HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

04 | Geology

Section 04 Geology

Hancock Prospecting Pty Ltd (HPPL) proposes to establish an open cut mine in the Galilee Basin, Central Queensland, to service international export energy markets for thermal coal. The geology environment associated with the mine component of the proposed project is discussed in this section.

4.1 Tenure

The Alpha Coal Project (Mine) (the Project) coal tenements are situated approximately 50 km north of Alpha and 420 km west of Rockhampton. The mine is located within mining lease application (MLA) 70426. HPPL currently holds two mineral development licences (MDLs), 333 and 285, in the Galilee Basin and has an exploration permit for coal (EPC 1210), a Mining Lease Application (MLA 70426) overlies this tenure as described Volume 2, Section 6.

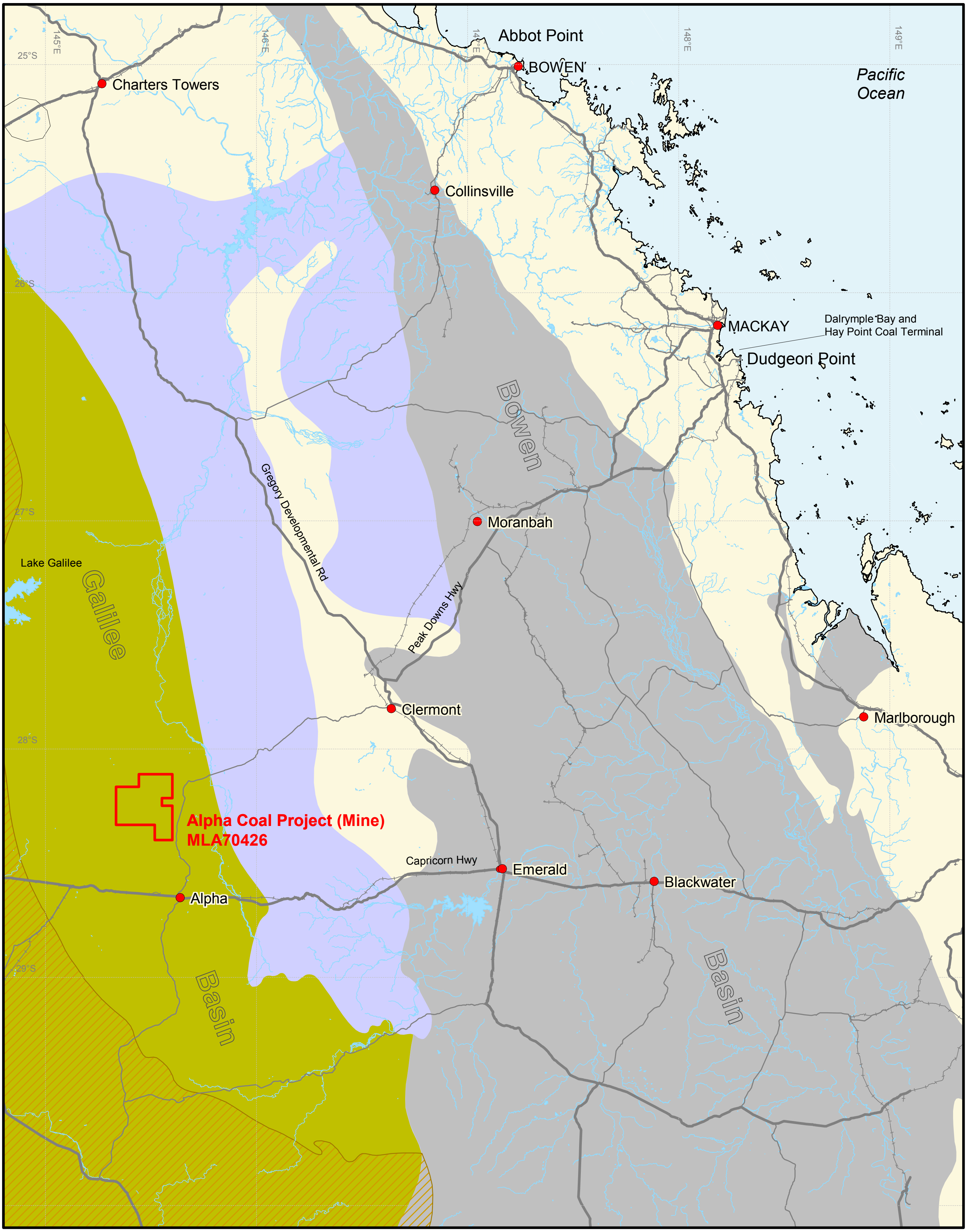
4.2 Regional Geology

The Alpha coal deposits occur within the Galilee Basin, a sequence of Late Carboniferous to Middle Triassic sedimentary rocks overlying Late Devonian to Early Carboniferous sedimentary and volcanic rocks of the Drummond Basin, exposed in a linear belt between the towns of Pentland in the north and Tambo in the south. Refer to Figure 4-1.

The rocks of the Galilee Basin are of similar age to those of the Bowen Basin (Late Permian) which are exposed to the east of the Drummond Basin. The Bowen and Galilee basins are separated along a north-trending structural ridge between Anakie and Springsure, referred to as the Springsure Shelf. Much of the western portion of the Galilee Basin is interpreted as occurring beneath Mesozoic sediments of the Eromanga Basin. The Anakie Inlier comprises older Palaeozoic rocks.

Late Permian, coal-bearing strata of the Galilee Basin sub-crop are found in a linear, north-trending Belt in the central portion of the exposed section of the Basin and are essentially flat lying (dip estimated at < 1° to the west). No major, regional scale fold and fault structures have been identified in regional mapping of the project area (Golder, 2007a and Bridge Oil, 1993). This being the case, the geology is very stable and consistent throughout the region.

The stratigraphy of the Galilee Basin in the Alpha area is described in Table 4-1. A schematic geological cross-section of the geology mapped within the region is presented in Figure 4-2.



SEDIMENTARY BASINS
- Galilee
- Bowen
- Drummond
- Eromanga

Mining Lease Application (MLA70426) Boundary

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Scale 1:2 500 000 (A4) — 0, 25, 50km

Datum: GDA94, MGA Zone55

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GALILEE BASIN AND THE PROJECT REGIONAL SETTING

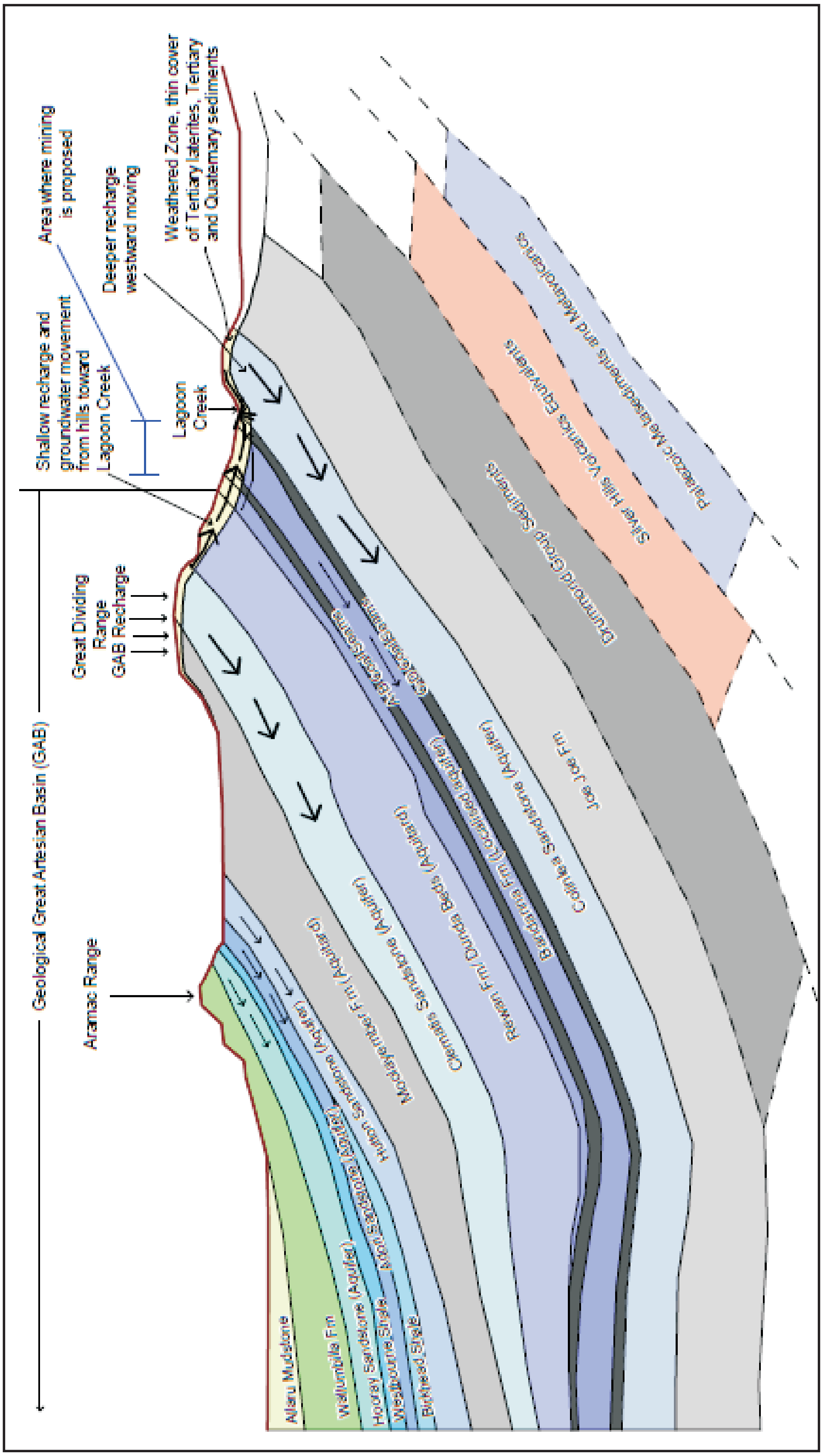
Job Number	4262 6580
Revision	A
Date	27-10-2010

Figure: 4-1

File No: 42626580-g-2033.wor

Table 4-1 Galilee Basin Stratigraphy - Alpha Area

Era	Period	Basin	Unit	Rock Types
Cainozoic	Quaternary	-	-	Alluvium
	Tertiary	-	-	Argillaceous sandstones and clays
Mesozoic	Jurassic	Sub Eromanga Surat equivalent	Hutton Sandstone	
			Moolayember Formation	
			Clematis Sandstone	Quartz sandstone, minor siltstone and mudstone
	Triassic	Galilee	Rewan Formation	Green-grey mudstone, siltstone and labile sandstones
Paleozoic	Permian		Bandanna Formation	Coal seams (A and B), labile sandstones, siltstone and mudstone
			Colinlea Sandstone	Coal seams C,D and E, Labile and quartz sandstone
	Late Carboniferous to Early Permian		Joe Joe Formation	Mudstone, labile sandstone, siltstone, shale and thin carbonaceous beds
	Early Carboniferous	Drummond Basin		



(Source: JBT, 2010a)

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SCHEMATIC GEOLOGICAL CROSS-SECTION ACROSS STUDY AREA

Job Number	4262 6580
Revision	B
Date	27-10-2010

Figure: 4-2

File No: 42626580-g-2034b.cdr

The revised coal measure stratigraphy, based on the data compiled by HPPL and Wright in the Golder Associates Report (Golder, 2007a), is presented in Table 4-2.

Table 4-2 Late Permian Coal Measure Stratigraphy - Galilee Basin, Alpha Project area

Era	Period	Lithology	Stratigraphic Unit	Thickness (m)	Comments
Mesozoic	Triassic	Green brown-purple mudstone, siltstone and labile sandstone	Rewan Formation		Only in west
Palaeozoic	Late Permian	Sandstone	Bandanna Formation	10–30	Increasingly argillaceous
		Coal seam A. Seam contains thin dirt bands that thicken from south to north.		1–2.5	
		Labile sandstone, siltstone and mudstone		10	
		Coal seam B. Seam contains numerous dirt bands that constitute between 15 and 30% of seam. Variable in quality.		6–8	
		Labile sandstone, siltstone and mudstone		70–90	
		Coal seam C. Coal seam thins northward and splits apart	Colinlea Sandstone	2–3	Increasingly arenaceous
		Labile sandstone, siltstone and mudstone		5–20	
		Coal seam D. Stone bands present with seam thickening westward, upper section splits off main seam to north west		4.5–6	
		Labile sandstone, siltstone and mudstone		15	
		Coal seam E. Thin (0.2 m) clean coal bands, usually 2 bands E1 and E2		0.1 – 0.4	
		Labile sandstone, siltstone and mudstone		15 – 20	
		Coal seam F. Localised thick geological section, no working section		0.5 – 5	
		Labile sandstone, siltstone and mudstone		Unknown	
	Early Permian	Labile and quartz sandstone	Undefined	Transition to Joe Joe Formation	

4.3 Project Specific Geology

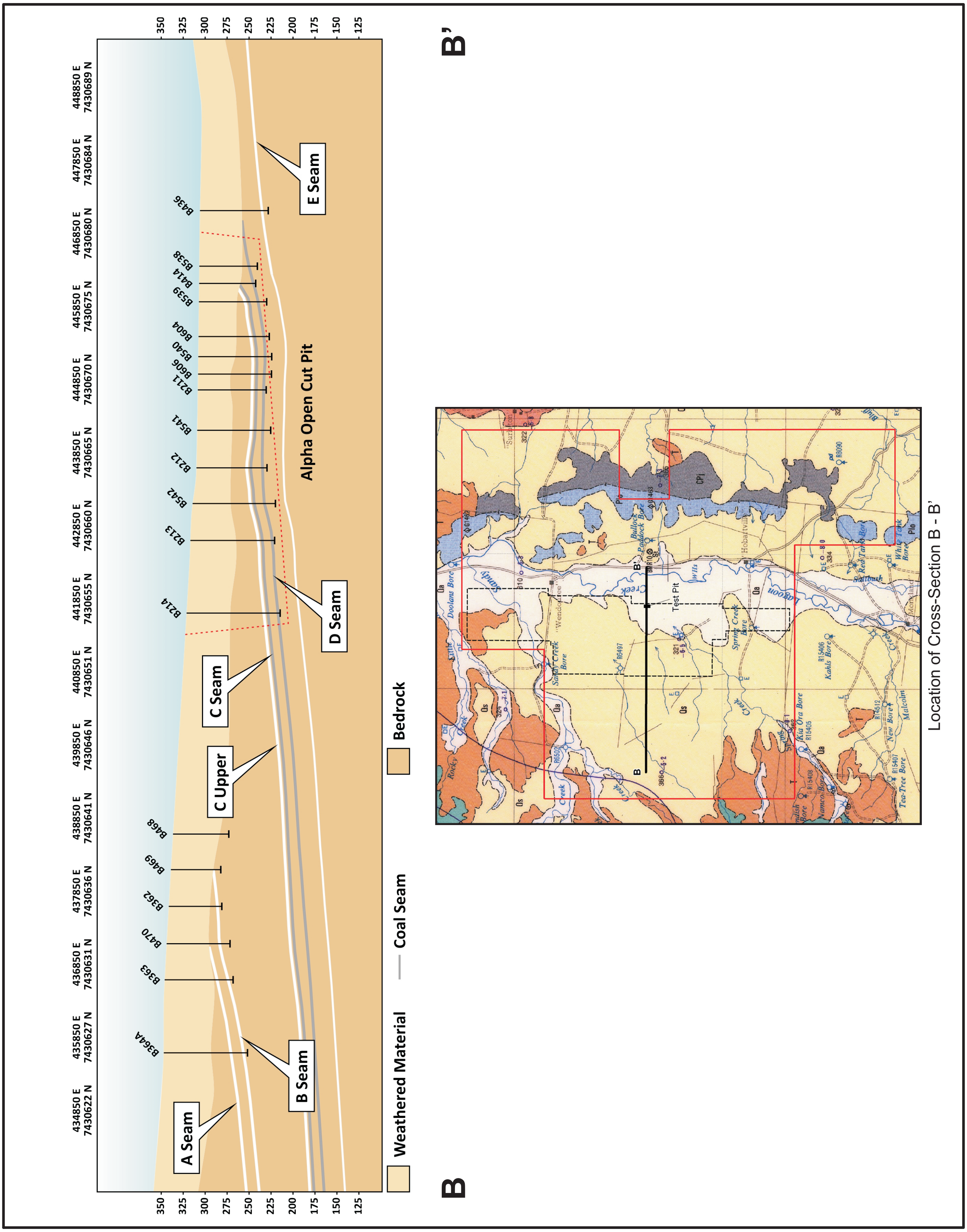
The Alpha Coal deposit lies on the eastern side of the Galilee Basin. The geology consists of gently westerly dipping sediments of Upper Permian age, overlain by Tertiary and Quaternary (Cainozoic) sediments, which is an unconformable and erosional contact (refer to Table 4-1).

Both historical and recent borehole data shows that the thickness of Tertiary and Quaternary sediments varies from greater than 60 m in places to less than 20 m in the north of MLA 70426. In addition to the Tertiary and Quaternary sediments, a variable thickness of weathered Permian material is also commonly present.

The coal bearing strata subcrop, based on the Project's Geological model, in a north/south strip along the eastern section of the project area and are essentially flat lying (dip estimated at 0.5° to 1° to the west). No major, regional scale fold and fault structures have yet been identified in regional geology of the project area. This would indicate a stable depositional history with little structural activity post-deposition. This is supported by analysis of sedimentary units, finding that all holes contain consistent characteristics which form marker horizons that can be seen across the project area (Dr Sasha Pontual, HyChips Report, 2008). The uniform geology, dip and strike, is presented in the east-west cross-section, Figure 4-3.

