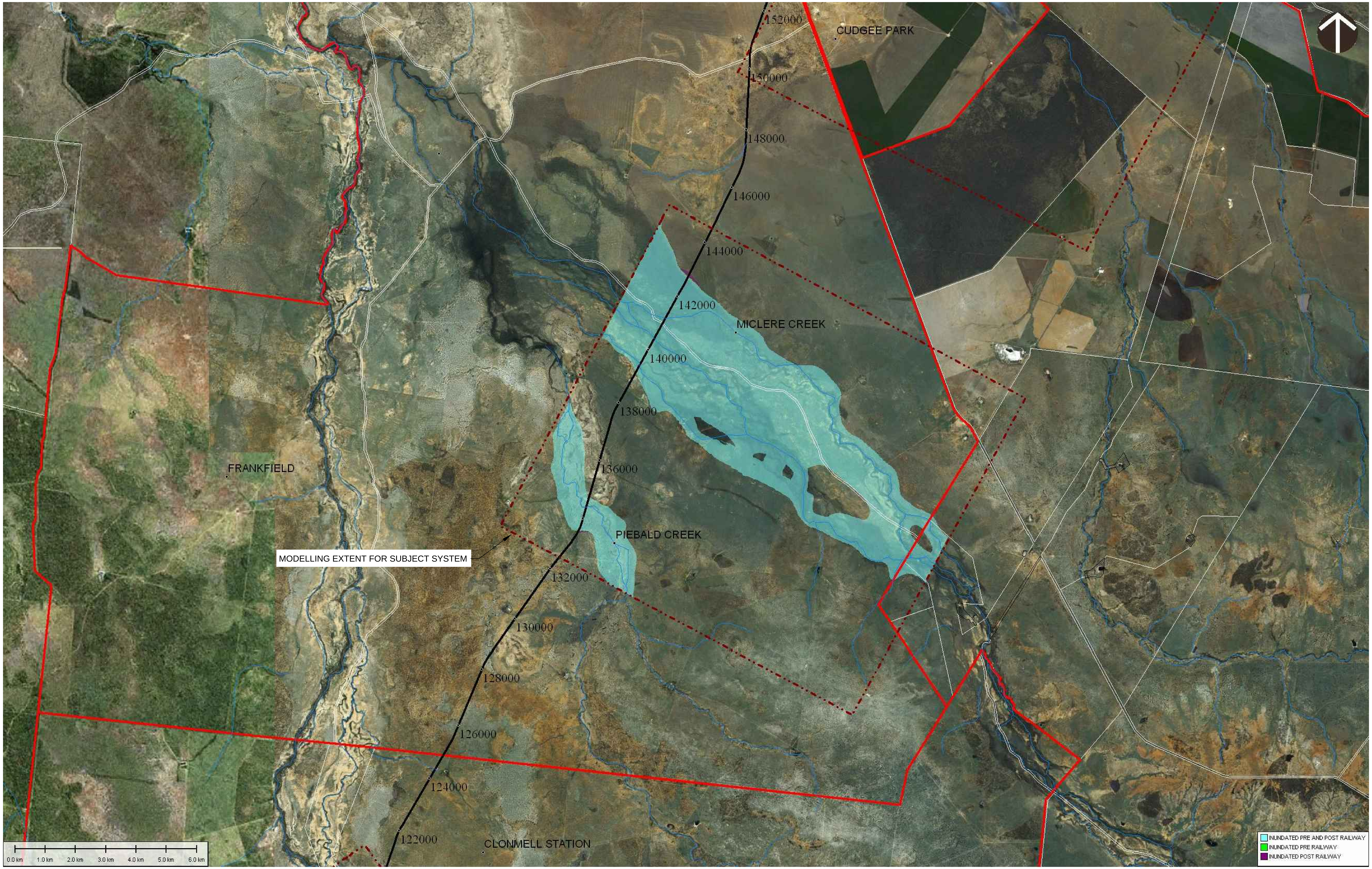

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ALPHA COAL PROJECT
RAIL ALIGNMENT - MINE TO ABBOT POINT
FLOOD INUNDATION
MICLERE CREEK / PIEBALD CREEK - Q50

