



PHOTO 15: 56.6 m to 60.53 m



PHOTO 16: 60.43 m to 64.15 m



PHOTO 17: 64.15 m to 67.88 m



PHOTO 18: 67.88 m to 71.64 m



PHOTO 19: 71.64 m to 75.52 m



PHOTO 20: 75.52 m to 80.95 m



PHOTO 1: 45.05 m to 48.4 m



PHOTO 2: 48.4 m to 52.3 m

Core Photos for Bore 301

PROJECT
39663D





PHOTO 3: 52.3 m to 56.1 m

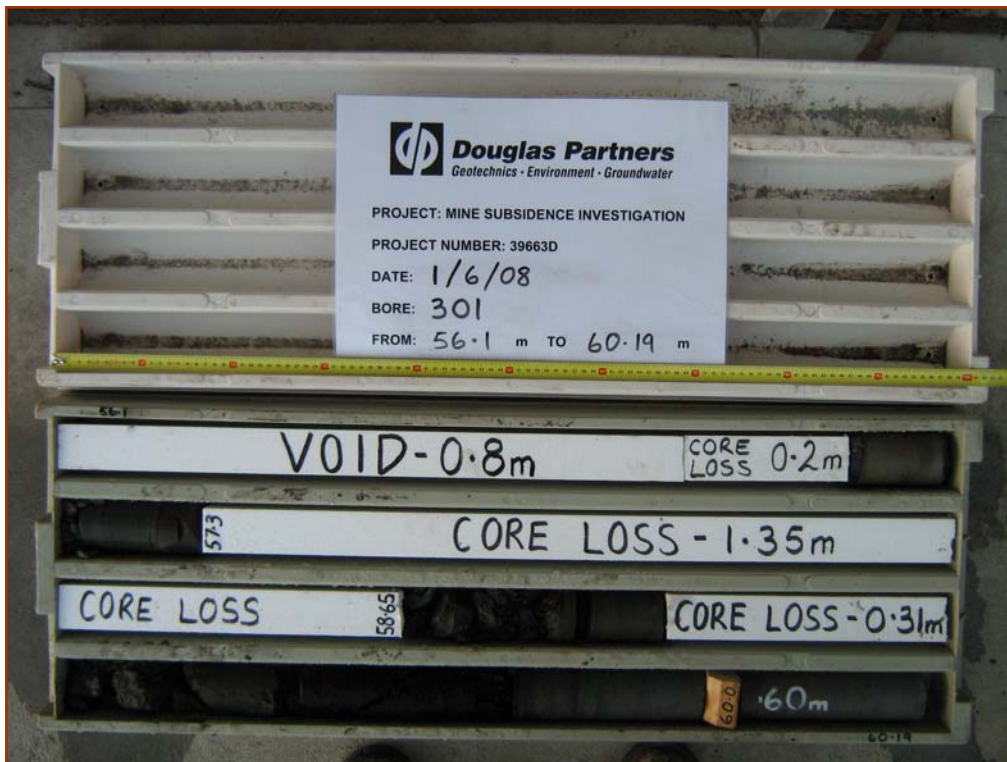


PHOTO 4: 56.1 m to 60.19 m

Core Photos for Bore 301

PROJECT
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PHOTO 5: 60.19 m to 63.05 m



PHOTO 1: 4.1 m to 7.7 m



PHOTO 2: 7.7 m to 10.41 m



PHOTO 3: 10.41 m to 15.16 m



PHOTO 4: 15.16 m to 18.89 m



PHOTO 5: 18.89 m to 22.8 m



PHOTO 6: 22.8 m to 26.57 m

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PHOTO 7: 26.57 m to 30.27 m



PHOTO 8: 30.27 m to 33.92 m



PHOTO 9: 33.98 m to 37.73 m



PHOTO 10: 37.37 m to 41.58 m



PHOTO 11: 41.58 m to 45.4 m



PHOTO 12: 45.4 m to 49.23 m

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PHOTO 13: 49.23 m to 53.0 m



PHOTO 14: 53.0 m to 56.7 m



PHOTO 15: 56.7 m to 60.58 m



PHOTO 16: 60.58 m to 64.5 m



PHOTO 17: 64.5 m to 65.85 m



PHOTO 1: 51.05 m to 54.82 m



PHOTO 2: 54.82 m to 58.72 m

Core Photos for Bore 305

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PHOTO 3: 58.72 m to 62.58 m



PHOTO 4: 62.58 m to 66.15 m

TABLE A1

SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
140	1.2	12.2	14.7	2.5			15.1	369941	6360564	25.81	
139	1.2	12.2	14.8	2.6			15.0	369942	6360566		
138	1.8	12.0	14.6	2.6			15.0	369944	6360569		
137	1.4	12.2	14.8	2.6			15.0	369945	6360572		
136	2.8	12.3	15	2.7			15.0	369946	6360575	26.539	
53	1.0	12.8	14.6	1.8			15.6	369947	6360577	26.623	
52	0.8	12.7	15.4	2.7			16.1	369948	6360580		
51	1.0	12.5	15.5	3			16.0	369949	6360582		
50	1.0	12.5	15.5	3			16.0	369950	6360584		
49	1.0	12.6	15.0	2.4			15.5	369951	6360587		
48	1.0	12.5	15.0	2.5			15.5	369952	6360589		
47	1.0	12.4	15.0	2.6			15.5	369953	6360591		
46	0.9	12.3	14.7	2.4			15.3	369954	6360594		
45	1.0	12.4	14.9	2.5			15.5	369955	6360596	26.872	
44	0.7	12.4	15.5	3.1			16.0	369958	6360598		
43	1.0	12.8	15.4	2.6			16.0	369961	6360599		
42	1.0	12.8	15.4	2.6			15.9	369963	6360601		
41	1.0	13.0	15.5	2.5			16.2	369966	6360602		
40	1.0	13.1	15.7	2.6			16.2	369968	6360604		
39	1.0	13.3	16.1	2.8			16.5	369971	6360605		
38	1.0	13.7	16.3	2.6			16.8	369973	6360607		
37	1.0	13.9	16.4	2.5			16.9	369976	6360609		
36	1.0	13.8	16.4	2.6			17.0	369979	6360610		
35	0.9	13.8	16.3	2.5			16.8	369981	6360612		
34	1.0	13.8	16.4	2.6			16.9	369984	6360613		
33	1.1	14.4	16.8	2.4			17.3	369986	6360615		
32	1.1	14.0	16.5	2.5			17.0	369989	6360616	30.228	
31	1.2	13.5	16.3	2.8			16.8	369989	6360620		
30	0.5	13.4	16.4	3			17.1	369989	6360623		
29	1.2	13.4	16.8	3.4			17.3	369990	6360626		
28	1.5	13.1	15.5	2.4			16.0	369990	6360630		
27	1.2	12.4	15.7	3.3			16.2	369990	6360633		
26	0.8	12.0	14.8	2.8			15.3	369991	6360637		
25	0.5	11.6	14.4	2.8			15.0	369991	6360640	28.786	
24	0.9	11.8	14.5	2.7			15.3	369994	6360641		
23	1.0	11.9	14.7	2.8			15.3	369996	6360643		
22	1.0	12.0	14.5	2.5			15.2	369999	6360644		
21	0.9	12.0	14.7	2.7			15.3	370002	6360646		
20	1.0	12.0	14.7	2.7			15.4	370004	6360647		
19	1.0	11.8	14.5	2.7			15.0	370007	6360648		
18	0.9	11.8	14.5	2.7			15.0	370010	6360650		
17	0.5	11.8	14.4	2.6			15.0	370012	6360651		
16	0.5	11.7	14.4	2.7			15.0	370015	6360652		
15	0.5	11.7	14.4	2.7			15.2	370018	6360654		
14	0.9	11.7	14.4	2.7			15.1	370020	6360655		
13	1.2	11.6	14.2	2.6			14.8	370023	6360657		
12	1.0	11.3	14.1	2.8			14.7	370026	6360658		
11	0.3	11.1	14.0	2.9			14.5	370028	6360659		
10	0.6	10.8	13.6	2.8			14.0	370031	6360661		
9	1.0	10.7	13.3	2.6			14.0	370034	6360662		
8	0.6	10.7	13.7	3			15.0	370036	6360663		
7	1.0	10.5	13.3	2.8			15.0	370039	6360665		
6	0.5	10.0	10.05	0.05				370042	6360666		
			10.3	13.1	2.8						
5	0.6	9.8	12.7	2.9			15.0	370044	6360668		
4	0.5	9.8	12.5	2.7			15.0	370047	6360669		
3	0.5	10.3	12.8	2.5			15.0	370050	6360670		
2	0.6	10.2	12.8	2.6			15.0	370052	6360672		
1	1.0	11.2	13.8	2.6			15.0	370055	6360673	30.14	
55	1.1	11.0	13.5	2.5			14.4	370058	6360675	30.163	
56	1.0	10.8	13.4	2.6			13.8	370060	6360676		
57	1.0	10.7	13.2	2.5			13.7	370063	6360676		
58	1.0	10.1	12.9	2.8			13.8	370066	6360677		
59	1.0	10.1	12.7	2.6			13.8	370069	6360678		
60	1.0	10.1	12.7	2.6			13.4	370072	6360679		
61	0.7	10.0	12.5	2.5			13.5	370075	6360680		
62	0.1	9.6	12.1	2.5			12.6	370077	6360681		
63	0.5	9.3	12.0	2.7			12.8	370080	6360682		
64	0.5	9.3	12.0	2.7			12.8	370083	6360683		
65	0.5	9.2	11.9	2.7			12.5	370086	6360683		
66	1.0	9.1	11.9	2.8			12.6	370089	6360684		
67	0.9	9.0	11.8	2.8			12.5	370092	6360685		
68	1.0	9.0	11.2	2.2			11.7	370095	6360686		
69	1.2	9.3	11.4	2.1			12.0	370097	6360687		
70	1.0	8.0	10.7	2.7			11.5	370100	6360688		
71	1.1	7.5	9.3	1.8			10.0	370103	6360689		
72	1.0	7.5	10.1	2.6			10.6	370106	6360689		
73	1.0	7.3	10.0	2.7			10.5	370109	6360690		
74	1.0	6.8	9.5	2.7			10.2	370112	6360691		
75	0.7	6.0	8.5	2.5			9.3	370114	6360692		
76	0.6	5.5	8.2	2.7			9.0	370117	6360693		
77	0.5	5.6	7.7	2.1			9.0	370120	6360694	26.227	
78	1.5	7.2	10.2	3			10.7	370138	6360695	25.327	
79	1.5	7.2	10.1	2.9			10.3	370140	6360693		
80	0.4	6.7	10.1	3.4			10.3	370143	6360692		
81	0.5	3.1	5.5	2.4			6.4	370146	6360691		
82	0.4	3.1	5.3	2.2			6.1	370149	6360690		
83	0.4	4.0	4.6	0.6			5.1	370151	6360689		

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SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
84	0.5	3.4	4.4	1			4.8	370154	6360688		
85	1.1	8.7	7.4	-1.3			12.0	370157	6360687		
86	1.2			0				370160	6360686	22.618	TBD @ 3.0 m - damp alluvial/colluvial topsoil causing blockages
87	2.0	7.6	7.7	0.1			9.0	370178	6360676	23.188	
88	0.6	5.1	7.7	2.6			8.2	370204	6360669	25.88	
89	1.0	5.2	7.9	2.7			8.5	370207	6360669		
90	0.5	5.8	8.6	2.8			9.0	370210	6360668		
91	1.0	7.0	9.5	2.5			10.0	370213	6360667		
92	0.7	7.1	10.1	3			10.7	370216	6360666		
93	0.2	7.3	10.1	2.8			11.0	370219	6360666		
94	1.0	8.0	10.9	2.9			11.5	370222	6360665		
95	1.0	8.5	11.4	2.9			11.9	370225	6360664		
96	0.8	9.0	11.6	2.6			12.2	370228	6360663		
97	0.6	9.7	12.6	2.9			13.2	370231	6360663		
98	0.8	9.9	12.9	3			13.4	370234	6360662		
99	0.5	10.0	13.0	3			13.7	370237	6360661		
129	0.8	10.1	13.1	3			13.2	370240	6360663		
128	1.2	10.3	13.3	3			13.8	370242	6360665		
127	1.3	10.7	13.5	2.8			13.8	370245	6360667		
126	0.8	10.8	13.7	2.9			13.8	370248	6360668		
125	1.0	11.3	13.9	2.6			14.4	370251	6360670		
124	0.9	11.6	14.2	2.6			14.6	370253	6360672		
123	1.1	11.6	14.4	2.8			14.7	370256	6360674		
122	1.0	11.7	14.4	2.7			14.8	370259	6360676		
121	1.2	11.9	14.6	2.7			15.0	370261	6360678		
120	1.1	11.9	14.6	2.7			15.1	370264	6360680		
119	0.6	11.8					13.1	370267	6360681		
118	0.6	11.3	14.0	2.7			14.6	370269	6360683		
117	1.1	11.2	14.0	2.8			14.4	370272	6360685		
116	0.9	11.5	13.7	2.2			14.2	370275	6360687		
115	0.8	11.7	14.0	2.3			14.5	370278	6360689		
114	1.0	12.2	14.6	2.4			15.0	370280	6360691		
113	0.7	13.2	14.6	1.4				370283	6360693		stopped due to blockage in coal and moved on.
112	0.8	13.1	15.9	2.8			16.6	370286	6360695		
111	1.0	13.2	15.8	2.6			16.4	370288	6360696		
110	1.0	13.2	15.8	2.6			16.3	370291	6360698		
109	0.5	13.2	15.4	2.2			17.0	370294	6360700		
108	1.5	13.2	16.0	2.8			16.5	370297	6360702		
107	1.4	13.3	16.0	2.7			16.7	370299	6360704		
106	1.6	13.3	15.9	2.6			16.5	370302	6360706		
105	2.0	13.2	15.9	2.7			16.5	370305	6360708		
104	2.5	13.2	16.3	3.1			17.0	370307	6360709		
103	2.0	13.2	16.4	3.2			17.4	370310	6360711		
102	1.2	13.0	16.2	3.2			16.5	370313	6360713		
101	0.5	12.8	16.1	3.3			16.7	370315	6360715		
100	0.2	12.8	15.9	3.1			16.4	370318	6360717	32.655	
413	0.4	3.5	3.8	0.3				370384	6360705	36.089	
			4.1	4.1							
		15.7	18.4	2.7			19.0				
414	0.4	3.5	3.8	0.3				370387	6360706		
		3.8	4.0	0.2							
		15.9	18.5	2.6			19.1				
415	0.9	15.9	18.4	2.5			19.1	370390	6360706		
416	0.9	15.8	18.5	2.7			19.0	370393	6360706		
417	1.0	15.8	18.5	2.7			19.0	370396	6360706		
418	0.5	15.7	18.6	2.9			19.0	370399	6360706		
419	2.3	15.6	18.4	2.8			19.0	370403	6360706		
420	0.4	15.7		-15.7			17.9	370406	6360706		possible wet clay and coal
421	0.4	15.7		-15.7			17.3	370409	6360706		caved in
422	0.5	15.5	18.3	2.8			19.0	370412	6360706		
423	0.6	15.5	18.2	2.7			19.0	370415	6360706		
424	0.4	15.5		-15.5			18.6	370418	6360706		caved in
425	0.8	15.3	18.0	2.7			18.5	370421	6360706		
426	0.4	14.7		-14.7			16.3	370424	6360706		collapsed
427	0.5	14.3	17.2	2.9			17.8	370427	6360706		
428	0.5	13.9	16.8	2.9			17.4	370430	6360706		
429	1.1	13.6	16.4	2.8			17.0	370433	6360706		
430	1.1			0			12.3	370436	6360706		collapsing
485	1.7	12.9	15.7	2.8			16.2	370438	6360707		
486	1.5	13.1	15.9	2.8			16.4	370440	6360708		Rods jamed at 14.9
487	0.1	13.2	15.9	2.7			16.4	370442	6360709		
488	0.1			0			11.7	370444	6360711		
488A	0.1	13.3	16.2	2.9			16.7				
488E	0.1	13.4	16.2	2.8			16.8				
489	0.1	13.7	16.4	2.7			16.9	370446	6360712		Possible Coal in top 3.6 felt more like black clay
490	0.1	14	16.7	2.7			17.3	370448	6360713		Possible Coal in top 3.6 felt more like black clay
491	0.1	14.4	17.1	2.7			17.4	370450	6360714		Possible Coal in top 3.6 felt more like black clay
492	0.1	15	17.7	2.7			18.2	370453	6360714		Possible Coal in top 3.6 felt more like black clay
493	0.1	3.4	3.6	0.2				370457	6360714		Possible Coal in top 3.6 felt more like black clay
		15.2	18	2.8			18.5				

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SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
494	0.1	2.8	3	0.2			18.9	370460	6360713		
		15.7	18.4	2.7							
495	0.1	3.1	3.4	0.3				370463	6360713		
		3.6	3.9	0.3							
		16.2	18.8	2.6			19.3				
496	0.1	3.1	3.9	0.8				370466	6360713		Interlaced with some thin lighter colored layers, one in each
		4	4.4	0.4							
		16.7	19.3	2.6			19.8				
497	0.1	3.5	4.2	0.7				370470	6360713		Interlaced with some thin lighter colored layers, one in each
		4.4	4.7	0.3							
		16.9	19.5	2.6			20				
498	0.1	3.9	4.6	0.7				370473	6360712		Interlaced with some thin lighter colored layers, one in each
		4.8	5.1	0.3							
		17.2	19.8	2.6			20.3				
499	0.1	3.9	5.4	1.5				370476	6360712		
		17.3	20	2.7			20.5				Interlaced with some thin lighter colored layers, one in each
500	0.1	4.7	5.6	0.9				370480	6360710		
		5.7	6	0.3							
		18	20.7	2.7			21				
501	0.1	5.1	6.1	1				370484	6360707		
		6.4	6.6	0.2							
		18.5	21.4	2.9			21.9				
502	0.1	5.9	6.6	0.7				370488	6360705		
		7.2	7.3	0.1							
		19.2	21.9	2.7			22.4				
503	0.1	6.5	7.2	0.7				370492	6360702		
		7.7	8	0.3							
		19.5	22.5	3			23				
504	0.1	7.2	8.2	1			16	370496	6360700		Incomplete
		8.4	8.6	0.2							
504A	0.1	7.2	8.1	0.9							
		8.3	8.5	0.2			24.1				
		20.5	23.6	3.1							
505	0.1	8	9.2	1.2				370500	6360697		
		21	23.6	2.6			24.1				
506	0.1	8.2	8.5	0.3				370504	6360695		
		8.5	9.5	1							
		21.1	23.9	2.8			24.4				
507	No Results	No Results	No Results	#VALUE!	No Results	No Results	No Results	370503	6360694		
508	No Results	No Results	No Results	#VALUE!	No Results	No Results	No Results	370502	6360692		
509	No Results	No Results	No Results	#VALUE!	No Results	No Results	No Results	370501	6360691		
510	No Results	No Results	No Results	#VALUE!	No Results	No Results	No Results	370504	6360692		
511	No Results	No Results	No Results	#VALUE!	No Results	No Results	No Results	370506	6360693		
512	No Results	No Results	No Results	#VALUE!	No Results	No Results	No Results	370509	6360694		
450	0.4	10.1	11.1	1				370509	6360692	42.986	
		22.6		-22.6			22.9				unable to go further down hard substance
449	0.5	9.8	11.1	1.3				370512	6360692	43.102	
		22.6		-22.6			24.6				
448	0.4	9.7	11.2	1.5				370515	6360692	43.182	
		22.5		-22.5			24.6				
447	0.3	9.9	11.3	1.4			19.0	370518	6360693	43.454	sinking and sliding rig, collapsed
446	0.3	10.1	11.3	1.2				370521	6360693	43.573	
		22.4		-22.4			24.6				
445	0.5	10.2	11.4	1.2				370524	6360694	43.555	
		22.9		-22.9			24.6				
444	0.4	10.2	11.5	1.3				370530	6360694	43.913	
		22.7		-22.7			24.6				
443	0.1	9.7	11.1	1.4				370541	6360700	44.091	
		22.2		-22.2			24.6				end of rod lengths collapsed at 24.4 m
442	0.1	9.3	10.6	1.3				370548	6360703	44.022	
		21.7	24.5	2.8			24.6				
441	0.3	9.2	10.3	1.1				370550	6360704		
		21.5	24.2	2.7			24.6				
440	0.1	9.2	10.3	1.1				370552	6360704		
		21.4	24.2	2.8			24.6				
439	0.2	8.8	10.1	1.3				370554	6360705		
		21.1	24.1	3			24.6				
438	0.3	8.5	9.8	1.3				370557	6360706		
		20.7	23.5	2.8			24.0				
437	0.2	8.2	9.5	1.3				370559	6360706	43.513	
		20.5		-20.5			22.5				collapsed
436	0.5	8.2	9.5	1.3				370562	6360707		
		20.5	23.2	2.7			23.7				
435	0.3	7.7	9.0	1.3				370565	6360707		
		19.9	22.7	2.8			23.1				
434	0.1	7.1	8.4	1.3				370568	6360707		
		19.5	22.7	3.2			23.1				
433	0.1	6.7	8.2	1.5				370571	6360708		
		19.1	22.1	3			22.6				
432	0.2	6.5	7.8	1.3				370575	6360708		
		19.0	21.6	2.6			22.4				
431	0.3	6.3	7.7	1.4				370578	6360709		