The geology and coal seam continuity persist along strike and down dip to the west. Figure 4-3 is a cross-section of the project representing the coal seams of the lease area and indicating the Alpha Project open cut pit area in section. The same coal seams can be correlated with drilling 100 km to the west. See Figure 4-4, the Splitters Creek 1 oil and gas well, showing correlatable A, B, C and D seams at depth. This well is located 100 km west (down-dip) of the Alpha project

Figure 4-5 indicates the approximate sub outcrops of the A, B, C, and D coal seams as well as the Rewan Formation, to the west of MLA 70426. An additional schematic stratigraphical column is presented in Figure 4-6 based on site specific data.



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GEOLOGICAL W-E CROSS-SECTION THROUGH THE MLA

Job Number	4262 6580
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Figure: 4-3

File No: 42626580-g-2123.cdr

Figure 4-5: Enron; Splitters Creek 1, oil and gas well. (CR28226A) – Collar = 349302E, 7458186.5N

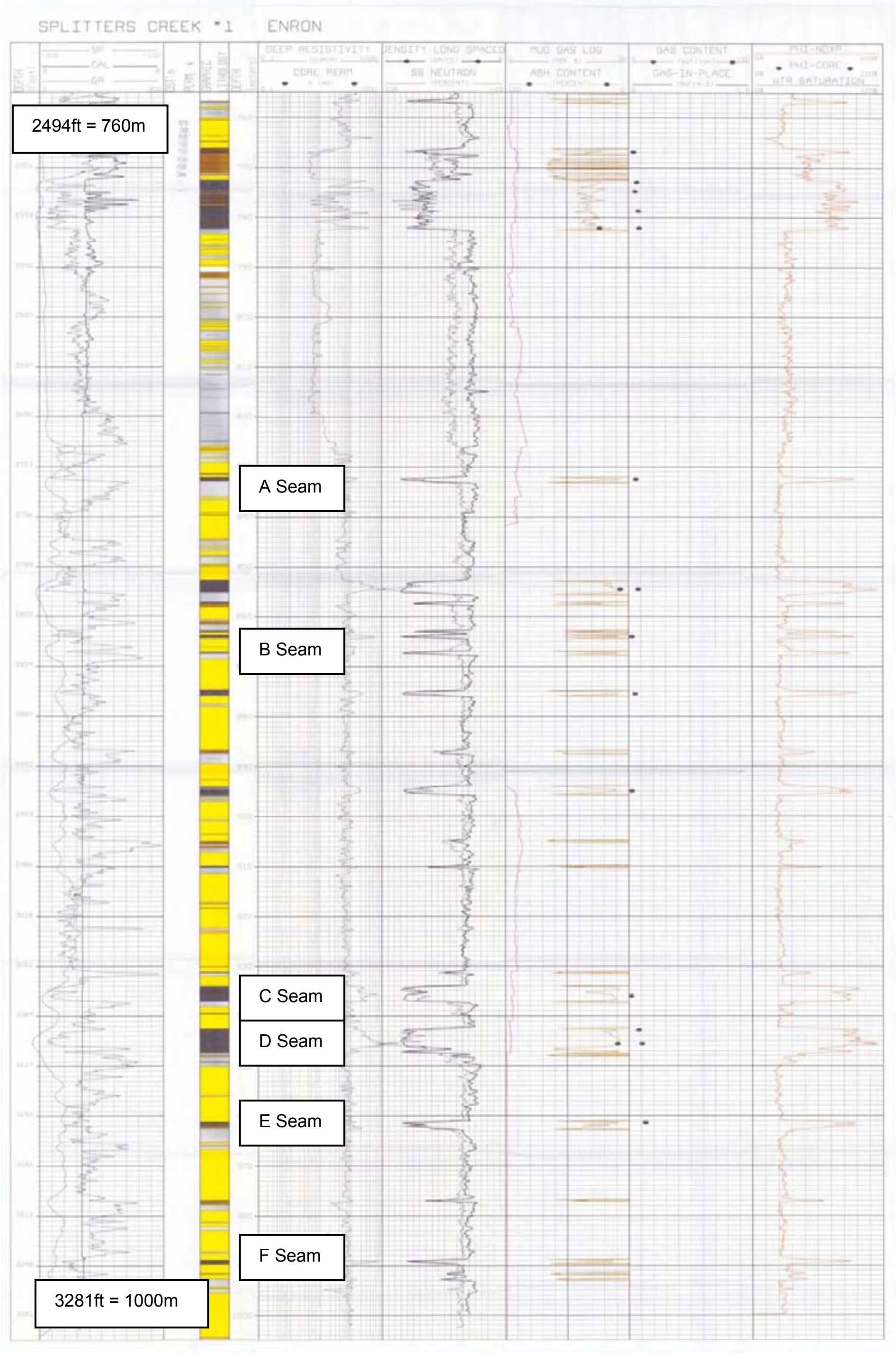


Figure 4-6: Plan showing the subcrop of A - B and C- D seams and Rewan Subcrop

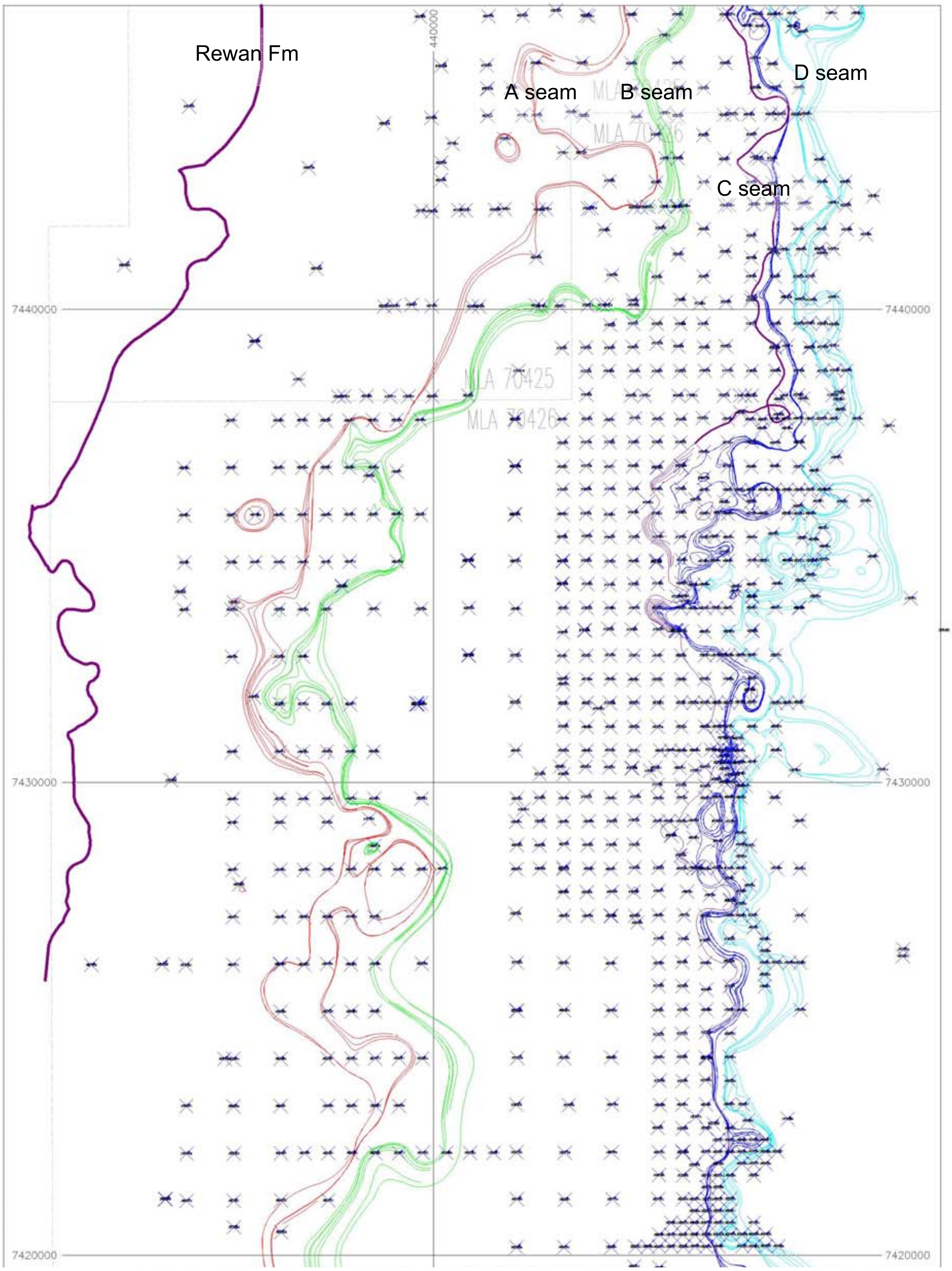
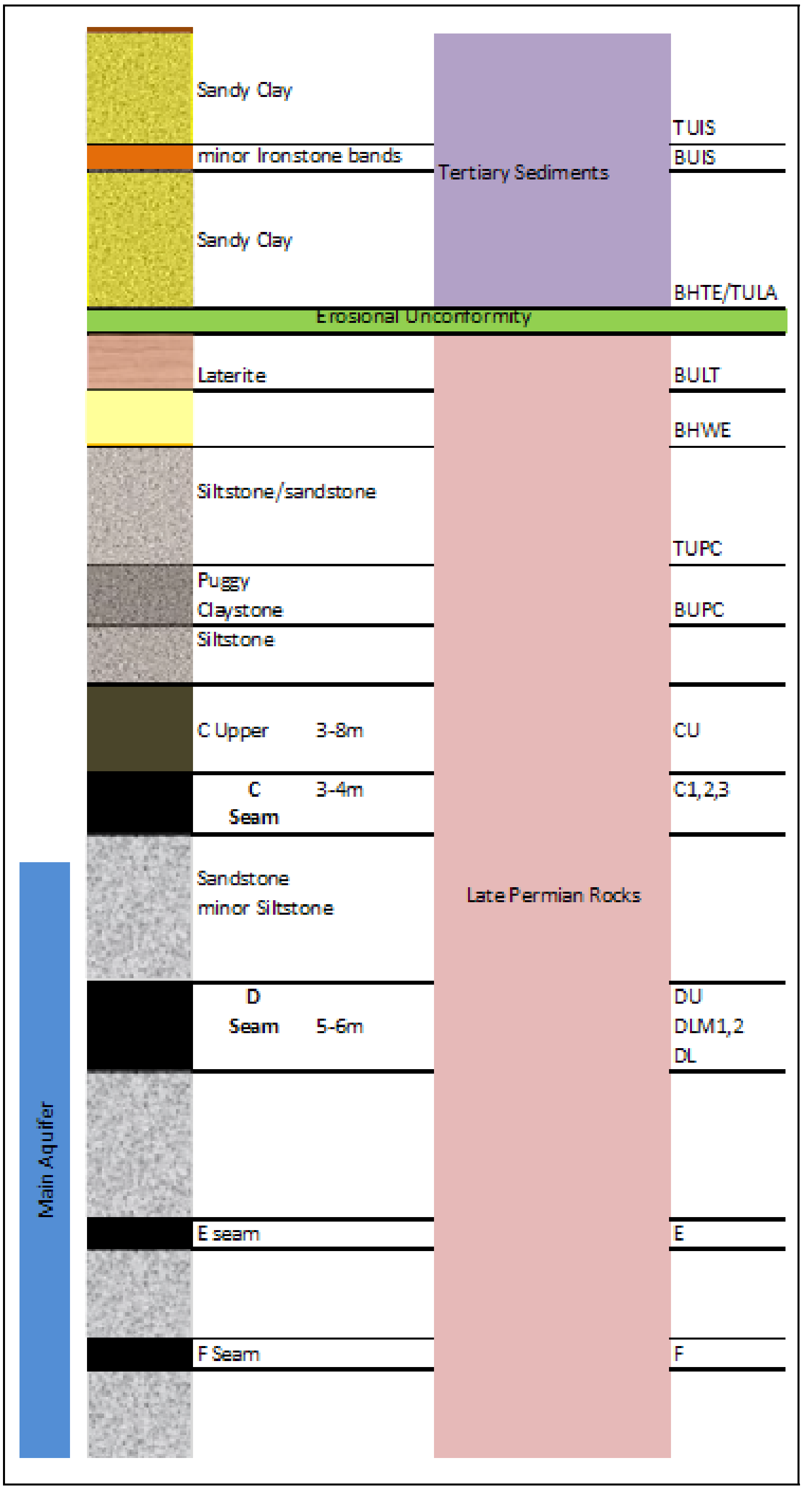


Figure 4-7: Schematic stratigraphic section in the Project area



4.3.1 Quaternary and Tertiary (Cainozoic)

An unconsolidated sequence of sand, fine gravel and minor clay horizon having an average thickness of 40 m in the east and central regions of the deposit and thin towards west (5 m), record sedimentation within an alluvial-coastal plain in a low-accommodation basin-margin setting (J.P. Allen and C.R. Fielding, 2007).

At the base of Tertiary there is a stacked lateritic horizon (Plate 4-1) recorded along with mottled clay palesols, which has been interpreted as the beginning of the weathered Permian sequence. Minor, localised perched groundwater was recorded during exploration drilling within the Cainozoic.

Sediments of the Mesozoic / Palaeozoic are not present in the project area. Tertiary intrusive and extrusive rocks have not been encountered on site.

Plate 4-1 Chip tray showing Tertiary sediments and Lateritic zone Chip tray showing Tertiary sediments and Lateritic zone

4.3.2 Rewan Formation

The Cainozoic is unconformable and erosional onto the underlying Rewan Formation and Permian Sequence. Drilling shows the contact to undulate. The Rewan Formation occurs only in the far west of MLA 70426 and MLA 70425 (HPPL's Kevin's Corner Project), where it subcrops under Cainozoic cover. The Rewan Formation comprises typical green to brown-purple siltstone and fine grained sandstone. The base of the Rewan Formation is unconformable onto the Permian, and can be located some 30 to 50 m above the uppermost A seam coal ply.

The Rewan Formation does not exist over the current project area (see Figure 4-7).

4.3.3 Permian

The over burden, within the Upper Permian layer in the Project consists primarily of Betts Creek Group, this formation has the local equivalent units of the Bandana Formation and the Colinlea Sandstone. This Group has been mapped to outcrop along the south-easterly section of the Galilee Basin, running northward and represents the eastern flank of the intracratonic Galilee Basin (Senior; 1973, Jenson 1975).

The coal measures are equivalent in age to the Rangal coal measures of the Bowen Basin, the Newcastle Coal measures of the Sydney Basin, and tuffaceous stony coal facies of the Black Jack Formation of the Gunnedah Basin (Permian-Triassic Pangean Basins, 1994).

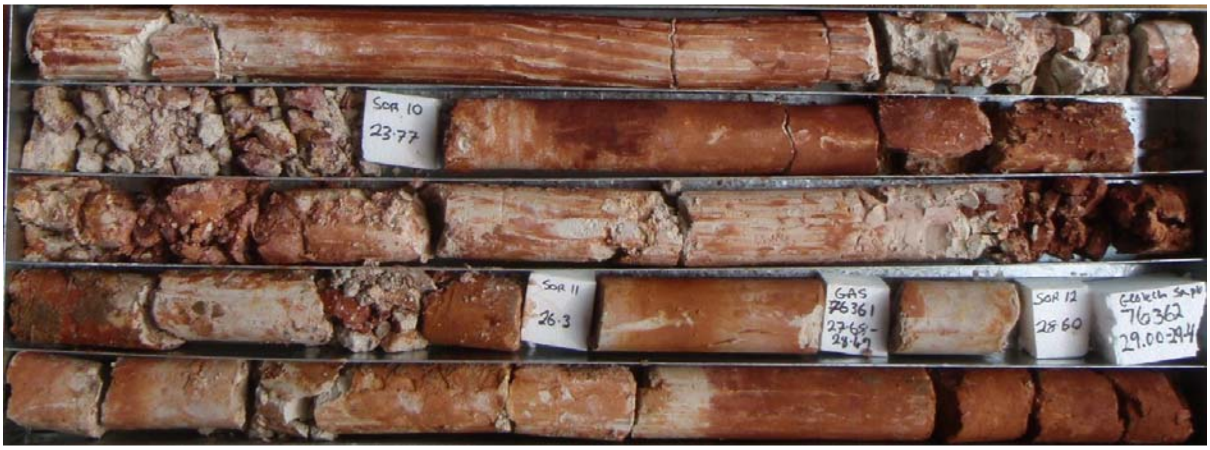
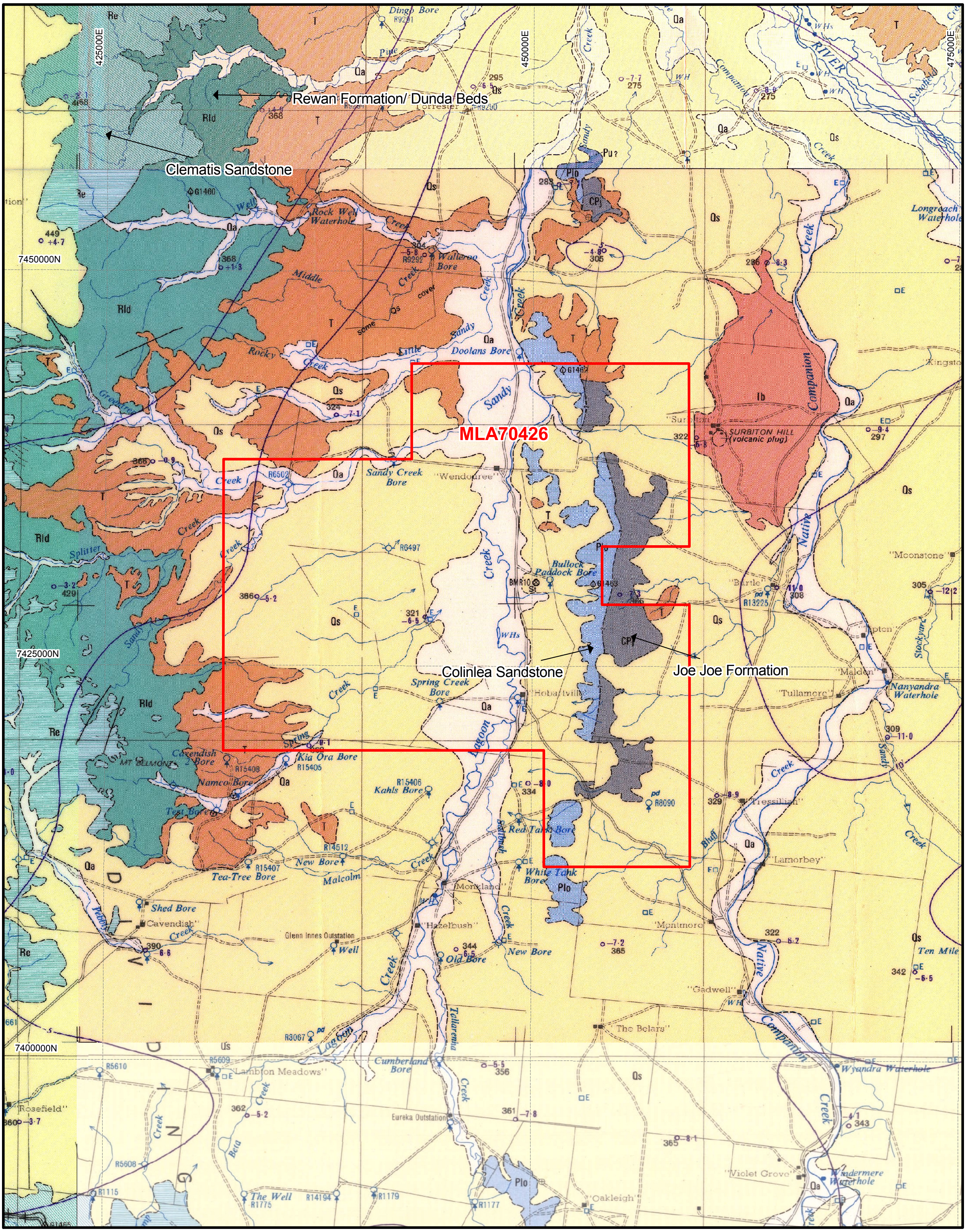


