



CONSULTING CIVIL & TRAFFIC ENGINEERS, RISK MANAGERS.



Civil Engineering



Traffic Engineering



Risk Management

Project: Transport Statement, Clay and Sand Extraction and
Cartage, Walyunga Road, Walyunga.

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1. Summary.

Shawmac was commissioned to assess the traffic impacts associated with the generation of traffic from the continuing operation of clay and sand extraction operation at part Lot 5 Walyunga Road in Bullsbrook.

The assessment follows the recommended outline contained in the West Australian Planning Commission draft guideline "Transport Statement Guidelines for Developments". Potential traffic flow from the site was estimated by applying the daily tonnage rate of product to be hauled offsite and the capacity of the proposed haulage vehicle type.

Traffic was assigned to the adjacent existing road network and flows used as a basis for assessing traffic impacts associated with the site. Based on the assessment it was shown that the flows predicted can be accommodated within the existing network without unacceptable adverse impacts with some modifications to the existing intersection geometry.

2. Introduction and Background.

2.1. Proponent.

Shawmac was commissioned by Brikmakers to assess the traffic impacts associated with the generation of traffic from the proposed clay and sand extraction operation at part Lot 5 Walyunga Road in Bullsbrook.

2.2. Site Location and Land Use.

The site is located as shown on Figure 1 and is within the City of Swan.



Figure 1 - Site Location

The study site is currently being used for extraction of clay and sand.

The existing site together with the surrounding area is shown on the aerial photograph, refer Figure 2.



Figure 2 - Aerial Photograph

2.3. Referenced Information.

In undertaking the study, the information listed below was referenced.

- Austroads Guide to Road Design Part 4A – Unsignalised and Signalised Intersections.
- MRWA Supplement to Austroads Guide to Road Design Part 4A – Unsignalised and Signalised Intersections.

3. Site Proposal.

3.1. Regional Context.

The site is located within the City of Swan approximately 30 km northeast of the Perth CBD and has direct street frontage to Walyunga Road which connects to Great Northern Highway.

3.2. Land Use.

The site is zoned under the City of Swan Local Planning Scheme 17 (LPS No.17) for "Regional Reserve, Primary Regional Road". The site is currently being used for clay and sand extraction and it is proposed to develop the site further for ongoing extractive industry purposes.



Figure 3 - Extract of City of Swan Town Planning Scheme

3.3. Major Attractors and Generators of Traffic.

Access to the site is via Walyunga Road which connects to Great Northern Highway. All movements to and from the site will be to the south.

4. Existing Situation.

4.1. Existing Roads.

4.1.1. Walyunga Road

Walyunga Road is classified as an access road and is under the care and control of the City of Swan. Walyunga Road runs generally in an east west direction from Great Northern Highway to a point approximately 4.0 kilometres to the east. The road consists of a sealed pavement about 7.7 metres wide near the Great Northern Highway intersection with 1.0 metre wide unsealed shoulders. Further east, the road width is about 7.4 metres with 1.0 metre shoulders. The speed zoning on Walyunga Road is unrestricted (110 km/h).

Walyunga Road is on the RAV network and is classified as Network 4. Conditions apply to Walyunga Road which requires permit vehicles to carry and produce on demand a current written approval from Local Government permitting use of the road.

4.1.1. Great Northern Highway (GNH)

GNH is classified as a Primary Distributor and has a RAV network 7 status according to the MRWA digital mapping website. GNH at the site is described as a sealed kerbed single carriageway road with traffic lanes approximately 3.5 metres wide and marked cycle lanes 1.5 metres wide. In the vicinity of the site, GNH has been widened to provide for auxiliary lanes including a right turn lane into Walyunga Road and an acceleration lane on the southbound turn from Walyunga Road onto Great Northern Highway.

GNH has a posted speed limit of 100 km/hr.

Traffic flows in GNH based on MRWA counts taken in February 2016 are shown on Table 1.

As the Great Northern Highway counts were taken post mining boom, there may be some concern that the flows under peak mining conditions may be higher than those recorded in 2016. As such, a review was undertaken of historical counts for Great Northern Highway and this indicated that in 2010/11 daily traffic was in the order of 12,900 vpd and in 2012/13 13,900 vpd. As such it is considered relevant to use the higher 2016 flows for assessment. Refer Figure 4.

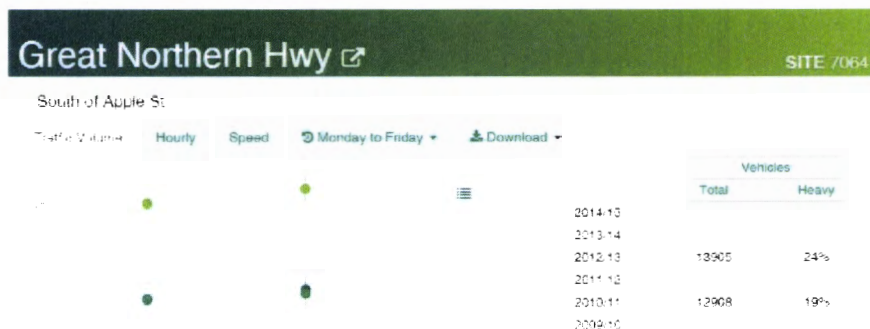


Figure 4 - Great Northern Highway - Historical flows

Counts for Walyunga Road provided by the City of Swan taken in September 2015 are also shown.



Table 1 - Adjacent Road Traffic Flows

Section - Direction	ADT	AM Peak	PM Peak
Great Northern Highway South of Bullsbrook Road Northbound	7,003 vpd	472 vph	673 vph
Great Northern Highway South of Bullsbrook Road Southbound	7,372 vpd	783 vph	489 vph
Great Northern Highway North of Apple Street Northbound	8,050 vpd	523 vph	765 vph
Great Northern Highway North of Apple Street Southbound	7,662 vpd	813 vph	544 vph
Walyunga Road Eastbound	263 vpd	23 ¹ vph	26 vph
Walyunga Road Westbound	262 vpd	23 vph	26 vph

Full count details are shown in Appendix A.