TABLE A1

SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
		18.8	21.6	2.8			22.1				
412	0.2	5.8	7.1	1.3				370581	6360709		
		18.3		-18.3			21.0				end of rods
411	0.1	5.1	5.6	0.5				370584	6360710		
			6.5	6.5							
		17.6	20.5	2.9			21.0				
410	0.3	4.6	5.6	1				370587	6360710		
			6.1	6.1							
		17.1	20.0	2.9							
409	0.4	3.9	5.4	1.5				370590	6360710		
		16.6	19.5	2.9			20.0				
408	0.5	3.5	4.7	1.2				370593	6360711		
		16.1	18.9	2.8			19.4				
407	0.7	3.1	4.4	1.3				370596	6360711	39.438	
		15.7	18.4	2.7			19.0				
406	0.6	3.4	4.6	1.2				370598	6360709	39.509	
		15.9	18.6	2.7			19.0				
405	0.3	3.4	3.9	0.5				370601	6360706	39.178	
		15.7	18.4	2.7			18.8				
404	0.4	3.1	4.0	0.9				370602	6360703	39.074	
		15.4	18.3	2.9			18.8				
403	0.3	3.4	3.8	0.4				370604	6360701	38.961	
		15.3	18.1	2.8			18.6				
402	0.4	3.0	3.7	0.7				370605	6360698	38.871	
		15.2	18	2.8			18.5				
401	0.3	3.0	3.9	0.9				370606	6360695	38.835	
		15.1	18.0	2.9			18.5				
400	0.4	2.9	3.6	0.7				370607	6360693	38.739	
		14.9	17.8	2.9			18.5				
399	0.5	3.0	3.5	0.5				370609	6360690	38.44	
		14.9	17.6	2.7			18.4				
398	0.5	2.5	3.0	0.5				370611	6360688	38.069	
		14.4	17.3	2.9			18.0				
397	0.4	2.0	2.5	0.5				370613	6360685	37.704	
		2.7	2.8	0.1							
		14.2	16.7	2.5			17.4				
396	0.6	14.4	17.2	2.8			17.8	370614	6360683	37.852	
451	0.6	10.7	13.6	2.9				370621	6360691	34.679	
		15.4	16.2	0.8							
		19.0	19.1	0.1			21.0				
452	0.4	10.6	13.5	2.9			13.8				
453	0.2	10.7	13.5	2.8			13.8				
454	0.1	10.3		-10.3			11.6				bore caved in and discontinued
455	0.2	10.3	13.1	2.8			13.7				
456	0.2	10.2	13.0	2.8			13.5				
457	0.2	10.1	12.9	2.8			13.3				
458	0.2	10.1	12.8	2.7			13.3				
459	0.1	9.8	12.6	2.8			13.0				
460	0.2	9.7	12.6	2.9			13.1				
461	0.1			0							stopped due to water interference,
462	0.1			0							thick wet clay
463	0.1	9.6	12.4	2.8			12.8				thick wet clay
464	0.10	9.50	12.30	2.8			12.80				
465	0.10	9.50	12.20	2.7			12.80				
466	0.20	9.20	12.10	2.9			12.80				
467	0.20	9.10	12.00	2.9			12.50				
468	0.10	9.10	11.90	2.8			12.40				
469	0.1	8.8	11.4	2.6			12.0				
470	0.2	8.6	11.3	2.7			11.8				
471	0.1	8.3	11.2	2.9			11.7				
472	0.1	8.2	11.0	2.8			11.6				
473	0.1	8.0	10.8	2.8			11.4				
474	0.1	7.9	10.6	2.7			11.1				
475	0.1	7.6	10.4	2.8			11.0				
476	0.1	7.4	10.2	2.8			10.7				
477	0.1	7.2	10.1	2.9			10.8				
478	0.1	6.9	9.7	2.8			10.2	370688	6360660	32.842	
141	0.6	4.9	5.7	0.8			6.2	370664	6360620	42.32	
142	0.5	5.0	5.9	0.9			6.4	370665	6360617		
143	0.5	4.5	5.6	1.1			6.1	370667	6360614		
144	0.5	4.5	5.5	1			6.0	370669	6360611		
145	0.3	5.6	6.5	0.9			6.5	370671	6360607		
146	0.4	6.5	7.3	0.8			7.7	370673	6360604		
146A	0.2	6.4	7.7	1.3	19.5		21.0				
147	0.8	6.6	7.7	1.1			8.2	370674	6360604		
148	0.6	6.7	7.9	1.2			8.5	370676	6360601		
149	0.3	7.0	8.1	1.1			8.5	370678	6360598		
150	0.7	7.2	8.2	1			8.5	370680	6360595		
151	0.5	7.2	8.1	0.9			8.4	370681	6360592		
152	0.5	7.2	8.2	1			8.4	370683	6360588		
153	0.75	7	8.5	1.5			8.7	370685	6360585		
154	0.6	6.8	8.0	1.2			8.2	370687	6360582	43.5624	
199	0.3	12.6	15.4	2.8			16.0	370700	6360618	37.7287	
198	0.3	12.8	15.7	2.9			16.4	370700	6360615		
197	0.3	13.0	15.9	2.9			16.5	370701	6360612		
196	0.5	13.2	16.1	2.9			16.5	370702	6360610		
196A	0.5	13.1	16.6	3.5			21.0				

TABLE A1

SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
195	0.6	13.5	16.2	2.7			16.7	370703	6360607		
194	0.5	13.5	16.4	2.9			16.9	370704	6360604		
193	0.6	13.6	16.6	3			17.0	370705	6360601		
192	0.6	13.7	16.4	2.7			16.8	370706	6360598		
191	0.6	13.7	16.2	2.5			16.5	370707	6360595		
190	0.6	13.7	16.2	2.5			16.6	370708	6360592		
189	0.6	13.7	16.8	3.1			17.3	370709	6360589		
188	0.5	13.8	16.4	2.6			16.8	370710	6360586		
187	0.5	13.7	16.8	3.1			16.9	370711	6360583		
186	0.4	13.4	16.4	3			16.8	370711	6360580		
185	0.5	13.1	16.4	3.3			16.8	370712	6360577		
184	0.4	12.9	15.7	2.8			16.1	370713	6360574		
183	1.0	12.6	15.6	3			16.0	370714	6360571	36.2657	
182	1.0	12.2	15.8	3.6			16.3	370714	6360568		
181	1.0	12.3	15.4	3.1			15.9	370713	6360566		
180				0				370712	6360563		
179	0.2	12.6	15.7	3.1			16.0	370712	6360560		
178	0.5	11.8	14.9	3.1			15.0	370711	6360557	35.1015	
177	0.3	11.7	14.8	3.1			15.0	370709	6360552		
176	0.3	11.6	13.8	2.2			13.8	370707	6360547		
175	0.3	11.3	13.8	2.5			13.8	370705	6360542		
174	0.4			0			8	370703	6360538	34.2673	stuck in wet clay at 8 m and abandoned
173	0.4	10.9	13.9	3			14.0	370701	6360535		
172	0.4	11.1	14.1	3			14.6	370700	6360533		
171	0.5	11.1	13.9	2.8			14.4	370698	6360530		
170	0.5	11.2	14.1	2.9			14.4	370697	6360528		
169	0.6	11.1	14.2	3.1			14.6	370696	6360525		
168	0.8	11.2	13.9	2.7			14.2	370694	6360523		
167	0.6	11.2	13.9	2.7			14.2	370693	6360521		
166	0.8	11.1	14.0	2.9			14.3	370691	6360518		
165	0.8			0			10.0	370690	6360516		stuck at 10 m and abandoned
164	0.8	11.3	14.3	3			14.9	370688	6360513		
163	0.6	11.3	14.2	2.9			14.4	370687	6360511		
162	0.8	11.2	14.2	3			14.4	370685	6360508		
161	1.0	11.2	14.2	3			14.5	370684	6360506		
160	1.0	11.3	14.2	2.9			15.0	370682	6360503		
159	0.8	11.1	14.0	2.9			15.0	370681	6360501		
158	0.9	11.0	13.9	2.9			14.4	370679	6360499		
157	1.0	10.9	13.8	2.9			14.0	370678	6360496		
156	0.6	10.6	13.5	2.9			13.8	370676	6360494		
155	1.0	10.6	13.5	2.9			13.8	370675	6360491	31.986	
200	1.0	10.3	13.3	3			13.8	370669	6360487	31.912	
201	1.2	10.4	13.4	3			13.8	370667	6360485		
202	0.9	10.6	13.4	2.8			13.8	370665	6360483		
203	1.0	10.6	13.4	2.8			13.8	370663	6360481		
204	1.3	10.7	13.4	2.7			13.8	370661	6360479		
205	1.2	10.8	13.6	2.8			13.8	370659	6360477		
206	1.0	10.7	13.6	2.9			13.8	370657	6360475		
207	1.2	10.8	13.6	2.8			13.8	370655	6360473		
208	1.2	10.8	13.7	2.9			13.8	370653	6360471		
209	1.3	10.7	13.6	2.9			13.8	370650	6360469		
210	1.2	10.7	13.6	2.9			13.8	370648	6360467		
211	1.0	10.8	13.7	2.9			13.8	370646	6360465		
212	1.1	10.9	13.8	2.9			14.4	370644	6360463		
213	1.2	11.0	13.9	2.9			14.5	370642	6360461		
214				0				370640	6360459		soft ground causing the base plate to sink due to a fair bit of rain
215	0.9	10.7	13.8	3.1			14.3	370638	6360457		
216	1.0	10.8	13.8	3			14.4	370636	6360455		
217	1.2	10.9	13.9	3			14.4	370634	6360453		
218	1.2	11.0	13.8	2.8			14.2	370631	6360451		
219	1.0	10.8	13.7	2.9			14.3	370629	6360449		
220	1.0	10.7	13.7	3			14.4	370627	6360447		
221	1.0	10.5	13.4	2.9			13.8	370625	6360445		
222	1.1	10.6	13.6	3			13.8	370623	6360443		
223	1.2	10.5	13.6	3.1			13.8	370621	6360441	29.509	
224	1.4	10.3	13.2	2.9			13.8	370596	6360437	29.49	
225	1.5	10	12.8	2.8			13.3	370594	6360435		
256	1.0	9.7	12.7	3			13.1	370592	6360433	28.693	
257	1.0	9.7	12.6	2.9			12.9	370590	6360431		
258	1.0	9.6	12.5	2.9			12.8	370588	6360429		
259	1.0	9.4	12.3	2.9			12.7	370586	6360427		
260	1.0	9.3	12.1	2.8			12.4	370583	6360425		
261	1.0	9.0	11.8	2.8			12.2	370581	6360423		
262	1.0	8.5	11.1	2.6			11.6	370579	6360421	26.863	
263	0.7	8.1	10.8	2.7			11.2	370577	6360419		
264	0.6	8.0	10.7	2.7			11.1	370575	6360417		
265	0.6	7.8	10.5	2.7			10.8	370574	6360414		
266	0.6	7.5	10.5	3			10.8	370572	6360412		
267	0.5	7.3	10.1	2.8			10.4	370570	6360409		
268	0.4	6.7	9.5	2.8			9.9	370568	6360407		
269	0.4	5.9	8.7	2.8			9.1	370567	6360404		
270	0.4	5.4	8.2	2.8			8.5	370565	6360402	23.0518	
271	0.4	5.2	8.1	2.9			8.6	370564	6360399		
272	0.5	5.3	8.1	2.8			8.6	370563	6360396		
273	0.5	5.4	8.4	3			8.9	370562	6360393		

TABLE A1

SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
274	0.5	5.8	8.7	2.9			9.1	370561	6360391		
275	0.4	6.2	9.2	3			9.6	370560	6360388	23.5081	
276	0.4	7.0	9.7	2.7			10.1	370558	6360385		
277	0.5	7.5	10.2	2.7			10.7	370556	6360383		
278	0.6	8.2	10.9	2.7			11.4	370554	6360381		
279	0.7	9.0	11.7	2.7			12.2	370552	6360378		
280	0.6	9.6	12.3	2.7			12.8	370551	6360376		
281	0.5	10.0	12.7	2.7			13.2	370549	6360374		
282	0.5	10.5	13.1	2.6			13.6	370547	6360371		
283	0.5	10.8	13.6	2.8			13.9	370545	6360369	26.8045	
284	0.5	11.3	14.0	2.7			14.5	370546	6360366		
285	0.3	11.4	14.2	2.8			14.5	370547	6360363		
286	0.4	11.5	14.3	2.8			14.8	370547	6360360		
287	0.4	11.4	14.2	2.8			14.7	370548	6360357		
288	0.5	11.7	14.4	2.7			15.0	370549	6360354		
289	0.4	11.8	14.4	2.6			14.9	370550	6360351		
290	0.4	11.9	12.8	0.9	12.8	14.7	15.0	370551	6360348	27.3095	
290A	0.3	11.7	14.4	2.7			14.8				
290B	0.3	12.4	15.2	2.8			15.7				
290C	0.5			0	11.8	14.8	15.8	370549	6360349	27.4386	
290D	0.5	11.8	14.8	3			15.3				
290E	0.5	11.8	14.7	2.9			15.2				
290F	0.5	12.1	14.9	2.8			15.4				
290G	0.3			0	11.3	14.2		370547	6360351	27.4721	
				0		14.9	14.9				
290H	0.3	11.8		-11.8	12.2	14.5	14.6	370548	6360354	27.2639	
290I	0.3	11.7	14.4	2.7			14.8				
290J	0.3	11.7	14.4	2.7			14.9				
290K	0.3			0	12.2	15.2	15.3	370546	6360348	27.7295	
290L	1.0	12.8	15.1	2.3							
		15.2	15.8	0.6			16.4				
290M	0.4	11.1	13.6	2.5							
		13.7	13.8	0.1			14.4				
291	0.4	12.3	14.9	2.6			15.4	370551	6360345		
292	0.4	12.4	15.2	2.8			15.6	370552	6360343		
293	0.4	12.6	15.2	2.6			15.8	370552	6360340	27.3381	
294	0.8	12.2	14.8	2.6			15.3	370555	6360338		
295	0.4	11.7	14.4	2.7			14.8	370557	6360336		
296	0.0	11.8	14.5	2.7			15.2	370559	6360335		
297	0.2	11.2	13.9	2.7			14.4	370562	6360333		
298	0.2	11.1	13.9	2.8			14.4	370564	6360331		
299	0.2	11.0	13.7	2.7			13.8	370566	6360330		
300	0.5	10.6	13.3	2.7			13.8	370569	6360328		
301	0.2	10.2	13.1	2.9			13.5	370571	6360326		
302	0.4	10.2	12.8	2.6			13.2	370573	6360325		
303	0.3	10.0	12.7	2.7			13.2	370576	6360323		
304	0.4	10.1	12.7	2.6			13.1	370578	6360321		
305	0.2	9.5	12.3	2.8			12.7	370581	6360320		
306	0.3	9.5	12.2	2.7			12.7	370583	6360318		
307	0.2	9.4	12.1	2.7			12.6	370585	6360316		
308	0.3	9.2	11.9	2.7			12.4	370588	6360315		
309	0.2	9.0		-9				370590	6360313		
310	0.2	8.8	11.6	2.8			12.0	370592	6360311		
311	0.2	8.7	11.7	3			12.1	370595	6360310		
312	0.1	8.6	11.5	2.9			11.8	370597	6360308		
313	0.1	8.3	11.2	2.9			11.6	370599	6360307		
314	0.1	8.6	11.5	2.9			12.3	370602	6360305		
315	0.5	11.3	14.3	3			14.8	370604	6360303		
316	0.4	11.3	14.2	2.9			14.7	370607	6360302		
317	0.1	11.1	14.0	2.9			15.4	370609	6360300		
318	0.2	10.8	13.8	3			14.4	370611	6360298		
319	0.2	10.7	13.7	3			14.2	370614	6360297		
320	0.1	10.4	13.3	2.9			13.7	370616	6360295		
321	0.2	10.3	13.2	2.9			13.6	370618	6360293		
322	0.2	10.2	13.0	2.8			13.6	370621	6360292		
323	0.2	10.1	13.0	2.9			13.6	370623	6360290		
324	0.2	10.0	12.8	2.8			13.2	370625	6360288		
325	0.3	9.6	12.6	3			13.1	370628	6360287	20.077	
370		3.6	3.9	0.3				370735	6360273	17.6618	
		4.5	5.6	1.1							
		6.4	6.6	0.2							
		7.5	7.7	0.2			17.2				
371	0.3	3.2	4.0	0.8				370738	6360273		
		5.6	5.8	0.2							
		7.6		-7.6			7.9				wet clay clogged rod
372	0.4	3.6	4.0	0.4				370741	6360272		
		5.6	5.9	0.3							
		7.6	8.0	0.4			9.6				
373	0.3	2.8	3.7	0.9				370744	6360272		
		5.6	5.9	0.3							
		7.4	7.7	0.3			9.2				
374	0.2	2.5	3.4	0.9				370747	6360272		
		5.1	5.5	0.4							
		7.2	7.5	0.3			8.7				
375	0.4	1.0	3.1	2.1				370750	6360272		
		5.1	5.3	0.2							
		5.6	5.8	0.2							
		7.0	7.2	0.2			8.7				

TABLE A1

SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
376	0.3	1.0	2.9	1.9				370753	6360271		
		4.4	4.9	0.5							
		6.1	6.2	0.1							
		6.5	7.0	0.5			8.2				
377	0.3			0				370756	6360271		something hard in ground
378	0.3	4.1	5.9	1.8			9.1	370759	6360271		
		5.6	5.9	0.3							
		6.6	7.0	0.4							
379	0.3	4.4	5.1	0.7			8.7	370762	6360271		
		6.7	7.0	0.3							
380	1.4	4.5	5.1	0.6				370764	6360271		
		5.9	6.1	0.2							
		6.7	7.1	0.4			8.6				
381	1.5	4.6	5.1	0.5				370767	6360270		
		5.9	6.1	0.2							
		7.0	7.2	0.2			9.0				
382	0.3	4.9	5.4	0.5				370770	6360270		
		6.1	6.2	0.1							
		7.2	7.3	0.1			9.0				
383	0.8	4.9	5.4	0.5				370773	6360270		
		6.2	6.3	0.1							
		7.2	7.5	0.3			8.7				
384	0.3	5.0	5.6	0.6				370776	6360270		
		6.4	6.6	0.2							
		7.2	7.6	0.4			9.1				
385	0.3	0.8	1.3	0.5				370779	6360269		
		5.1	5.9	0.8							
		6.6	7.0	0.4							
		7.5	7.9	0.4			9.2				
386	0.4	5.6	6.4	0.8				370782	6360269		
	4.5	6.9	7.1	0.2							
		7.6	8.2	0.6			9.2				
387	0.3	5.6	6.4	0.8				370785	6360269		
	2.5	7.2	7.3	0.1							
		8.1	8.4	0.3			9.7				
388	0.2			0			6.3	370788	6360269		water at 6.3 m
	3.4			0							
389	0.3	3.6	4.1	0.5				370791	6360268		
		5.5	5.6	0.1							
		6.1	7.0	0.9							
		7.6	7.7	0.1							
		8.3	8.7	0.4			10.2				
390	0.3	4.6	4.7	0.1			5.6	370794	6360268		water at 5.6 m
391	0.5	6.1	6.7	0.6				370797	6360268		
		7.5	7.7	0.2							
		8.4	8.7	0.3			10.2				
392	0.3	6.1	7.0	0.9				370800	6360268		
		7.5	7.7	0.2							
		8.4	8.7	0.3			10.2				
393	0.3	6.3	7.0	0.7				370803	6360267		
		7.7	8.0	0.3			10.2				
394	0.5			0			5.6	370806	6360267		water at 3.6 m
395	0.5	7.1	7.7	0.6				370809	6360267	20.863	
		8.2		-8.2			8.7				water at 8.7 m
364	11.3	11.1	11.3	0.2			12.3	370879	6360310	25.031	
363	10.2	10.8	11.1	0.3			12.3	370881	6360313		
362	0.3	5.1	7.2	2.1				370883	6360315		with carbonaceous mudstone
		8.5	11.3	2.8			11.8				
361	0.3	3.6	7.0	3.4				370885	6360317		with carbonaceous mudstone
		7.9	8.5	0.6							
		9.5	9.6	0.1							
		10.3	10.4	0.1			11.3				
360	0.3	3.8	6.7	2.9			11.3	370887	6360319		with carbonaceous mudstone
		7.6	8.4	0.8							
		10.1	10.2	0.1							
361	0.3	3.9	6.5	2.6				370889	6360322		with carbonaceous mudstone
		7.7	8.3	0.6							with carbonaceous mudstone
		9.8	10.1	0.3			11.3				
360	0.5	3.7	6.3	2.6				370891	6360324		with carbonaceous mudstone
		7.5	7.7	0.2							
		9.8	10.0	0.2			10.8				
359	0.3	3.6	6.7	3.1				370893	6360326		with carbonaceous mudstone
		9.7	9.9	0.2			10.9				
358	0.5	3.6	6.1	2.5				370895	6360328		with carbonaceous mudstone
		7.6	7.9	0.3							
		9.7	9.9	0.2			10.8				
357	0.5	3.8	6.2	2.4				370897	6360330		
		7.5	7.8	0.3							
		9.6	9.9	0.3			10.8				
356	0.5	3.6	6.1	2.5				370899	6360333		with carbonaceous mudstone
		7.0	7.5	0.5							
		9.6	9.9	0.3			11.3				
355	0.6			0			11.3	370900	6360335		
354	0.8	7.0	7.7	0.7				370902	6360337		
		9.4	9.7	0.3			10.8				
353	0.8	7.0	7.8	0.8				370904	6360339		
		9.4	9.7	0.3			10.8				
352	0.8	5.2	5.7	0.5				370906	6360342		carbonaceous mudstone / coal