Plate 4-2 Permian overburden reddened alluvial sediments, approximately 22.5 to 30 m below surface

Jenson (1975) clearly states that uplift within the Permian, coupled with an inferred climatic change gave rise to the accumulation of reddened alluvial sediments throughout the basin (Plate 4-2). This is also supported by Senior (1973) that the Galilee Basin was a depression west of the Belyando Feature (Permian-Triassic Pangean Basins, 1994; Senior, 1973). The lower Permian sediment spread to the west, as the surrounding areas of the Galilee Basin were elevated, the area was washed with alluvial sands and sediments. At the end of the glacial period, paludal and lacustrine sediments were deposited, and the source areas were lowered by erosion (Senior, 1973).

As the late Permian was a time of great stability, (APEA, 1993) an outcrop of the Betts Creek Group coal measures showed two distinct, fluvial sandstone facies. These two facies include:



Mining Lease Application (MLA70426) Boundary

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0 3.75 7.5km
Scale 300:00 (A4)
Datum: GDA94, MGA Zone55

N W E S

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EXTENT OF REWAN FORMATION WITHIN MLA70426

Job Number	4262 6580
Revision	B
Date	27-10-2010

Figure: 4-7

File No: 42626580-g-2110b.wor

- A lower thickly bedded, medium course grained quartzose, sandstone facies; and
- An upper laminated to massively bedded, fine grained, labile to sublabile sandstone with interbedded mudstone facies (APEA; 1993, Hawkins; 1992).

The consistency of the overburden is also demonstrated by its mineralogy, Figure 4-8 is a selection of 6 holes from the mineralogy of 2,972 samples from 32 bores across the Project, analysis was undertaken using visible, near infrared, short wavelength infrared (vis-NIR-SWIR) reflectance measurements using the HyChips system.

Coal seams within the lease area are schematically represented in Figure 4-9. Note only seams C and D are planned to be mined in the Project area.

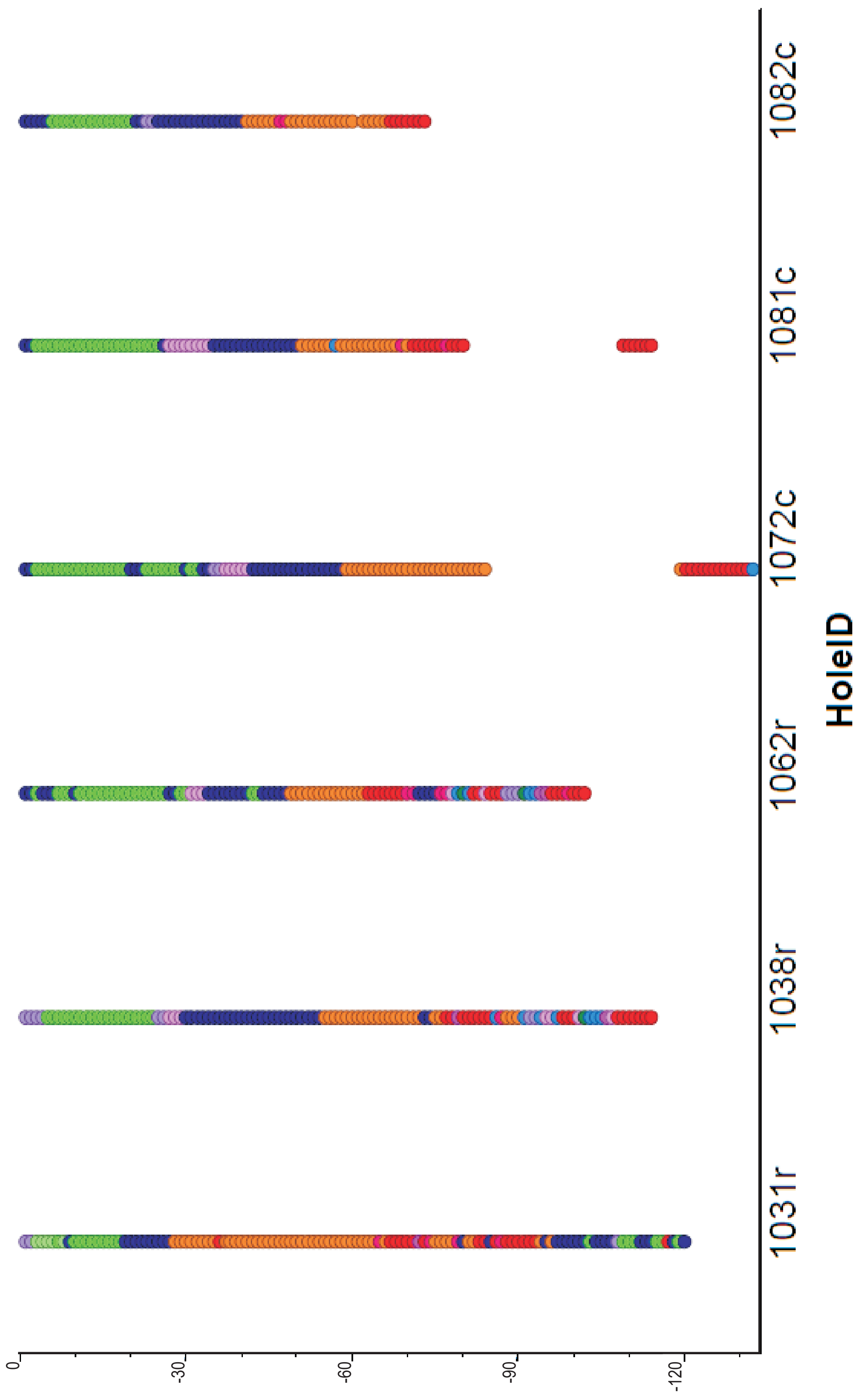
4.3.3.1 A Seam

The A coal seam exists in the Bandanna Formation, which underlies the Rewan Formation in the sequence (where the Rewan is absent, it is replaced by Cainozoic cover) and 15 to 25 m above the roof of the B seam.

The A seam is present only in the far west of MLA 70426. Insignificant A seam within the Project area means that no A seam resource evaluation has not been conducted nor are there plans to mine it as part of the Alpha Coal Project.

The A seam averages approximately 1 m in thickness and is generally described as a dull to dull and brightly banded coal. Normal coal quality for the full A seam interval is in the order of 18% - 20% ash.

The A seam is comprised of the A1, A2, and A3 plies, but these are inconsistent across the lease. The most common form the A seam takes is the A1 splitting off to the south (see Figure 4-10).



Red and orange sections showing the thickly bedded sandstone and the upper fine grained in orange to blue sections tertiary sections in green

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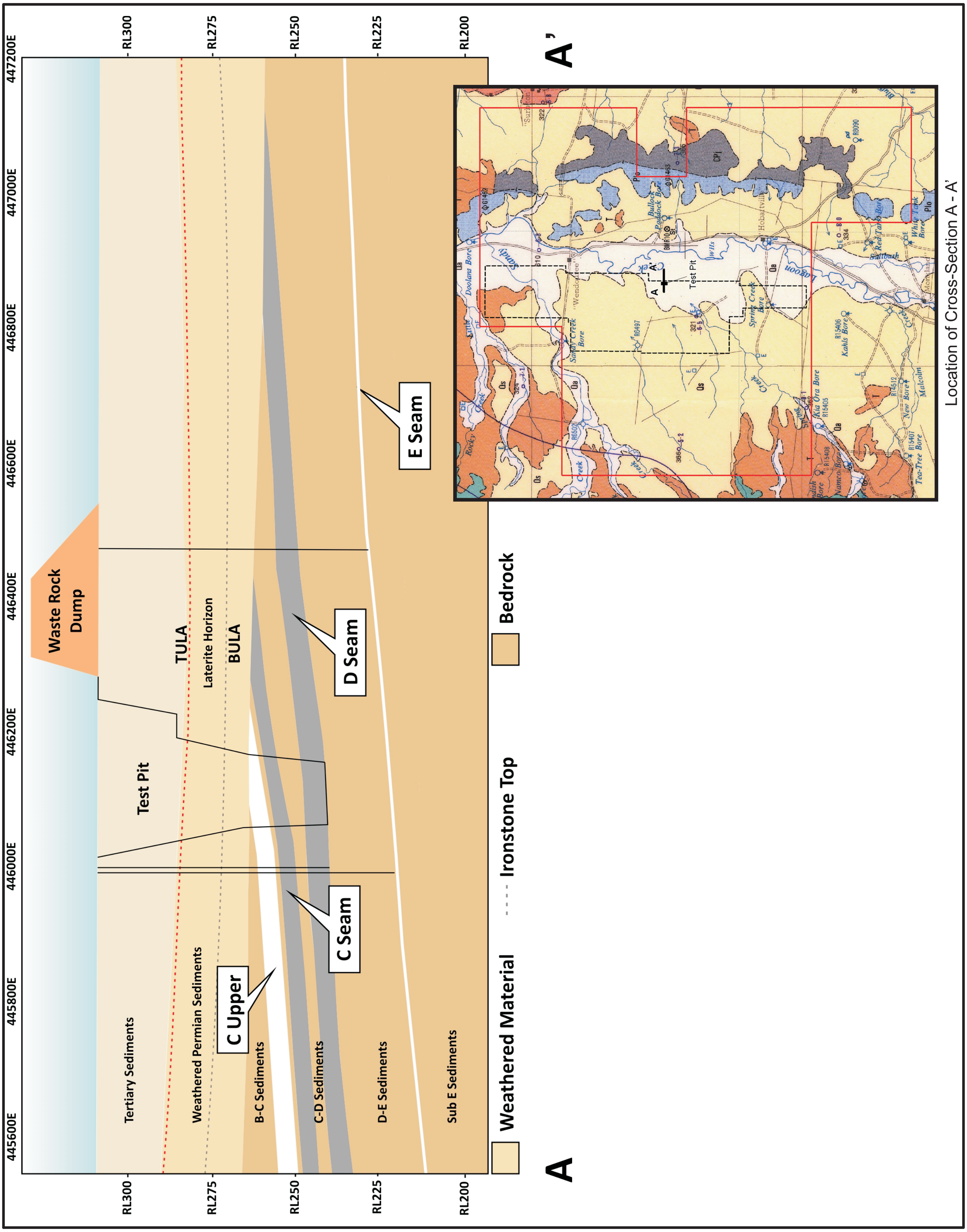
RED AND ORANGE SECTIONS SHOWING THE THICKLY BEDDED SANDSTONE

Job Number	4262 6580
Revision	A
Date	27-10-2010

Figure: 4-8

File No: 42626580-g-2124.cdr



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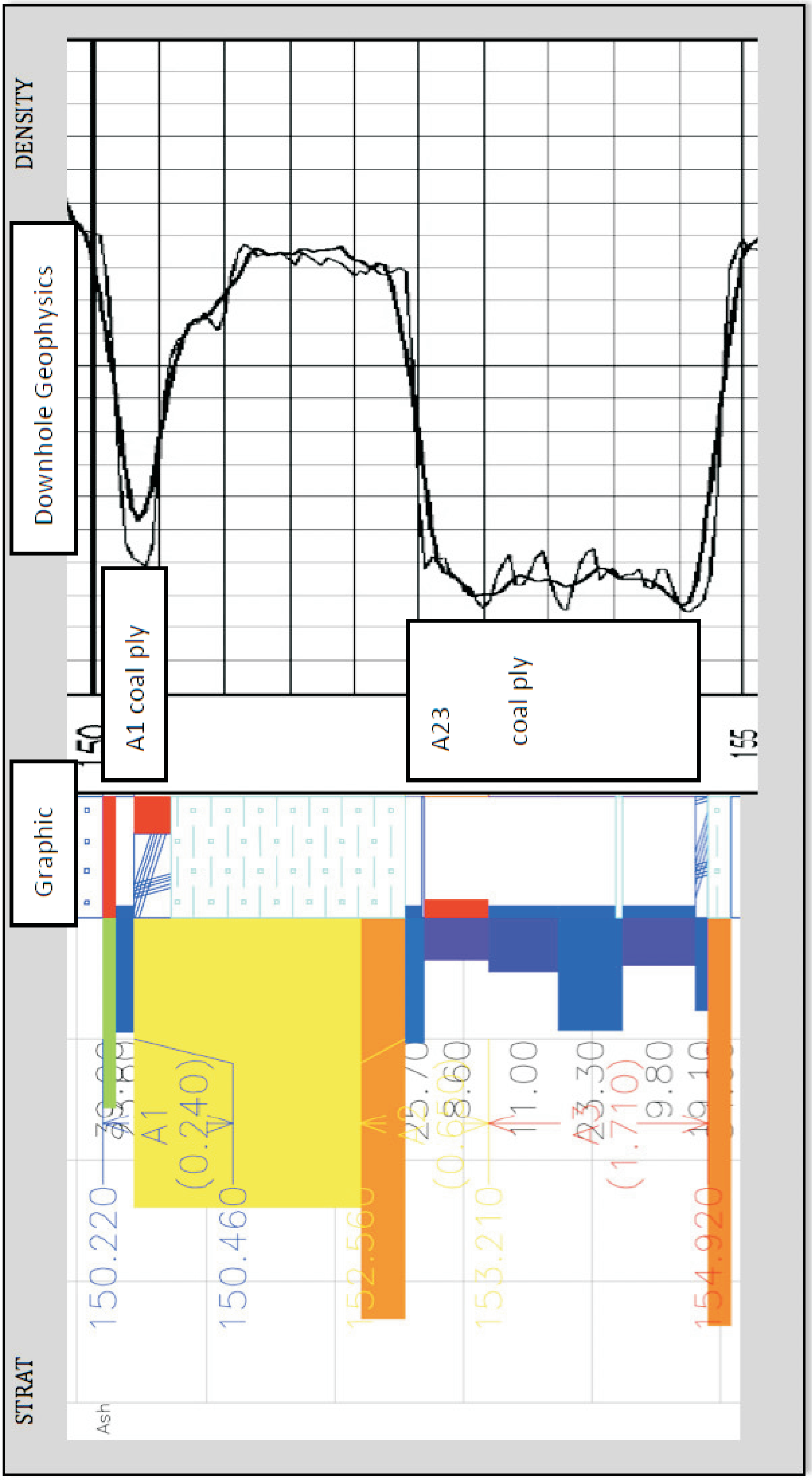
WEST - EAST SCHEMATIC CROSS-SECTION ACROSS THE ALPHA PROJECT OPEN-CUT PIT AREA INDICATING THE TEST-PIT AREA

Job Number	4262 6580
Revision	A
Date	27-10-2010

Figure: 4-9

File No: 42626580-g-2125.cdr



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TYPICAL SECTION
THROUGH THE A SEAM

Job Number | 4262 6580
Revision | A
Date | 27-10-2010

Figure: 4-10

File No: 42626580-g-2126.cdr

4.3.3.2 B Seam

The B seam exists in the Bandanna Formation, which sits stratigraphically above the Colinlea Sandstone unit; this seam is logged on the western boundary of the lease area only. The B seam is made up of four main plies (but up to six in places), which are B1 through to B6 (Figure 4-11).

The B1 through to B4 plies are consistent over the Project area, and the B4 ply can often be made up of up to three sub-plies (B41, B42, B43) or a combination of these (B412, B423). Across the majority of MLA 70426, the B3-B4 interval has the best quality, with an average raw ash of approximately 25%. The upper plies (B1 and B2) generally have a raw ash greater than 30% and the coal plies are separated by distinctive soft, pale, tuffaceous claystone. As with the A coal seam, due to seam structure and arrangement of the Project boundary, only minor B seam is present within the Project area and the B seam only contributes a nominal resource tonnage over a restricted geography.