Great Northern Highway carries 25% heavy vehicles while Walyunga Road carries 49.2% heavy vehicles Monday to Friday and 22.9% heavy vehicles on the weekend.

4.2. Intersections.

The intersection of Walyunga Road with GNH is configured as a standard "T" junction with a northbound right turn lane and a southbound left turn acceleration lane.

The intersection layout is shown on Figure 5.

¹ AM and PM peak counts provided are combined counts. The directional counts assume an even split in flows.



Figure 5 - Intersection of Walyunga Road and GNH

4.3. Road Hierarchy and Status.

Figure 6 shows the Road Hierarchy for the road network adjacent to and around the site.



Primary Distributors provide for major regional and inter-regional traffic movement and carry large volumes of generally fast moving traffic. Some are strategic freight routes and all are National or State roads. They are managed by Main Roads WA. Indicative traffic volumes are above 15,000 vehicles per day with operating speeds typically between 60 and 110 km/h.

Access Roads provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement role. These roads are bicycle and pedestrian friendly. They are managed by local government. Maximum desirable volume is in the order of 3,000 vehicles per day with typical operating speeds of 40 to 50 km/h.

4.4. Road Hierarchy vs Actual Flows.

Table 2 details the comparison of flows against the maximum desirable flows under the MRWA Functional Hierarchy criteria.

Table 2 - Desirable Maximum Flow vs Actual Flow

Location and date of count.		Classification	Desirable Max Traffic Volume (vpd)	Actual Daily Traffic Flows (vpd)
Great Northern Highway	South of Apple Street (2016)	Primary Distributor	35,000 vpd.	15,705 vpd
Walyunga Road	East of GNH	Access Road	3,000 vpd.	525 vpd

The table above indicates that all roads are operating within their capacity.

5. Crash History.

A review of the MRWA crash history for the 5 years to December 2014 indicates that no crashes occurred at the intersection of Walyunga Road and GNH. No atypical crash patterns were identified and there is no indication that the proposed increase in traffic associated with the development would change the risk profile to an unacceptable level.

6. Changes to Surrounding Transport Networks.

The planned development of Northlink (Perth to Darwin Highway) will result in the transference of traffic from GNH onto the new road alignment. Construction of Northlink Stage 1 is expected to commence within the next 6 months and tenders for Northlink Stage 2 are currently being assessed by MRWA. The completion of stages 1 and 2 will see the road built between Guildford and Ellenbrook by 2019. MRWA indicate that the third stage between Ellenbrook and Muchea will also be completed by mid 2019.



7. Assessment Years.

The development is assessed on current network conditions.

8. Time Periods for Assessment.

Assessment is based on both daily traffic and peak hour periods.

9. Development Generation and Distribution.

Potential traffic flows from the site were calculated based on the extraction rate and cartage details as advised by the proponent and summarised below:

9.1. Clay Extraction.

Pit life: 10 years.

Operational Time: Approximately 2 excavation campaigns per year each of 1 to 2 month duration for excavation and stockpiling of clay onsite for mixing and later cartage.

Cartage campaigns will happen approximately 2-3 days a month, however they may vary in frequency from time to time depending on market demand. Cartage campaigns will be based on a maximum cartage of 4,000 tonnes per day.

Transport Metrics: Truck and trailer combinations.

Daily Extraction Rate: up to 4,000 tonnes maximum.

Truck Movements have been assessed as shown below²:

² Truck details as advised by BGC.



Vehicle type	Payload (tonnes)	Number running	Trips per day	Tonnes carted	Total trips
Truck and dog	40	10	6	2400	60
Pocket Road Train	50	2	5	500	10
Semi and Pig	38	5	6	1140	30
Total				4040	100

Truck configurations are shown in Appendix A.

Advice from BGC Operations Manager is that the cartage would typically be 5 round trips per vehicle per day; with the fleet of trucks utilised this would allow a total of 3,450 tonnes to be moved in a day equating to 85 trips in total. For the purpose of assessment it has been assumed that a total of 4,040 tonnes could be transported in a day.

Therefore the number of trucks carting out in a day is 100. On a 10 hour working day this equates to 10 movements to and 10 movements from the site.

9.2. Sand Extraction.

Transport Metrics: Truck and Dog

Daily Extraction Rate: up to 2,000 tonnes.

Truck Movements have been assessed as shown below

Daily extraction = 2,000 tonnes. Truck and Dog capacity = 40 tonnes

Therefore number of trucks carting out in a day is given by $2,000/40 = 50$ truck movements out.

On a 10 hour working day this equates to 5 loaded trucks per hour (5 movements to and 5 movements from the site).

The distribution of traffic is expected to be exclusively to and from the south and the impact on adjacent roads based on concurrent clay carting (20 movements per hour) and sand carting (10 movements per hour) is summarised on Table 3.

Table 3 - Midblock Traffic Prediction Adjacent Network

Location	Daily Traffic (Existing / Predicted)	AM Peak (Existing / Predicted)	PM Peak (Existing / Predicted)
GNH South of Walyunga Road (NB)	8,050 / 8,200 vpd	523 / 538 vph	765 / 780 vph
GNH South of Walyunga Road (SB)	7,662 / 7,812 vpd	813 / 827 vph	544 / 559 vph
Walyunga Road (EB)	263 / 413 vpd	23 / 38 vph	26 / 41 vph
Walyunga Road (WB)	262 / 412 vpd	23 / 38 vph	26 / 41 vph

9.3. Impact on Intersections.

Turning movements were predicted for both the AM peak and the PM peak periods for the intersection of Walyunga Road and GNH and are shown on Figure 7. The turning movements assumed that:

- Existing peak hour movements in the AM peak hour would be in the order of 20 movements to and from the south and 3 movements to and from the north and during the PM peak hour, 22 movements to and from the south and 4 movements to and from the north.
- Additional movements would be in the order of 15 movements to the south in both the AM and PM peak and 15 movements from the south during both the AM and PM peak.