TABLE A1

SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (9m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
		7.0	7.7	0.7			10.1				silty clay / coal
351		4.1	5.6	1.5				370908	6360344		silty clay / some coal possible fill carbonaceous mudstone / some coal
		7.0	7.7	0.7			10.8				
		9.5	9.1	-0.4							
350	0.5	4.6	4.7	0.1				370910	6360346		carbonaceous mudstone / some coal
		7.4	7.8	0.4			10.8				
349	0.5	5.6	5.7	0.1				370912	6360348		carbonaceous mudstone / some coal
		7.0	7.6	0.6			10.8				
348	0.5	7.0	7.7	0.7				370914	6360351		
		8.5	8.5	0							
		9.7	9.8	0.1			11.0				
347	0.5	6.9	7.6	0.7				370916	6360353		
		9.2	9.7	0.5			10.1				
346	0.5	6.5	7.6	1.1				370918	6360355		carbonaceous mudstone / some coal
		9.2	9.6	0.4			10.1				
345	0.5	6.5	7.3	0.8				370920	6360357	25.809	carbonaceous mudstone / some coal
		8.2	9.5	1.3			10.8				intermittent coal layers
344	0.5	6.7	7.7	1				370923	6360357		carbonaceous mudstone / some coal
		9.2	9.6	0.4			10.2				
343	0.5	6.8	7.8	1				370926	6360357		carbonaceous mudstone / some coal
		9.6	10.0	0.4			11.0				
342	0.5	7.2	8.0	0.8				370929	6360357		carbonaceous mudstone / some coal
		9.5	10.0	0.5			11.8				
341	0.3	7.1	8.0	0.9				370932	6360358		carbonaceous mudstone / some coal
		9.9	10.3	0.4			11.8				
340	0.5	7.1	8.0	0.9				370935	6360358		carbonaceous mudstone / some coal
		10.6	11.3	0.7			11.8				
339	0.4	6.7	8.0	1.3				370938	6360358		carbonaceous mudstone / some coal
		9.2	10.0	0.8							
338	0.2	7.0	8.2	1.2				370941	6360358		carbonaceous mudstone / some coal
							11.3				
337	0.3			0				370944	6360358		collaps / blocked at 6.5 m attempted 3 or 4 times
336	0.5	7.7	8.4	0.7				370947	6360358		carbonaceous mudstone / some coal
		9.6	10.0	0.4			10.8				
335	0.5			0				370950	6360358		collapse at 6.5 m depth, attempted 4 or 5 times
335A				0			6.5				wet clay clogged rod
	0.1	0.5	1.5	1			5.6				wet clay clogged rod
334	0.5	7.6	8.6	1				370952	6360358	28.471	carbonaceous mudstone / trace coal
		10.0	10.2	0.2							
333	0.5	7.6	8.3	0.7				370956	6360359		
		9.0	9.2	0.2							
		9.9	10.1	0.2			11.3				
369	1.4	7.7	8.5	0.8				370959	6360360		With carbonaceous mudstone
		9.0	9.2	0.2							
		10.0	10.1	0.1			10.8				
368	1.3	7.7	8	0.3				370963	6360361		
		9.0	9.2	0.2							
		10.0	10.2	0.2			10.8				
367	1.8			0			3.0	370966	6360362		water 3.0 m
366	0.8	7.2	7.6	0.4				370969	6360363		with carbonaceous mudstone
		8.8	9.1	0.3							
		9.7	9.9	0.2			11.8				
365	0.9	7.3	8.4	1.1				370973	6360364		with clay
		8.8	10.2	1.4							
332	1.0	7.1	8.0	0.9				370976	6360365		
		8.8	9.0	0.2			9.2				
332A	1.0	7.2	8.3	1.1							
		8.7	8.9	0.2							
		9.7	10.0	0.3			10.8				
331	2.0	7.2	8.0	0.8				370979	6360366		
		8.7	9.0	0.3							
		9.3	9.9	0.6			10.2				
327	1.8	7.8	10.0	2.2			21.0	370983	6360367		
328	1.3	7.3	8.3	1				370986	6360368		
		8.9	9.1	0.2							
		9.7	10.0	0.3			11.3				
329	2.0	7.3	8.0	0.7				370990	6360369		coal and carbonaceous mudstone
		9.5	10.0	0.5			11.3				
330	1.2	7.3	8.0	0.7				370993	6360370		coal and carbonaceous rock
		8.5	8.7	0.2							
		9.5	9.9	0.4							

TABLE A1

SUMMARY OF PERCUSSION DRILLING RESULTS

PROPOSED RESIDENTIAL SUBDIVISION, MINMI 39663D

Bold Coordinates were subject to detailed survey, remaining points area interpolated

BORE	Depth to Top of Rock (m)	Depth to Top of Coal (m)	Depth to Base of Coal (m)	Thickness of Coal Seam (m)	Depth to Top of Void (m)	Depth to Base of Void (m)	Base of Bore (m)	EASTING	NORTHING	RL	COMMENTS
326				0				370996	6360371	29.161	
				0							
				0							
				0							
Near pothole on track to Jack's											
479	0.1	2.9	3.0	0.1				370721	6360390	17.548	
		3.9	4.4	0.5							
		5.1	5.9	0.8							
		20.3					21.0				
480	0.1	4.1	4.4	0.3				370723	6360392		
		5.4	5.7	0.3							
		20.3					21.0				
481	0.9	4.1	4.4	0.3				370725	6360395		
		5.4	5.8	0.4			14.2				water in hole
482	1.5			0			3.0	370726	6360398		water in hole
483	1.5			0			3.0	370728	6360401		collapsing soil to losse and wet
484	1.2	4.6	4.9	0.3				370730	6360403	18.679	
		5.9	6.3	0.4			6.6				can't grab rods
				0							
				0							
Near Alleged Pothole P4 refer to Drawing 15											
226	1.0			0							
227	1.0	13.8	16.8	3			17.3				
228	1.0	14.4	17.3	2.9			17.4				
229	1.0	14.5	17.3	2.8			17.4				
230	0.6	15.8		-15.8			17.4				
231	0.6	15.3		-15.3			17.4				
232	0.6	15.2		-15.2			17.4				
233	1.0	14.2		-14.2			15.4				Collapsed hole
234	1.0	13.8	16.7	2.9			17.1				
235	0.6	14.1	17.0	2.9			17.4				
236	0.5	14.5	17.3	2.8			17.4				
237	0.5	13.1	16.0	2.9			16.4				
238	0.5	13.0	15.8	2.8			16.4				
239	0.5	12.6	15.2	2.6			15.6				
240	0.5	12.3	14.9	2.6			15.2				
241	0.5	12.3	14.8	2.5			15.3				
242	0.5	11.8	14.5	2.7			14.9				
243	2.0	11.8	14.4	2.6			14.8				
244	2.0	11.9	14.2	2.3			14.5				
245	2.0	12.1	14.8	2.7			15.3				
246	0.8	12.3	15.0	2.7			15.4				
247	0.7	12.6	15.3	2.7			15.7				
248	0.6	12.6	15.0	2.4			15.4				
249	0.6	12.1	14.8	2.7			15.2				
250	2.0	11.8	14.5	2.7			14.9				
251	0.6	12.1	15.5	3.4			15.9				
252	0.6	13.1	15.7	2.6			16.0				
253	1.0	12	14.8	2.8			15.2				
254	4.0	12.1	14.7	2.6			15.0				
255	1.0	11.7	14.4	2.7			14.9				
				0							
				0							
Various bores near some test pits											
130	1.0	12.0	14.4	2.4			14.9	370237	6360661		Offset 300mm NW of 119
131	1.0	11.8	14.4	2.6			14.6	370236	6360661		Offset 200mm SW of 119
				0							
133	1.5	20.9		-20.9			21.0				limit of reach
132	2.0			0			21.0	370270	6360788		pretty sure definitely came up coal
				0							
135	1.0			0			13.0	370238	6360562	34.122	
54	1.0	7.8	10.5	2.7			11.4				

APPENDIX B

***TABLE B1 – SHAFT REGISTER
KEVIN PRICE DATA SUMMARY***

TABLE B1
REGISTER OF SHAFT LOCATIONS

Name	General Location	Designation on RT	ISG Easting	ISG Northing	MGA Easting	MGA Northing	Elevation	Survey origin	C&A Number	Status on 25/2/69 (Coal & Allied Records)	Status on 5/9/75 (Coal & Allied Records)	DPI - Minerals Information	Visual Assessment 2008
A	Below house on West side of Woodford St, North of Railway St	Pit A	357411	1360197	370413	6360939	Not Measured	M&P Survey 1994	4	Have been filled some years ago. Slight subsidence from time to time has been made good.	Filled as described previously		House constructed over
B	South side of Railway St, just to west of Woodford St.	Pit B	357345	1360117	370349	6360858	20.74	M&P Survey 1994	5	Have been filled some years ago. Slight subsidence from time to time has been made good.	Filled as described previously		Filled with no obvious capping - grasses only
C	South of Railway St in paddock	Pit C	357065	1360014	370071	6360749	24.76	M&P Survey 1994	6	Shaft sealed at ground level with concrete slab, appears to be in sound condition. Approximately 150-200' deep.	Concrete slab appears safe and secure		Capped 9 x 9m Concrete Slab, Dated 1992
ABC entry	Blue Gum Hills	unlabelled entry	357268	1360194	370270	6360933	Not Measured	RT257		Not mentioned	Not mentioned		Not Located. Mapped location is covered with dense vegetation.
B2	Blue Gum Hills	No 2 Entry	358034	1359718	371045	6360472	Not Measured	RT257		Not mentioned	Not mentioned		Not located. Mapped location is off access track in area of filling
B4	Blue Gum Hills	No 4 Entry	357877	1359665	370889	6360416	Not Measured	RT257		Not mentioned	Not mentioned		Not Located. Mapped location is in area of overburden filling. Shaft probably covered over.
B5	Blue Gum Hills	unlabelled	358008	1359628	371021	6360381	Not Measured	RT257	1	South of Back Creek Open Cut workings and approximately 50 yards north of Miller's coal access road. Reported to be covered with mahogany logs and filled over with loam about years prior (1959). Shaft about 100' deep	Shafts no located, assumed to be filled over.		Not Located. Undulating surface. Coarse overburden and chitter. Moderate vegetation.
B6	Blue Gum Hills	unlabelled	358066	1359649	371078	6360403	Not Measured	RT257	2	As per 1. 50 yards to the east.	Shafts no located, assumed to be filled over. Later found and was already partly filled - 10' deep.		No Located. Mapped location is near the toe of a cut with some filling oushed over. Dense vegetation is present.
B7	Blue Gum Hills	shaft	358187	1359496	371202	6360253	Not Measured	RT257		Not mentioned	Not mentioned		Not located. Mapped location is near various remnant structures included concrete pedestals and masonry structures. Steel railing is also evident.
B8	Blue Gum Hills	shaft	358221	1359518	371236	6360275	Not Measured	RT257		Not mentioned	Not mentioned		Not Located. Mapped location is in dense vegetation.
B9	Blue Gum Hills	Furnace	357742	1360085	370770	6360840	Not Measured	RT257		Not mentioned	Not mentioned		Undulating, small trees, No signs of shaft.
B10	Blue Gum Hills	unlabelled entry	357959	1359698	370971	6360450	Not Measured	RT257		Not mentioned	Not mentioned		Not located. Mapped location is in cut with mine spoil pushed over, highly undulating, mature trees, erosion in place
Dam	NE of corner of Link Road and Woodford St, near masonry dam.	unlabelled			370030	6359462	Not Measured		16	Known as No.9 Shaft Minmi Colliery. Walls of what was substantial fan building still standing. Shaft not located but reported to be covered with concrete slab at ground level.	Not sealed but well fenced.		Slab built 500mm above ground level. Mass concrete about 500mm thick. Partially overgrown. Appears to be backfilled 1-2m down from top of cap. Inscribed with W. Grilly 1988. Concrete footings on eastern side.
Furnace Shaft	Blue Gum Hills		358305	1359155	371327	6359914	23.5	M&P Survey 1994	3	Furnace shaft, 12' diameter brick lined, about 300' deep, brick chimney above surface.	Brickwork gradually deteriorating but is still sound		Chimney still present
Purple Hill	Between Minmi Creek and Purple Hill Open Cut	Not shown			369979	6360965	Not Measured		12	Shaft approximately 10' by 8' rectangular section in solid sandstone, fenced with barbed wire. Shaft is open and appears to be bottom at about 30' but cover would be about 50-100' in this area.	As previously described.		Approximately 7m diameter grass covered, Earth fill with some slumping and piping evident
WS	West of Woodford St, South of old school	Water shaft			369824	6360046	Not Measured		15	Brick collar extends above ground surface inside fenced area. Shaft is covered with 8 inch mahogany logs filled over with loam - ends of logs visible. Been covered 10 years plus.	Log and loam seal now partially open. Plenty of fill available. In October 1975 filled and piled 2 m above surface.		Concrete Capped 4 x 4m, 600mm thick slab, Steel pipe and bolted end plate in centre
1	Blue Gum Hills		358549	1358955	371574	6359719	23.4	M&P Survey 1994		Not mentioned			Not assessed (off site)
2	Blue Gum Hills		358187	1359452	371203	6360209	28.4	M&P Survey 1994		Not mentioned			Cut into Eastern Side of Road Embankment - no obvious shaft or capping present
3			358112	1359581	371126	6360336	25.7	M&P Survey 1994		Not mentioned			7 x 7m battered cut - no obvious shaft or capping present.
4	Gully near transmission line	unlabelled	357535	1359325	370554	6360069	16	M&P Survey 1994	14	100 yards east of 13. Site fenced with barbed wire and heavily overgrown with lantana. Shaft not visible but rock thrown into depression resounded from water level estimated to be 60-100' below surface.	Open, sides falling in, fill available. In October 1975 filled and piled 2 m above surface.		Not located
5	Gully near transmission line		356487	1360710	369480	6361434	46.5	M&P Survey 1994	10	Shaft top not located but reported to be covered with mahogany logs and loam, depth estimated to be 200-300'	Inaccessible. Shaft is said to be partly filled and fenced over.		
18	Gully near transmission line		355701	1360618	368696	6361327	90.25	M&P Survey 1994	11	Brick collar extends above surface and is open. Area is fenced. Depth about 300'	Not located		
21	Gully near transmission line		356569	1360111	369573	6360837	26.5	M&P Survey 1994	8	Similar to 7.	Filled and secure. In October 1975 sealed including two thickness of mesh and thickness of concrete 150 mm.		
23	Gully near transmission line		356061	1360017	369067	6360733	27.99	M&P Survey 1994	9	In bushland west of town. Shaft sealed at surface with concrete slab, appears to be in sound condition.	Seal has collapsed and shaft is extremely dangerous. To be capped. In October 1975 sealed with two thicknesses of mesh and thickness of concrete of 150 mm.		
27	Gully near transmission line		355869	1359596	368883	6360309	44.74	M&P Survey 1994	not shown				
6	Gully near transmission line	unlabelled	357442	1359337	370461	6360080	24.5	M&P Survey 1994	13	Fan shaft. Substantial brick fan structure over shaft. Shaft currently used to dewater Miller's	Brickwork now dismantled. Open and insecurely fenced. Fill available.	3.06m square, lined with bricks	concrete capping observed
12	Link Road North	No 12 Shaft	358129.51	1358188.38	371169.55	6358944.53	55.169m	Gritley Survey/GPS	17	Know as No.12 shaft. Old fan building stills standing. Concrete slab over shaft top at ground level with is intact and appears to be in sound condition. Depth to seam about 550'	Used as fan shaft and dewatering by Gritley who have broken previous concrete seal.	2.7m lined with bricks to depth of 12.25 metres	4 x 4m square cap, Capped and filled 1993, cap 150mm above ground level. Heavily overgrown, slab at edge of cut. Galvanised steel plate with plug.
14	Link Road North	No. 14 Shaft	358614.04	1358323.69	371651.34	6359088.97	52.444	Gritley Survey/GPS	18	Known as No.14 shaft. Brick collar of shaft protrudes about 18' above ground level and is covered with 8' mahogany logs filled over with loam, ends of logs visible.	Steel girder and chain wire mech cover in place sitting on brickwork rising 1.25 m above ground.		Hexagonal Shaped Slab, 250mm above ground, 75mm galvanised screw pipe and cap. Heavily vegetated.
40	West side of Gully in Minmi West	Not shown	356863	1359914	369871	6360646	23.45	M&P Survey 1994	7	Old prospect shaft, depth unknown. Has been filled in. Surface Depression approximately 6 ft holds water for stock watering.	Fill and secure		Capped 7 x 7m Concrete Slab, 200mm above Ground Level, 2 Holes in Slab
Undesignated	Minmi East - Near Fletched	Unlabelled	Not Measured		Not Measured		Not Measured	RT257		Not mentioned			Numerous shafts shown on RTs. No attempt to locate on site as numerous potholes present in area.

Shaded entries are not located on proposed development site
Bold entries are where accurate survey has been undertaken

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REPORT**Douglas Partners Report 091107**

SUBJECT : Preliminary Research Into Borehole Seam Workings – Minmi Area

TO : Steven Ditton (Ditton Geotechnical Services Pty Ltd)
Will Wright (Douglas Partners Pty Ltd)

DATE : 10 November 2007

Following a meeting at Douglas Partners offices on Friday 24 October 2007, Brunskill has been requested to research various information relating to possible working heights, shafts, and limits of both first and second workings in the Borehole Seam in an area adjacent to Minmi township. Preliminary reference to workings in the Young Wallsend Seam has also been made.

Listed below is a summary of information relating to the above items located in records at Mineral Resources (Maitland office), personal records and various enquiries. The information cannot be guaranteed as accurate or complete as it consists of a compilation of information, prepared by others obtained in a preliminary investigation. The actual mine workings, particularly their extent, is reliant on the accuracy of the plans held at Mineral Resources as Record Tracings.

As noted above, the information provided is preliminary and is intended to provide an overview. Please advise if a more detailed study of any of these items is required.

Workings Shown on Plans Provided by Douglas Partners

The workings shown on the plans provided by Douglas Partners generally agree with the Record Tracings reviewed at Mineral Resources. However some workings in the area near A Pit are shown in more detail on Sheet 2 of Record Tracing 497 (Browns or Browns Minmi).

Mines and Mining Methods

The mines in the study area that mined the Borehole seam are Browns or Brown's Minmi (RT 497), Duckenfield No1 and No2 (RT 256, 257 and 257A) and Minmi Open Cut (RT 621).

The mines in the study area that mined the Dudley / Young Wallsend seam are Wallsend Borehole and Gretley.

Underground mining method in the Borehole seam was hand mining which generally consisted of first workings including Welsh bords, pillar extraction and a limited amount of hand mined longwall.

Underground mining in the upper seam (Dudley / Young Wallsend) was mechanised (continuous miner) consisting of first working followed by pillar extraction, including some Wongawilli type lifts.

General Accuracy of Workings

Borehole Seam

The underground workings in the Borehole seam date from the late 1800's through to 1955. Mine surveying methods have obviously improved over the years and equipment is much more sophisticated. However, the accuracy of surveyed workings of this era have been shown to be accurate, in some cases to within less than a metre. The extent of the Borehole seam workings in the study area cannot be guaranteed. The plans viewed are not "certified as accurate", although they have date lines near or at the extremity of the majority of workings. These date lines do not, however, coincide with the date of discontinuance or abandonment so the prospect of unrecorded workings cannot be disregarded. These workings have been, in some cases reproduced at 4 chain to 1 inch from the original, then later converted and traced, digitised or later scanned into either ISG or MGA format with the resultant potential inaccuracies.