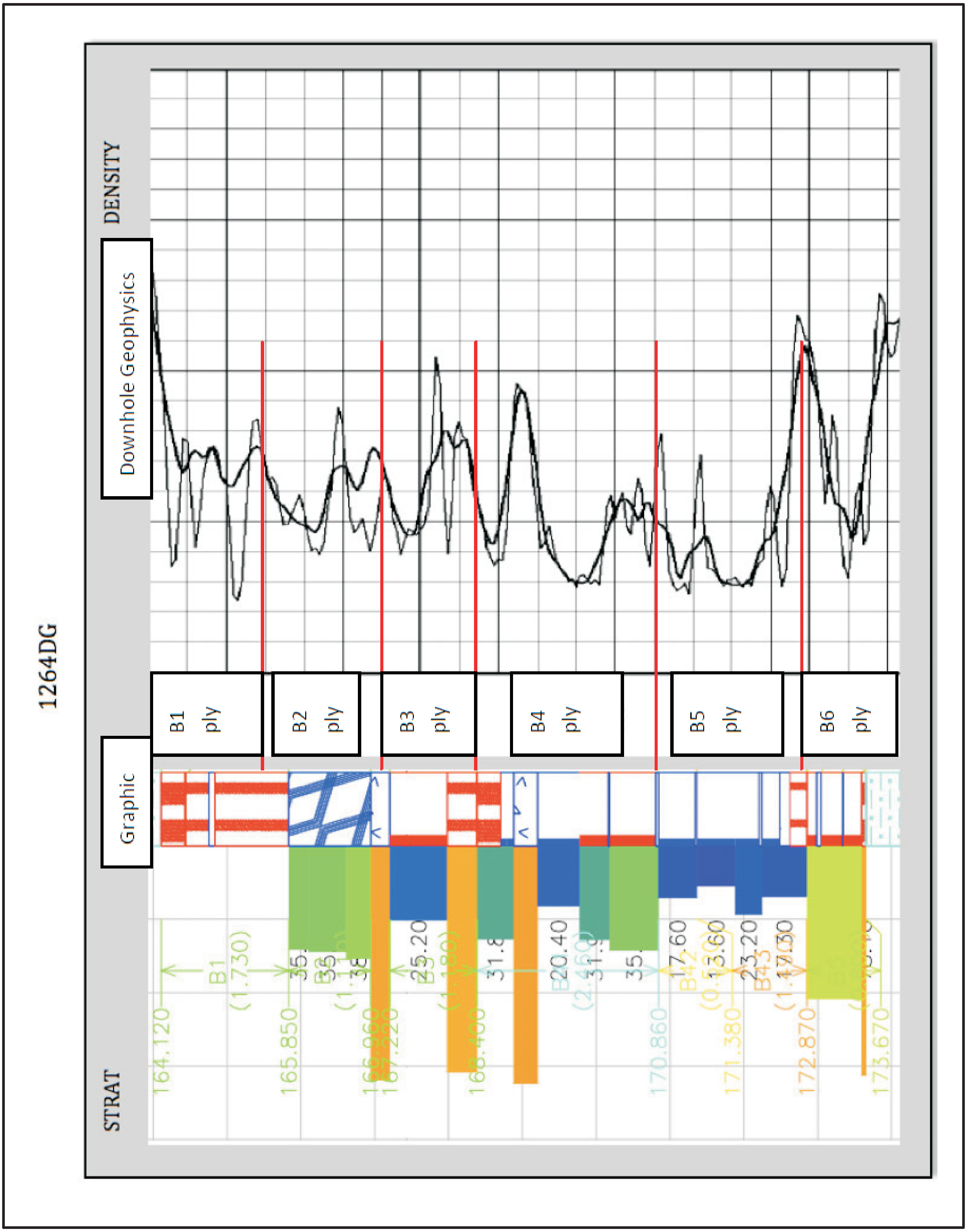
The B1 and B2 plies are present throughout the far west of the lease; their average thickness is 1.12 m and 1.28 m, respectively. The coal in these plies is described as dull to brightly banded coal with minor stone bands present. The top of the B1 ply is usually marked by a sharp contact with the overlying sediments and the parting between B1 and B2 is a tuffaceous claystone which also forms the stone bands present in the B2 ply. The B3 ply of the B seam is a consistent unit of dull coal with bright bands, which has an ash content of around 25% with an approximate thickness of 1.2 m (although this can be variable in places). Again it is separated from the surrounding plies by a slightly carbonaceous or tuffaceous claystone.

The B4 ply of the B seam is consistent across the western area of the lease. It is broken down into sub plies; B41, B42, and B43 that are separated by stone bands of varying sizes, the biggest of these tends to separate the B41 from the B42 and can be in the order of 0.5 m thick. This parting is representative of the others included in the B4 unit and is seen as a tuffaceous claystone that can often be puggy in nature. The B4 sub plies are dull to brightly banded coal, with moderate (25%) ash content and are generally clean in nature.

The sub plies of the B4 can be variable, but generally the B41 and B43 are the largest of these sub plies representing the bulk of the B4. The B41 can be up to 2 m in thickness, with the B43 similar with a thickness in the order of 1.5 m. The B42 sub ply is usually 0.5 m thick. The most erratic plies of the B seam are the B5 and B6, which are often of a dull to stony coal with bright bands and can contain numerous tuffaceous claystone bands throughout.

4.3.3.3 B-C Interburden

The interburden between the B and C seams is generally greater than 60 m. The sediments above the C seam comprise labile sandstone with a clayey matrix and subordinate siltstone (Plate 4-3). Drilling has intersected an area of puggy claystone or clay matrix sandstone mid way down into the C seam interburden. This zone may be of importance to highwall and waste stability considerations (see Section 4.5) and thus has been included as surfaces in the geological model.



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TYPICAL SECTION
SHOWING B SEAM PLIES

Job Number	4262 6580
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Date	27-10-2010

Figure: 4-11

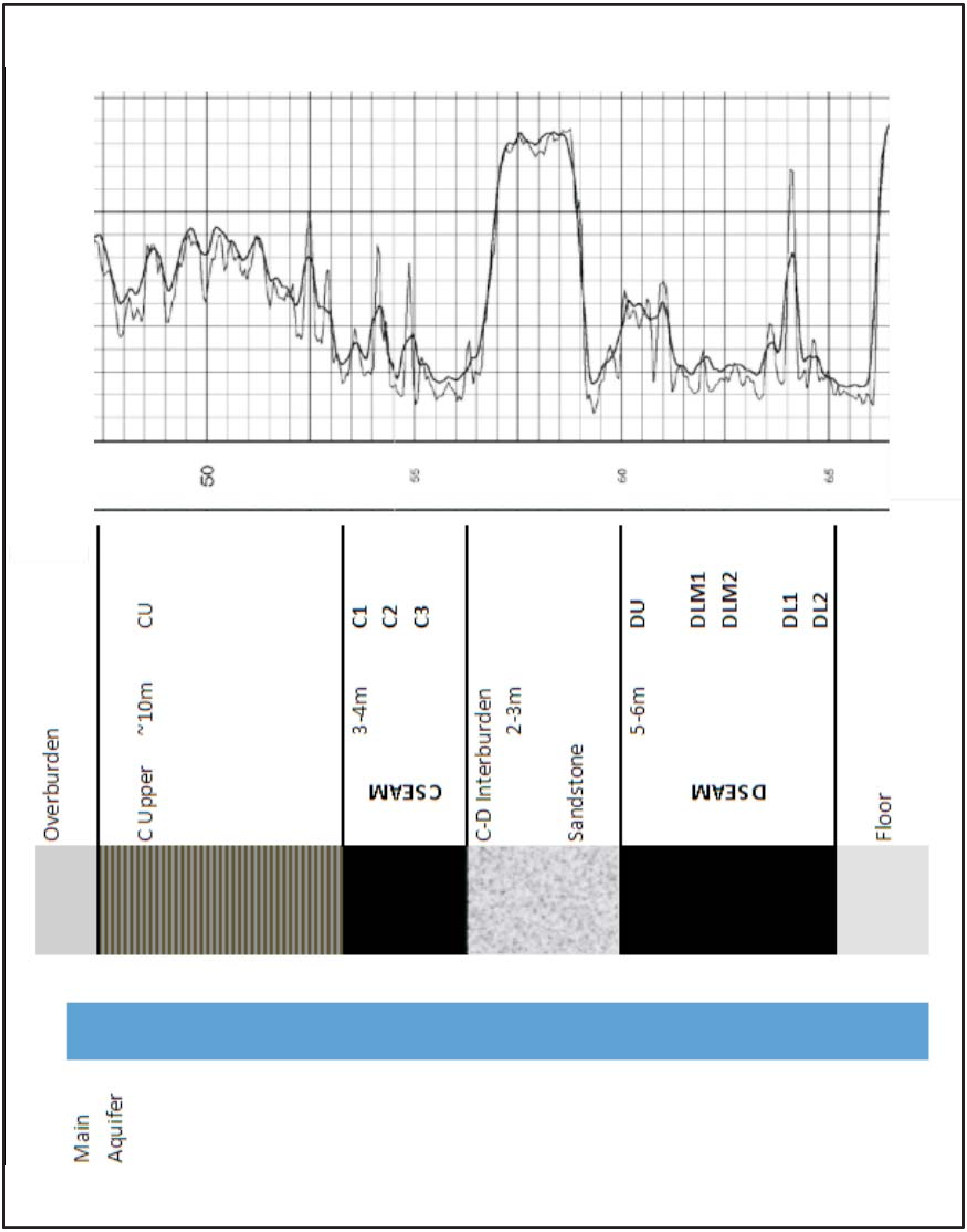
File No: 42626580-g-2127.cdr

Plate 4-3 Representative samples of the B-C interburden material

4.3.3.4 C Seam

The economic coal seams within the Project area include the C and D coal seams. The details of the coal plies making up the C seam within MLA 70426 are shown on Figure 4-12.

The C seam exists in the Colinlea Sandstone and consists of two distinct zones, the non-coal C Upper (CU) section and the main economic interest, the Lower C seam (which is historically referred to as the 'C Best'). Below (Figure 4-13) is a typical section of the C seam. The C Upper is represented in red and the Lower C seam in blue (showing plies C1, C2 and C3).



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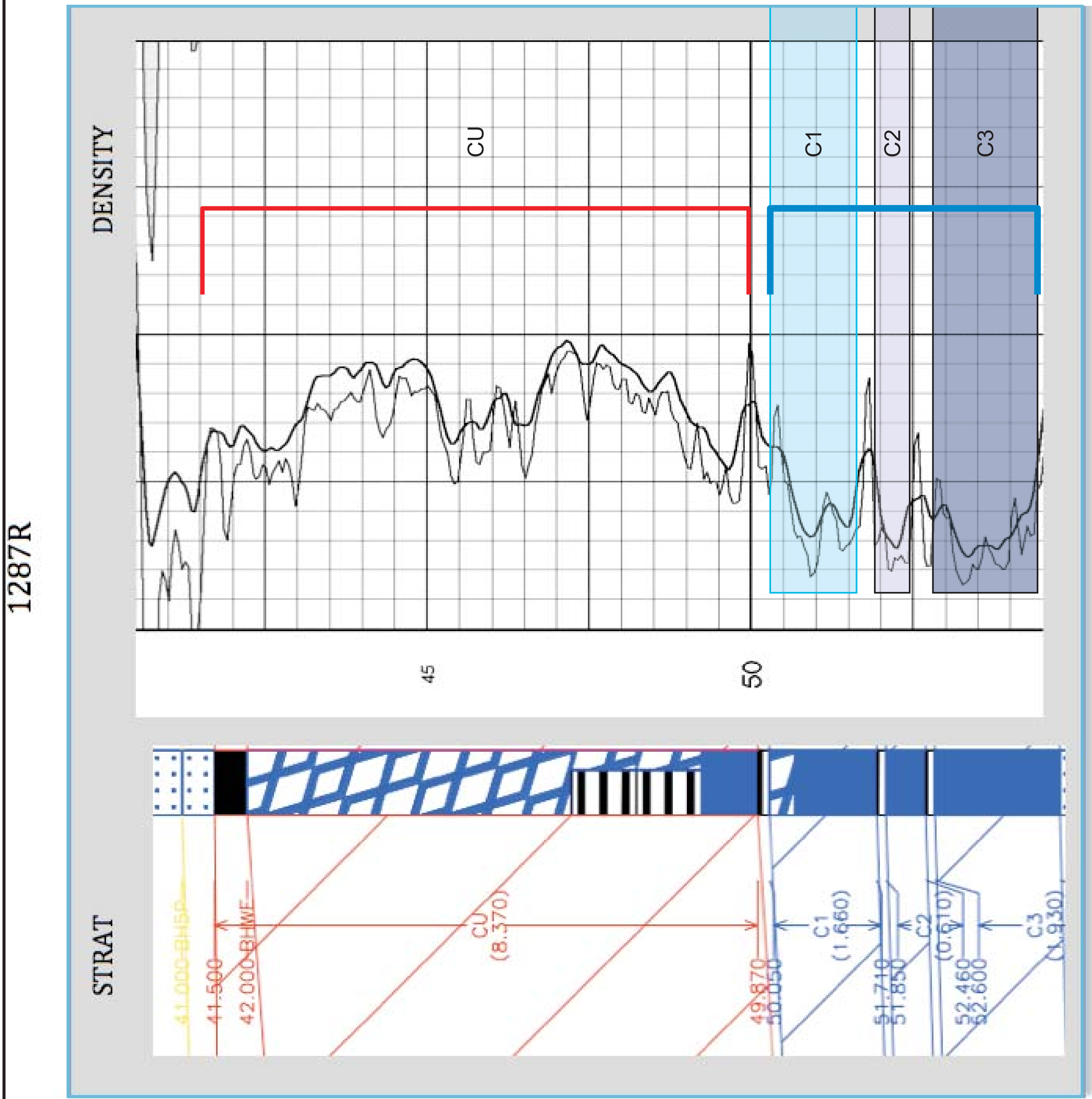
WORKING SECTION THROUGH
C AND D SEAMS WITH DENSITY LOG

Job Number	4262 6580
Revision	A
Date	27-10-2010

Figure: 4-12

File No: 42626580-g-2128.cdr



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Alpha Coal Project
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TYPICAL SECTION OF THE C SEAM

Job Number	4262 6580
Revision	A
Date	27-10-2010

Figure: 4-13

File No: 42626580-g-2129.cdr

4.3.3.4.1 C Upper, non-coal unit

The C Upper unit (CU) sits directly above the C seam, and is seen as a unit of interbedded minor stony coal, clayey tuffs and carbonaceous mudstone (see Plate 4-4 below). There is generally only stony coal, however, some thin sections of dull to bright coal bands can be found, but these are inconsistent in nature.

Plate 4-4 Typical C Upper unit in 10” large diameter core

The C Upper unit has an average thickness of around 7.5 m but can be up to 10 m or more in areas towards the Subcrop. There is no resource potential in this unit, due to the inferior nature of the coal bands and dominance of waste rock within the sequence. Results from previous drilling programs have confirmed that the C Upper is excessively high in ash (>70% raw ash) and is not suitable as export quality thermal coal.

The C Upper section is not of resource potential and, while included in the structural model, it is not considered as part of the current resource. In order to mine the lower seams, the C Upper will need to be excavated; therefore, it needs to be understood in terms of waste disposal.

4.3.3.4.2 C Seam

The C seam lies directly beneath the C Upper and has an average cumulative thickness of around 3 m. The C seam has been split into 3 separate plies, namely C1, C2 and C3. These plies are comprised of dull to dull banded coal usually with claystone partings. It is generally greater than 20% ash, but in places it can contain plies of less than 10% ash. The plies of the Lower C seam are fairly consistent, but can at times combine to form variations, commonly C1 and C2 combine to form C12, also C2 and C3 can form C23.

The C1 ply of the Lower C seam sits under the C Upper in the sequence, and can usually be seen as quite an obvious change from the banded claystone and carbonaceous mudstone (see Plate 4-5 below). The average thickness of the C1 is around 1.2 m, and it consists of dull coal with bright bands, no partings and occasional stony coal bands toward the top of the unit.

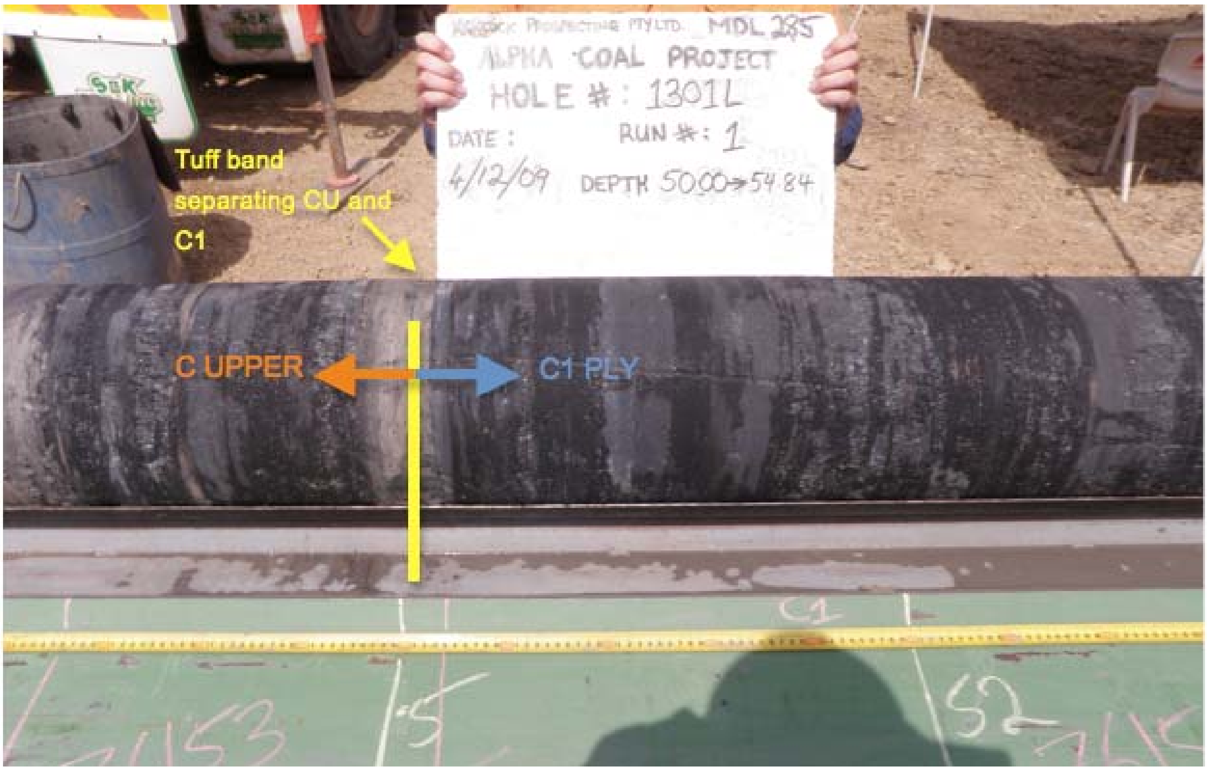


Plate 4-5 Boundary between CU and C1

The C2 ply follows the C1, and is the smallest of the three plies, usually being around 0.6 m thick. It is separated from C1 and C3 by small claystone bands that do not usually exceed 0.1 m each. Again, this is a fairly clean ply of dull, brightly banded coal, with occasional minor stone bands (Plate 4-6).