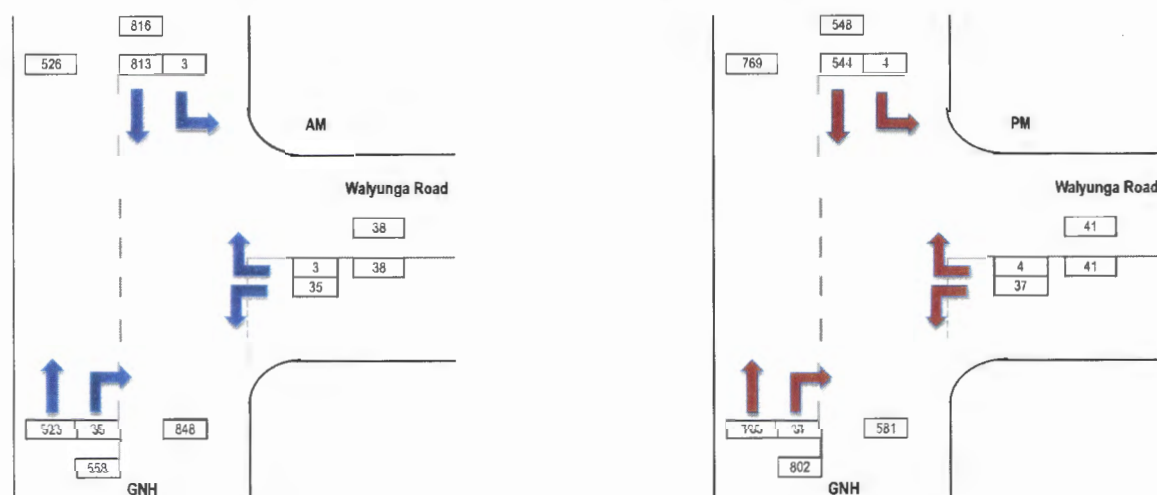


Figure 7 - Predicted AM and PM Peak Hour Counts

The capacity of an intersection is generally evaluated using SIDRA intersection software and warrants for analysis for unsignalised intersections with minor roads are shown in Table 4 which is an extract of Table 6.1 of *Austrroads Guide to Traffic Management Part 3, Traffic Studies and Analysis*. In this instance the warrants are met for detailed assessment.

Table 4 - Intersection Analysis Assessment

Type of Road	Light Cross turning volumes maximum design hour volumes per hour (two way)		
Two-lane major road	400	500	600
Cross Road	250	200	100
Four-lane major road	1000	1500	2000
Cross road	100	50	25
GNH	1,374		
Walyunga Road	41		

Assessment of the intersection performance for both the AM and PM Peak Hour using Sidra Intersection software indicates that under predicted traffic loads, the intersection will generally operate at acceptable levels of service.

Notwithstanding this, delays on the northbound right turning movements during the morning and afternoon peak will be in excess of 35 seconds resulting in a Level of Service (LoS) of "D" for these movements. Additionally, in the morning peak the northbound right turn into Walyunga Road is predicted to operate at a Level of Service "D" on account of an estimated 29 second average delay; however the back of queue is predicted to be less than 1 vehicle. Sidra outputs are shown on Figure 8 and Figure 9.

Note: Sidra default values were used for the peak flow factor and basic saturation flow. Gap acceptance values were based on those recommended by Austroads. Given that the increase in traffic on Walyunga Road is all heavy haulage, an assumed HV percentage of 80% was adopted.

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
	v	Total	HV	v/c	sec		Vehicles	m		per veh	km/h
South: Great Northern Highway											
2	T1	551	25.0	0.325	0.0	LOS A	0.0	0.0	0.00	0.00	99.8
3	R2	37	80.0	0.182	28.9	LOS D	0.6	15.9	0.87	0.96	45.0
Approach		587	28.4	0.325	1.9	NA	0.6	15.9	0.05	0.06	92.6
East: Walyunga Road											
4	L2	37	80.0	0.031	6.4	LOS A	0.0	0.0	0.00	0.49	52.2
6	R2	3	80.0	0.026	33.1	LOS D	0.1	1.8	0.91	0.96	36.5
Approach		40	80.0	0.031	8.5	LOS A	0.1	1.8	0.07	0.52	50.5
North: Great Northern Highway											
7	L2	3	80.0	0.508	10.0	LOS A	0.0	0.0	0.00	0.00	59.2
8	T1	856	25.0	0.508	0.1	LOS A	0.0	0.0	0.00	0.00	99.3
Approach		859	25.2	0.508	0.1	NA	0.0	0.0	0.00	0.00	99.1
All Vehicles		1486	28.0	0.508	1.0	NA	0.6	15.9	0.02	0.04	94.0

Figure 8 - Sidra Output - AM Peak Hour Assessment

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Distance	Prop. Queued	Effective Stop Rate	Average Speed
	v	Total	HV	v/c	sec		Vehicles	m		per veh	km/h
South: Great Northern Highway											
2	T1	805	25.0	0.475	0.1	LOS A	0.0	0.0	0.00	0.00	99.5
3	R2	39	80.0	0.085	16.9	LOS C	0.3	8.3	0.66	0.88	52.8
Approach		844	27.5	0.475	0.9	NA	0.3	8.3	0.03	0.04	95.6
East: Walyunga Road											
4	L2	39	80.0	0.033	6.4	LOS A	0.0	0.0	0.00	0.49	52.2
6	R2	4	80.0	0.031	30.8	LOS D	0.1	2.2	0.90	0.96	37.4
Approach		43	80.0	0.033	8.8	LOS A	0.1	2.2	0.09	0.53	50.3
North: Great Northern Highway											
7	L2	4	80.0	0.341	9.9	LOS A	0.0	0.0	0.00	0.00	59.2
8	T1	573	25.0	0.341	0.0	LOS A	0.0	0.0	0.00	0.00	99.4
Approach		577	25.4	0.341	0.1	NA	0.0	0.0	0.00	0.00	98.9
All Vehicles		1464	28.2	0.475	0.8	NA	0.3	8.3	0.02	0.04	94.3

Figure 9 - Sidra Output - PM Peak Hour Assessment

A further review of turning movements at the intersection of Walyunga Road and GNH indicates that based on hourly volumes and the application of warrants as described in Austroads "Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections" a right turn lane is warranted; refer Figure 10.