"Best fit" and "rubber sheeting" techniques following the introduction of ISG and MGA may limit accuracy to +/- 10 metres.

On previous occasions, at another mine, when this method has been employed, later exposure in open cut workings has confirmed inaccuracies in the order of 6 metres.

Dudley / Young Wallsend Seam

The workings in No 4 Tunnel at Gretley and Wallsend Borehole have been surveyed with closed traverses with modern equipment.

In later years the Gretley No 3 Tunnel workings were deliberately holed into the old Wallsend Borehole workings with a closing survey between the two mine surveys revealing a misclose in the order of 3 metres.

The limit of the extent of workings and accuracy of the survey of the workings would be considered to be accurate to within say 3-5 metres.

Total Height and Working Heights in the Borehole Seam

Various information has been researched regarding the seam height and working height of the Borehole seam. A summary is listed below.

Mine	Borehole Seam Total Thickness	Borehole Seam Working Thickness	Note
Minmi (later Duckenfield)	3.18m	1.74m with 0.41m of bottoms left below working section – westward workings	RT 257 Sheet 3 (mined in 1950's) north of study area.
Minmi (later Duckenfield)	3.18m	2.16m – eastward workings	RT 257 Sheet 3 (mined in 1950's) north of study area
Minmi (later Duckenfield)	1.9 (?)	1.65m with 0.25m bottom coal left below working section	RT 257 Sheet 5 early workings
Killingworth	2.52m	1.56	Edgeworth David Memoirs 4 - 1907
Killingworth	3.22m	1.60m	Edgeworth David Memoirs 4 – 1907. Tops all inferior coal
Seaham (formerly Monkwearmouth)	2.45m	1.66m	Edgeworth David Memoirs 4 – 1907
Young Wallsend	2.91m	1.54m	Edgeworth David Memoirs 4 - 1907

Bold - Workings below site.

Working Heights in the Dudley / Young Wallsend Seam

Though unconfirmed by hard copy information at this point, memory is that mining height in both Gretley No 4 Tunnel and Wallsend Borehole workings was in the order of 2.3 to 2.4 metres. A small area of Gretley No 4 Tunnel was mined at about 1.52 metres, though its exact location is unconfirmed at this point.

Information from Edgeworth David indicates that the Young Wallsend thickness in mines in and around the study area ranged from 1.83m to 2.52m.

Shafts in the Area

A number of shafts were sunk in the study area, including several within the sub lease area to Gretley (No 12 and No 14 Shaft).

No detailed research has been carried out on the Minmi Shafts at this stage.

Nos 12 and 14 Shafts were filled and sealed in 1986 in accordance with the recommendations of the then Mines Department. Both shafts were capped with an engineered designed concrete cap.

Shaft Name	ISG Coords N	ISG Coords E	Reduced Level of Collar	Diameter
No 12	1358188.38	358129.51	55.169m	3.06m square, lined with bricks
No 14	1358323.69	358614.04	52.444	2.7m lined with bricks to depth of 12.25 metres

Subsidence Surveying in the Area

Some subsidence surveys were carried out in the early 1970's over the Gretley pillar extraction workings. Any records would be hard copy only and may no longer exist. Please advise if this area is to be further researched.

MINE PLAN RESEARCH NOTES

MINE NAME : BROWNS or BROWNS MINMI
SEAM : Borehole
COLLIERY CARD INDEX : Papers 31/21585 Now Duckenfield No 1 Colliery No 4 Tunnel
COLLIERY NAMES INDEX : Listed under Browns Minmi – Formerly Stockrington : Borehole Seam Now Duckenfield

COLLIERY WORKINGS AND HOLDINGS MAP INDEX :

DISTRICT / PARISH WORKINGS MAP : Duckenfield holding – RT 257
Old Minmi workings – RT 497
See also Minmi Open Cut – RT 621

COLLIERY HOLDINGS DISTRICT/PARISH MAP :

COLLIERY HOLDING PLAN / REGISTER :

TITLES SERIES MAP :

MINE RECORD TRACING : RT 497

FIELD NOTES / BOOKS :

SURVEY PLANS (M,P etc)

RECORD TRACING CHECK LIST

PLAN OF ABANDONMENT : Note on spine of sheets
DATE OF ABANDONMENT : No date
NOTATION :
DATE LINES : Some dates, no lines
SURVEYOR'S SIGNATURE : No
SURVEY INFORMATION : No
DRIFT / SHAFT : Tunnels and shafts
CONNECTION TO BOUNDARY : No, but some cadastral information shown.
NAME OF LAST SURVEYOR :
NOTES :

MINE PLAN RESEARCH NOTES

MINE NAME : **DUCKENFIELD No 1**

SEAM : **Borehole**

COLLIERY CARD INDEX : Notice of discontinuance 5/5/1955
26-2-31.1 No 6 Tunnel - near Minmi boundary
No 5 Tunnel – small tunnel near Stockrington
No 4 Tunnel – Browns
3-32.1 No 6 Tunnel then No 5 Tunnel – discontinuance
Notice of discontinuance 5-5-1955

COLLIERY NAMES INDEX : Duckenfield Old, Portion 96 Parish Stockrington RT 256
(Borehole seam).
Portions 28, 29 etc Parish Teralba, Portion 52 Stockrington,
Portion 15 Hexham. Two separate mines.
RT 257, Plan of encroachment M11211
No 4 Tunnel RT 257A. Abandoned 23-5-55 / 4923 Ms (ruled
through) Discontinuance only , vide report by CICM dated 1-3-56
papers Ms 55 / 9374.

COLLIERY WORKINGS AND HOLDINGS MAP INDEX :

DISTRICT / PARISH WORKINGS MAP : Abandoned

COLLIERY HOLDINGS DISTRICT/PARISH MAP :

COLLIERY HOLDING PLAN / REGISTER :

TITLES SERIES MAP :

MINE RECORD TRACING : **RTs 256, 257 (in 3 sheets) and 257A**

FIELD NOTES / BOOKS :

SURVEY PLANS (M,P etc)

RECORD TRACING CHECK LIST – RT 257

PLAN OF ABANDONMENT : Not noted as abandoned

DATE OF ABANDONMENT :

NOTATION : No

DATE LINES : Dates

SURVEYOR'S SIGNATURE : No

SURVEY INFORMATION : No

DRIFT / SHAFT : Tunnel and shaft

CONNECTION TO BOUNDARY : No

NAME OF LAST SURVEYOR :

NOTES :

RT 256 – Limited information available.
For preliminary area refer to Colliery Names Index.
Workings in Portion 96, Parish of Stockrington, also Parishes of Teralba
(Portions 28, 29 etc) and Hexham (Portion 15)

RT 257 – Provides some further detail.
Workings in Portions 52 and 96, Parish of Stockrington, Portion 7 Parish
of Hexham. Note date of abandonment (No 5 Tunnel – Sheet 3) at 16-
4-1955)
Extremities mined up to 1917 (Sheet 1) - 4 chains to 1 inch

MINE PLAN RESEARCH NOTES

<u>MINE NAME :</u>	DUCKENFIELD No 2
<u>SEAM :</u>	Borehole
<u>COLLIERY CARD INDEX :</u> Later note	1930 – Recommenced operations with a prospecting tunnel. This proposed tunnel now No 5 Tunnel No 1 Colliery
<u>COLLIERY NAMES INDEX :</u>	Borehole seam – now Stockrington RT 318
<u>COLLIERY WORKINGS AND HOLDINGS MAP INDEX :</u>	
<u>DISTRICT / PARISH WORKINGS MAP :</u>	Abandoned
<u>COLLIERY HOLDINGS DISTRICT/PARISH MAP :</u>	
<u>COLLIERY HOLDING PLAN / REGISTER :</u>	
<u>TITLES SERIES MAP :</u>	
<u>MINE RECORD TRACING :</u>	RTs 256 (2 sheets)
<u>FIELD NOTES / BOOKS :</u>	
<u>SURVEY PLANS (M,P etc)</u>	

RECORD TRACING CHECK LIST

<u>PLAN OF ABANDONMENT :</u>	Not on spine of sheets
<u>DATE OF ABANDONMENT :</u>	No
<u>NOTATION :</u>	
<u>DATE LINES :</u>	Some dates
<u>SURVEYOR'S SIGNATURE :</u>	No
<u>SURVEY INFORMATION :</u>	No
<u>DRIFT / SHAFT :</u>	Shaft and tunnel
<u>CONNECTION TO BOUNDARY :</u>	No, but some cadastral information shown.
<u>NAME OF LAST SURVEYOR :</u>	
<u>NOTES :</u>	Note on sheet – For early workings (Minmi) see RT 497

MINE PLAN RESEARCH NOTES

MINE NAME : MINMI OPEN CUT

SEAM : Borehole

COLLIERY CARD INDEX : Papers 49/3306 Notice of opening – Open Cut mine 25/3/49
Papers 54/8039 Notice of discontinuance 19/8/54
Notice of recommencement of operation

COLLIERY NAMES INDEX : RT 621 (Duckenfield Holding RT 257, Old Minmi workings RT 497)

COLLIERY WORKINGS AND HOLDINGS MAP INDEX :

DISTRICT / PARISH WORKINGS MAP :

COLLIERY HOLDINGS DISTRICT/PARISH MAP :

COLLIERY HOLDING PLAN / REGISTER :

TITLES SERIES MAP :

MINE RECORD TRACING : RT 621

FIELD NOTES / BOOKS :

SURVEY PLANS (M,P etc)

RECORD TRACING CHECK LIST

PLAN OF ABANDONMENT :

DATE OF ABANDONMENT :

NOTATION :

DATE LINES :

SURVEYOR'S SIGNATURE :

SURVEY INFORMATION :

DRIFT / SHAFT :

CONNECTION TO BOUNDARY :

NAME OF LAST SURVEYOR :

NOTES : Workings around perimeter of RT 257

APPENDIX C

DITTON GEOTECHNICAL SERVICES REPORT

Ditton Geotechnical Services Pty Ltd
80 Roslyn Avenue Charlestown NSW 2290
PO Box 5100 Kahibah NSW 2290



Douglas Partners Pty Ltd

Worst-Case Mine Subsidence Assessment for the Proposed Minmi Subdivision, Link Road, Minmi

Report No. DPS-002/1

Date: 8 August 2008



8th August, 2008

Mr Will Wright
Senior Associate
Douglas Partners Pty Ltd
15 Callistemon Close
Warabrook NSW 2310

Report No. DPS-002/1

DRAFT

Dear Will,

Subject: Worst-Case Mine Subsidence Assessment for the Proposed Residential Subdivision, Link Road, Minmi

This report has been prepared in accordance with the brief provided on the above project.

Please contact the undersigned if you have any questions regarding this matter.

For and on behalf of
Ditton Geotechnical Services Pty Ltd

Steven Ditton
Principal Engineer

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Appendix A - Pillar Factor of Safety and Subsidence Calculations

Appendix B - SPDS Program Details (User Manual Extracts)

1.0 Introduction

This report provides predictions of worst-case subsidence, tilt, curvature, and strain contours across the proposed Minmi Residential Subdivision, Link Road, Minmi in the event of a pillar 'run' or widespread collapse of old mine workings in the Young Wallsend and Borehole Seams.

The site is located 10 m to 130 m above old Brown's Minmi/ Duckenfield Colliery's welsh bord and pillar workings in the Borehole Seam (circa pre-1950's) and old Wallsend Borehole and Gretley Colliery pillar extraction workings (circa post-1950's) in the Young Wallsend Seam. The Young Wallsend Seam is approximately 20 to 25 m above the Borehole Seam at this location.

The proposed development will consist of a 1 to 2 storey residential and commercial / retail buildings and associated infrastructure. Based on reference to **Appleyard, 2001** and **Mine Subsidence Board** correspondence for the project, these structures could be subject to potentially damaging tilts in excess of 4 mm/m, curvature radii of <10 km and strains of >2 mm/m if subsidence of more than 0.25 m was to develop at the site.

The purpose of the study was to define surface subsidence hazard zones for the subsequent definition of development restriction zones. The study was completed in two stages as follows:

Stage 1 - Preliminary worst-case subsidence contour predictions for exploration drilling planning, and

Stage 2 - Final worst-case subsidence predictions, based on the Stage 1 outcomes, and definition of subsidence impact hazard zones for the site.

The subsidence assessment has been based on reference to information provided in **Douglas Partners, 2008**.

2.0 Method

The study methodology included the following activities for Stages 1 and 2:

- (i) Prediction of the respective subsidence contours for the site after all of the remnant pillars in the Borehole Seam and Young Wallsend Seam have 'failed' or crushed.
- (ii) Prediction of the subsidence for the site due to the elastic compression of standing pillars and immediate roof and floor strata in partially extracted areas, first-workings areas and un-mined pillars in high extraction panels; and additional subsidence above goafed high extraction areas in the Borehole and Young Wallsend Seams due to 'pillar run' loading or goaf 're-activation' events.
- (iii) Estimate of future worst-case subsidence contours in each seam by subtracting the elastic subsidence from the fully crushed pillar or collapsed overburden (goaf) subsidence where appropriate. The contours were then added to develop the multiple-seam subsidence contours for both seams.
- (iv) Determine the systematic tilt, curvature, and strain contours from the worst-case subsidence contours.
- (v) Generate maximum tilt, curvature and strain hazard zones for subsequent building development constraint assessment.
- (vi) Estimate Factors of Safety (FoS) of Zone 1, 2 and un-mined pillars in Zone 3 areas and define probability / likelihood zones of standing and collapsed pillars.
- (vii) Repeat exercise (i) to (v) by assuming worst-case subsidence for pillars with FoS > 2.11 will be due to elastic compression from the full tributary area (FTA) acting on the pillar and > 1.6 for the case of single abutment loading along goaf edges.
- (viii) Provide suggestions on the above mining zones in regards to further drilling investigations required to ascertain whether a panel is standing or already failed.
- (ix) Review pillar geometry and subsidence prediction modelling assumptions, based on additional drilling investigations and adjust subsidence hazard zones as considered necessary.

The subsidence predictions were prepared based on the following:

- (i) A review of the available mine workings information for the site provided by Douglas Partners and sourced from the Department of Primary Industries, Maitland.
- (ii) A review of a report prepared by Brunskill Pty Ltd on the mine workings history and likely mining heights. A search for available mine subsidence data did not yield any information in the study area. A walk over inspection of the site was completed by a DP

Engineer and indicated that the surface had been subsided in places due to the presence of old cracks (refer to **DPS, 2008** for details).

- (iii) The worst-case predictions were based the published **ACARP, 2003** database of subsidence above longwall panels and chain pillars in the Newcastle Coalfield. The maximum subsidence was then adjusted for bulking effects of remnant pillars and collapsed roof material and multiple seam effects as described in **Li et al, 2007, Zipf, 2005** and **Holt, 2001**.

Estimates of maximum subsidence, tilt, curvature and strain contours over the workings in both seams beneath the site were then determined using SPDS[®] software and **ACARP, 2003** model outcomes. The contours were developed from Autocad[®] plans of the workings outlines in each seam. The maximum potential subsidence contours for each seam were then superimposed to derive the combined seam subsidence contours.

- (iv) Factor of Safety estimates for the pillars were estimated using the empirical models described in the **ACARP, 1998a** and **ACARP, 1998b** reports, and based on full tributary and side abutment load case scenarios were appropriate.
- (v) Elastic compression of pillar/floor/roof under full tributary area load were based on analytical solid mechanics theories presented in **Das, 1998**.
- (vi) Bearing capacity of floor and roof was based on empirical observations by **Pells, 1998** and shallow bearing capacity theories in **Das,1998**.

The outcomes of the subsidence contouring exercises described above are presented in the following sections.

3.0 Existing Conditions of Mine Workings

A review of record tracings for each of the mines, indicates that the workings in each seam may be sub-divided into the following zones:

Zone 1 - 'Low' extraction ratio first workings (15% to 45% of the coal extracted)

Zone 2 - 'Moderate' pillar extraction ratio second workings (50% to 72% of the coal extracted)

Zone 3 - 'High' pillar extraction ratio second workings (80% to 85% of coal extracted)

The above mine workings zones and cover depth contours for the Young Wallsend and Borehole Seams are presented in **Figures 1** and **2** respectively.

The Young Wallsend Seam (YWS) workings are predominately Zone 3 or 'High' pillar extraction ratio panels with a large proportion of the workings likely to have already collapsed roof or goaf. The panels are supercritical and separated by first workings pillars (Zone 1) with some Zone 2 areas around the peripheries. The average working height in the YWS panels was 2.4 m in the 2.9 m to 3.0 m thick seam. Approximately 0.5 m of shaley coal was left in the roof.

The Borehole Seam (BHS) workings are predominately Zone 2 or 'Moderate' pillar extraction ratio panels which could have remnant pillars that are still standing or have crushed out. The panels are separated by first workings pillars with some Zone 3 panels present below the eastern and western limits of the mining area. The average working height in the BHS panels ranged between 1.65 and 2.1 m in the 1.9 m to 2.3 m thick seam. Approximately 0.25 to 0.33 m of coal was left in the floor.

Based on discussions with ex-mine and land management representatives for the mines at Minmi, some areas of the Zone 2 workings in both seams have probably collapsed and some are still standing. Both seams generally dip towards the south west at about 2° to 3° and are partially flooded.

Mine washery tailings consisting of sand, silt and clay-sized particles were also pumped during mine operations into both of the seams from boreholes that were drilled down from the surface above the Duckenfield mine workings and from the YWS in the Gretley mine workings. The voids in the workings have only been partly filled with tailings and the location an extent of the backfill is unknown at this stage.

The Stage 2 drilling consisted of five cored boreholes to the BHS (Bore No.s 201, 202, 301, 302 and 305) where cover depths ranged from 58 to 77 m. The location of the bores is indicated on **Figures 1** and **2**.

The YWS was encountered at depths ranging from 37.5 m to 56.5 m with the following range of conditions in a 'High' extraction panel (Zone 3):

- 3 m of intact, full seam thickness coal;
- 1.09 m to 2.2 m of solid coal with 0.5 m to 1.1 m of overlying rubble; and
- 2.25 m of rubble (with no coal) overlain by 0.75 m of void.

The pillars in this area of the mine were formed on 24 m x 30 m centres with 5 m wide ‘splits’ driven through the pillars on retreat to leave irregular corner or intersection stooks to provide temporary support to the immediate roof. Soft, soil-like tailings were also encountered in Bores 201-202 but not in the bores to the north (301, 302 -305).

In the BHS, the bores encountered the following conditions in the ‘Moderate’ Extraction panels (Zone 2):

- 2.33 m of solid, full seam thickness coal;
- 0.25 to 0.33 of floor coal overlain by 0.73 to 2.05 m of void with 0.0 to 3.0 m of rubble .

The workings are welsh bords with an average 4 to 5 m wide x 31 to 38 m long pillars and 7 to 8 m wide bords and 3 m to 5 m wide cut-throughs (61% to 72% extraction ratio). The cover depth to the BHS workings is 58 and 76 m. No tailings were encountered and the water level was coincident with the roof of the seam.

The overburden and YWS / BHS interburden consists of thinly interbedded sandstone and siltstone (laminite) with moderate to high strength. The floor of the BHS is the Waratah Sandstone Member with high to very high strength (UCS >50 MPa)

The UCS of the laminate units ranges between 25 MPa and 60 MPa, based on point load and UCS testing of representative core samples. Some low to medium strength minor shale and coal seams exist in the immediate roof and floor of the workings and overburden, see **Figure 3**.

4.0 Stability of Pillar System

The worst-case subsidence that may develop beneath the Minmi site will depend upon (i) the long-term stability of the Zone 2 pillars that are still standing in the BHS workings and (ii) the degree of further goaf consolidation in the Zone 3 areas of both seams if the pillars mentioned above become unstable.

The stability of the pillars in the two seams below the site have been assessed based on consideration of the following key factors usually associated with long-term behaviour of pillar-roof-floor strata systems:

- Pillar load
- Pillar strength
- Bearing capacity of immediate roof and floor strata
- Multi-seam stress interaction effects
- Elastic properties of coal pillar-roof-floor strata system
- Deterioration effects

Each of the above items will be addressed in the following sub-sections.

4.1 Pillar Load

Based on the RT of the workings, the pillars beneath the site in Zones 1 to 3 exist in predominantly super-critical panel geometries (i.e. with panel width to cover depth (W/H) > 1.4) with some sub-critical panels. The stability of the pillars will depend primarily upon the cover depth, average pillar width and height for the panel and overburden / interburden thickness ratio (i.e. a multiple seam interaction factor).

Reference to **Zipf, 2005** indicates that if the overburden to interburden thickness ratio (O/I) for the site (which ranges from 1.7 to 6) is less than 7, then multi-seam pillar stress interaction is unlikely to occur.