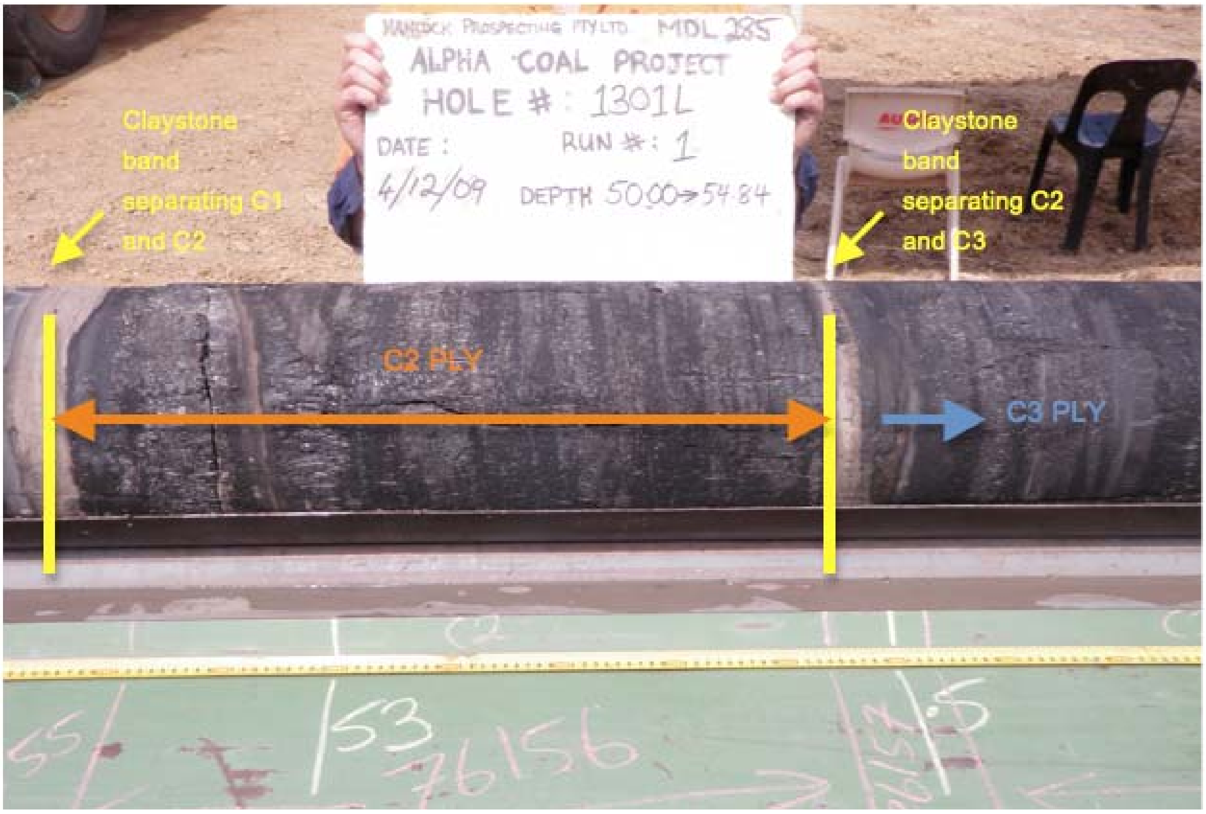


Plate 4-6 C2 ply separated from C1 and C3 by small claystone bands

The C3 ply of the Lower C seam is the generally the largest ply with an average thickness of 1.55 m. It has the same characteristics as the other plies in the seam, with occasional stone bands present throughout the unit. The C3 ply can often have a gradational base, grading from a dull to dull banded coal into a carbonaceous siltstone with some coaly bands, and finally into a medium grey siltstone (Plate 4-7).

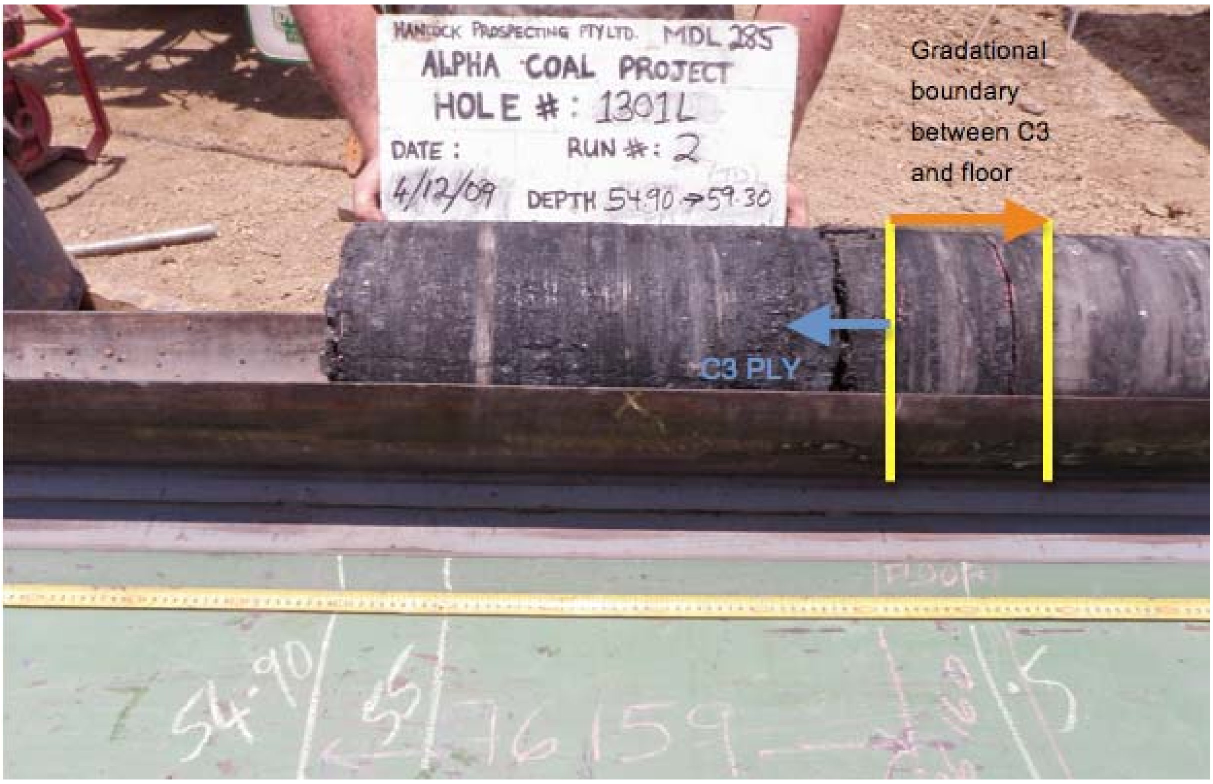


Plate 4-7 Gradational boundary at the base of the C3 ply

4.3.3.5 C-D Interburden

The interburden between the C and D separation can vary from around 3 m in the subcrop area to 7 m or more in the west. This unit is generally composed of competent sandstone, interlaminated with silty bands and wisps, with occasional coaly traces and in places can grade into siltstone (generally where interburden thickens) (Plate 4-8).

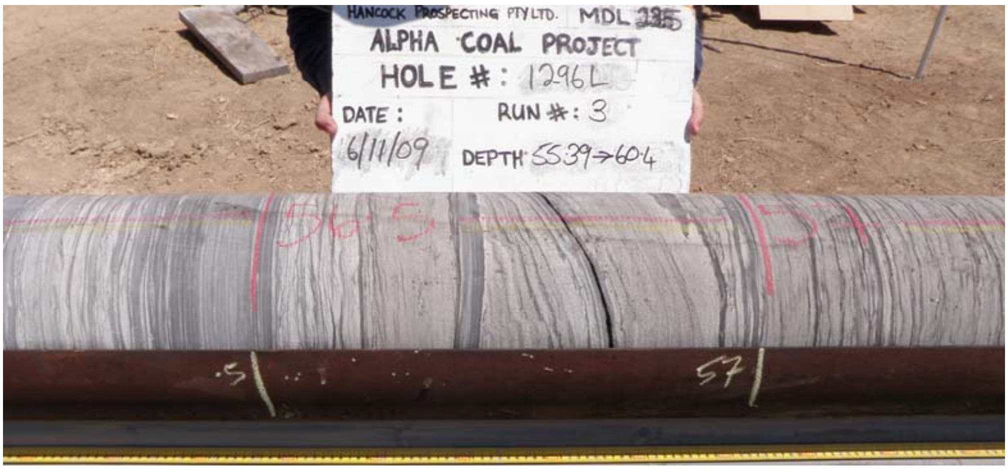


Plate 4-8 Interburden between C and D seams showing laminated sandstone/siltstone

4.3.3.6 D Seam

The D seam occurs within the Colinlea sandstone and consists of the three main plies that can be divided in to five. These plies are:

- D Upper (DU);
- D Middle (DLM), which can consist of DLM1 and DLM2; and
- D Lower (DLL) with can consist of DL1 and DL2.

Stone bands within the D seam thicken to the west, with smaller bands to the east. The D seam usually has a thickness of 6 to 7.5 m inclusive of stone bands with 4.5 m of clean coal (Figure 4-14).

4.3.3.6.1 D Upper (DU)

The D Upper seam (DU) is a dull to dull and brightly banded ply of coal that ranges from 0.3 to approximately 1 m thick. It is commonly separated from the rest of the D seam by a band of coaly shale around 0.75 m. This can be difficult to define due to the coaly nature of the unit (Plate 4-9). The D Upper to DLM parting thins significantly to the south, but can be up to 1 m thick in the north of the Project area.

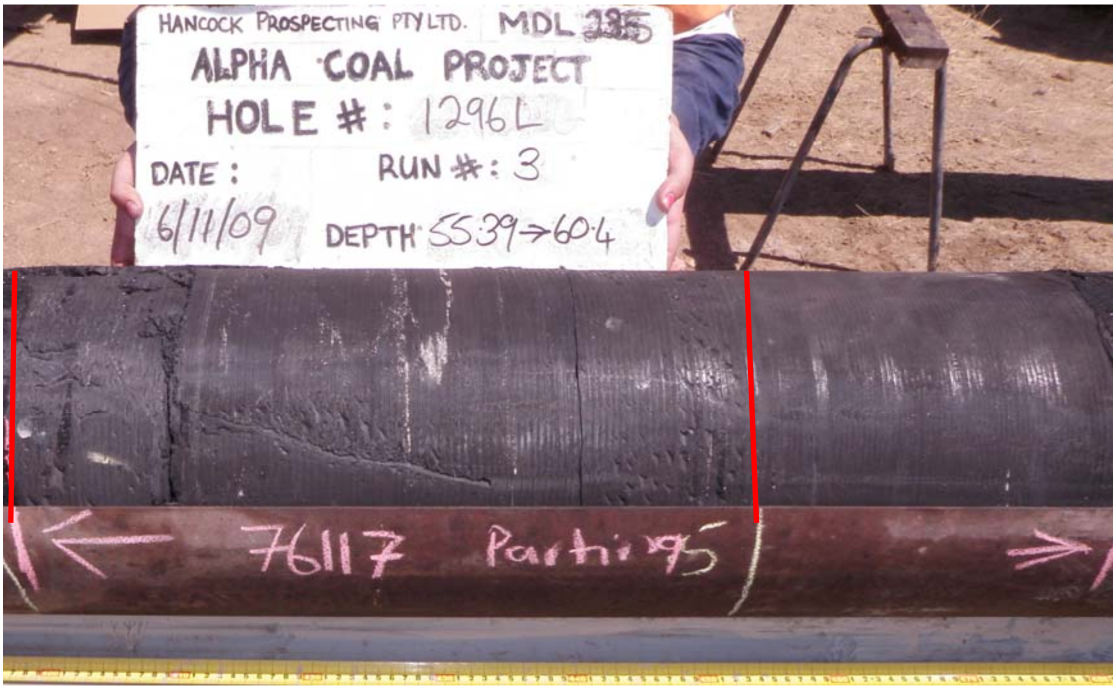
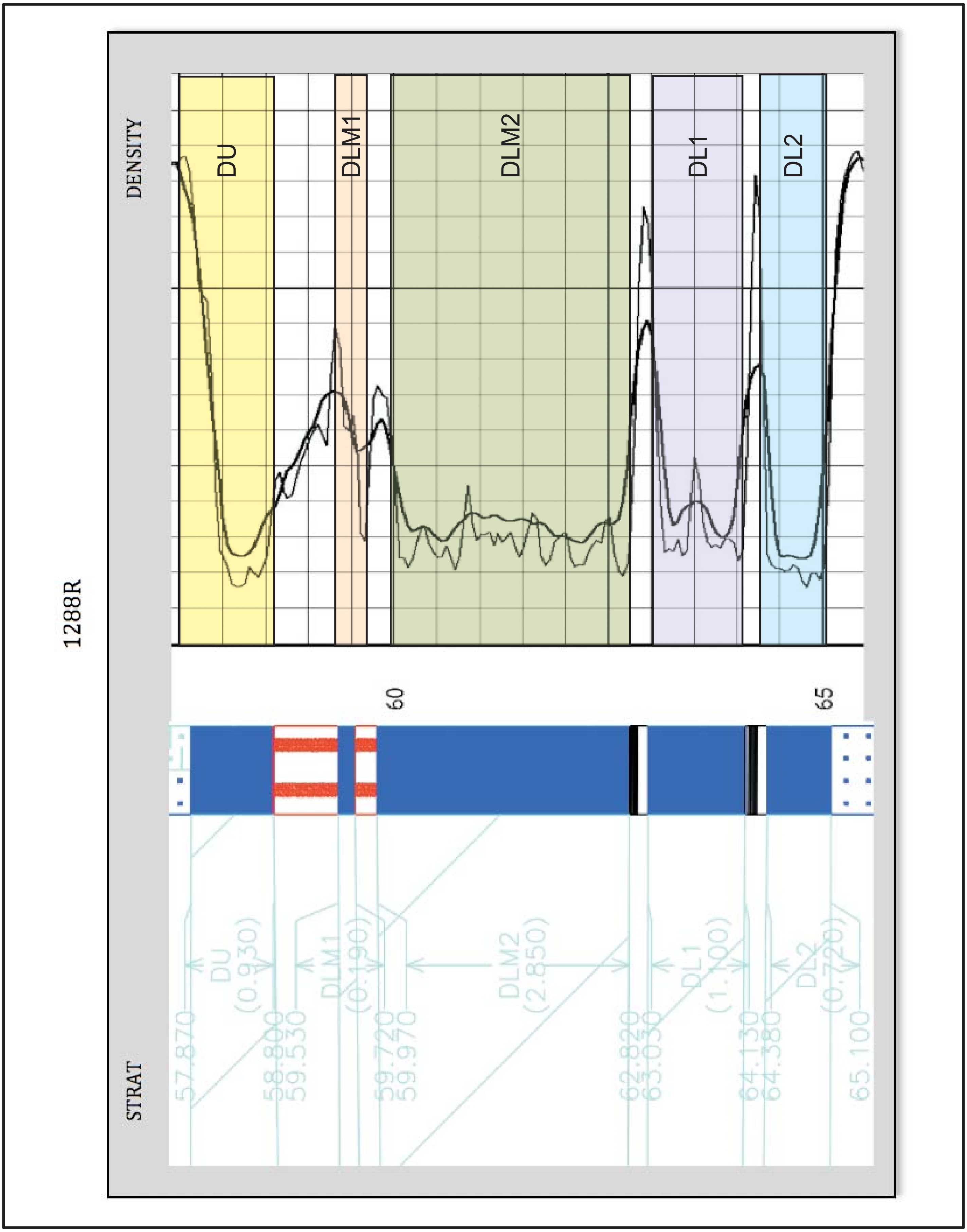


Plate 4-9 The splitting of the D seam showing the coaly shale parting

4.3.3.6.2 D Middle (DLM1 and DLM2)

The DLM1 ply is a high ash (approximately 30%) ply of dull coal to coaly shale that is located above the DLM2 ply and is around 1 m thick. The DLM1 ply generally combines with the DLM2 seam to form DLM to the south of the lease, but this trend can be unreliable.



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TYPICAL SECTION OF D SEAM
SHOWING ALL 5 PLIES

Job Number | 4262 6580
Revision | A
Date | 27-10-2010

Figure: 4-14

File No: 42626580-g-2130.cdr

The DLM2 ply of the D seam is a consistent unit ranging in thickness from 2.5 – 3 m. This ply consists of dull to dull and brightly banded coal and often contains small stony bands within the seam, with DLM2 containing the better quality coal within the D seam, having a raw ash content of between 10 and 15%. DLM2 combines with DLM1 towards the north of the lease forming DLM. DLM2 is separated from DLL by an interbedded sequence of siltstone/sandstone (Plate 4-10).