SHEET SIZE A1

PN No CJVP10007

SCALE NTS

CALIBRE DRAWING No. CJVP10007-DWG-G-735

HANCOCK COAL REFERENCE No. HC-CRL-24100-DRG-0667

REV A

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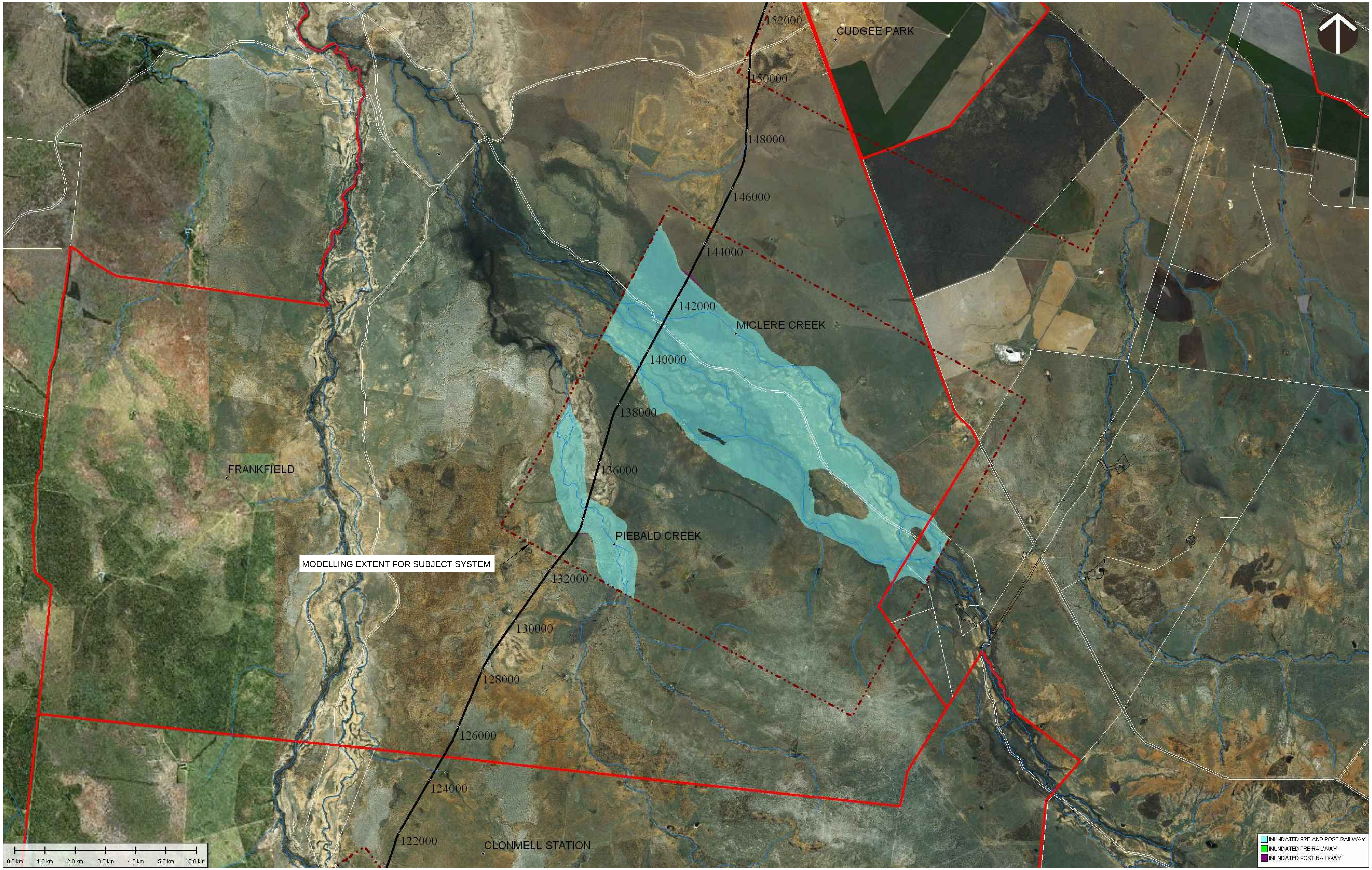