Therefore, the pillars beneath the site are only likely to have full tributary area (FTA) load acting upon them in the upper and lower seams. A conceptual model of FTA conditions is shown in **Figure 4**.

The estimate of the total stress acting on the remnant pillars under full tributary area (FTA) loading conditions (i.e. the full column of rock above the pillar is supported by the pillar system). The total stress acting on the pillars after mining was estimated as follows:

$$\sigma_{\text{pillar}} = \text{pillar load/area} = T/w^2$$

where:

T = Full tributary area load of column of rock above each pillar;

$$= (w + r)^2 \cdot \rho \cdot g \cdot H;$$

w = pillar width (solid);

r = roadway width;

H = depth of cover;

The Zone 1 and 2 Pillars in the overlying Wallsend Borehole Colliery Workings YWS, pillar stress ranges from 0.72 MPa to 4.38 MPa. The Zone 3 Pillars in the YWS will have multi-abutment loads acting on them and pillar stress is estimated to range from 1.66 MPa to 36 MPa.

4.2 Worst-case Loading Conditions due to a Pillar Run

Worst-case conditions, due to a pillar run, will probably result in extra load being transferred to the pillars as the overburden above the failing pillars deflects. Underground stress and surface subsidence monitoring around super-critical width longwall panels in the Newcastle Coalfield (refer to **ACARP, 1998a** and **ACARP, 2003**) indicates that the additional load may be estimated based on an abutment or overbreak angle of 21°.

The abutment-load limit line is drawn from the mid-point of the bord next to the pillar adjacent to the goaf at seam level to the surface; the concept is shown in **Figure 5**.

For a 5 m wide pillar with 8 m wide bords, the increased load/ m length (A) acting on the pillars adjacent to a collapsed area may be estimated as follows for 45 m to 120 m:

$$\begin{aligned} A &= 0.5 u H^2 \tan(\theta) && \text{where } u = \text{unit weight of overburden} \\ & && \text{(0.025 MPa/m)} \\ & && \theta = \text{abutment angle (21}^\circ\text{)} \\ &= 0.5 (0.025) H^2 \tan (21^\circ) \\ &= 9.7 - 69 \text{ MN/m length of pillar adjacent to goaf} \end{aligned}$$

The equivalent average pillar stress in a panel could then be estimated by multiplying 'A' by the pillar length plus the bord width to derive the total load and then dividing it by the pillar area to arrive at the total stress increment. The abutment load is also concentrated closer to the rib side and distributed out from the rib-side based on the parabolic stress distribution profile presented in **ACARP, 1998a**, see **Figure 5**.

The proportion, R of the abutment load, A that will load a goaf edge pillar may be estimated using the formula presented in **ACARP, 1998a**:

$$R = 1 - [(D-w-r)/D]^3$$

where D = distance that load distribution will extend from goaf edge = $5.13 \sqrt{H}$ = 34 to 56 m
(Peng and Chiang, 1984).

H = cover depth (m).

w = goaf edge pillar width or dimension normal to the goaf edge.

r = bord width on either side of the loaded pillar.

The outcome of this exercise indicates that approximately 70% of the abutment load will be applied to the first pillar adjacent to the goaf and result in average pillar stresses increasing the FTA stresses by 0.9 to 6.8 MPa.

4.3 Pillar Strength

The strength and stability of coal pillars has been the topic of interest for numerous rock mechanics researchers over the past 40 years since the South African Colbrook disaster in 1960, which involved violent, sudden failure of over 4,400 pillars in a matter of minutes (and 7,700 pillars over several hours), **ACARP, 2005**.

Based on the outcomes of this research, the Australian, South African and US mining industries have found that the most reliable way to estimate the strength of a coal pillar is to apply empirical methods and statistical analysis techniques within the bounds of experience. The most reliable empirical pillar strength formulae to-date have used the pillar width, pillar height and a database of 'failed' and 'un-failed' pillar cases to derive 'calibrated' pillar factor of safety (FoS) values. The FoS of a panel of pillars is the ratio of pillar strength/average pillar stress.

The pillar width/height ratio is also a very important factor that indicates the post-yield behaviour of the pillars when they are overloaded. The width to height ratio of the pillars in the database ranges from 0.87 to 12.

Pillars with w/h ratios < 3 are considered most likely to 'strain-soften' and result in rapid failure and pillar runs, whereas w/h ratios > 5 are more likely to 'strain-harden' and fail slowly or 'squeeze'. These types of post-yield behaviour have been discussed in **ACARP, 2005** and demonstrated in **Figure 6** for various in-situ observations and laboratory experiments.

The pillars in the BHS workings have average width/height ratios ranging between 1.9 and 6.1 in the Zone 2 panels and between 2.4 and 9.7 in the Zone 1 panels for the maximum possible pillar height range of 2.1 m.

The pillars in the YWS workings have average width/height ratios ranging between 2.1 and 6.3 in the Zone 2 panels and between 2.1 and 10.4 in the Zone 1 panels for the maximum possible pillar height range of 3.0 m.

It is therefore possible that a pillar run could occur in the workings where slender pillars are still standing, and stop where 'squat' pillars are present.

The pillar strength formulae currently used in the Australian coal industry is based on a non-linear power law, which assumes that for an FoS of 1, the pillar panel will have a Probability of Failure (PoF) of 50%. The database of 177 cases includes 35% of ‘failed’ and 65% of ‘un-failed’ pillar panels from the SA and Australian Coal industries and is plotted in terms of pillar strength v. pillar load in **Figure 7a**. The pillars within the panels were all generally considered to be subject to full tributary area loading conditions, except for one failed case, which had several abutment loads applied to it from adjacent goaf development.

It is also apparent from the FoS lines drawn through the database in **Figure 7a**, that all of the failures occurred between FoS values of 0.74 and 1.62 and that there is a ‘blurring’ of failed and un-failed cases between an FoS range of 1.3 and 1.6.

Based on the database and reference to **ACARP, 1998b**, the strength of ‘strain-softening’ pillars, with width to height (w/h) ratios of < 5, may be estimated with the following non-linear power rule formula:

$$S_p = 8.6w^{0.51}/h^{0.84} \quad (\text{MPa}) \quad \text{where } w = \text{effective pillar width (m)} \\ h = \text{pillar height (m)}$$

The length of the pillar (l) increases the effective width for w/h ratios > 3 and < 6 as follows:

$$w_{\text{eff}} = [2l / (w+l)]^{(w/h - 3)/3}$$

For rectangular pillars with w/h < 3, the length of the pillar does not influence the strength.

The strength formula for ‘squat’ or strain hardening pillars with w/h ratios > 5, is as follows:

$$S_p = 27.63\Theta^{0.51} (0.29((w/5h)^{2.5} - 1) + 1) / (w^{0.22}h^{0.11}) \quad (\text{MPa})$$

where:

h = pillar height (m);

Θ = a dimensionless ‘aspect ratio’ factor or w/h ratio in this case.

4.4 Pillar Factor of Safety

The pillar FoS was then calculated by dividing the pillar strength, S_p , with the pillar stress, σ_{pillar} due to FTA loading. The applied pillar stress and strength for the range of pillar geometries in the YWS and BHS are presented in **Table 1**. Details of pillar FoS calculations are presented in **Appendix A**.

Table 1 - Summary of Pillar FoS Calculations for Existing Conditions in Mine Workings

Seam	Mine	Pillar Type Extraction Zone (refer to text)	Pillar Width (w)	Max Pillar Height (m)	Pillar Strength (MPa)	Panel Cover Depth Range (m)	Pillar FTA Stress (MPa)	Pillar FoS
YWS	Wallsend Borehole	1	8.7 - 12.5	3.0	9.2 - 33.7	20 - 120	0.72 - 4.38	29.3 - 4.2
		2	10.0 - 21.2	3.0	9.9 - 14.7	20 - 110	0.83 - 4.76	16.95 - 2.77
		3	12.5 - 43.7	3.0	11.3 - 36.1	20 - 115	0.74 - 4.49 (8.55)	25.48 - 2.55 (1.34)
	Gretley	1	6.3 - 31.2	3.0	7.8 - 21.1	30 - 110	1.41 - 4.80 (19.5)	9.77 - 1.62 (0.40)
		2	6.3 - 18.9	3.0	7.77 - 14.12	30 - 120	1.58 - 7.20 (23.8)	5.84 - 1.08 (0.33)
		3	7.5 - 37.5	3.0	8.52 - 28.28	30 - 120	1.07 - 6.48 (35.7)	20.8 - 1.31 (0.26)
BHS	Browns/ Duckenfield	1	5.1 - 20.4	2.1	9.4 - 24.7	30 - 150	1.1 - 8.1	18.7 - 1.42
		2	4.1 - 12.7	2.1	9.5 - 16.6	20 - 145	1.0 - 10.8	16.3 - 1.01
		3	-	2.1	-	-	-	-

YWS - Young Wallsend Seam

BHS - Borehole Seam

WBH - Wallsend Borehole Colliery Workings.

(*Italics*) - Single abutment load and FoS.

The pillar load and strength data for the YWS and BHS workings are also presented graphically in **Figures 7b, 7c and 7d**. The outcome of the FoS analysis suggests that some of the pillars in each seam will be standing and some will have collapsed.

This observation concurs with the view of the mine representatives and the results of recent drilling by DPS, which encountered crushed out remnant pillars in the Zone 3 goaf areas in the YWS and standing pillars in a 72% Zone 2 extraction panel in the BHS, despite a calculated FoS value of 1.40 at 73 m depth of cover.

As previously discussed, the maximum future subsidence was determined for the following two pillar run cases in the Zone 2 areas of the BHS workings:

Case (i) - by ignoring the inherent stability of the remnant pillars after yield and assuming complete pillar crush will occur in all standing pillars in Zone 2 across the site, and

Case (ii) - by assuming the pillars will behave elastically in Zone 2 where the FoS values under FTA loading conditions are > 2.11 or > 1.6 under abutment loading conditions along goaf edges.

The pillars in Zone 1 areas have been assumed to behave elastically for both of the above cases, as it is considered that this is both reasonable (due to their inherent stability of first workings pillars) and conservative (in terms of maximising potential tilts).

The unmined pillars in the Zone 3 panels are partially or fully surrounded by goaf and could be subject to multiple abutment loading conditions. The same logic has also been applied as was done for Zones 1 and 2 areas in assessing the stability of standing pillars in Zone 3.

Based on full tributary area loading theory (and ignoring multi-seam interaction effects) the cover depths above each of the Zone 1 and 2 pillar panels in the BHS and YWS workings where elastic pillar response would be likely to occur, have been estimated. The results are summarised in **Table 2**.

Table 2 - Pillar Extraction Zones and Estimated Cover Depth Limits for Elastic Behaviour (i.e. FoS > 2.11) under FTA Loading Conditions

Seam	Mine	Pillar Type Extraction Zone (refer to text)	Pillar Extraction Ratio Range	Pillar w/h	Elastic Depth of Cover Limit* (m)	Panel Cover Depth Range (m)
YWS	WBH	1	19 - 66%	2.9 - 12.5	343 - 60	20 - 120
		2	40 - 57%	3.3 - 7.1	116 - 75	20 - 110
		3	22 - 46%	4.2 - 14.6	NA	20 - 115
	Gretley	1	31 - 58%	2.1 - 10.4	221 - 54	30 - 110
		2	40 - 58%	2.1 - 6.3	134 - 54	30 - 120
		3	23 - 56%	2.5 - 12.5	NA	30 - 120
BHS	Browns/ Duckenfield	1	29 - 65%	2.4 - 9.7	237 - 60	30 - 150
		2	51 - 72%	2.0 - 6.1	128 - 45	20 - 145
		3	-	-	-	-

YWS - Young Wallsend Seam

BHS - Borehole Seam

WBH - Wallsend Borehole Colliery Workings.

* - Also satisfies FoS > 1.6 under single abutment loading conditions

NA- Elastic behaviour assumed under multiple abutment loading assumed if FoS > 1.6 (conservative).

Bold - Key extraction ratio and contour depths for Pillar Run Case (ii).

The FoS values used for elastic behaviour cut-off limits are considered conservative, based on the database of failed and unfailed pillar panels and the standing Zone2 area pillars in the BHS that were encountered in boreholes 301 and 302.

The above FoS values also consider the expected ‘strain-softening’ behaviour of the BHS pillars beneath the site, which is also a significant issue in regards to the consequences of pillar failure and potential risk to the proposed development structures.

4.5 Roof and Floor Bearing Capacity

Reference to **Pells *et al*, 1998** indicates that the bearing capacity of sedimentary rock under shallow footing type loading conditions is 3 to 5 times its UCS strength. Based on the estimated range of UCS values in the immediate floor and roof strata the general bearing capacity of the floor strata is estimated to range between 60 and 150 MPa.

A similar outcome is predicted by shallowing footing bearing capacity theory presented in **Das, 1998**.

For pillars with widths ranging from 4 to 25 m wide pillars and the average FTA pillar stress range of 1 to 11 MPa predicted (see **Table 1**), an overall average FoS against roof and floor bearing failure ranges between 5.45 and 13.6, which is highly likely to be within the elastic behaviour range.

Due to the absence of time-dependent subsidence observations above the flooded areas of the workings, it is also considered unlikely that long-term degradation or weakening of the roof/floor materials will be significant.

5.0 Future Worst-Case Subsidence Predictions

5.1 Maximum Panel Subsidence

In regards to Pillar Run Case (ii) and the Zone 1 and 2 panels, if the calculated FoS for the panels is < 2.11 under FTA loading or < 1.6 under single abutment loading conditions, the maximum panel subsidence has been estimated by multiplying the effective mining height of the pillars (T_e) and a subsidence factor (a) of 0.6. The effective mining height is determined based on **Salamon and Oravec, 1976**, whereby the actual mining height is multiplied by the pillar extraction ratio.

Alternatively, if the calculated FoS for the panels is > 2.11 under FTA loading or > 1.6 under single abutment loading conditions, the maximum panel subsidence has been estimated by multiplying the minimum pillar subsidence due to elastic pillar system compression (see **Section 5.2**) by 5 (to provide a conservative factor of safety on the elastic parameters assumed).

For the Zone 3 panels in each seam (which have already goafed or partially collapsed) additional goaf reactivation or additional consolidation movements equal to 12.5% and 8% of the mining height has been estimated for the YWS and BHS respectively, based on reference to **Holt, 2001**.

For Pillar Run Case (i) predictions, the FoS values for the Zone 2 panels has been ignored to provide for the possibility that the dimensions of the pillars are incorrect and the pillar run goes right to the panel limits.

5.2 Minimum Panel Subsidence

The following equations derived from elastic solid mechanics theories have been applied to predict minimum pillar subsidence for super-critical panel geometries:

$$S_{\max} = S_{\text{pillar}} + S_{\text{roof}} + S_{\text{floor}}$$

where

$$S_{\text{pillar}} = \sigma_{\text{net}} h / E_{\text{coal}} = \text{compression of pillar}$$

$$S_{\text{roof}} = \sigma_{\text{net}} w I(1-v^2) / E_{\text{roof}} = \text{compression roof strata}$$

$$S_{\text{floor}} = \sigma_{\text{net}} w I(1-v^2) / E_{\text{floor}} = \text{compression of floor strata}$$

$$\sigma_{\text{net}} = \text{net pillar stress (FTA stress - virgin stress)}$$

$$E_{\text{coal}} = \text{Young's Modulus for coal} = 2 \text{ GPa};$$

$$E_{\text{roof}} = \text{Rock Mass Young's Modulus for the roof strata within one pillar width of the roof} \\ = 40\% \text{ of } 300 \times \text{UCS} = 6 \text{ GPa};$$

E_{floor} = Rock Mass Young's Modulus for the floor strata with one pillar width of the floor
= 40% of 300 x UCS = 6 GPa;

ν = Poisson's Ratio = 0.25 for roof and floor strata;

I = shape factor for square footing = ~ 1 (for a semi-rigid footing)

w = pillar width.

h = pillar height.

Collapsed roof rubble adjacent to standing pillars will also provide load bearing capacity but only after significant subsidence has occurred (i.e. 10% of the seam thickness).

5.3 Results

The maximum future super-critical panel subsidence predictions for each seam's panel zones are presented in **Table 3**.

Table 3 - Predicted Worst-Case Subsidence above Supercritical Panel Geometries

Seam	Mine	Pillar Zone (refer to text)	Max Pillar h (m)	Pillar Run Case (i) - Pillar Panel FoS in Zone 2 Areas Ignored				Pillar Run Case (ii) - Pillar Panel FoS > 2.11 Cover Depth Limits in Zone 2 Areas Included			
				S_{max}/T	S_{min}/T	Net S/T	Subs (m)	S_{max}/T	S_{min}/T	Net S/T	Subs (m)
YW	WBH	1	3.0	0.002 -0.12	0.000- 0.003	0.002- 0.010	0.005- 0.03	0.002 -0.12	0.000- 0.003	0.002- 0.010	0.005- 0.029
		2	3.0	0.002 -0.22	0.001- 0.003	0.002- 0.22	0.006- 0.66	0.002 -0.22	0.001- 0.003	0.002- 0.22	0.006- 0.66
		3	2.4	0.125	0.000	0.125	0.30	0.125	0.000	0.125	0.30
	Gretley	1	3.0	0.006 -0.31	0.001- 0.004	0.005- 0.30	0.01- 0.91	0.006 -0.31	0.001- 0.004	0.005- 0.30	0.01- 0.91
		2	3.0	0.01- 0.31	0.001- 0.01	0.01- 0.30	0.02- 0.90	0.01- 0.31	0.001- 0.01	0.01- 0.30	0.02- 0.90
		3	2.4	0.125	0.000	0.125	0.3	0.125	0.000	0.125	0.3
BH	Browns/ Ducken- field	1	2.1	0.001 -0.33	0.001- 0.008	0.004- 0.33	0.01- 0.69	0.001 -0.33	0.001- 0.01	0.001- 0.33	0.01- 0.69
		2	2.1	0.27- 0.41	0.001- 0.013	0.26- 0.41	0.55- 0.86	0.01- 0.41	0.001- 0.013	0.01- 0.41	0.01- 0.86
		3	2.1	0.08	0.000	0.08	0.17	0.08	0.00	0.08	0.08

YWS - Young Wallsend Seam

BHS - Borehole Seam

WBH - Wallsend Borehole Colliery Workings.

Calculation details of subsidence results presented are given in **Attachment A**.

6.0 Future Worst-Case Subsidence Contours

6.1 SPDS Model Development for the Minmi Site

Based on the supercritical subsidence predictions presented in **Section 5.3**, the **SPDS[®]** (Surface Deformation Prediction System - version 5.5R, May, 2007) model has been used to generate the predicted worst-case contours for subsidence, tilt, curvature, and strains.

SPDS[®] is a US developed (Virginia Polytechnical Institute) influence function model for making subsidence predictions above longwalls or pillar extraction panels. The model requires calibration to measured subsidence profiles for it to reliably predict the subsidence and differential subsidence profiles. Further details of the program are provided in **Appendix B**.

The model for Minmi has been developed using the following key subsidence profile parameters derived from the Newcastle Subsidence coalfield data provided in **ACARP, 2003**:

- The supercritical panel subsidence factor (S_{\max}/T);
- Distance of the inflexion point (or maximum tilt location) from panel sides (d);
- Influence angle (β), which is defined by the angle (to the horizontal) from the inflexion point to the point of 'zero' or measurable subsidence (normally taken to be 20 mm);
- Angle of draw (θ), which is defined by the angle (to the vertical) from the panel edge to the point of 'zero' or measurable subsidence (normally taken to be 20 mm);
- The horizontal strain coefficient (β_s) is the linear constant used to estimate strain from the predicted curvature. It is equivalent to the reciprocal of the neutral axis of bending, d_n used in **ACARP, 2003**. Based on Newcastle Coalfield data, a value of $d_n = 10$ m or a $\beta_s = 0.1 \text{ m}^{-1}$ has been applied to predict 'smooth' profile strains using the **SPDS[®]** model curvatures.

The above input parameters determined for the Minimi site workings are summarised in **Table 4**.

Table 4 - Summary of the SPDS Model Input Parameters Used for the Minmi Subsidence Contour Predictions

Parameter	Units	Range
Maximum Panel Subsidence Factor, S_{max}/T	m/m	0.001 - 0.41
Panel Width, W	m	46 - 1072
Cover Depth, H	m	30 - 150
Panel W/H	m/m	0.5 - 7
Inflexion Point/Cover Depth Ratio, d/H	m/m	0.12 - 0.4
Inflexion Point Distance from Panel sides	m	12 - 48
Influence Angle (β)	degrees	47.5 - 58.1
$\tan\beta$	m/m	1.1 - 1.6
Angle of Draw (θ)	degrees	26.5
$\tan\theta$	m/m	0.5

The SPDS[®] model also uses a grid of cover depth points, which allows it to adjust the maximum panel subsidence when the panel widths are subcritical (i.e. $W/H < 1.4$).