Plate 4-10 Interburden between DLM2 and DLL, showing the interbedded sandstone/siltstone

4.3.3.6.3 D Lower (DL1 and DL2)

DL1 and DL2 sometimes combine to form the DLL ply of the D seam. No major separation exits between the DL1 and DL2, however, claystone band partings have been shown to separate DL1 and DL2 (Plate 4-11). The average thickness of the DLL ply is approximately 1.5 m and is generally the best quality coal of the D seam and commonly has a raw ash of less than 10%.

Plate 4-11 DLL ply comprised of DL1 and DL2 showing the stony parting

4.3.3.7 D to E Interburden

The D to E interburden can range from a fine to course sandstone and becomes pebbly toward the top of the E seam. The interburden and is usually around 15 m thick (Plate 4-12).

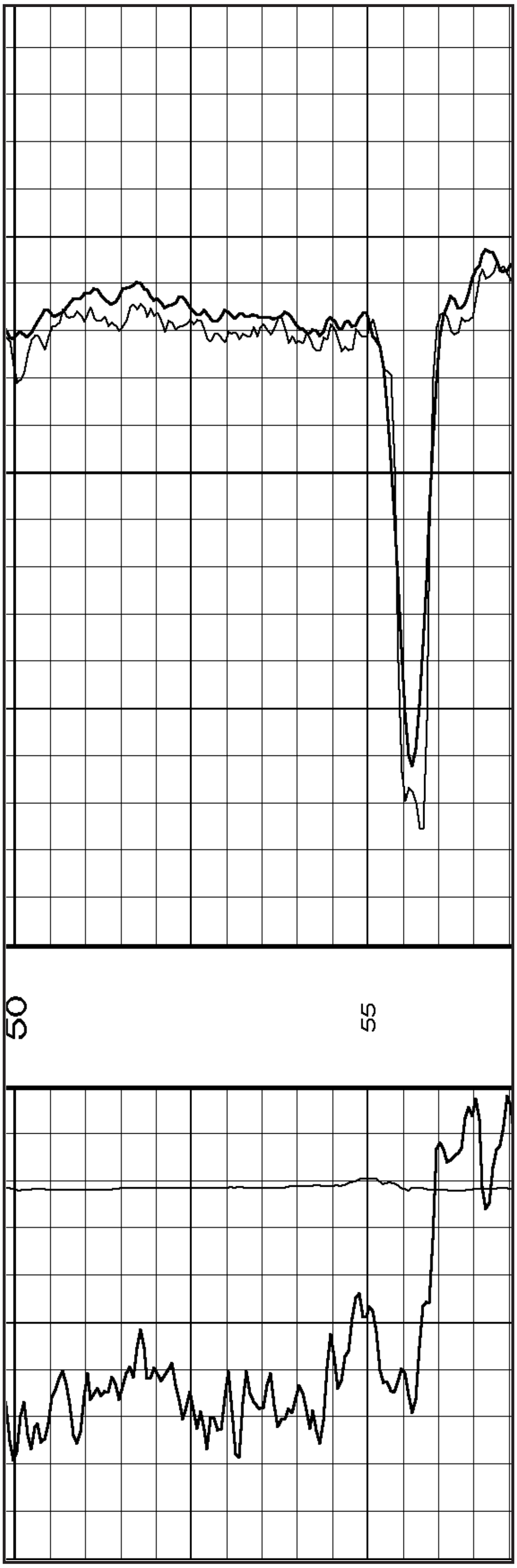
Plate 4-12 E to D interburden showing pebbly sandstone overlying the E seam

4.3.3.8 E and F Seams

The E seam is present as two 0.2 m thick clean coal bands (E1 and E2 (Plate 4-13)) that reside ~ 15 m below the D seam (Figure 4-15). The F seam displays patchy development and the full geological section can reach in excess of 5 m in isolated areas. However, excessive banding with non-coal parting, excessive and poor coal quality makes the F seam sub-economic. The F seam sits around 30 m below the D seam floor. No resource potential is currently attributed to either E or F seams within the project area (Figure 4-15 and Figure 4-16).

Plate 4-13 The E seam located between large sandstone/siltstone partings

All coal seams undulate slightly throughout the deposit, but generally the dip is < 1 ° towards the west. The dip increases to ~ 2–3 ° in the central and north of project area.



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Alpha Coal Project
Environmental Impact Statement

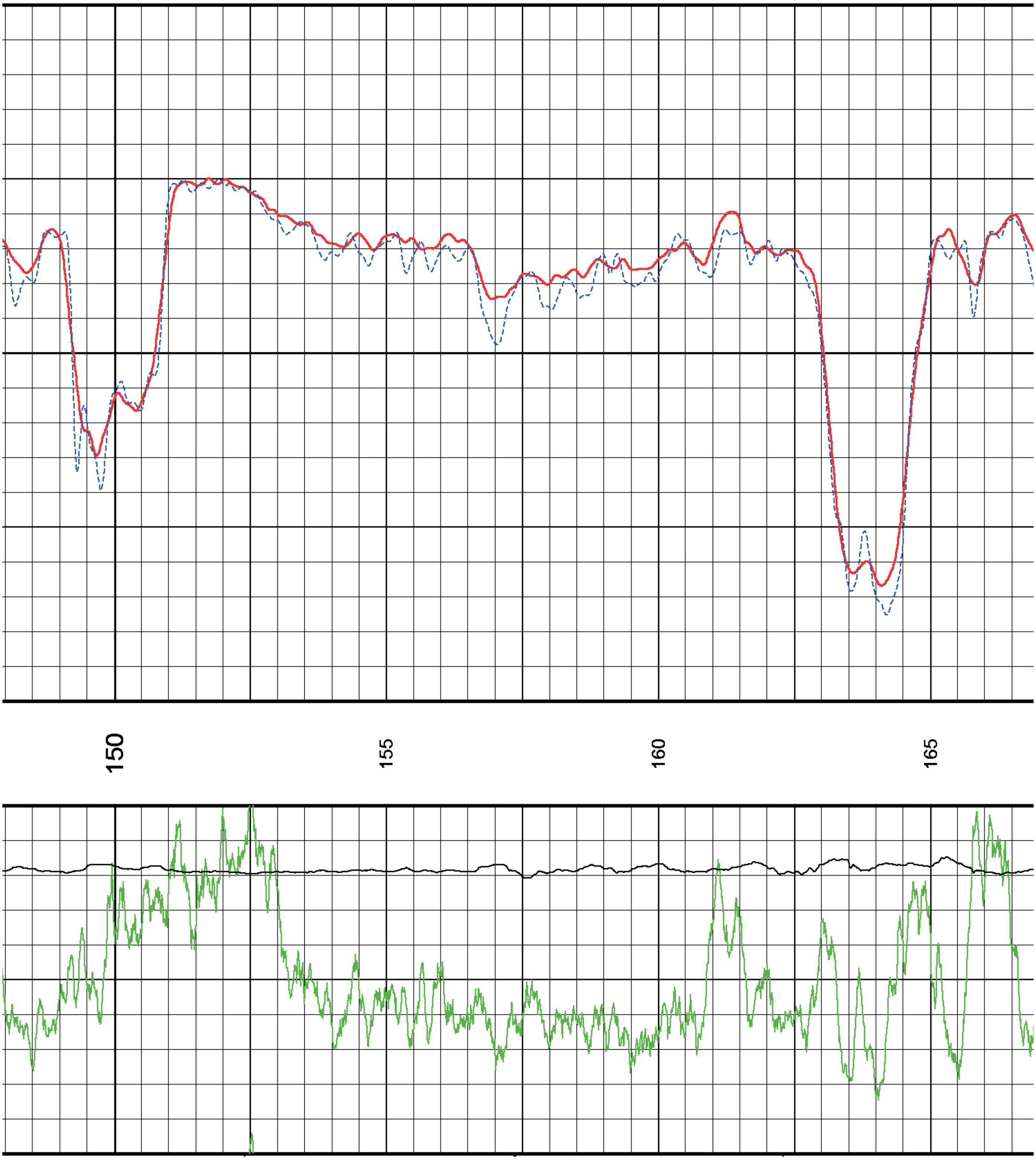
GEOPHYSICAL DENSITY LOG
SHOWING A TYPICAL E SEAM SPIKE

Job Number 4262 6580
Revision A
Date 27-10-2010

Figure: 4-15

Datum: GDA94, MGA Zone55

File No: 42626580-g-2131.cdr



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Datum: GDA94, MGA Zone55

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

DENSITY LOG SHOWING BOTH THE E AND F SEAMS

Job Number | 4262 6580
Revision | A
Date | 27-10-2010

Figure: 4-16

File No: 42626580-g-2132.cdr

4.4 Geological Structures within the Area of Disturbance

No major regional scale fold and fault structures have been identified to date in the geology logged across the Project area (Salva, 2010). Based on the high density drilling for the Project there is very little seam conflict to indicate the presence of large scale faulting.

Geological modelling of the coal resources at the Project does not include faults or intrusions. This is because there is no evidence of intrusive activity and major faulting appears to be absent, although small faults are likely to be distinguished when drill hole spacing becomes closer.

4.5 Geological Factors that may Influence Ground Stability

4.5.1 Geological studies

Two historical studies were conducted into the geotechnical considerations for open cut mining of the Alpha deposit. Additional geotechnical investigations have been undertaken as part of recent mine planning and infrastructure placement activities. Investigations included the assessment of slaking or swelling properties, rock strength, trafficability loads and handling ability and pit floor stability.

4.5.2 Slope Stability

During the historical geotechnical investigations some bedding parallel shear zones were detected in the sediments overlying the C seam. These appear to be persistent. It is noted that the dip of the strata will be into the walls at a low angle, which is a more favourable orientation for the shears in terms of slope stability.

Some weathering and erosion effects are expected on slopes containing these overburden materials, however, they are not expected to unduly affect the stability of the landform.

4.6 Metallurgical and Environmental Consideration

4.6.1 Coal Characterisation

Coal quality data was loaded into an Oracle global database for validation.

Where the coal seams have partings, they have been sampled on a ply-by-ply basis. In such cases, there is also often an analysed composite for the full seam. There are 454 holes yielding raw quality data and 372 holes yielding float 1.50 or float 1.60 data.

Coal quality data consists of:

- Raw Proximate Analysis, Specific Energy, Total Sulphur and Relative Density;
- Float 1.50 and float 1.60 product proximate analysis, specific energy, total sulphur, ash analysis, ash fusion temperatures, ultimate analysis, hardgrove grindability index, chlorine, trace element analyses; and
- Washability data.

Drill hole statistics for key raw parameters are listed in Table 4-3, while statistics for key product parameters are listed in **Table 4-4.**

Table 4-3 Drill hole statistics raw quality

Seam	IM				Ash				RD				GCV				TS			
	No.	Min	Max	Mean	No.	Min	Max	Mean	No.	Min	Max	Mean	No.	Min	Max	Mean	No.	Min	Max	Mean
A	67	3.1	14.2	7.96	69	11.82	42	20.24	45	1.38	1.72	1.51	3	5148.14	5540.11	5316.05	1	0.36	0.36	0.36
B	2	7.81	8.21	8.01	2	34.02	43.61	38.81	2	1.66	1.71	1.68	0	–	–	–	0	–	–	–
B1	94	4.6	10.9	7.71	96	19.2	52.4	33.15	64	1.48	1.82	1.63	8	3338.88	4789.63	4306.25	1	0.66	0.66	0.66
B2	112	3.3	12	7.67	117	17.4	49.2	28.84	77	1.45	1.9	1.59	10	4383.33	5793.45	4876.87	1	0.55	0.55	0.55
B234	2	6.8	9.38	8.09	2	21.89	22.1	22	0	–	–	–	0	–	–	–	0	–	–	–
B3	120	1.6	23.6	7.75	123	16.7	49.2	30.71	89	1.45	1.81	1.59	13	4177.78	5155.31	4662.04	1	0.39	0.39	0.39
B34	1	8.26	8.26	8.26	1	18.48	18.48	18.48	0	–	–	–	0	–	–	–	0	–	–	–
B4	125	5.1	14.2	8.08	129	16.8	57.3	24.5	67	1.42	1.91	1.56	14	4636.67	5611.81	5129.87	2	0.32	0.57	0.44
C	193	2.2	13.63	8.51	195	6.98	49.18	18.87	77	1.36	1.91	1.54	49	4897.19	6610.84	5587.62	20	0.45	0.9	0.54
CL	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–
CU	20	4.5	11.9	7.67	20	12.8	55	30.6	2	1.49	1.75	1.62	2	2595.58	4184.95	3390.27	0	–	–	–
D	7	6.44	10.7	7.78	7	14.68	24.85	19.57	3	1.47	1.54	1.5	1	5695.46	5695.46	5695.46	0	–	–	–
DL	9	7	9.6	8.39	9	13.6	23.56	17.86	4	1.43	1.52	1.49	3	5253.3	6113.71	5671.56	2	0.65	0.87	0.76
DL1	299	2.7	13.9	7.93	300	5.8	49.4	14.67	136	1.35	1.89	1.49	93	5023.86	6794.88	6177.17	29	0.31	0.87	0.54
DL2	300	2.7	13.9	8.01	301	5.4	49.4	13.82	137	1.3	1.89	1.47	93	5023.86	6794.88	6177.17	29	0.31	0.87	0.54
DLL	256	2.7	13.9	8.09	257	5.8	49.4	13.3	103	1.35	1.89	1.47	89	5023.86	6794.88	6199.62	27	0.31	0.76	0.53
DLM	52	4.05	13.9	8.41	52	8.8	24	14.92	14	1.37	1.47	1.44	20	5210.28	6338.38	5807.85	6	0.5	1.67	0.75
DLM1	139	2.5	13.9	8.42	142	6.2	41.3	17.65	48	1.36	1.83	1.51	48	4316.41	6431.59	5744.73	13	0.43	1.67	0.7
DLM2	263	2.2	13.9	7.9	264	8.2	56.5	16.03	116	1.37	1.99	1.48	78	5210.28	6505.68	5867.22	26	0.4	1.67	0.63
DU	163	3.7	14	8.48	164	7	36.8	14.5	85	1.31	1.68	1.46	36	2430.67	6479.39	5915.78	12	0.43	1.2	0.61

Seam	IM				Ash				RD				GCV				TS			
	No.	Min	Max	Mean	No.	Min	Max	Mean	No.	Min	Max	Mean	No.	Min	Max	Mean	No.	Min	Max	Mean
E	3	6.9	8.9	7.77	3	11.4	16.6	14.27	3	1.39	1.51	1.46	0	–	–	–	0	–	–	–
F	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	––
F1	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–
F2	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	––

IM – Inherent Moisture
RD – Relative Density
GCV – Gross Calorific Value
TS – Total Sulfur

Table 4-4 Drill hole statistics product quality

Seam	Yield				Ash				GCV				TS			
	No.	Minimum	Maximum	Mean	No.	Minimum	Maximum	Mean	No.	Minimum	Maximum	Mean	No.	Minimum	Maximum	Mean
A	44	20.6	93.4	76.81	45	6.8	19.8	10.79	27	5578.35	6309.7	6007.87	26	0.22	0.78	0.38
B	2	62.3	76.4	69.35	2	13.6	14.77	14.18	2	5809.82	5879.49	5844.65	2	0.38	0.45	0.41
B1	27	8.3	78.4	49.32	26	9.4	22.2	17.43	10	5444.5	6687.32	5759.03	9	0.25	0.5	0.4
B2	37	29.2	83.9	60.77	36	10.8	20.7	16.72	18	5382.36	6037.23	5746.71	16	0.34	0.63	0.41
B234	2	72.9	76.16	74.53	2	10.8	11.78	11.29	1	6037.23	6037.23	6037.23	1	0.36	0.36	0.36
B3	31	16.1	90.5	56.87	31	10.8	30.3	17.55	19	5379.97	6042.01	5755.96	16	0.35	0.63	0.45
B34	1	87.5	87.5	87.5	1	10.8	10.8	10.8	1	5970.31	5970.31	5970.31	1	0.39	0.39	0.39
B4	101	48.2	97.2	74.79	101	9	16.2	12.83	57	5430.16	6352.72	5898.15	52	0.26	0.58	0.4
C	131	55	97.8	81.06	135	4.7	16.6	8.88	99	5611.81	6849.85	6406.62	102	0.26	0.88	0.54
CL	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–
CU	10	23.9	74.4	57.05	10	9.1	18.2	13.76	3	6037.23	6658.64	6328.02	2	0.7	0.88	0.79

Seam	Yield				Ash				GCV				TS			
	No.	Minimum	Maximum	Mean	No.	Minimum	Maximum	Mean	No.	Minimum	Maximum	Mean	No.	Minimum	Maximum	Mean
D	3	76.6	83.3	80.87	3	5.7	9.4	8.03	3	6443.54	6615.62	6510.46	3	0.42	0.67	0.54
DL	8	73.5	88.12	79.95	8	6.4	8.4	7.29	7	6531.97	6871.36	6711.57	5	0.44	0.77	0.61
DL1	223	39	98.3	82.95	224	3.6	19.7	6.74	122	5401.48	7234.64	6605.16	132	0.27	0.83	0.52
DL2	223	39	98.3	83.07	224	3.6	19.7	6.72	122	5401.48	7234.64	6605.16	132	0.27	0.83	0.52
DLL	204	40.1	98.3	84.06	203	3.6	15.5	6.27	102	5678.73	7234.64	6690.04	113	0.27	0.83	0.51
DLM	44	66.94	91.4	83.84	44	6.9	10.6	8.32	14	6338.38	6811.61	6622.88	20	0.45	0.81	0.54
DLM1	89	4.2	96.4	80.98	89	4.2	18.7	8.08	45	6338.38	7012.37	6659.32	47	0.42	0.88	0.6
DLM2	203	31.1	94.3	81.27	205	0.87	19.7	8.59	118	5401.48	7045.83	6485.84	125	0.33	0.9	0.55
DU	94	47.4	97.1	81.64	91	5.2	28.8	8.35	88	4703.59	7012.37	6442.16	81	0.36	1.16	0.6
E	2	83.2	94.9	89.05	2	8.1	9.9	9	2	6367.06	6438.76	6402.91	2	0.48	0.52	0.5
F	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–
F1	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–
F2	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–

4.6.2 Coal Quality

The Project deposit (MLA 70426) comprise five recognised coal seams, designated (in descending stratigraphical order) as A, B, C, D,E and F seams A through D are considered to be economically recoverable. However, at this time only seams C and D are considered to be economically viable via open-cut mining in today's market.