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HANCOCK COAL PTY LTD

ALPHA COAL PROJECT
RAIL ALIGNMENT - MINE TO ABBOT POINT
FLOOD INUNDATION
MICLERE CREEK / PIEBALD CREEK - Q100

SHEET SIZE: A1
PN No: CJVP10007
SCALE: NTS

CALIBRE DRAWING No.: CJVP10007-DWG-G-736
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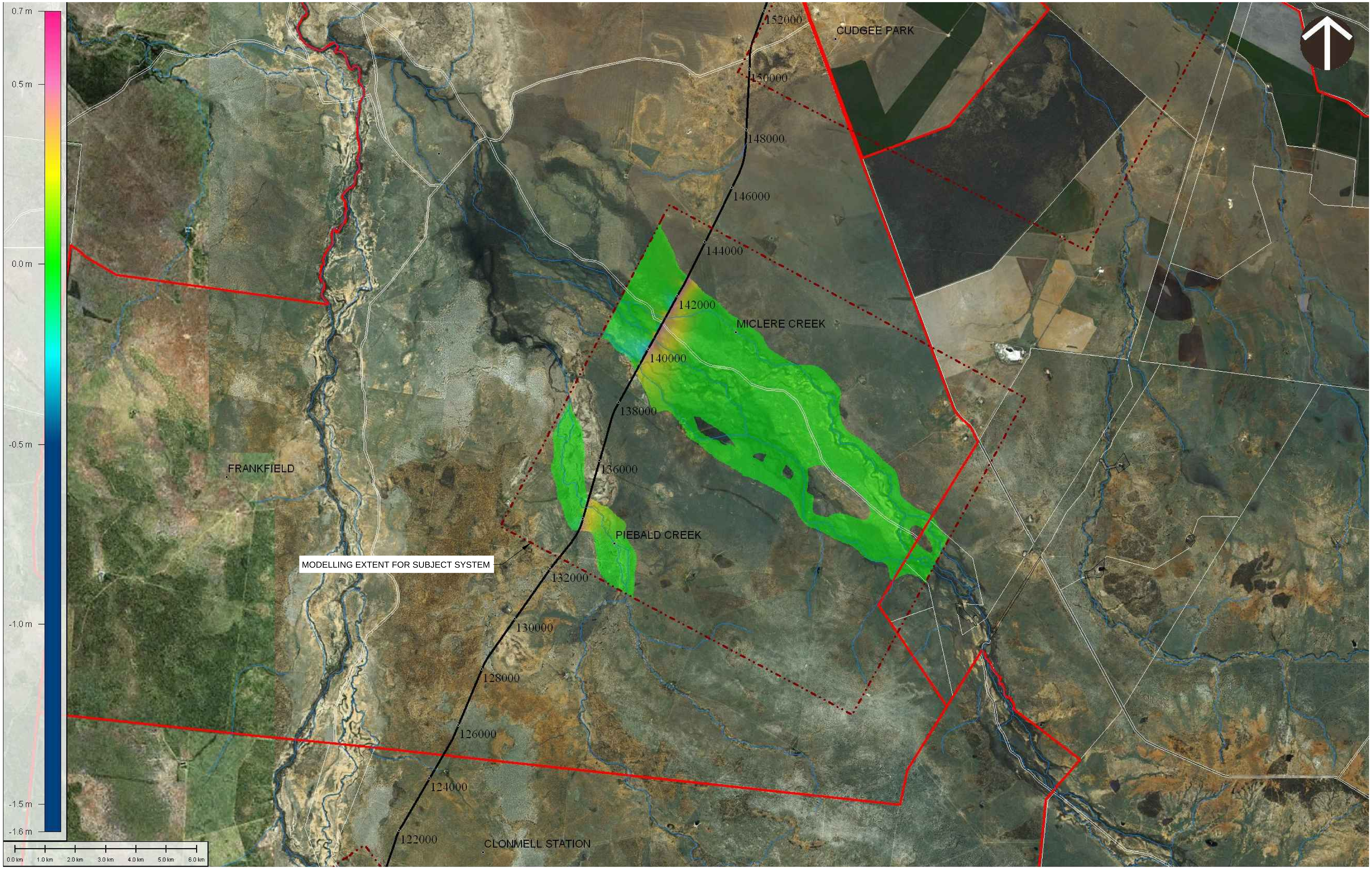
REV: A



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ALPHA COAL PROJECT
RAIL ALIGNMENT - MINE TO ABBOT POINT
AFFLUX
MICLERE CREEK / PIEBALD CREEK - Q50