6.2 Subsidence Contour Predictions

Subsidence contour predictions have been made for each seam by importing the Zone 1 to 3 panels in .dxf format into the SPDS[®] model and applying the appropriate subsidence profile values for each panel as previously discussed. The subsidence contours were then transformed into a 10 x 10 m grid in Surfer8[®] using data 'kriging' techniques. The grids were also given a light filter to reduce the artificial effect of grid 'noise' on the differential subsidence predictions.

The worst-case future subsidence contours for the BHS and YWS workings are presented in **Figures 8a** and **9a** for Pillar Run Case (i) and **Figure 11a** for Pillar Run Case (ii). *Note: The contours for the YWS panels did not change for Pillar Run Case (i) and (ii) due to the small Zone 2 areas in these workings.*

The multiple seam outcomes were determined by adding the contours for each seam together and are presented in **Figures 10a** and **12a** for Pillar Run Cases (i) and (ii) respectively.

The contours indicate that worst-case maximum subsidence will range from:

- 0.8 to 1.1 m above Zone 2 Pillar Panels in the BHS;
- 0.15 to 0.3 m above Zone 3 Panels in the BHS and YWS;
- <0.15 m above Zone 1 Pillars in both seams.

The location of the actual contours after a pillar run (if it occurs) will probably be somewhere between the predicted Pillar Run Cases (i) and (ii) contours.

6.3 Principal Tilt Contours

The maximum differential subsidence parameters were derived from the predicted subsidence contours using differential calculus techniques available in the **Surfer8[®]**.

The worst-case principle tilt contours for the BHS and YWS workings are presented in **Figures 8b** and **9b** for Pillar Run Case (i) and **Figure 11b** for Pillar Run Case (ii).

The multiple seam outcomes for tilt were determined from the multiple seam subsidence contours and are presented in **Figures 10b** and **12b** for Pillar Run Cases (i) and (ii) respectively.

A summary of the predicted ranges of maximum tilt for the Pillar Run Cases are shown in **Table 5**.

Table 5 - Predicted Maximum Tilts for Pillar Runs Cases (i) and (ii)

Pillar Run Case	Zone 2 Extraction Ratio (%)	Cover Depth to BHS Workings (m)	Maximum Tilt Range (mm/m)
(i) Complete Pillar Run in Zone 2	61 - 72	<30	14 - 17
		30 - 80	7 - 14
		80 - 150	2 - 7
(ii) Partial Pillar Run in Zone 2	72	<45	2 - 7
		45 - 80	7 - 14
		80 - 150	2 - 7
	61 - 65	<60	2 - 7
		60 - 80	7 - 12
		80 - 150	2 - 7

The maximum tilt in areas above Zones 1 and 3 are considered unlikely to be tilted by more than 3 mm/m, however, small areas with relatively stiff, standing pillars adjacent to or within low stiffness Zone 2 or 3 areas could also result in tilts with similar magnitudes as the values given in **Table 7** for the same depth of cover.

6.4 Principal Curvature Contours

The multiple seam outcomes for principle curvature were determined from the multiple seam subsidence contours and are presented in **Figures 10c** and **12c** for Pillar Run Cases (i) and (ii) respectively.

A summary of the predicted ranges of maximum tilt for the Pillar Run Cases are shown in **Table 6**.

Table 6 - Predicted Maximum Curvatures for Pillar Runs Cases (i) and (ii)

Pillar Run Case	Zone 2 Extraction Ratio (%)	Cover Depth to BHS Workings (m)	Maximum Curvature Range (1/km)	Minimum Curvature Radius Range (km)
(i) Complete Pillar Run in Zone 2	61 - 72	<30	+/- 0.6	+/- 1.7
		30 - 80	+/- 0.5	+/- 2.0
		80 - 150	+/- 0.2	+/- 5.0
(ii) Partial Pillar Run in Zone 2	72	<45	+/- 0.2	+/- 5.0
		45 - 80	+/- 0.5	+/- 2.0
		80 - 150	+/- 0.2	+/- 5.0
	61 - 65	<60	+/- 0.2	+/- 5.0
		60 - 80	+/- 0.4	+/- 2.5
		80 - 150	+/-0.2	+/- 5.0

All other areas with Zones 1 and 3 are likely to have curvatures of $< 0.1 \text{ km}^{-1}$ ($>10 \text{ km}$ radius), however, the presence of relatively stiff, standing pillars adjacent to or within low stiffness Zone 2 or 3 areas could also result in curvatures in with similar magnitudes as the values given in **Table 6** for the same depth of cover.

6.5 Principal Strain Contours

The multiple seam outcomes for principle horizontal strains (tensile and compressive) were determined from the multiple seam curvature contours and are presented in **Figures 10d** and **12d** for Pillar Run Cases (i) and (ii) respectively.

A summary of the predicted ranges of maximum tilt for the Pillar Run Cases are shown in **Table 6**.

Table 7 - Predicted Maximum Strains for Pillar Runs Cases (i) and (ii)

Pillar Run Case	Zone 2 Extraction Ratio (%)	Cover Depth to BHS Workings (m)	Maximum Horizontal Strain Range*+ (mm/m)
(i) Complete Pillar Run in Zone 2	61 - 72	<30	+/- 6
		30 - 80	+/- 5
		80 - 150	+/- 2
(ii) Partial Pillar Run in Zone 2	72	<45	+/- 2
		45 - 80	+/- 5
		80 - 150	+/- 2
	61 - 65	<60	+/- 2
		60 - 80	+/- 4
		80 - 150	+/-2

* - Tension is positive.

+ - Strain concentrations due to cracking of near surface rock can increase the predicted values locally by 2 times. Deep soil profiles tend to reduce the likelihood of strain magnification.

All other areas with Zones 1 and 3 are likely to have strains of < +/-1 mm/m, however, the presence of relatively stiff, standing pillars adjacent to or within low stiffness Zone 2 or 3 areas could also result in strains with similar magnitudes as the values given in **Table 7** for the same depth of cover.

6.6 Subsidence Impact Hazard Zones

Based on discussions with the MSB, the proposed development structure types will be mostly restricted by the potential maximum tilts that could develop if a pillar run occurs. The principal curvature and horizontal strain can usually be designed for by including an appropriate level of articulation or flexibility in the superstructure. As subsidence itself does not cause damage directly, it is only really used as an indicator of the tilt, curvature and strain magnitudes.

Predicted future tilts of > 7 mm/m represent a 'high' subsidence impact hazard as the buildings will be required to be re-levelled to remain serviceable.

Areas where the tilts could exceed this limit are shown as black line cross hatching in **Figures 10b** and **12b** for Pillar Run Cases (i) and (ii) respectively. Representative multi-seam subsidence and tilt profiles for Pillar Run Cases (i) and (ii) have also been prepared along Sections A and B (see **Figures 10a** or **12a** for their location) and are shown in **Figures 13** and **15** respectively.

The high tilt hazard zones have the potential to occur above the Zone 2 (partial extraction panels) in the BHS if the pillars are still standing and a pillar run develops at some point in the future. As previously discussed, Pillar Run Case (i) represents the scenario where the pillar run starts in the middle of the panel and goes right out to the panel sides. Pillar Run Case (ii) represents the scenario where the pillar run stops somewhere between the middle of the panel where the strength of the remnant coal pillars have sufficient strength to support the

applied abutment loads. It has been assessed that the pillar runs could stop when the cover depth decreases to < 60 m for the 61-65% extraction ratio BHS panels and < 45 m for the 72% extraction ratio BHS panels.

Based on the tilt v. cover depth profiles across the site (see **Figures 14** and **16** for each pillar run case) and the associated predicted tilt contours (see **Figures 10b** and **12b**), the high tilt hazard areas will only affect the areas where cover depths are < 80 m, as a pillar run in the Zone 2 panels are unlikely to generate tilts that will exceed 7 mm/m where the cover depth is greater.

The tilt profiles also indicate that where a pillar run stops, a band of high tilt between 7 and 14 mm/m could develop over a 50 m wide area along the goaf side edge of the run 'front' (see also **Figures 13** and **15**).

The high hazard curvature and strain zones are shown for each Pillar Run Case in **Figures 10c** and **10d** for Case (i) and **Figures 12c** and **12d** for Case (ii).

Zones of 'High' curvature hazard have been indicated where curvatures could exceed 0.2 km^{-1} or a curvature radius of < 5 km.

Zones of 'High' strain hazard have been indicated where strains could exceed +/- 3 mm/m (with tension positive).

It is also important to note that local tilt, curvatures and strains that are similar in magnitude to the predicted values for the 'High' impact hazard areas could also develop anywhere on the site where there are stiff standing pillars adjacent to relatively softer workings areas that may consolidate if water levels continue to rise in the panels.

7.0 Conclusions

The study has identified several potential high subsidence impact hazard zones for the Minmi Site where tilts > 7 mm/m could develop above the old welsh bord pillars in the Borehole Seam. Maximum subsidence is estimated to range from 0.8 to 1.1 above these panels.

The high tilt hazard areas have been defined for two possible pillar run case scenarios, which have either ignored or included the FoS of the pillars under full tributary area and abutment load conditions. Pillar Run Case (i) assumes the pillar run will occur right out to the panel limits and ignores the potential strength of the remnant pillars to support the applied abutment loads.

Pillar Run Case (ii) assumes that the pillar run will stop where pillar FoS is greater than 2.11 under FTA loading or > 1.6 under the assessed abutment loading conditions likely to be present along the goaf edges or pillar run 'front'. It is assessed that Pillar Run Case (ii) represents the more likely outcome as the worst-case scenario.

Areas above the BHS workings where a pillar run occurs and the depth of cover is > 80 m, are considered unlikely to develop tilts of more than 7 mm/m because of the cover depth and less severe subsidence profile that will develop.

Maximum curvatures in the potential pillar run areas are estimated to range from ± 0.3 to 0.6 km^{-1} (or radii of 1.7 to 3.33 km). Maximum strains associated with the pillar run curvatures are estimated to range between 3 and 5 mm/m.

Tilt, curvature and strain hazards will probably also exist in areas where 150 to 300 mm of subsidence is predicted above old goafs, although the likelihood that the tilts will exceed 7 mm/m, curvatures greater than 0.2 km^{-1} and strains in excess of 2 mm/m is very low.

It is considered likely that all the proposed buildings in the study area are likely to require articulation and subsidence impact amelioration details to be included in the design of the superstructure of the proposed buildings. Further discussions with the MSB in regards to appropriate building design constraints are recommended.

The locations of the high subsidence, tilt, curvature, and strain zones have been indicated in this report for subsequent assessment of appropriate building development constraints.

The design of driveways, retaining walls and site infrastructure (i.e. roads, drainage, sewerage and utilities) should also consider the worst-case subsidence contours presented herein.

8.0 References

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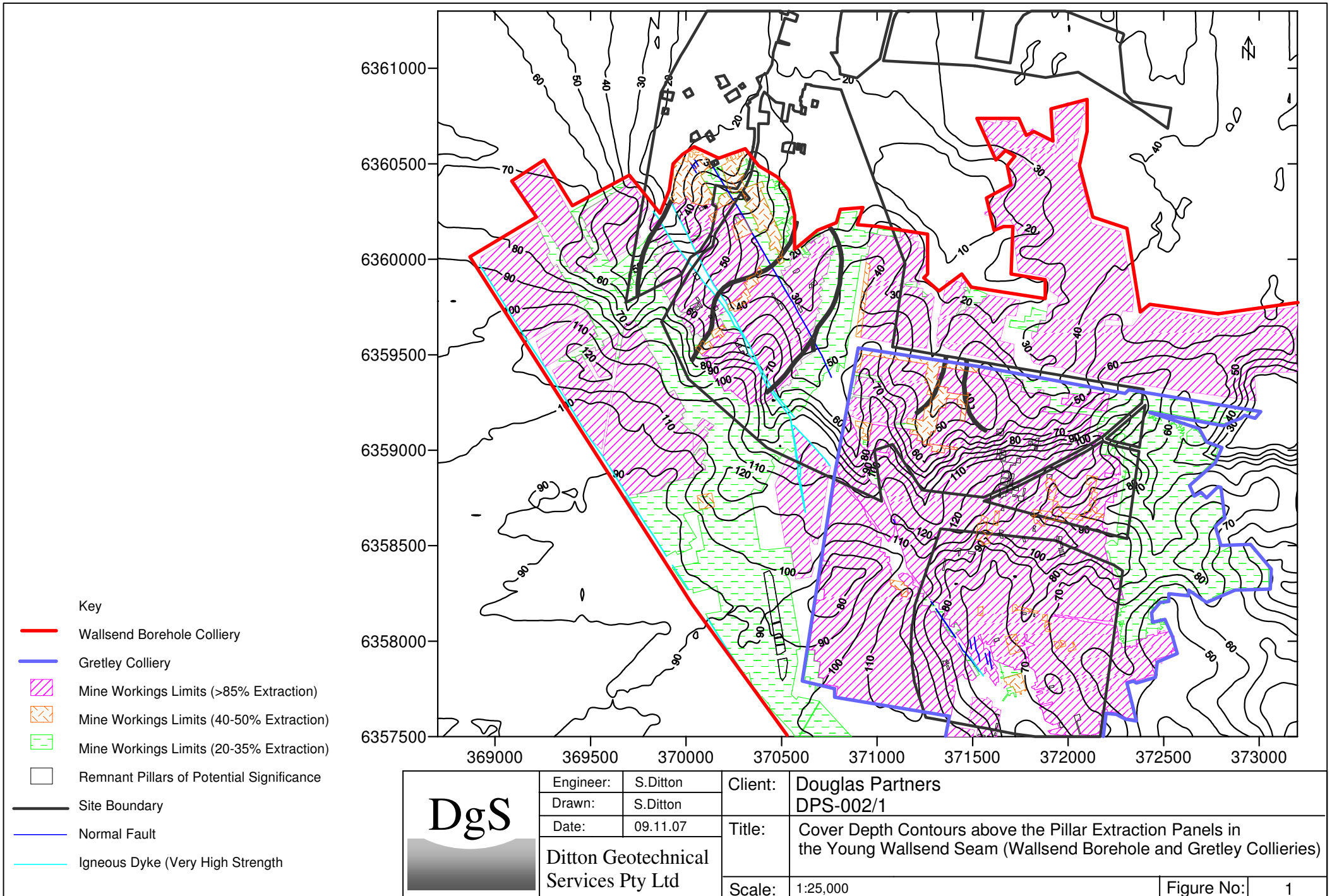
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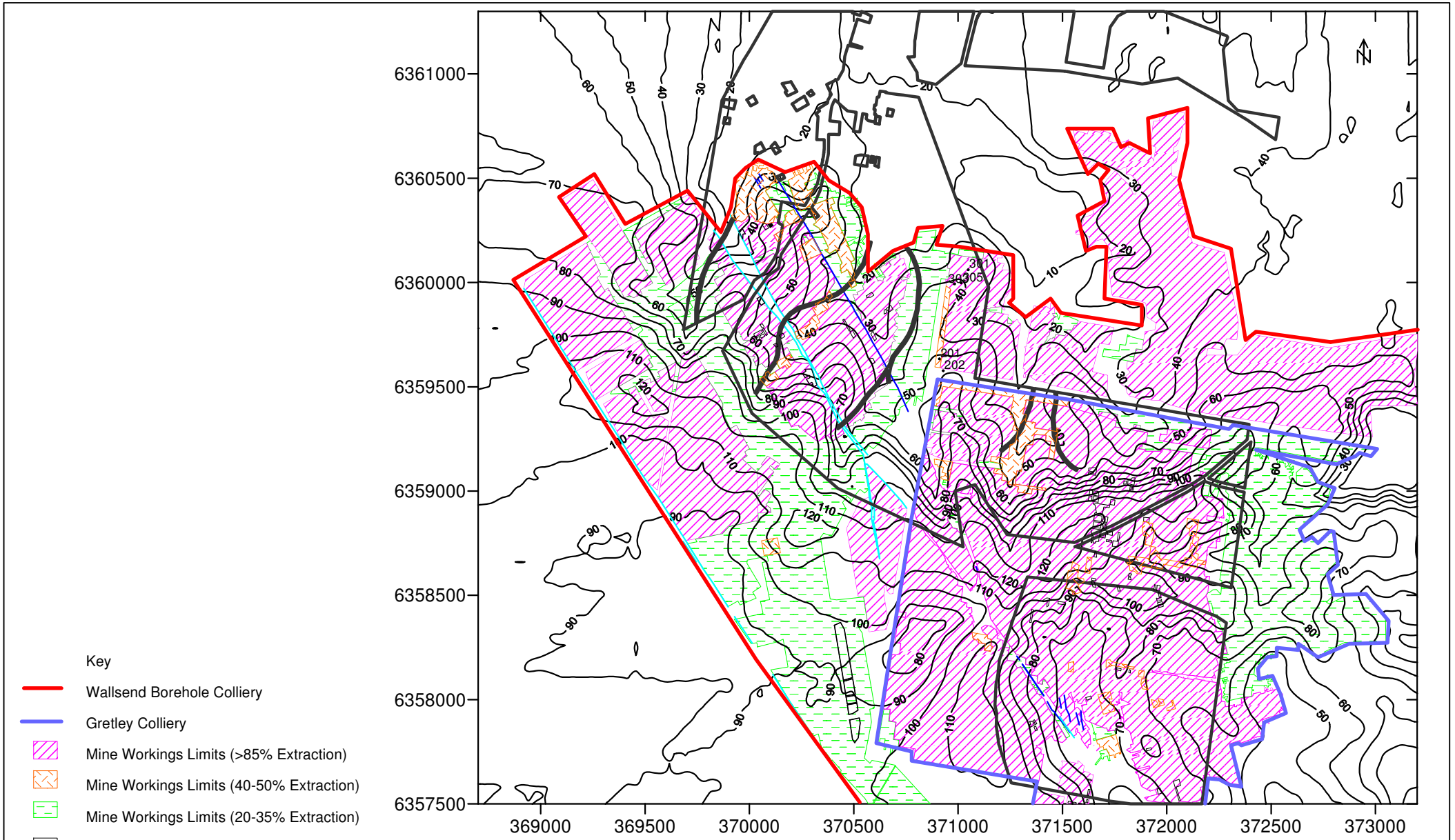
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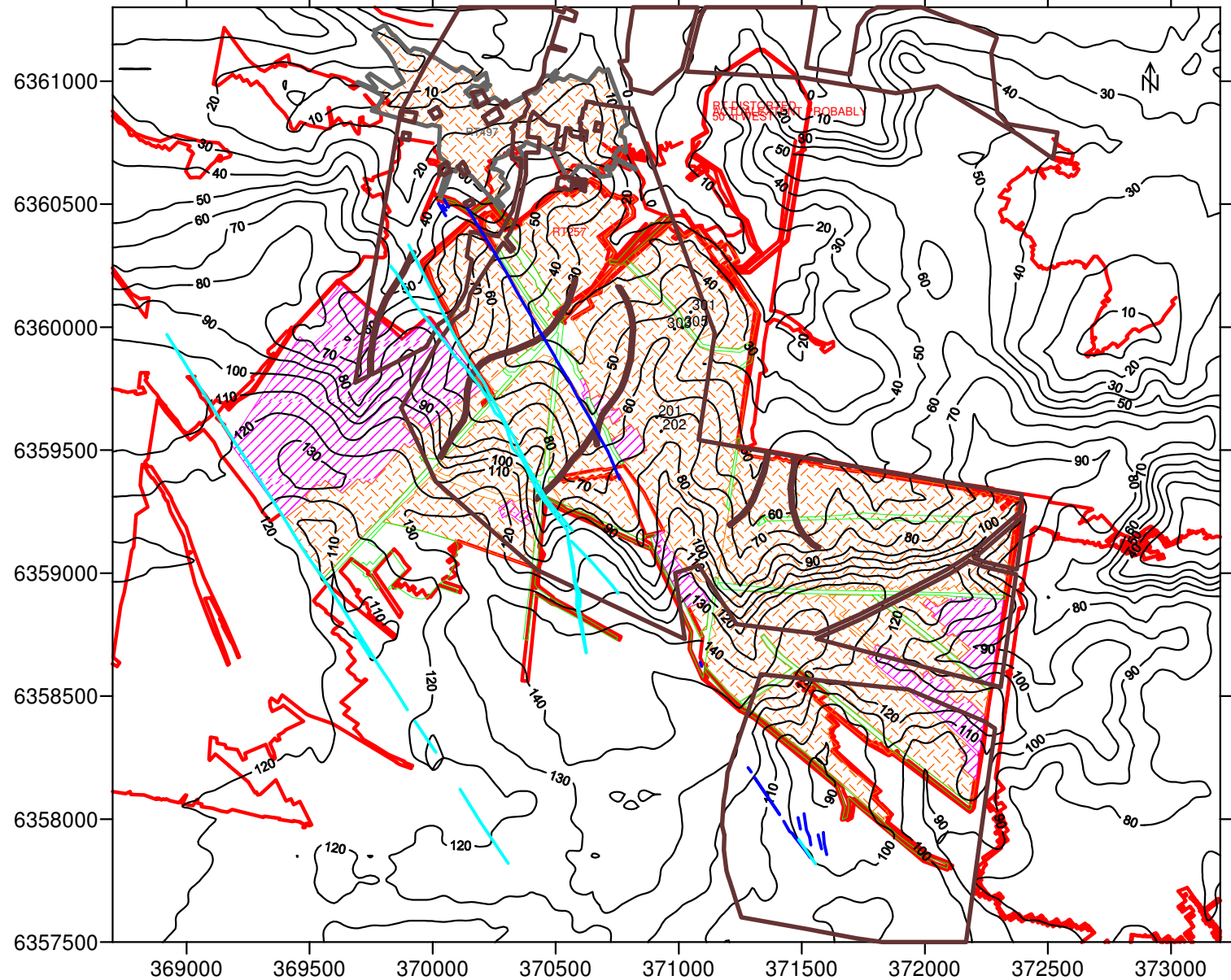