The existing intersection of Walyunga Road and GNH is currently configured with a channelised right turn and as such improvements to the intersection are not required.

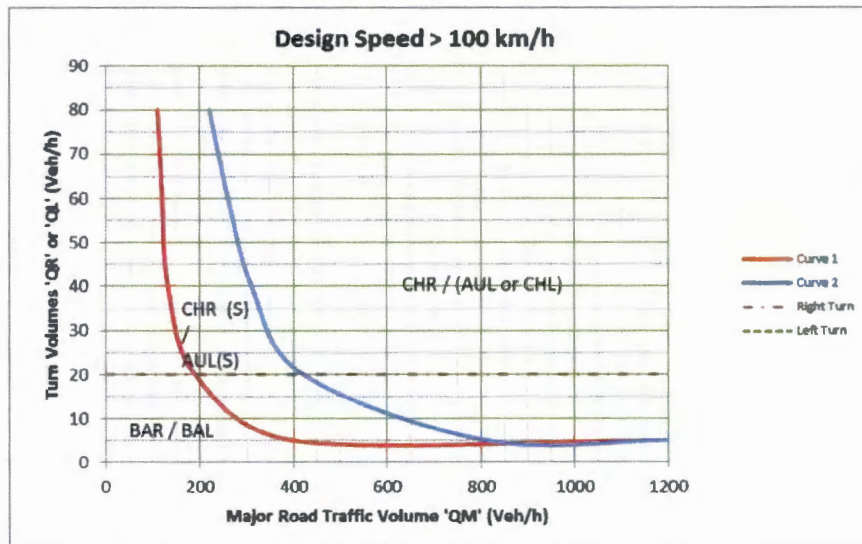


Figure 10 - Intersection Configuration Assessment

9.4. Walyunga Road.

Austrroads "Guide to the Design of Rural Roads" indicates the following width requirements based on design daily traffic.

Table 5 - Road Width Requirement

Element	Design AADT				
	1-150	150-500	500-1,000	1,000-3,000	>3,000
Traffic Lanes	3.5	6.2	6.2-7.0	7.0	7.0
	(1 x 3.5)	(2 x 3.1)	(2 x 3.1/3.5)	(2 x 3.5)	(2 x 3.5)
Total Shoulder	2.0	1.5	1.5	2.0	2.5
Shoulder Seal	0.5	0.5	0.5	1.0	1.5

Based on expected typical daily traffic volumes of about 825 vehicles per day, the Guideline recommends 2 x 3.1 / 2 x 3.5 metre lanes with 0.5 metre wide sealed shoulders and 1.0 metre wide unsealed shoulders. Existing sealed road width is typically 7.5 metres which provides adequate width.

9.5. Access Movements.

Access to and from the site will be via a crossover on Walyunga Road located approximately 900 metres east of Great Northern Highway. The existing crossover intersects at an acute angle as shown on Figure 11 and should be realigned generally as shown. As the cartage of clay has the potential to deposit detritus from truck chassis and wheels on the roadway and obscure pavement markings, all trucks will be brushed down prior to leaving the site to minimise the risk of loose material being deposited onto the roadway.



Figure 11 – Recommended Crossover Geometry

9.6. Sight Distance.

MRWA Supplement to Austroads Guide to Road Design — Part 4A indicates that where it is unreasonable or extremely difficult to achieve ASD, then as an absolute minimum, Stopping Sight Distance (SSD) should be provided. For a design speed of 110 km/h (10 km/h above the posted speed limit), and a reaction time of 2.5 seconds, the Approach Sight Distance is 208 metres. For the same design speed the Safe Intersection Sight Distance is 300 metres. Great Northern Highway is straight and relatively level north and south of the intersection and sight distance is available except to the north where it is impacted on by fringing vegetation. As such, a detailed assessment of available sight distance should be carried out and any clearing or trimming of overhanging vegetation should be undertaken as part of the overall improvement works.

Similarly, sight distance requirements from the Walyunga Road crossover would require in the order of 240 metres ASD and 340 metres SISD. Fringing vegetation currently impacts on the available sight distance and sight triangles should be cleared as part of the recommended crossover upgrading works.

10. Conclusions.

A review of the traffic impacts associated with the extraction and carting of clay from Lot 5 Walyunga Road indicated the following:



- Under the development scenario, the predicted maximum generation from the site is 300 vehicles per day, based on a maximum extraction rate of 4,000 tonne per day of clay and 2,000 tonne per day of sand.
- If sand and clay carting is operating concurrently, the carting will result in an additional 150 trips each way per day which will travel between the site and the Perth region via Walyunga Road and GNH.
- Expected increase in traffic using these roads is predicted to be in the order of 30 movements per hour; 15 of which will be to the site and 15 from the site.
- The width of Walyunga Road is in excess of the Austroads recommended minimum width for the predicted volume of traffic using the road and widening is not required.
- The additional traffic moving through the intersection of Walyunga Road and GNH is not likely to trigger the need for modification of the intersection as it is currently configured with a dedicated right turn pocket and a southbound left turn acceleration lane from Walyunga Road onto Great Northern Highway.
- To permit two vehicles to enter and exit the crossover onto Walyunga Road concurrently and remain lane correct, modification to the current geometry will be required.
- In order to provide adequate sight distance vegetation will need to be trimmed along the Walyunga Road edge and on Great Northern highway verge north of Walyunga Road.