The coal can generally be described as high volatile (30–35%) bituminous with low to moderate ash (8–35 %). The coal exhibits little or no swell characteristics crucible swelling number (CSN <0.5) and compares unfavourably to other Australian coals in pulverized coal injection (PCI) applications due to an inferior replacement ratio. The primary use for this coal is expected to be in export thermal applications.

4.6.2.1 Washability

The washability characteristics of Alpha Coal are considered to be good. There are relatively large proportions of material in the low density fractions (~ 66% mass at F1.40), little near-gravity material and relatively low proportions of high density material (~ 8% mass at S2.00). Figure 4-17 depicts the washability in four size fractions for a mass weighted blend of all the large diameter (LD) working sections excluding out-of-seam dilution. This washability is typical of the Alpha Coal quality data provided.

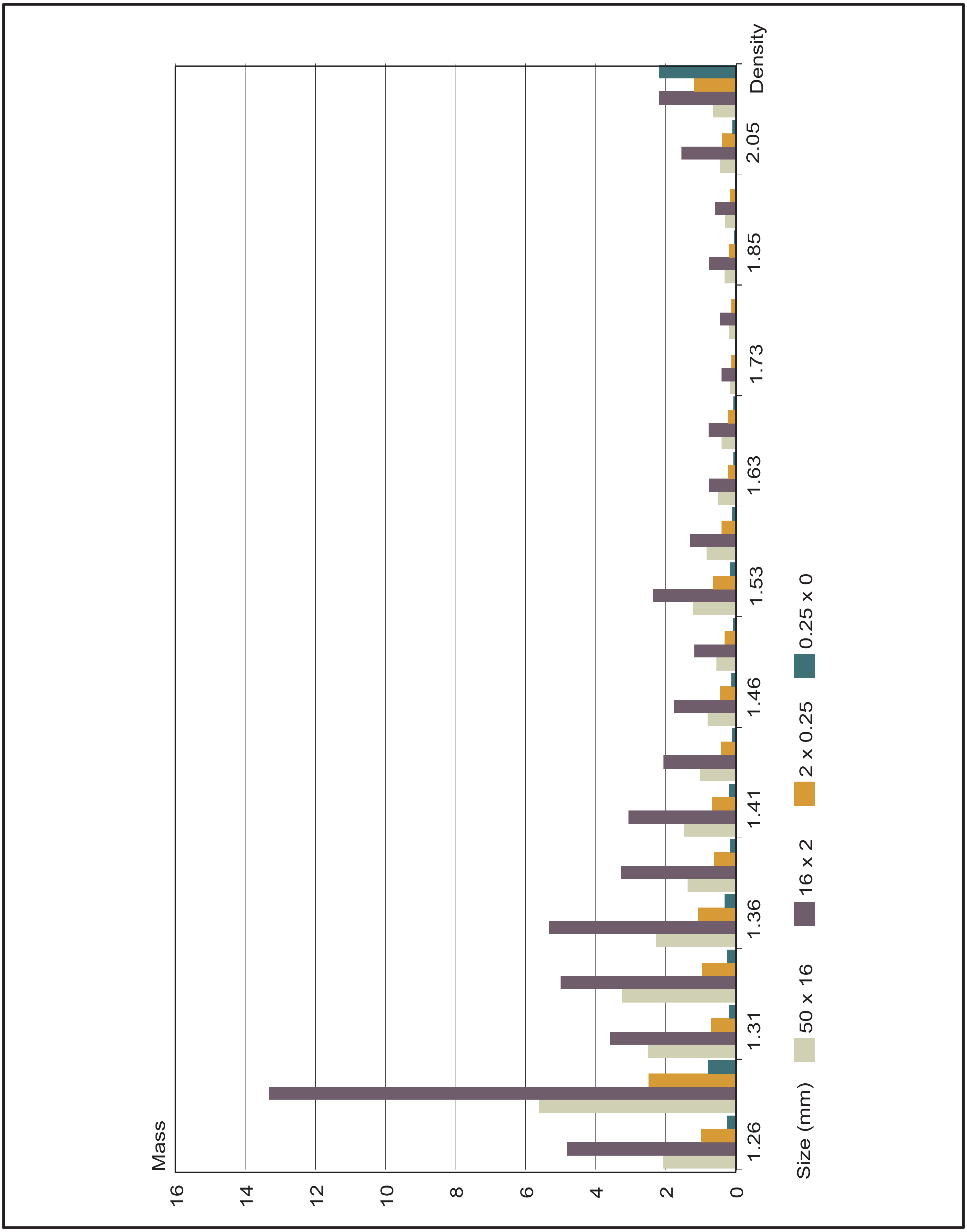
4.6.2.2 Spontaneous Combustion Propensity

A preliminary investigation of the spontaneous combustion propensity of coal from the Alpha Coal Project was conducted by the University of Queensland's Spontaneous Combustion Testing Laboratory (UQSCTL) using an adiabatic oven test procedure that is routinely used by the coal industry to obtain the R70 self-heating rate of the coal. This test also produced a value for the relative ignition temperature of the coal. A large database of R70 and relative ignition temperature values is held by UQSCTL, therefore comparisons between the Alpha Coal Project and other previous studies was used to obtain a relative indication of the propensity of the coal to spontaneously combust.

The samples tested in the adiabatic oven indicated that the R70 values are 3.55 ºC/h and 6.70 ºC/h for ash contents of 25.9% and 18.7%, respectively, on a dry basis. In addition, the relative ignition temperatures range between 132 ºC and 110 ºC. These values indicate the coal has a high intrinsic spontaneous combustion propensity based on Queensland conditions. While these results are not ideal, spontaneous combustion can be managed successfully by using appropriate mining planning techniques.

4.6.3 Mineralogy

The mineralogy of 2,972 samples from 32 bores on site was undertaken using visible, near infrared, short wavelength infrared (vis-NIR-SWIR) reflectance measurements using the HyChips system. The minerals observed included kaolinite, montmorillonite (Al smectite), nontronite (Fe smectite), and white mica.



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Alpha Coal Project
Environmental Impact Statement

WASHABILITY FOR BLEND OF ALL SEAMS FROM LD HOLES

Job Number	4262 6580
Revision	A
Date	27-10-2010

Figure: 4-17

Datum: GDA94, MGA Zone55

File No: 42626580-g-2133.cdr

Test pit floor material is variable with some samples classed NAF and others either UC or PAF. No chemical elements in either the overburden or washery waste material was found to be significantly enriched.

Neutral waters contacting the overburden would remain circum-neutral. Salinity release would be expected to occur over the short term. However, it is not expected to occur in the longer term. Metal and metalloid concentrations of waters contacting the overburden or washery waste are not expected to increase significantly.

Dispersivity testing was conducted on 15 samples selected from overburden and coal washery waste by chemical and physical tests. Results of the testing indicate that the claystone, mudstone, and clays are dispersive or potentially dispersive. The siltstone and sandstone are slightly dispersive and washery waste non-dispersive.

4.6.3.1 Implications

The majority of overburden can be managed as NAF material. However, up to 11% of the overburden waste, comprising stoney coal and mudstone, may have a potential for acid generation and may require special management strategies to prevent acid generation.

The coal washery waste is expected to be net acid generating and will require measures to prevent or control acid generation.

Precautions will be taken to prevent water flow over the dispersive materials of overburden dumps.

Management of poor quality runoff from mine waste rock dumps, the tailings storage facility, and disturbed areas is detailed in EIS Volume 2, Section 11 and Section 16.

4.7 Summary of Exploration Process

The following description of the historical exploration of the Alpha Coal Project is partially sourced from the Golder Associates report (Golder, 2007a).

4.7.1 1970 to 1979

Coal exploration commenced in the area in the 1970s, during which time four exploration permits were explored. Three of these covered the Kevins Corner and Alpha tenements and the fourth covered an area a short distance to the north.

Available historical data suggests that intensive exploration was undertaken within EPC245, covering the current extent of MDL 285. Work concentrated on the evaluation of thermal coal reserves and studies into the potential to produce liquid fuels from coal within the exploration permit areas.

Initial coal exploration was undertaken by the Queensland Department of Mines (QDM) from 1971 to 1972, with results for three drill holes reported in 1973. The drilling indicated the presence of a substantial resource of non-coking, sub-bituminous coal in structurally simple rocks of Late Permian age. The coal resources were identified below a thick Tertiary cover (up to 47 m).

EPC136 was explored by Dampier Mining Company Limited (Dampier) and Queensland Coal Mining Company Ltd (Queensland Coal), both subsidiaries of BHP Limited. Some 148 drill holes were completed by BHP. Five seams were intersected and considered to occur within the Bandanna (A and B) and Colinlea (C, D, E) Formations. Minor coal seams were also identified in deeper, older rocks assigned to the Late Carboniferous Joe Joe Formation. BHP conducted studies into the liquefaction potential of coal within its EPC using hydrogenation and solvent extraction technologies. Coal resources identified during exploration of EPC136 were considered to be uneconomic by Queensland Coal at the time the tenement was relinquished (14 February 1975).

EPC137 was granted to a Joint Venture between Shell Development (Aust) Pty Ltd (Shell) and Western Mining Corporation Ltd (WMC) for three years on 15 February 1974. The exploration permit was relinquished at the end of the second year of tenure upon completion of some fifty drill holes, including five large diameter cored holes. Five seams were identified in the permit area and assigned by Shell geologists to the Late Permian Colinlea and Bandanna Formations. The coal intersected was classified as sub-bituminous, low sulphur, moderate ash (15.5% to 25.8%) coal, with moderate specific energy (22.4 MJ/kg). Bedding was interpreted to dip at between one and two degrees to the west and no major faults were proposed within the Project area. An Indicated Resource of 4.7 billion tonnes was estimated to a maximum depth of 250 m, with little coal being present within 90 m of surface due to the presence of thick Tertiary cover.

EPC244 was granted to Hancock Prospecting Pty Ltd and Wright Prospecting Pty Ltd (HPPL and Wright) in 1978. Some 82 of the 148 holes drilled by BHP under EPC136 occur within EPC244, providing a substantial technical basis for selection and initial exploration of the area. The coal measure stratigraphy defined by HPPL and Wright in the Golder Associates report (Golder, 2007a), supplemented with a description of the individual coal seams by BHP.

4.7.2 1980 to 2007

Coal exploration in the Galilee Basin was subdued during the 1980s and 1990s. Post 2007 there was a rapid upsurge in Galilee Basin coal exploration.

4.7.3 2008 to August 2010

MDL 285, covering an area of 33,706 ha (approximately 337 km^2), was granted to HPPL on 11 March 2008 and is set to expire on the 11 March 2013. Exploration activities to date have been conducted by Salva Resources Pty Ltd with recent exploration activities focused on the planning and execution of an annual drilling program. The purpose of the annual drilling program was to:

- Combine the data yielded with historical data to help develop the Alpha Coal Project;
- Improve the understanding of the coal seams and associated rock units;
- Confirm coal quality and washability characteristics of target seams; and
- Further coal quality characterisation through infill drilling thereby improving JORC status.

A total of 3 drilling campaigns have been conducted within MDL 285 since 2008, the first of which commenced in May and concluded in December of 2008. During this time a total of 153 holes were drilled for 15,714 m and consisted mainly of open holes and partly cored medium diameter (4”) holes. Eight large diameter (8”) holes were also drilled during this period. Down-hole geophysical surveys were conducted on 132 out of the 153 holes using dual density, gamma, calliper, and sonic methods.

A number of confirmation holes were drilled adjacent to historical drill holes during this drilling campaign to address reliability of historical data. Furthermore, a detailed topographic survey was conducted by AAMHatch using the Light Detection and Ranging (LiDAR) technique due to the unavailability detailed topographic data at the time of the commencement of the Pre-feasibility Study

(PFS). The results of the LiDAR survey included high resolution aerial photography with image resolution of 50 cm or better and a new Digital Terrain Model (DTM) accurate to +/- 0.5 m or better for use in the geological model.

A second drilling campaign was conducted from March 2009 to March 2010 involving the drilling of 60 holes for a total of 5,746 m. Drilling consisted primarily of open holes and partly cored medium diameter holes. Ten large diameter holes were also drilled during this period. In addition to these, 12 Rotary Chip holes were drilled for a total of 1,014 m and 12 line of oxidation (LOX) holes were drilled for a total of 846 m. LOX delineation was required to define the initial box cut for mining. Down-hole geophysical surveys were conducted on 49 of the 60 holes drilled using dual density, gamma, calliper, and sonic methods. Exploration drilling during this drilling campaign was more focussed towards better defining the geotechnical aspects of the deposit, pit limits of the proposed open-cut, and updating the coal quality model.

From May to August 2010, 19 holes were drilled for a total of 1,601 m (the third drilling campaign). Drilling consisted mainly of cored holes for geotechnical and coal quality analyses, with the addition of 4 chip holes for geochemical sampling. Down-hole geophysical surveys were conducted on each of the holes with subsequent sampling conducted for geochemical analysis.

4.7.4 Mineral and Petroleum Exploration

Waratah Coal has lodged a number of mineral exploration permit applications over-pegging coal exploration permits held by both Waratah and competitors surrounding the two HPPL MLAs. Golder Associates (Golder, 2007b) suggests that these tenements have been applied for to remove potential for interference in coal exploration and development activities by third parties.

Most of the remaining permit applications covering the Galilee Basin have been lodged by Drummond Uranium Pty Ltd.

The HPPL MDLs are currently over-pegged by a petroleum exploration permit granted to Tri-Star Petroleum Company (EPP668) current until 30 April 2019, and a petroleum exploration permit application lodged by Comet Ridge Ltd (EPP744).

The nearest petroleum well in the area, Jericho 1, drilled in June 1965 and approximately 20 km to the south of Jericho, is more than 50 km from the HPPL MDLs. Only limited seismic surveying has been undertaken in the vicinity of the HPPL MDLs limiting the amount of information available relating to the stratigraphy and structure of the basin in this area.

A single coal seam gas well has been drilled in the area (Splitters Creek 1), approximately 32 km to the east of Aramac ~ 100 km west of the Project area.

4.8 Coal Resources

4.8.1 Geological Modelling

The Mincom's Stratmodel was used for the geological modelling. The model, based on an assessment of geological information, included the following information regarding the coal on site.

4.8.1.1 Weathered zone

The base of weathering was determined by colour change of the lithology. This is shown in Plate 4-14 at 29.61 m. The depth of weathering ranges from 10 m to 70 m with an average depth of 40 m. Base of weathering is used as a coal seam cut-off in the model.

Plate 4-14 Weathering depth defined by colour change

4.8.1.2 A Seam

The uppermost A coal seam occurs in the western half of MLA 70426. It averages 1.5 m in thickness and does not have any splits. It is underlain by the B seam with an average interburden thickness of 18 m.

4.8.1.3 B Seam

The B seam consists of four plies:

- The B1 seam averages 0.8 m in thickness;
- The B2 seam 0.7 m thick;
- The B3 seam 0.5 m thick; and
- The B4 seam 3 m thick.

The interburden between the various splits averages about 0.3 m to 0.5 m and rarely exceeds 1 m.

4.8.1.4 C Seam

The C seam occurs over most of the lease area and is around 2 to 4 m thick. It appears to thicken down-dip in the north-west to around 6 m and thins (< 2 m) towards the south.

Interburden between the B and C seams averages 80 m.

4.8.1.5 D Seam

The D seam occurs over most of the lease area and splits into an upper (DU), middle (DLM), and lower (DLL) section. The middle section splits again.

- The DU seam averages 0.8 m in thickness;
- The DLM1 seam 1 m in thickness;
- The DLM2 seam 2 m in thickness; and
- The DLL seam 2 m.

The interburden between the C and D seams averages 9 m, but ranges up to 20 m.

The seams dip gently to the west generally at < 1°.

4.8.2 Coal Resource Estimation Results

4.8.2.1 Joint Ore Reserves Committee Code Requirements

The Joint Ore Reserves Committee (JORC) Code provides minimum standards for public reporting of Resources and Reserves to the investment community. For coal deposits, the JORC Code is supplemented by the Australian Guidelines for Estimating and Reporting of Inventory Coal, Coal Resources and Coal Reserves (referred to as 'the Guidelines').

The Code and the Guidelines provide a methodology which reflects best industry practice to be followed when estimating the quality and quantity of Coal Resources and Reserves. A Coal Resource is defined as that portion of a coal deposit in such form and quantity that there are reasonable prospects for economic extraction. The location, quantity, quality, geological characteristics and continuity of a Coal Resource are known, estimated or interpreted from specific geological evidence and knowledge. Coal Resources are divided into three categories:

- Measured – for which quantity and quality can be estimated with a high degree of confidence. The level of confidence is such that detailed mine plans can be generated, mining and beneficiation costs and wash plant yields and quality specifications can be determined;
- Indicated – for which quantity and quality can be estimated with a reasonable degree of confidence. The level of confidence is such that mine plans can be generated and likely product coal quality can be determined; and
- Inferred – for which quantity and quality can be estimated with a low degree of confidence. The level of confidence is such that mine plans cannot be generated.

Resources are estimated based on information gathered from points of observation. Points of observation include surface or underground exposures, bore cores, geophysical logs, and drill cuttings in non-cored boreholes. It should be noted that points of observation for coal quantity estimation need not necessarily be used for coal quality estimation.