SHEET SIZE A1

PN No CJVP10007

SCALE NTS

CALIBRE DRAWING No. CJVP10007-DWG-G-737

HANCOCK COAL REFERENCE No. HC-CRL-24100-DRG-0669

REV A

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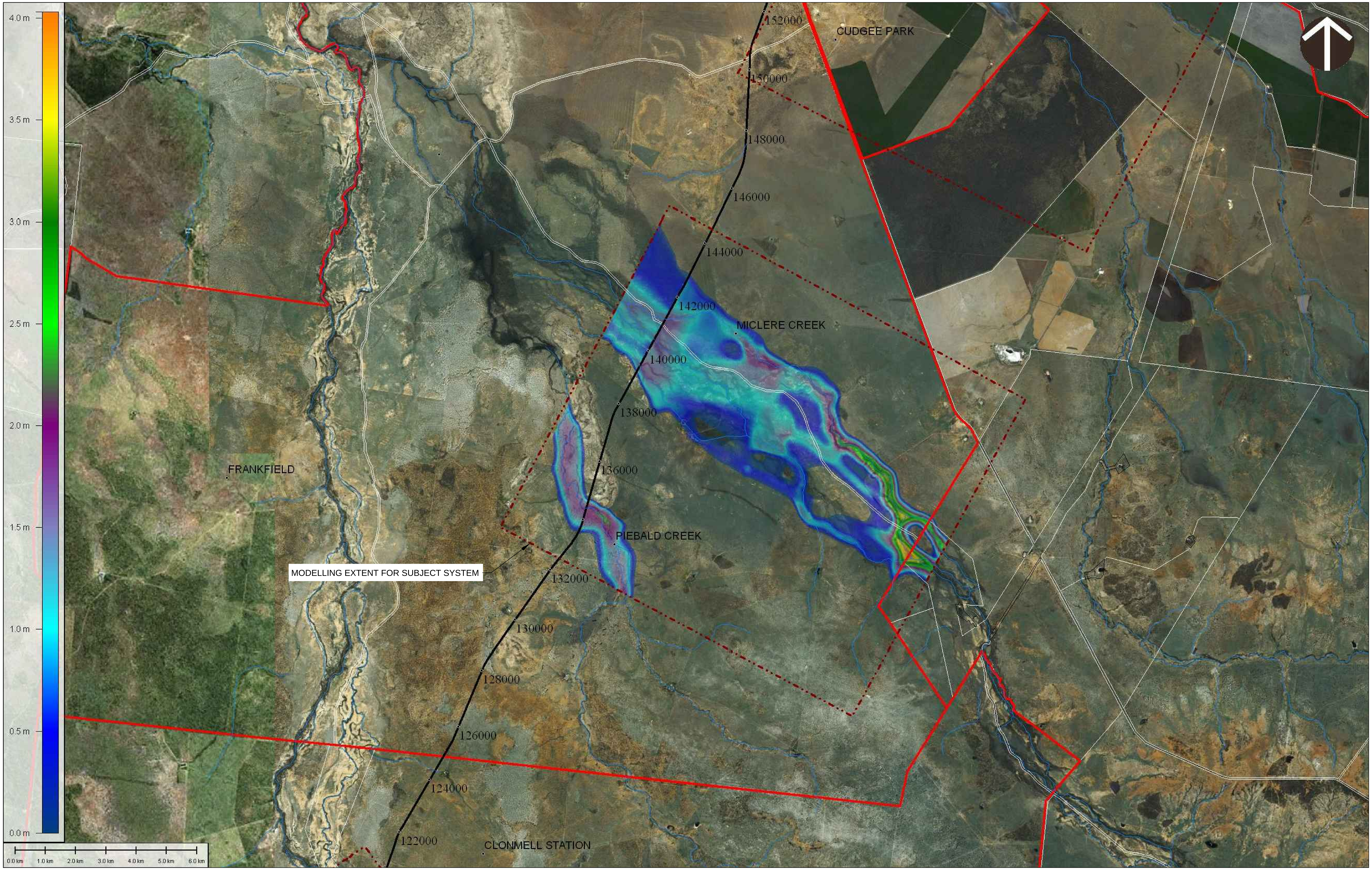