11. Appendix A – Traffic Counts.

SITE 6847

Volume by Hour

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
South of Bullsbrook Rd (SLK 25.05)

Count: Classification Counts

Average Vehicle Volume

Both Directions

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
0000		49	88						69
0100		34	39						37
0200		44	41						43
0300		61	55						58
0400		197	212						205
0500		844	884						684
0600		1045	1030						1038
0700		1194	1253						1224
0800		969	976						968
0900		884	846						855
1000		783	816						800
1100		736	759						748
1200		723	738						731
1300		781	734						758
1400		936	925						931
1500		1051	1003						1027
1600		1059	1155						1107
1700		1079	1035						1053
1800		715	806						761
1900		447	440						444
2000		313	357						335
2100		242	239						241
2200		193	130						162
2300		88	134						111
Total		14228	14495						14370

Peak Statistics

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
AM	1/4 Hour	0745	0730					0730	
	1/4 Hr Vol	312	330					311	
	1 Hour	0700	0700					0700	
	1 Hr Vol	1194	1253					1224	
	1 Hr Fact	.9567	.9492					.9830	
PM	1/4 Hour	1715	1600					1530	
	1/4 Hr Vol	294	298					287	
	1 Hour	1530	1600					1600	
	1 Hr Vol	1089	1155					1107	
	1 Hr Fact	.9654	.969					.9814	

→ = Public Holiday

↔ = School Holiday

Figure 12 – Great Northern Highway - Traffic Counts (South of Bullsbrook Road)



SITE 6847

Volume by Hour

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
South of Bullsbrook Rd (SLK 25.05)

Count: Classification Counts

Average Vehicle Volume															Directional			
Hour	Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
0000			32	17	41	47									37	32		
0100			19	15	15	24									17	20		
0200			14	30	19	22									17	26		
0300			32	29	23	32									28	31		
0400			69	128	82	130									76	129		
0500			249	395	266	418									258	407		
0600			436	609	406	624									421	617		
0700			460	744	431	622									441	783		
0800			365	594	363	613									364	604		
0900			356	506	358	488									358	497		
1000			360	423	360	456									360	440		
1100			339	397	338	421									339	409		
1200			342	381	350	388									346	385		
1300			381	400	359	375									370	388		
1400			495	441	456	469									476	455		
1500			554	497	539	484									547	481		
1600			614	445	640	515									627	480		
1700			677	393	669	366									673	380		
1800			447	268	523	283									485	278		
1900			257	190	266	184									267	187		
2000			179	134	226	131									203	133		
2100			141	101	163	76									152	89		
2200			96	97	90	40									93	69		
2300			41	47	74	60									58	54		
Total			6947	7281	7047	7448									7003	7372		

Peak Statistics																		
	Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
AM	1/4 Hour		0630	0745	0645	0730									0630	0745		
	1/4 Hr Vol		131	205	120	217									123	205		
	1 Hour		0615	0700	0630	0700									0630	0700		
	1 Hr Vol		491	744	460	822									472	783		
	1 Hr Fact		.937	.9073	.9583	.947									.9633	.9572		
PM	1/4 Hour		1715	1500	1700	1530									1715	1530		
	1/4 Hr Vol		187	139	172	142									178	134		
	1 Hour		1700	1500	1630	1600									1700	1530		
	1 Hr Vol		677	497	675	515									673	489		
	1 Hr Fact		.9051	.8939	.9811	.9131									.9479	.9157		

→ = Public Holiday

↙ = School Holiday

Figure 13 - Great Northern Highway - Traffic Counts (South of Bullsbrook Road)



SITE 5877

Volume by Hour

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
North of Apple St (SLK 15.39)

Count: Classification Counts

Average Vehicle Volume								Both Directions	
Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
0000		48	61					55	
0100		32	34					33	
0200		38	34					35	
0300		62	61					62	
0400		205	209					207	
0500		662	658					661	
0600		1121	1112					1117	
0700		1256	1272					1264	
0800		1089	1104					1097	
0900		984	913					949	
1000		859	872					866	
1100		917	854					886	
1200		871	853					862	
1300		954	826					890	
1400		1151	1069					1110	
1500		1244	1142					1193	
1600		1222	1311					1267	
1700		1185	1144					1165	
1800		721	788					755	
1900		431	435					433	
2000		299	325					312	
2100		257	242					247	
2200		159	137					148	
2300		74	110					92	
Total		15833	15667					15706	

Peak Statistics									
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
AM	1/4 Hour	0715	0745					0715	
	1/4 Hr Vol	341	340					337	
	1 Hour	0700	0715					0700	
	1 Hr Vol	1256	1282					1264	
	1 Hr Fact	9206	9426					9391	
PM	1/4 Hour	1530	1615					1615	
	1/4 Hr Vol	358	344					338	
	1 Hour	1530	1600					1530	
	1 Hr Vol	1299	1311					1285	
	1 Hr Fact	9071	9528					9504	

→ = Public Holiday
← = School Holiday

Figure 14 - Great Northern Highway - Traffic counts (North of Apple Street)

SITE 5877

Volume by Hour

23 Feb 2016 to 24 Feb 2016

Great Northern Hwy (H006)
North of Apple St (SLK 15.39)

Count: Classification Counts

Average Vehicle Volume														Directional				
Hour	Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
0000			32	16	34	27									33	22		
0100			15	17	15	19									15	18		
0200			13	23	13	21									13	22		
0300			30	32	25	36									28	34		
0400			91	114	96	113									94	114		
0500			295	367	281	378									288	373		
0600			483	638	475	637									479	638		
0700			467	789	486	786									477	788		
0800			426	683	454	650									440	657		
0900			451	533	417	496									434	515		
1000			415	444	429	443									422	444		
1100			463	454	398	456									431	455		
1200			463	408	422	431									443	420		
1300			511	443	421	405									466	424		
1400			633	518	530	539									582	529		
1500			710	534	658	484									684	509		
1600			726	496	750	561									738	529		
1700			749	436	728	416									739	426		
1800			433	288	520	268									477	278		
1900			258	173	257	178									258	176		
2000			188	113	223	102									205	108		
2100			156	95	159	83									158	89		
2200			91	68	99	38									95	53		
2300			39	35	63	47									51	41		
Total			8136	7697	7953	7614									8050	7662		

Peak Statistics																	
		Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri	
		N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
AM	1/4 Hour			0630	0745	0645	0715									0630	0715
	1/4 Hr Vol			145	208	148	222									143	212
	1 Hour			0630	0715	0630	0715									0630	0715
	1 Hr Vol			514	791	531	835									523	813
	1 Hr Fact			.8862	.9507	.897	.9403									.9143	.9587
PM	1/4 Hour			1530	1515	1615	1600									1615	1415
	1/4 Hr Vol			217	145	200	159									199	143
	1 Hour			1530	1515	1615	1600									1615	1530
	1 Hr Vol			769	540	780	561									765	544
	1 Hr Fact			.8859	.931	.975	.8821									.9635	.9544

→ = Public Holiday

↖ = School Holiday

Figure 15 - Great Northern Highway - Traffic Counts (North of Apple Street).