The estimate is calculated using the area, thickness and in situ density of the coal seam. The basis from which the in situ density is derived will be clearly stated. It is important to note that in situ density is not the same as the density reported by the standard laboratory measurement.

The Guidelines suggest distances that should be used between points of observation when estimating resources:

- Measured – Points of Observation no more than 500 m apart;
- Indicated – Points of Observation no more than 1,000 m apart; and
- Inferred – Points of Observation no more than 4,000 m apart.

4.8.2.2 Resource Estimation Approach and Assumptions

The 2009 drilling program has built on the existing database of both structure and quality. Any old holes for which the data was considered to be unreliable or invalid, have been excluded from the geological model and thus the resource estimate. The Points of Observation used to define the Coal Resources at Alpha are those drillholes with a reliability type of 1, 2 or 3, as shown in Table 4-5.

Table 4-5 Points of Observation Categorisation

<table>
<tr><th>Type</th><th>Point of Observation Description</th><th colspan="4">Value and Use of Point of Observation</th></tr>
<tr><td>1</td><td>Cored and analysed intersection of seam with wireline log, may or may not have lithology log</td><td rowspan="3">Types 1-3
Reliable for structure and thickness</td><td></td><td rowspan="2">Types 1-2
Required for quality confirmation</td><td></td></tr>
<tr><td>2</td><td>Cored and analysed intersection of seam without wireline log, may or may not have lithology log</td><td></td><td></td></tr>
<tr><td>3</td><td>Non cored intersection of seam with wireline log, may or may not have lithology log</td><td></td><td></td><td>Type 3
May support quality</td></tr>
<tr><td>4</td><td>Non cored intersection of seam without wireline log, may or may not have lithology log</td><td></td><td>Type 4
Supportive of structure and thickness</td><td></td><td></td></tr>
</table>

The drill hole spacing for structure and for quality which has been used to define the Resources categories at the Alpha Coal Project (Mine) is as follows:

Measured Structure – Points of Observation less than 500 m apart

Quality – Points of Observation less than 1,000 m apart

Indicated Structure – Points of Observation less than 1,000 m apart

Quality – Points of Observation less than 2,000 m apart

Inferred Structure – Points of Observation less than 2,000 m apart

Quality – Points of Observation less than 4,000 m apart

Resource classification was developed from the confidence levels of key criteria including drilling methods, geological understanding and interpretation, sampling, data density and location, grade estimation and quality (see Table 4-6). This classification was completed in accordance with the guidelines as set out on JORC Code (2004).

4.8.2.2.1 Confidence levels

The Alpha Coal Project resource has been classified as containing Measured, Indicated and Inferred Coal Resources based on the assessment of the input data, geological interpretation and coal quality data. The key criteria assessed as part of the resource categorisation is set out in Table 4-6.

Table 4-6 Confidence Levels of Key Criteria

Items	Discussion	Confidence
Drilling Techniques	Combination of open hole and core (4" air core, HQ and NQ) – Industry standard approach. Cainozoic cover and depth to seams requires HQ wireline drilling in central/western areas which precludes large mass 4" drilling there	Moderate
Logging	Recorded codes match those that have been defined; codes are fitting the deposit and inline with industry practise. Downhole logging is completed on all suitable holes and LAS/graphic output provided. Logs are corrected to downhole geophysical levels as is standard practice.	Moderate - high
Drill Sample Recovery	Core logs generally record recovery and core loss where field geologist identifies recovery issues. Holes with >95% loss are redrilled	Moderate
Sampling Techniques and Sample Preparation	Samples are well identified and recorded with geological logs; sample sheets included in log data	Moderate-high
Coal Quality Data	Coal quality analysis is conducted in experienced, long time established coal labs, with various NATA certifications and Australian Standards, ISO Standards applied. Washability model reduced confidence in wide spaced data areas and in regions with prevelance of old holes	Moderate
Location of Sampling Points	Borehole survey ranges in quality from high precision DGPS to setout collars with hand held stand alone GPS. The lack of survey for some holes with DGPS causes small reduction in confidence; setout locations are available for all holes. Downhole survey is available for recent drilling.	Moderate
Data Density and Distribution	Drilling density supports or exceeds required intervals for the resource allocated	Moderate-high
Audits or Reviews	Several resource estimates have been completed by other parties and reviews have been carried out. Subset of model audited by IMC/Multries March 2010	Moderate - high

Items	Discussion	Confidence
Database Integrity	All historic data was captured from the available reports and was validated before use. Database verification and confirmation drilling undertaken in 2008	Moderate
Geological Interpretation	There is a good understanding of the stratigraphy and structural elements and sufficient data to construct a robust geological model. Coal quality data is adequate to allow definition of product quality.	Moderate
Density	Resource density has been calculated using in situ moisture estimate derived from quality data and ACARP C10042 model.	Moderate
Estimation and Modelling Techniques	Stratigraphic model has been generated using industry standard software and techniques and cross checked with manual samples.	Moderate

4.8.2.2.2 Limits to Resource Areas

The following limits/restrictions have been placed on the resource areas:

- Only within HPPL granted tenure. For Alpha Coal Project this is MDL285, MDL333 and EPC1210. All seams subcrop within MDLs and no resource is present in EPC1210;
- The south eastern corner of MDL333 is included in the Alpha Coal Project (Figure 2-1 in Volume 2, Section 2). The Alpha Coal Project area is covered by MLA 70426;
- Subcrop limits all seams in the east;
- No coal thickness cut-off has been used for resource estimation. In general the seams are thicker than 0.3 metres, except at the subcrop;
- No quality cut-offs have been used;
- The CU, E and F seams have been excluded due to failure to meet thickness, quality or geometry (e.g. ratio) criteria required to be considered for future economic extraction under current mining methods;
- No resource is reported for the B seam within the Torbanite zone mask; and
- No resource is reported for the respective DL seam within the DL seam shale masks.

4.8.2.3 Alpha Coal Project Resource Estimate

The Alpha Coal Project resource estimate is outlined in Table 4-7. It is estimated that the total resources for B, C, and D seams are 1.821 billion tonnes (Bt), of which 821 million tonnes (Mt) are Measured and 700 Mt are Indicated, the balance (300 Mt) are Inferred.

Table 4-7 MDL285 and MDL333 coal resources July 2010

Resource Category	Value	Seam Group				Tonnes Total (Mt)
		A	B	C	D	
Measured	Volume (Mm^3)			155	382	
	Area (Ha)			36	39	
	Thickness (m)			3.2	5.6	
	In situ Density (t/m^3)			1.55	1.52	
	Subtotal Tonnes (Mt)	-	-	**240**	**581**	**821**
Indicated	Volume (Mm^3)		0.60	163	300	
	Area (Ha)		0	36	34	
	Thickness (m)		3.92	3.1	5.4	
	In situ Density (t/m^3)		1.64	1.53	1.50	
	Subtotal Tonnes (Mt)	-	-	**250**	**450**	**700**
Inferred	Volume (Mm^3)	1	23	46	126	
	Area (ha)	1.9	5	10	25	
	Thickness (m)	1.1	6.16	3.2	5.6	
	In situ Density (t/m^3)	1.50	1.76	1.52	1.51	
	Subtotal Tonnes (Mt)	-	**40**	**70**	**190**	**150**
Grand Total Tonnes (Mt)			**40**	**560**	**1,221**	**1,821**

Note for resource table:

- Volumes, areas and tonnages have been rounded and may not total; and
- Coal masses are in situ based on application of in situ moisture model in ACARP C10042 and Preston Sanders formula to adjust density.

4.9 Potential Impacts and Mitigation

Based on the compilation and review of available geology data and mining activities (Volume 2, Section 2), the following potential impacts associated with the geological resources have been identified:

- Floor instability;
- B-C interburden instability;
- Possible Acid Metalliferous Drainage (AMD);
- Possible AMD impacts associated with the CU carbonaceous shale;
- Depressurisation of the C-D aquifer;
- Resource sterilisation;

- Spontaneous combustion;
- Blasting using ANFO;
- Mine efficiency;
- Identification and disturbance of fossils;
- Slaking and tailings; and
- Alteration due to rehabilitation and closure.

4.9.1 Floor Stability

The floor of the D seam comprises relatively competent rock, as testing indicates that the floor of the D seam has the highest strength, straddling two rock classes medium to high strength. Thus the floor should not pose significant instability concerns. However, aquifer pressures (confined D-E sands aquifer) have the potential to cause floor heave (Volume 5, Appendix G Groundwater Technical Report).

Mitigation

Active depressurisation of the D-E sands aquifer may required to reduce the potential for floor heave and minimise the risk of uncontrolled inflows to the floor of the pit. Dewatering systems and impacts have been detailed in EIS Volume 5, Appendix G.

4.9.2 B-C Interburden Stability

The thick (> 60 m) interburden between the B and C coal seams comprises labile sandstone with a clayey matrix and subordinate siltstone. Puggy claystone or clay matrix sandstone is logged within the interburden.

Geochemical studies indicate that the clay-rich sediments are dispersive or potentially dispersive. In addition, this material can have rapid slaking properties, which effects slope stability. The clayey materials will slake on exposure.

The slake-prone strata have clays of high to extremely high plasticity; as such these clays are not suitable for road building (pavement construction) and will tend to adhere to machinery and conveyor belts once they have been exposed to the weather.

The B-C interburden material may, therefore, be of importance to highwall and waste stability considerations.

Mitigation

Good surface water drainage control will be essential to prevent ponding of water as well as traffic-ability and handle-ability problems. Consideration of the puggy claystone or clay matrix sandstone within the interburden must be given when considering high wall slope angles.

Precautions will be taken to prevent water flow over the dispersive materials of overburden dumps.

4.9.3 Acid and Metalliferous Drainage

Preliminary geochemical assessments regarding the potential for the generation of acid and metalliferous drainage (AMD) is discussed in Section 4.6.4. Volume 5, Appendix J (Mine Waste) contains the detailed AMD study. The preliminary results indicate the potential for acid mine drainage, which has implications in terms of waste management, rehabilitation and backfilling, as well as final void considerations.

Mitigation

The stoney coal and mudstone within the overburden has the potential for acid generation and may require special management strategies to prevent/minimise oxidation and thus reduce acid generation.

The coal washery waste is expected to be net acid generating and will require measures to prevent or control acid generation. This has implications for disposal at the tailings storage facility (TSF) and long term impacts of possible acidic and metalliferous seepage.

4.9.4 Upper C Seam Carbonaceous Material

The Upper C seam (CU) includes interbedded stoney coal, puggy clays and carbonaceous shale. This upper zone is not economic due to the inferior nature of the coal bands. The puggy clays within this unit will also present problems for processing.

The carbonaceous shale is potentially acid forming as well as the clay-rich material being dispersive. As it will be necessary to mine the lower seams, the CU will need to be excavated; therefore it needs to be understood in terms of waste disposal.

Mitigation

Consideration of the CU seam must be given when developing the optimum AMD, waste rock, and tailings management schemes.

4.9.5 C-D Aquifer

The main aquifer unit on site within the Bandanna Formation are the sediments comprising the C coal seam, underlying D coal seam, and interburden sediments. The coal seams and interburden are in hydraulic connection and effectively form one hydrostratigraphic unit. This is referred to as the C-D sands aquifer (JBT, 2010a).

High ingress is envisaged to occur from the C-D sandstone aquifer and other higher units, particularly as mining extends to the west and the depth to D seam (and hence thickness of saturated Permian sediments). It's predicted a potential for extensive inflows in areas where coarse sands occur.

Mitigation

In order to ensure a "dry" safe working environment active dewatering will be required within the hanging wall C-D aquifer, as well as the floor. Dewatering behind and within the high wall will ensure reduced pore pressure and ingress, which will reduce pit slope stability risks. EIS Volume 2, Section 12 provides details of the required dewatering.

4.9.6 Resource Sterilisation

Section 4.3 above details the geology underlying the proposed mine infrastructure. The infrastructure is located on the sub outcrop of the Bandanna Formation and Colinlea Sandstone, and younger Quaternary, Tertiary and weathered Permian cover.

It was determined that the E and F coal seams underlie the infrastructure. The E seam is present as two 0.2 m thick clean coal bands (E1 and E2). The F seam displays patchy development and the full geological section can reach in excess of 5 m in isolated areas. However, excessive banding with non-coal parting, excessive and poor coal quality makes the F seam sub-economic. No resource potential by current practices and economic conditions is currently attributed to either E or F seams within the Project area.

The coal associated with the E and F seams below the site is considered sterilised due to the placement of the mine infrastructure. The coal resources associated with the E and F, based on limited available data regarding these seams, are limited and sub-economic due to the poor quality and limited thickness.

Due to the requirement to establish water diversion drains and access corridors at the south and north end of the mine area (Volume 2, Section 2) approximately 18 Mt of coal (within the C and D seams) will be sterilised over the 30 year mine life.

Section 4.7 above details the petroleum and mineral exploration permits granted (over-pegged) on the HPPL MDLs. It is considered that shallow surface mining would not sterilise deep petroleum reserves, should they exist, and that access to these resource would be feasible.

4.9.7 Spontaneous Combustion

The coal is a high moisture, high volatility, low to medium rank thermal coal. These coals have been known internationally to display spontaneous combustion. A 2008 study of borecore from MDL285 revealed steep R70 curves and indicators of a high propensity for spontaneous combustion (Section 4.6.2.2 above).

Mitigation

The deposit run of mine (ROM), product and working places will require attention to detail to prevent spontaneous combustion (Salva, 2010). Management must include consideration of wind direction, compaction, the use of coal wetting systems, and possible burial.

4.9.8 Blasting using Ammonium Nitrate/Fuel Oil

Blasting will be carried out using ammonium nitrate/fuel oil (ANFO) explosive. The average amount of ANFO used per annum is estimated to be approximately 82,000 tonnes. Blasting may be required to maintain productivity of digging in areas where harder bands require drilling and blasting for fragmentation.

The impacts of blasting using ANFO can include increased fracturing and the increase in nitrate concentrations within the groundwater and pit water.

Mitigation

Consideration of a blasting zone around the pit, based on rock mechanics, is required to determine any possible risk to mine infrastructure and neighbouring infrastructure.

An evaluation of the use of ANFO on water resources will be included in the water management studies. Alternative blasting materials and methods could be considered should nitrate concentrations increase to levels which may impact human health or the environment.

4.9.9 Mine Efficiency

The proposed mining methodology was considered to determine the effectiveness in achieving the optimum utilisation of the coal resources within the Project area. The open cut mining using the techniques discussed above will allow for the maximum exposure to the economic C and D seam coal seams across the entire mine lease area. The proposed mining method will also provide access to the A and B coal seams to the west should additional resource evaluation studies indicate that these coal resources are economically viable.

The mine infrastructure is located over the sub outcrop of the E and F coal seams. Current evaluations consider these resources sub-economic, however, the location of the infrastructure does sterilise a portion of these coal seams on the site.

4.9.10 Fossils

Should significant fossil specimens be identified within the mine then steps will be taken to secure and protect the fossils. The Queensland Museum will be notified to allow for the identification and correct preservation and removal.

4.9.11 Slaking and Tailings

The Tertiary strata and some of the Permian deposit contain mudstone, claystone and sandstone, which have a clayey matrix. Sections of the sequence are prone to slaking and thus often rapidly degrade on exposure to air or water. These materials will slake on exposure to water and can lead to handle-ability problems. These materials, if associated with the coal processed in the Coal Handling Preparation Plant (CHPP), can result in:

- Increased fine rejects (tailings);
- Reduced volume of coarse material;
- Difficulties in transport and deposition; and
- Reduction in water recovery due to high water takes (interstitial water).

Results from a single bore test, B1071C, indicates that slaking did not occur from about 9 m above the C seam and in the interburden materials. Thus the likelihood of slaking material being associated and processed with the C and D coal seams is reduced.

4.9.12 Rehabilitation and Closure

Mining will permanently impact on the geological resources within the MLA 70426. Coal, interburden, and overburden will be removed and rehabilitation (backfilling) will result in the alteration to the pre-mining geology.

The mine will develop a closure plan to minimise the impacts and rehabilitate the overburden and soils to restore to pre-mining land use.

The details regarding decommissioning and rehabilitation is presented in this EIS Volume 2, Section 25.

4.10 Infrastructure Corridor Geology

4.10.1 Associated Infrastructure

The mine infrastructure will include:

- Main workshop; warehouse; administration buildings; training and emergency services building; tyre bay; light vehicle workshop; and bucket repair shop;
- Train load out (TLO) facility and rail loop;
- Raw water dams and environment dams;
- Construction camp and main accommodation camp;
- Mine access road;
- Landfill;
- Fire Management System;
- Tailings Storage Facility;
- Quarry/borrow pits;
- Fuel and oil, explosives storage facilities;
- Creek diversions, drainage channels and levee bunds;
- Water and wastewater systems;
- Water treatment plant and sewerage treatment plant;
- Electrical systems; and
- Communications systems.

Volume 2, Section 2 of this EIS presents the location of all the above key components of the Project, including the four proposed open cut pits.

The associated infrastructure is underlain by the same geological units described in Section 4.3 above. The majority of the infrastructure is located adjacent to the open cut pits low walls, to the east. The infrastructure is located on the sub outcrop of the Bandanna Formation and Colinlea Sandstone, and younger Quaternary, Tertiary and weathered Permian cover.

C and D coal seam subcrop in this area while E and F coal seams underlie the infrastructure.

The Colinlea Sandstone and older Joe Joe Formation outcrop within the higher lying areas along the eastern boundary of the Project.

4.10.2 Rail Corridor Geology

The coal mine will be supported by privately owned and operated rail and port infrastructure facilities. At the Project site the coal will be mined, washed and conveyed to a train load-out facility where it will be transported more than 400 km to the east coast of Australia to the port facility of Abbot Point for export.

Volume 3, Section 4 of the EIS contains details of the railway corridor geological information.