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PROJECT MANAGER		
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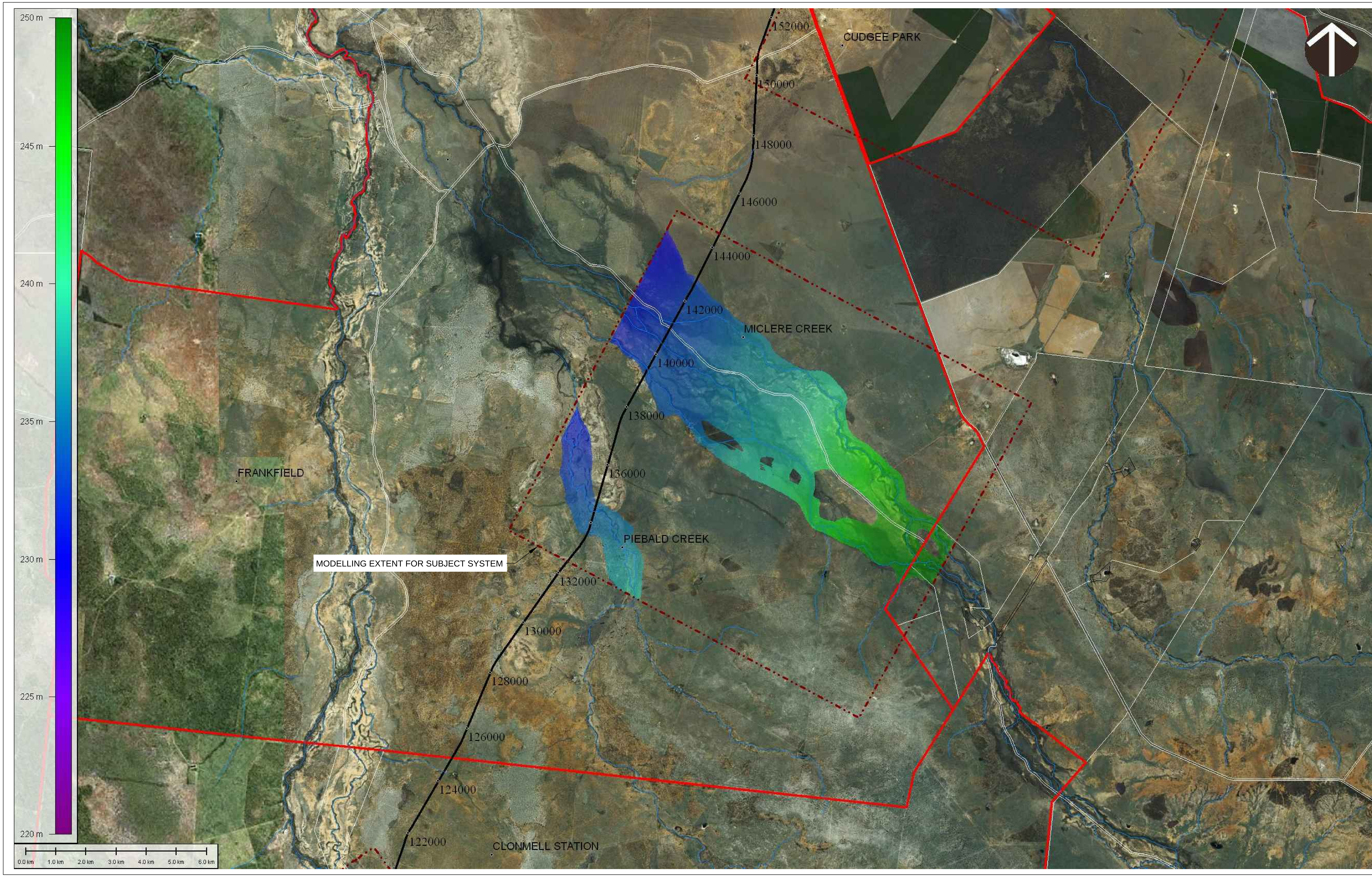
HANCOCK COAL PTY LTD