AXLE GROUP LOADING

Both the semi and pig and the road train may be able to get the .5 tonne allowance for the steer tyre

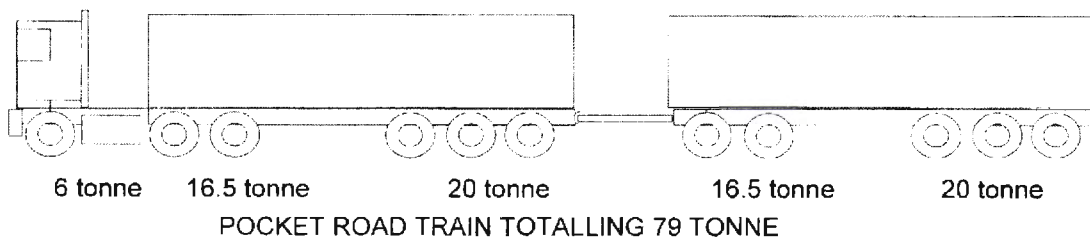
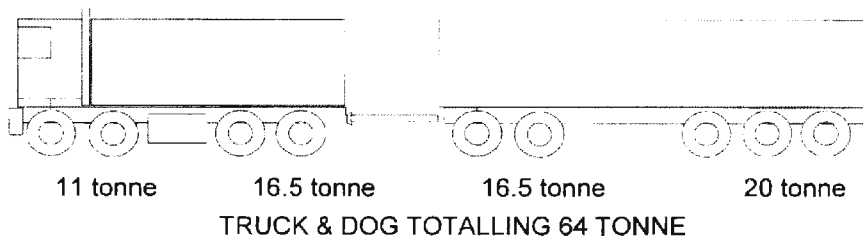
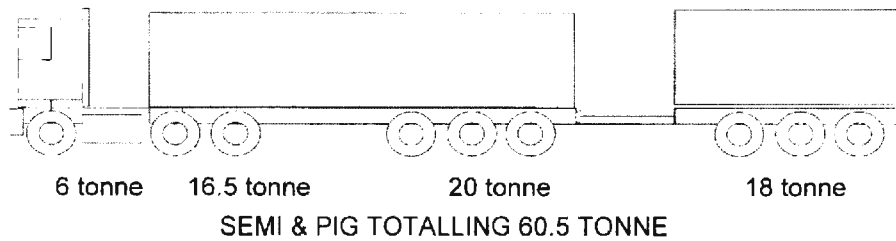


Figure 16 - Truck Configurations

**POTENTIAL ACID FORMATION ASSESSMENT
FOR A PROPOSED CLAY PIT
LOT 5, ON PLAN 7892
WALYUNGA ROAD
CITY OF SWAN**

OCTOBER 2007

PREPARED FOR

BGC AUSTRALIA PTY LTD

BY

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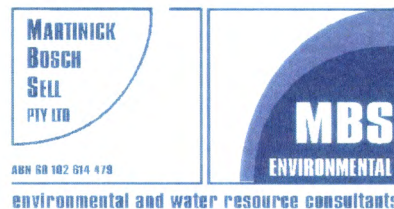


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Table 1:	Surface Water Quality
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Figure 1:	Location Plan
Figure 2	Site Map

1. INTRODUCTION

1.1 BACKGROUND

BGC Clay Products Pty Ltd (BGC) propose to extract clay from Lot 5, Walyunga Road, Bullsbrook, under an extractive industry licence applied for in January 2007. This site has previously been mined for clay during the 1980's, but has since been abandoned. The locality of the site is shown in Figure 1.

Project development proposals include the extraction of clay as indicated on Figure 2. MBS Environmental Pty Ltd has been commissioned by BGC to undertake testing for Potential Acid Forming (PAF) materials within their proposed extraction area on Lot 5 Walyunga Road.

1.2 PROPOSED DEVELOPMENT OF SITE

The development proposal of the subject site involves the excavation of weathered schist and unweathered schist to a depth of up to 10 metres. The total identified deposits cover 10 hectares. Two stages of extraction are proposed.

1.3 SCOPING OF SURVEY

The materials to be extracted are weathered metamorphic rocks and are not subject to the conditions normally associated with coastal plain acid sulphate soils formed as a result of oxidation of framboidal pyrite laid down within wetland environments. The investigation focuses rather on the potential occurrence of native pyrite which might occur in the Chittering Metamorphic Belt and which, if present, may give rise to PAF conditions.

Thus, the scope of this study included a background study of available geotechnical information on the Chittering Metamorphic Belt, the drilling of selected locations within the deposit, chemical field testing, microscopic examination and laboratory testing.



2. GEOLOGICAL AND HYDROGEOLOGICAL ENVIRONMENT

2.1 GEOLOGY

The Chittering Metamorphic Belt is an amphibolite facies meta-sedimentary sequence composed mainly of per-aluminous rocks with lesser Meta mafic rocks.

Most of the sequence is composed of banded biotite-feldspar gneiss which is migmatitic in some locations. The second more abundant unit is staunolite-biotite-muscovite schist with lesser biotite-hornblende schist and small areas of kyanite-sillimanite-biotite schist.

None of the rock types contain any sulphide minerals and only rare quartz veins are found.

No mineralisation is known within the belt.

2.2 HYDROGEOLOGY

Due to the very low hydraulic conductivity associated with the schists and the clays which are derived from them, the presence of groundwater is very limited. Standing water in the base of the old clay pit on the site is an indication of the very low permeability of these materials. No bores exist within the material on the property that could be used to determine depth to the water table. During the clay exploration drilling program, hole depths reached a maximum of 30 metres with no groundwater being encountered in any of them.