Key

- Wallsend Borehole Colliery
- Gretley Colliery
- Mine Workings Limits (>85% Extraction)
- Mine Workings Limits (40-50% Extraction)
- Mine Workings Limits (20-35% Extraction)
- Remnant Pillars of Potential Significance
- Site Boundary
- Normal Fault
- Igneous Dyke (Very High Strength)

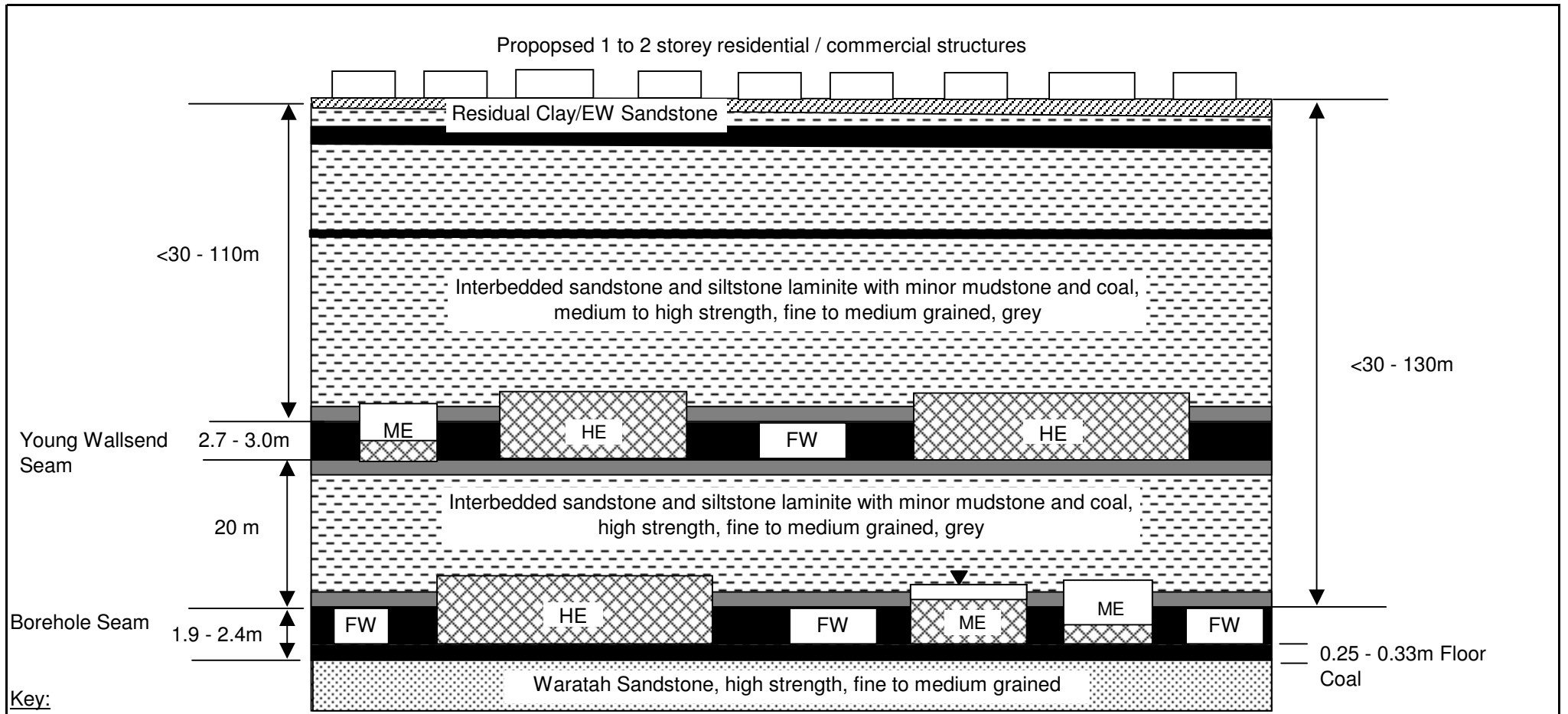
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	Drawn: S.Ditton	
	Date: 09.11.07	
Ditton Geotechnical Services Pty Ltd	Title: Cover Depth Contours above the Pillar Extraction Panels in the Young Wallsend Seam (Wallsend Borehole and Gretley Collieries)	
	Scale: 1:25,000	Figure No: 1




Key

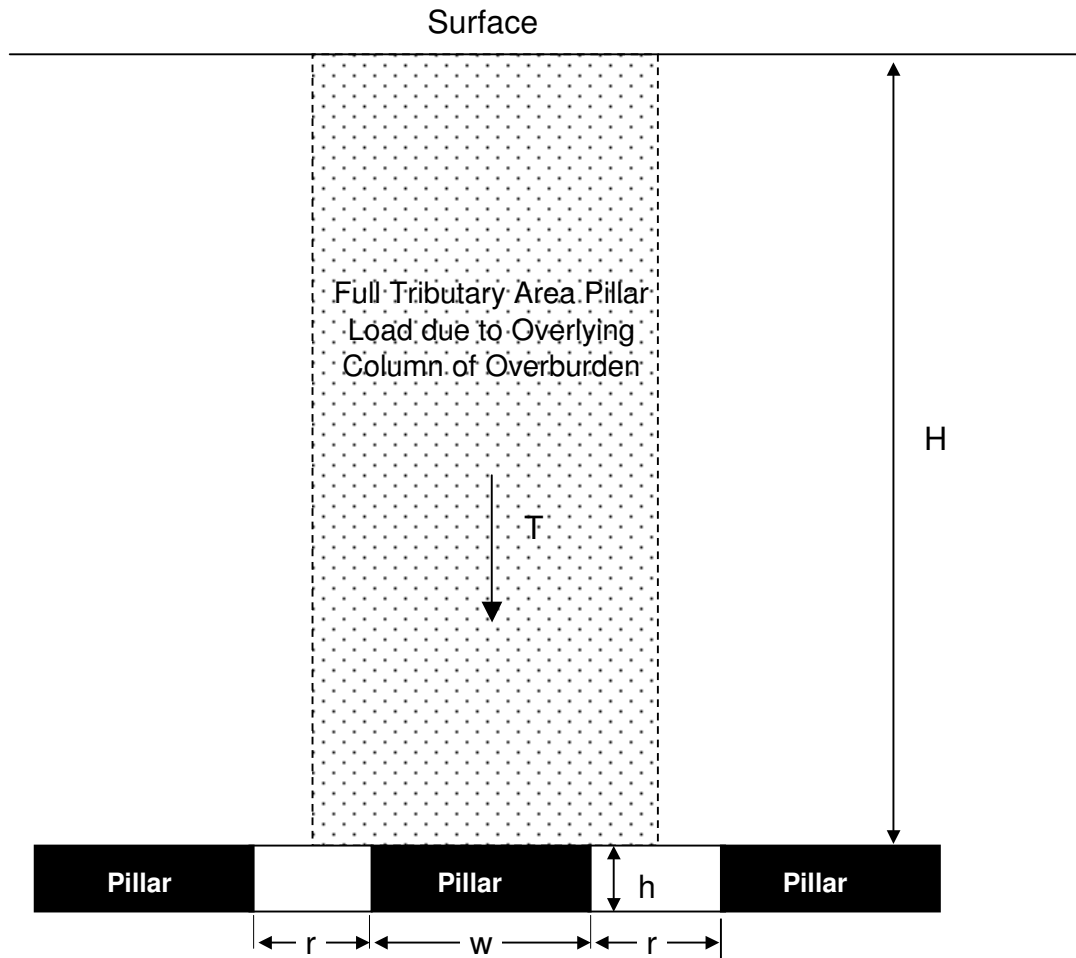
- Browns Minmi - A,B&C Pits (RT497)
- Duckenfield No.1 & No.2 (256, 257 & 257A)
- Mine Workings Limits (>85% Extraction)
- Mine Workings Limits (50-75% Extraction)
- Mine Workings Limits (20-40% Extraction)
- Site Boundary
- Normal Fault
- Igneous Dyke (Very High Strength)

	Engineer:	S.Ditton	Client:	Douglas Partners	
	Drawn:	S.Ditton		DPS-002/1	
	Date:	09.11.07	Title:	Cover Depth Contours above the Pillar Extraction Panels in the Borehole Seam (Browns & Duckenfield Collieries)	
Ditton Geotechnical Services Pty Ltd			Scale:	1:25,000	
				Figure No:	2



Key:
 FW - First Workings (e = 15 - 45%)
 ME - Moderate Second Workings (e = 50 - 60% in YW Seam; 61 - 72% in BH Seam)
 HE - High Extraction (e = 80 - 85%)

	Engineer:	S.Ditton	Client:	Douglas Partners Pty Ltd	
	Drawn:	S.Ditton		DPS-002/1	
	Date:	25.07.08	Title:	Overburden Conditions Beneath the Minmi Site	
	Ditton Geotechnical Services Pty Ltd		Scale:	NTS	Figure No:



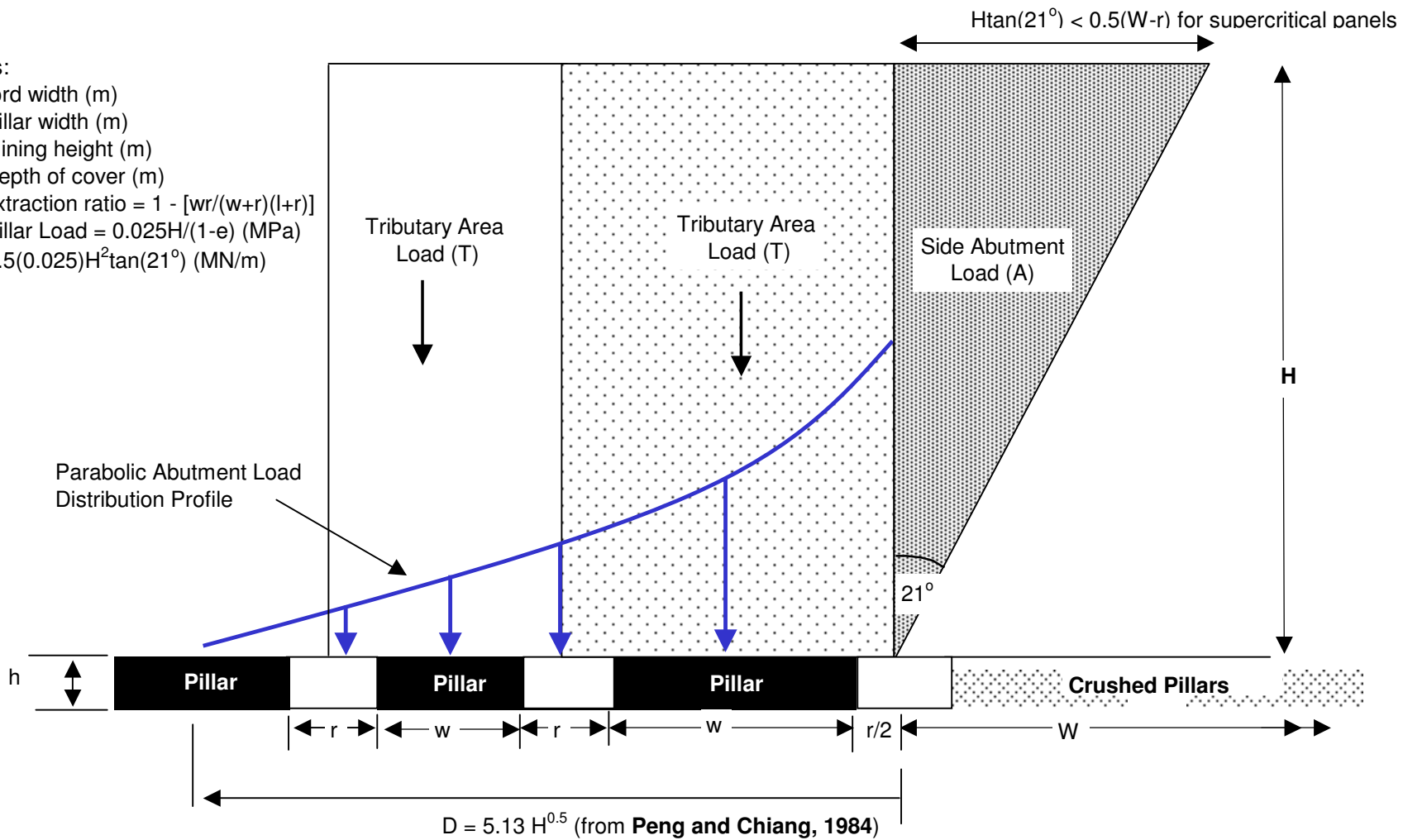
Notes:


- r = bord width (m)
- w = pillar width (m)
- h = mining height (m)
- H = depth of cover (m)
- e = extraction ratio = $1 - [wr/(w+r)(l+r)]$
- T = Pillar Load = $0.025H/(1-e)$ (MPa)

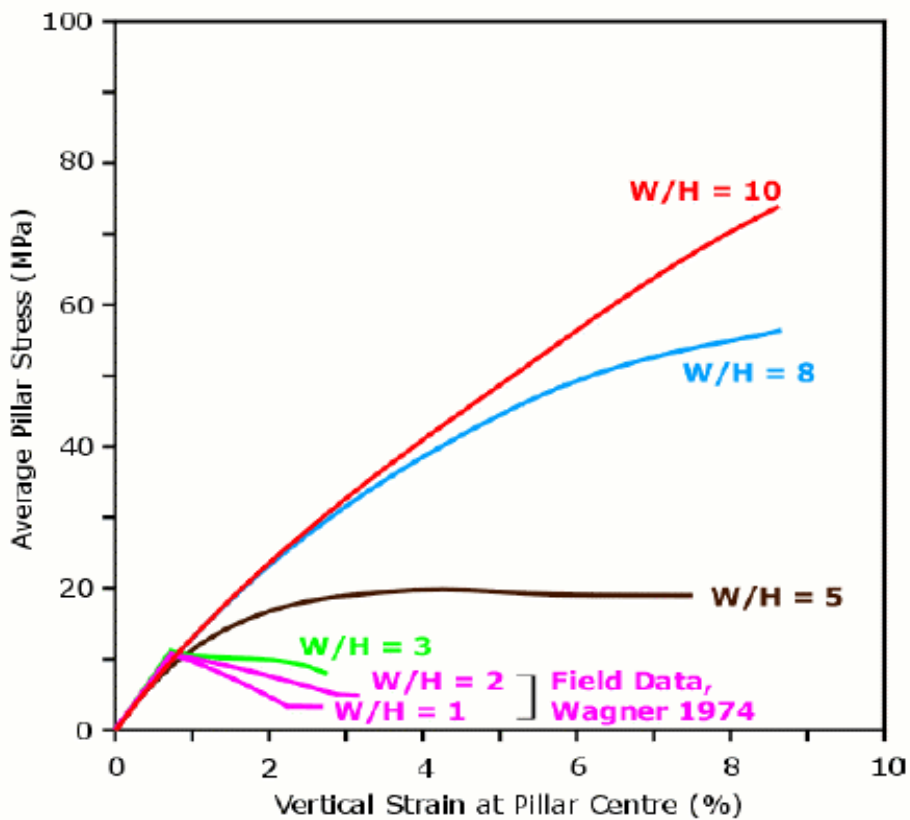


Engineer:	S.Ditton	Client:	Douglas Partners Pty Ltd	
Drawn:	S.Ditton		DPS-002/1	
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Ditton Geotechnical Services Pty Ltd		Scale:	NTS	Figure No: 4

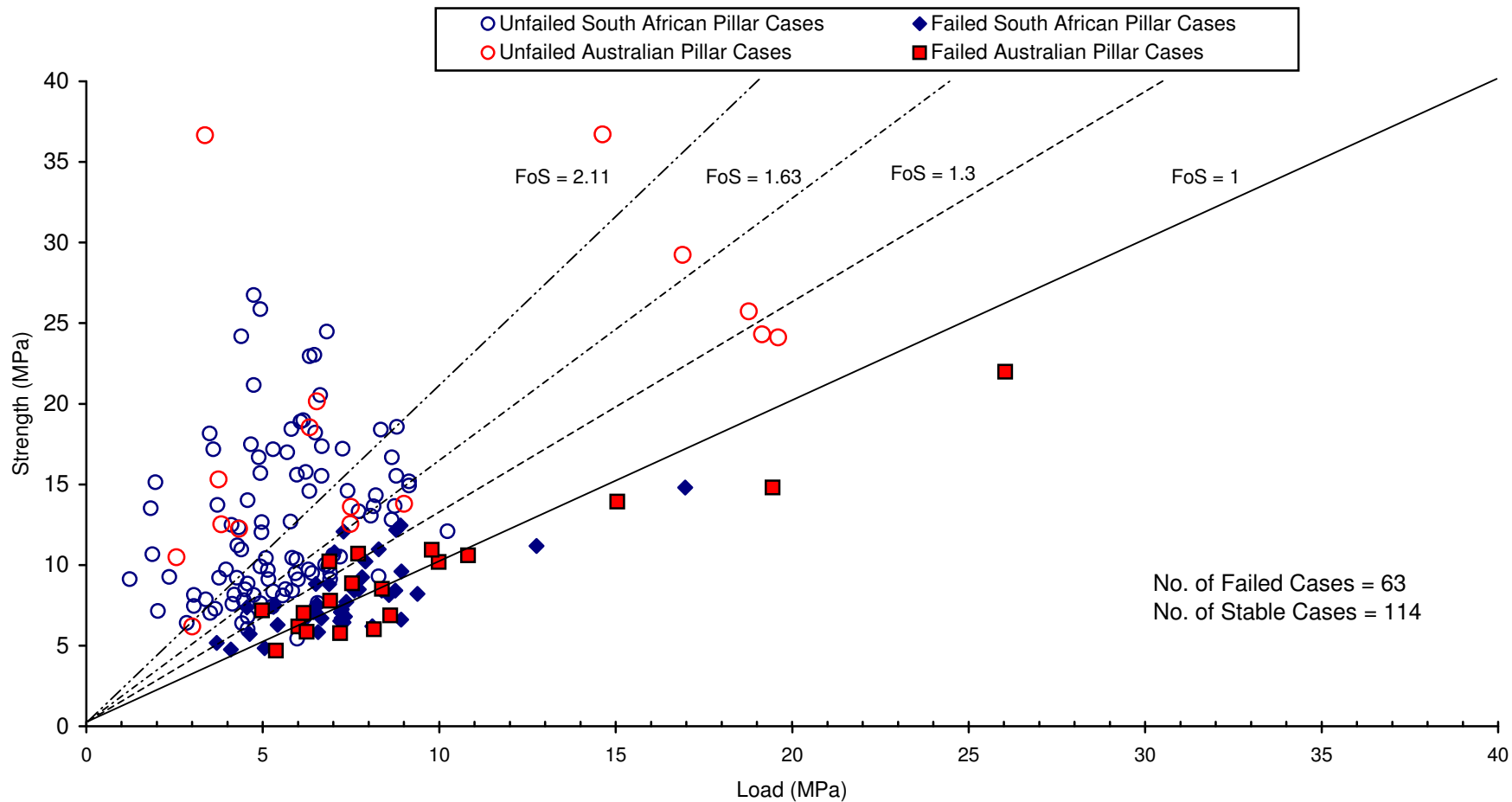
Notes:
 r = bord width (m)
 w = pillar width (m)
 h = mining height (m)
 H = depth of cover (m)
 e = extraction ratio = $1 - [wr/(w+r)(l+r)]$
 T = Pillar Load = $0.025H/(1-e)$ (MPa)
 A = $0.5(0.025)H^2 \tan(21^\circ)$ (MN/m)