ALPHA COAL PROJECT
RAIL ALIGNMENT - MINE TO ABBOT POINT
DEPTH
MICLERE CREEK / PIEBALD CREEK - Q50

SHEET SIZE: A1
PN No: CJVP10007
SCALE: NTS

CALIBRE DRAWING No. CJVP10007-DWG-G-738
HANCOCK COAL REFERENCE No. HC-CRL-24100-DRG-0670
REV A



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HANCOCK COAL PTY LTD

ALPHA COAL PROJECT
RAIL ALIGNMENT - MINE TO ABBOT POINT
SURFACE ELEVATION
MICLERE CREEK / PIEBALD CREEK - Q50

SHEET SIZE A1
PN No CJVP10007
SCALE NTS

CALIBRE DRAWING No. CJVP10007-DWG-G-739
HANCOCK COAL REFERENCE No. HC-CRL-24100-DRG-0671
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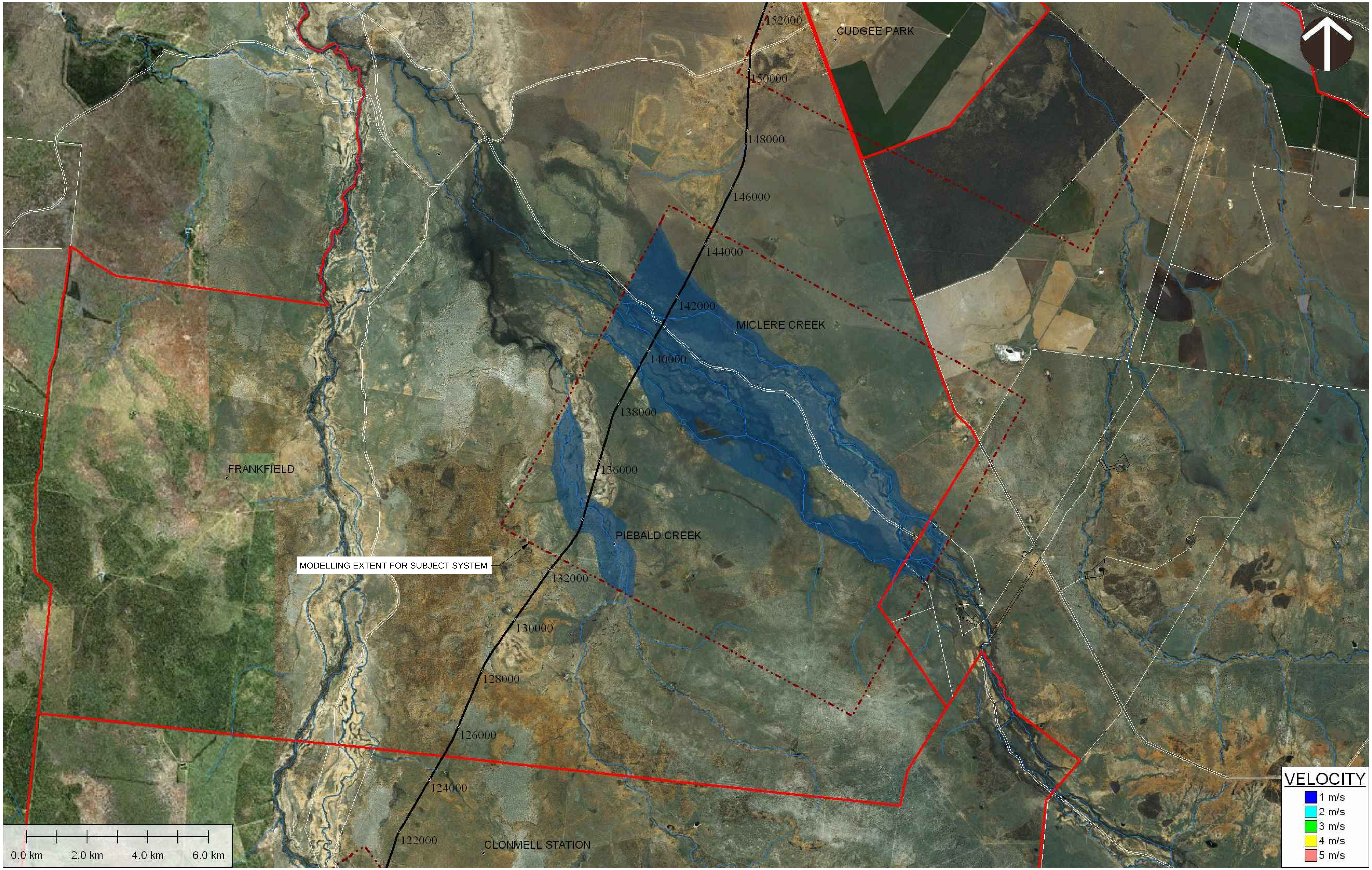

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HANCOCK COAL PTY LTD

ALPHA COAL PROJECT
RAIL ALIGNMENT - MINE TO ABBOT POINT
VELOCITY
MICLERE CREEK / PIEBALD CREEK - Q50

SHEET SIZE A1
PN No CJVP10007
SCALE NTS

CALIBRE DRAWING No. CJVP10007-DWG-G-740
HANCOCK COAL REFERENCE No. HC-CRL-24100-DRG-0672
REV A