3. METHODOLOGY

3.1 FIELDWORK

Fieldwork was conducted on 11 September 2007 and included the drilling of a total of six holes using an air core drill rig. This was incapable of penetrating into fresh rock, so only the weathered overburden was tested. The positions of these holes are shown in Figure 2. Due to weather conditions and conditions of the land surface at the time of the survey no further holes could be tested.

3.2 SAMPLING

Generally, sampling was done from 1 metre and at approximately 1 metre intervals. Samples were placed in new plastic bags, sealed, numbered and stored in a cool, dry place. Field pH testing was undertaken on all samples in accordance with the guidelines outlined in Hey *et al.*, 2000. The results of the field testing are shown in Table 2 below. Samples were transported to the laboratory on the following day, where they were frozen. 15 samples were chosen at various depths from all holes based on the field testing results to have full laboratory analysis completed. The results of these tests are outlined in section 4.3 below.

3.3 FIELD, VISUAL AND LABORATORY TESTING

3.3.1 Field Testing

3.3.1.1 Surface Water Testing

Surface water from existing dams and pits was tested for pH, electrical conductivity (EC) and total dissolved solids (TDS). These results are included in Table 1.

3.3.1.2 Soil Testing

During drilling, fresh soil samples were tested by oxidising with 30 percent hydrogen peroxide, observing the strength of the reaction and after 20 minutes, comparing the pH of a deionised water paste sample with the oxidised sample. These results are included in Table 2.

3.3.2 Visual (Microscopic) Evaluation

31 of the total 46 samples were examined under a 10 to 50 times magnification binocular microscope by Dr Ian Martin of MBS Environmental. Due to very high clay content in the close to surface samples, all were washed through a 0.5 millimetre stainless screen prior to examination in the wet state.

3.3.3 Laboratory testing

3.3.3.1 Sample Identification

15 of a total of 46 samples of soils were provided to the Chemistry Centre of WA on 14 September 2007. On receipt, the samples were identified and allocated a Laboratory Number.

3.3.3.2 Test Methods

The test methods of the Acid Sulphate Soils Laboratory Methods Guidelines manual, specifically Method Code 23 – SPOCAS (Suspension Peroxide Oxidation Combined Acidity and Sulphate) formed the basis of this work.

The SPOCAS method is a standardised set of procedures useful in assessing the environmental impact of soils suspected of containing pyrite and other iron sulphides which might lead to an acid sulphate soil problem if disturbed (Chemistry Centre, 2007).

3.3.3.3 Sample Preparation

The samples were dried at 80°C for 48 hours and sieved to remove coarse material >2 millimetres. The <2 millimetre fraction was ground to <150 microns, and sub samples of the milled homogenised material were then subjected to chemical tests. All results are reported on a dry weight basis (Chemistry Centre, 2007).

3.3.3.4 Test Procedures

Testing involved the SPOCAS method as outlined below and described by the Chemistry Centre (2007).

SPOCAS Method

Step 1: Determination of Potassium Chloride Extractable Sulphur (S_{KCl} %) and Total Actual Acidity (TAA)

In this procedure the sample is extracted with potassium chloride solution. The extraction with potassium chloride is used to determine soluble and absorbed sulphur (non-sulphidic sulphur) and the titratable actual acidity of the sample (TAA). The sulphur is determined using inductively coupled plasma atomic emission spectrometry (ICPAES).

The pH, acidity, and sulphur content of the resultant solution are reported as pH_{KCl} , TAA_{KCl} , and S_{KCl} respectively.

Step 2: Determination of the Peroxide Oxidation Sulphur (S_p %), and Titratable Peroxide Acidity (TPA).

This step involves oxidation of the sample with hydrogen peroxide to produce maximum acidity from any reduced sulphidic material. The sulphur content (S_p %), the Titratable Peroxide Acidity (TPA), and pH (pH_{ox}) of the oxidised solution are determined. S_p % will include the soluble, absorbed, and sulphide, sulphur species.

Step 3: Determination of Retained Acidity (a-S_{NAS})

Existing acidity in acid sulphate soils includes 'actual' acidity (TAA) and 'retained' acidity (acidity stored in largely insoluble iron and aluminium sulphate minerals). A dilute hydrochloric acid (HCl) extraction performed on the sample will give S_{HCL}. The net acid soluble sulphur (S_{NAS}) due to sparingly soluble sulphate containing compounds such as jarosite, can be calculated by subtracting S_{KCL} from S_{HCL}. The equivalent acidity is expressed as a-S_{NAS}. For soil samples with pH_{KCL}<4.5 the S_{NAS} must be determined.

Step 4: Determination of the Excess Acid Neutralising Capacity (ANCe)

This determination is optional depending on the peroxide solution pH.

If the solution pH after the peroxide step is >6.5, the material may have an acid neutralization capacity. The fine grinding of the sample for analysis will lead to an over estimation of the effective acid neutralising capacity and an appropriate safety factor must be applied.

Step 5: Peroxide Oxidisable Sulphur (S_{POS})

This step involves calculating the differences between the extracts from Step 2 and Step 1. The peroxide oxidisable sulphur is used to predict the potential acid risk from non-oxidised sulphur compounds.

$$\text{Peroxide oxidisable sulphur:} \quad S_{POS} = (SP - SKCL) \%$$

If it is assumed that all the S_{POS} is a result of pyrite oxidation then S_{POS} can be converted to acidity units:

$$S_{POS} (\%S) \times 624 = \text{equivalent mol H}^+/\text{t}$$

4. RESULTS

4.1 FIELD TESTING

4.1.1 Surface Water

Surface and shallow subsurface water flowing across the site has a high quality, as indicated by pH and TDS tests undertaken on 17 December 2006 from three areas of standing water (Table 1). These include the dams to the north and south of the proposed pit, and standing water within the old pit itself.