	Engineer:	S.Ditton	Client:	Douglas Partners Pty Ltd
	Drawn:	S.Ditton		DPS-002/1
	Date:	28.07.08	Title:	Conceptual Model of Abutment Load Acting on Site Pillars Due to Pillar Run Scenario
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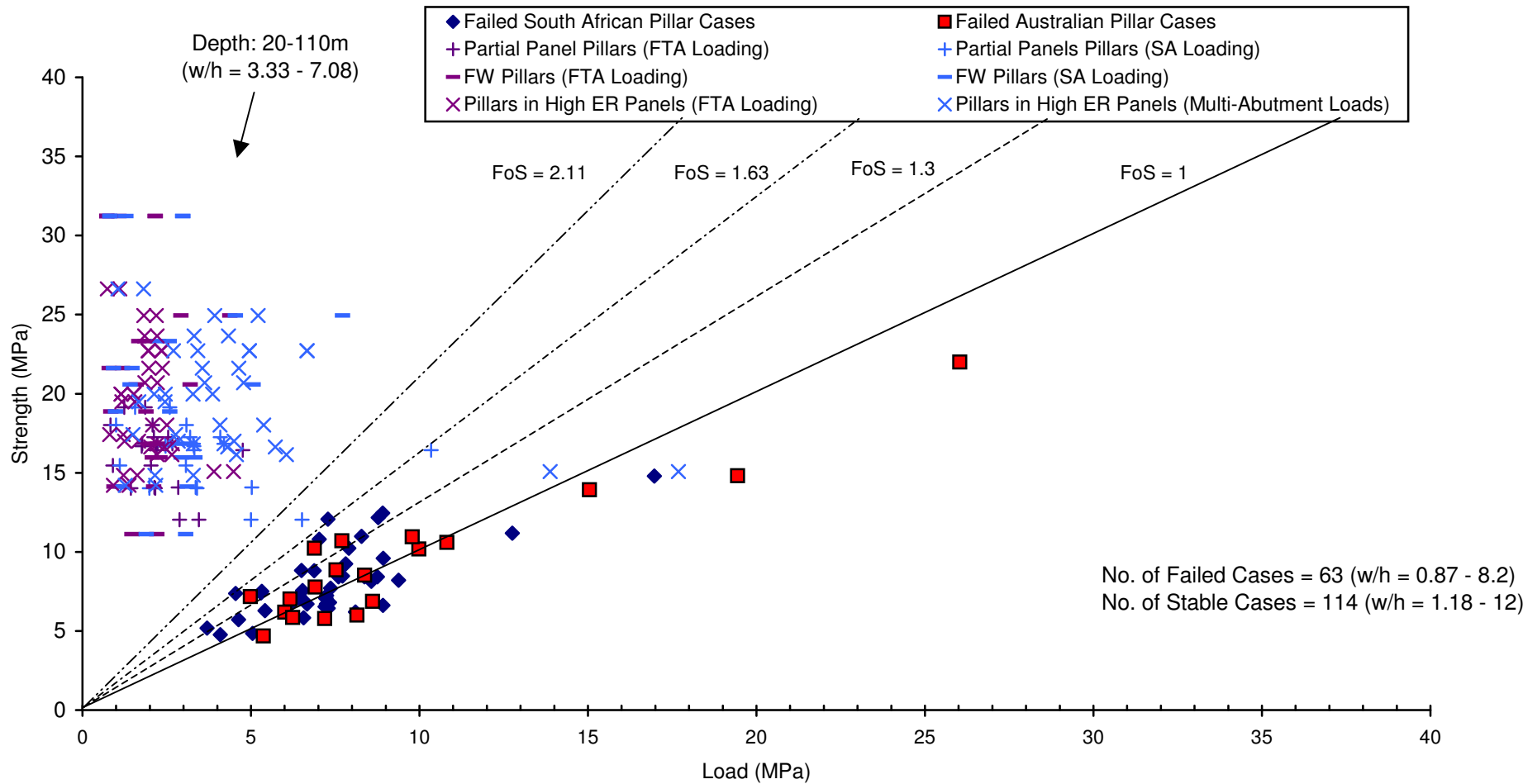


Engineer:	S.Ditton	Client:	Douglas Partners Pty Ltd
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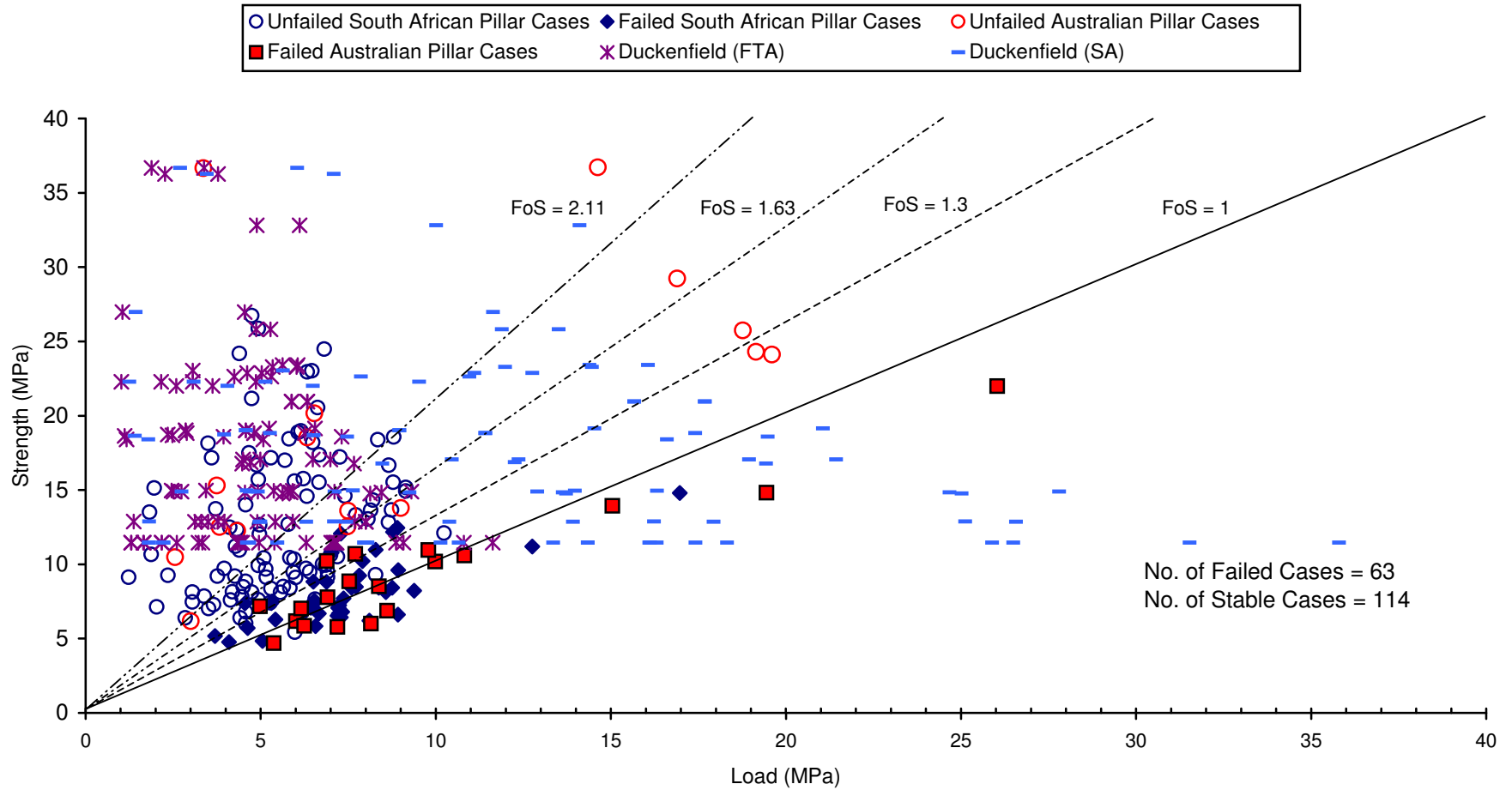
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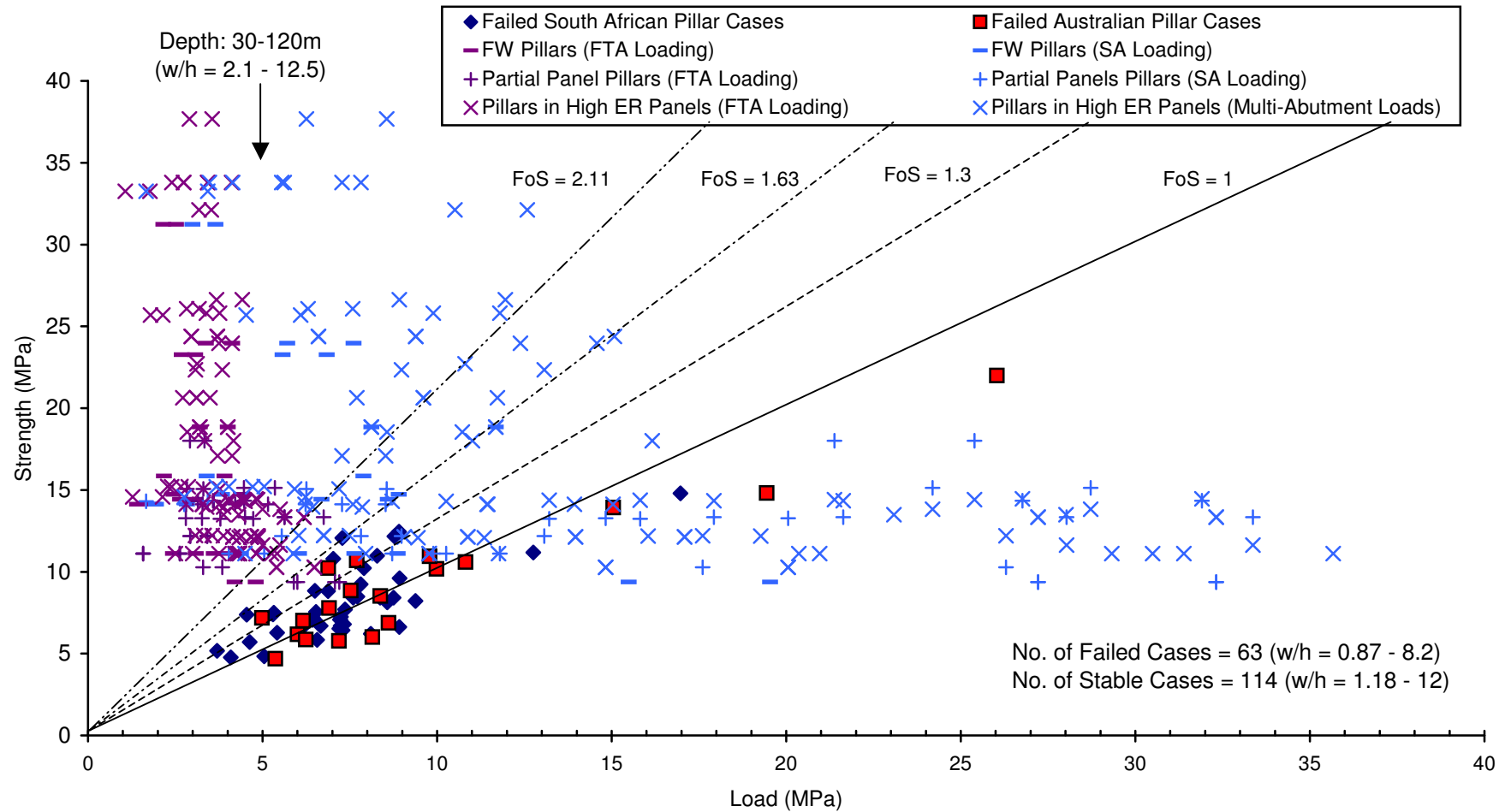
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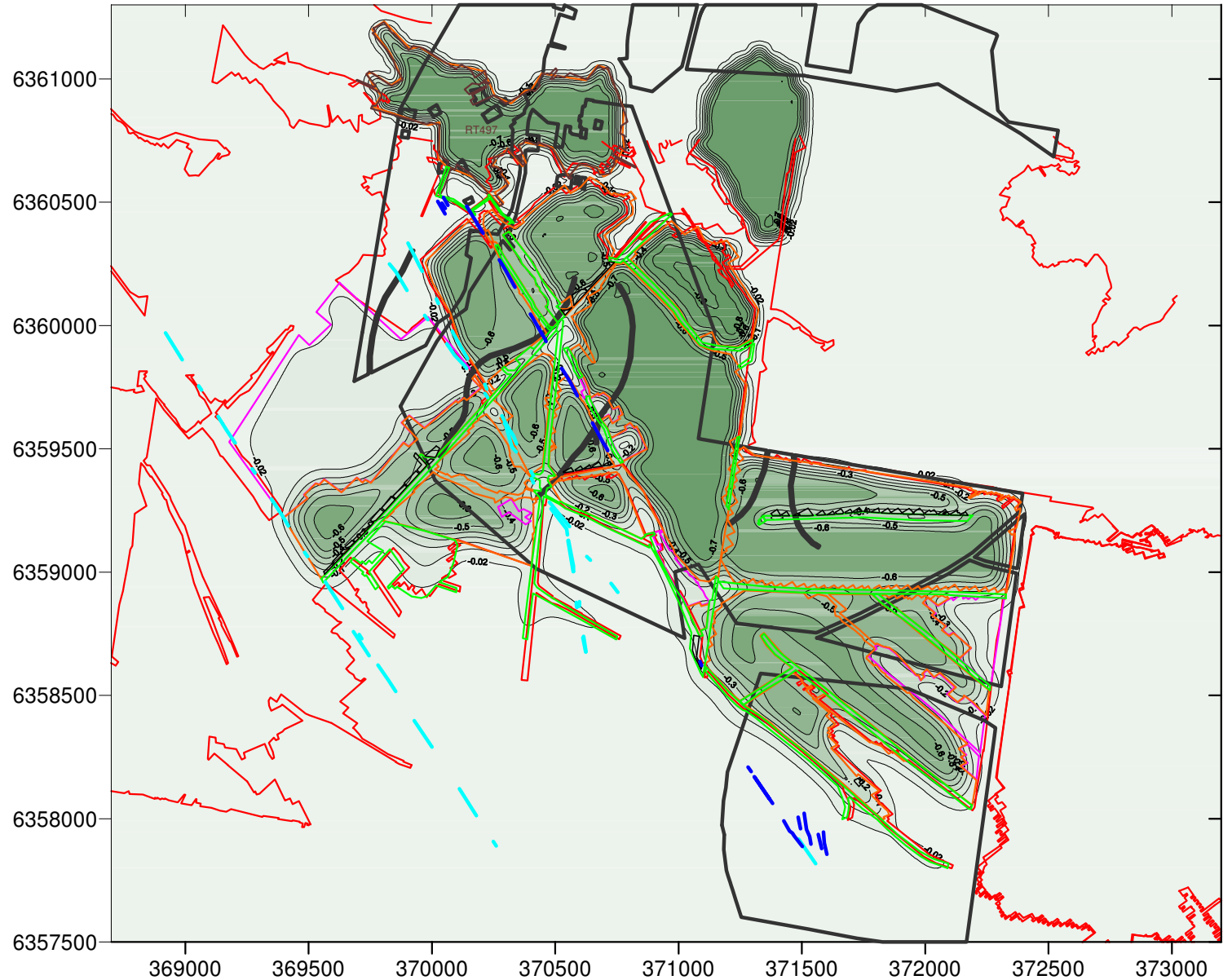
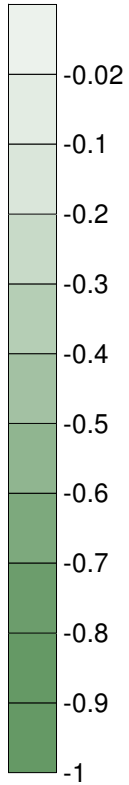
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Data extracted from Salamon, *et al* 1996.


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Subsidence (m)

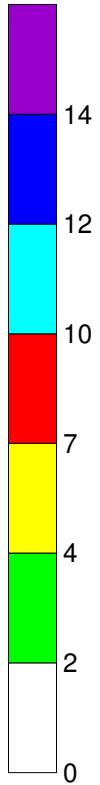


Key








-  Mine Workings Limits (>85% Extraction)
-  Mine Workings Limits (50-70% Extraction)
-  Mine Workings Limits (20-40% Extraction)
-  Site Boundary
-  Normal Fault
-  Igneous Dyke (Very High Strength)
-  Extent of Browns-Minmi & Duckenfield Mines
-  Extent of Browns Pit No.s A, B and C

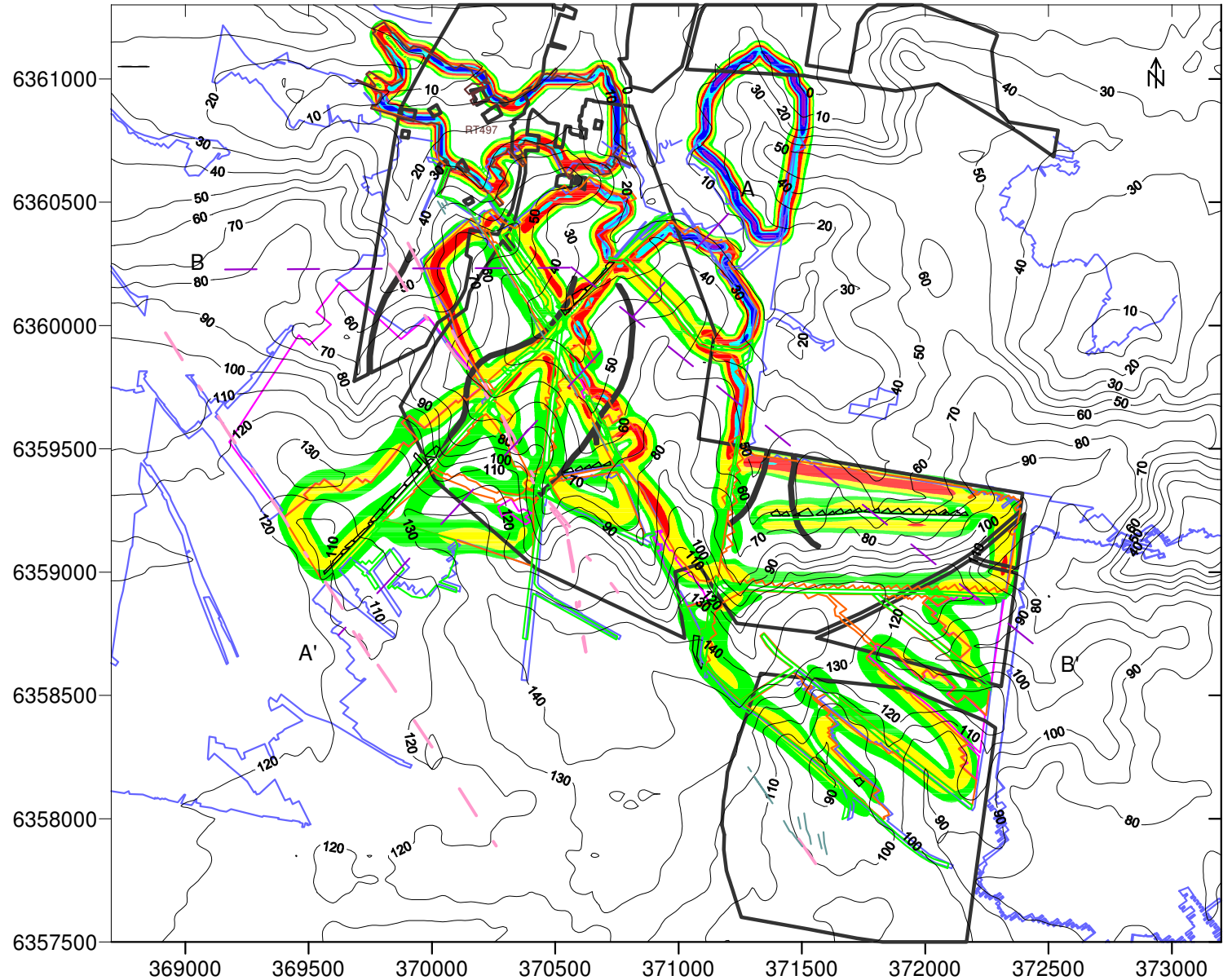
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Ditton Geotechnical Services Pty Ltd			Scale:	1:25,000	Figure No: 8a


Tilt (mm/m)



Key

-  High Tilt Hazard Zones (>7mm/m)
-  Moderate Tilt Hazard Zones (4 - 7 mm/m)
-  Site Boundary
-  Normal Fault
-  Igneous Dyke (Very High Strength)
-  Extent of Browns-Minmi & Duckenfield Mines in Borehole Seam
-  Depth of Cover above Borehole Seam



	Engineer:	S.Ditton	Client:	Douglas Partners DPS-002/1
	Drawn:	S.Ditton	Title:	Worst-case Future Tilt Contours above the Pillar Extraction Panels in the Borehole Seam (Browns & Duckenfield) with Pillar FoS for the FTA Load Case Ignored
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