Table 1: Surface Water Quality

Sample Location	Sample No.	EC (mS/cm)	TDS (ppm)	pH	Temperature Degrees C
Pond 1 (south of pit)	1	0.38	190	7.89	22.8
	2	0.38	190	8.01	22.8
Pond 2 (previous extraction area)	1	0.8	400	9.21	18.3
	2	0.8	400	9.21	18.3
Pond 3 (north of pit)	1	0.63	310	8.29	29
	2	0.64	310	8.23	28

The high pH recorded within the old clay pit suggests that the material exposed within these impoundments does not have the propensity to develop acid sulphate soil conditions. No salinity issues are identified by the tests shown in Table 1.

4.1.2 Soil Tests

A total of 45 field tests were undertaken. None of these field tests gave a strong indication of the presence of PAF material. The majority of the paste pH measurements were above 7, whilst only three were between 5 and 6. In general the difference between pH_f and pH_{fox} was low, averaging 1.2. None of the differences exceeded 4, which is generally considered to be a strong indication of PAF conditions. Observed peroxide reactions were generally small and, given the small pH changes, are most probably related to the presence of organic matter such as fine roots. These results are set out in Table 2 below.

Table 2: Field Soil Test Results

Date	Borehole No	Sample Depth (m)	Description	Field Results				pH gap >4
				pH (F)	Peroxide Reaction	pH (FOX)	pH(F) - pH(FOX)	
11/09/2007	1	1	Strong brown plastic clay	7.94	xxx	5.8	2.14	No
11/09/2007		2	Reddish yellow plastic clay	7.98	xxx	5.96	2.02	No
11/09/2007		3	Reddish yellow clay-silt	7.05	None	5.47	1.58	No
11/09/2007		4	Reddish yellow clay-silt	6.71	None	4.74	1.97	No
11/09/2007		5	Reddish yellow clay-silt	6.74	x	5.28	1.46	No
11/09/2007		6	Reddish yellow clay-silt	6.62	x	5.37	1.25	No
11/09/2007		7	Reddish yellow clay-silt	6.35	None	4.88	1.47	No
11/09/2007		8	Reddish yellow clay-silt	6.87	xx	6.11	0.76	No
11/09/2007		9	Reddish yellow clay-silt	6.93	x	6.1	0.83	No
11/09/2007		10	Reddish yellow clay-silt	7.10	x	6.15	0.95	No
11/09/2007	2	1	Yellowish brown clay	6.05	xx	4.54	1.51	No
11/09/2007		2	Bright yellowish brown clay	6.15	xx	4.62	1.53	No
11/09/2007		3	Bright yellowish brown clay	7.04	x	5.54	1.50	No
11/09/2007		4	Yellow rock	7.81	x	6.11	1.70	No
11/09/2007	3	1	Strong brown clay	7.42	xxxx	5.4	2.02	No
11/09/2007		2	Yellowish brown clay	7.35	xxxx	6.77	0.58	No
11/09/2007		3	Yellowish brown clay	7.46	xxxx	6.9	0.56	No
11/09/2007		4	Light red rock	7.80	xxxx	7.12	0.68	No
12/09/2007	4	1	Strong brown clay	7.65	x	5.81	1.84	No
12/09/2007		2	Reddish yellow clay	7.27	None	5.9	1.37	No
12/09/2007		3	Reddish yellow clay	6.21	None	5.07	1.14	No
12/09/2007		4	Reddish yellow clay	5.26	None	5	0.26	No
12/09/2007		5	Yellowish brown clay	5.67	None	5.17	0.50	No
12/09/2007		6	Yellowish brown clay	5.45	x	5.31	0.14	No
12/09/2007		7	Yellowish brown clay	6.31	x	5.87	0.44	No
12/09/2007		8	Reddish yellow clay	6.35	x	6.04	0.31	No
12/09/2007		9	Reddish yellow clay	6.21	xxx	7.75	-1.54	No
12/09/2007		10	Yellow clay	6.40	xxx	7.46	-1.06	No
12/09/2007		11	Yellowish brown clay	7.70	xxx	8.54	-0.84	No
12/09/2007		12	Red clay with rock	8.05	x	6.53	1.52	No
12/09/2007	5	1	Yellowish red clay	7.06	x	5.27	1.79	No
12/09/2007		2	Yellowish brown clay	9.01	xxx	8.17	0.84	No
12/09/2007		3	Reddish yellow clay	8.82	None	5.97	2.85	No
12/09/2007		4	Reddish yellow clay	8.67	None	6.09	2.58	No
12/09/2007		5	Strong brown clay	7.96	None	6.02	1.94	No
12/09/2007		6	Strong brown clay	8.06	None	6.02	2.04	No
12/09/2007		7	Yellowish brown clay	8.37	x	6.65	1.72	No
12/09/2007		8	Yellowish brown clay	8.85	xxx	8.78	0.07	No
12/09/2007		9	Reddish brown clay	9.17	xx	8.99	0.18	No
12/09/2007		10	Bright brown clay	9.26	x	6.55	2.71	No
12/09/2007	6	1	Reddish yellow clay	8.63	xx	6.63	2.00	No
12/09/2007		2	Strong brown clay	8.35	x	6.15	2.20	No
12/09/2007		3	Yellowish brown clay	8.42	xxx	7.48	0.94	No
12/09/2007		4	Yellowish brown clay	8.04	xxx	8.03	0.01	No
12/09/2007		5	Yellowish brown clay	8.77	xx	6.78	1.99	No

4.2 VISUAL (MICROSCOPIC) INSPECTION

Four separate rock types were recorded. These were all very weathered and the feldspar component almost totally converted to clay minerals. In addition there were rare fragments of non-magnetic iron oxide material.

Quartz – biotite schist	Holes 1, 2, 4 and 5.
Muscovite – quartz – biotite schist	Holes 1 and 6.
(Biotite)-quartz-feldspar rock (migmatite)	Holes 2, 3, 4, 6.
Quartz	Holes 1 and 5.

Based on the data, it appears that most of the area drilled is composed of quartz – biotite schist with very fine-grained quartz (less than one millimetre) making up 25 – 40% of the rock and coarser biotite ranging up to 3-5 millimetres making up the balance. There is occasionally a small component of silvery muscovite. In addition, there are distinct but narrow (generally less than 15 millimetres as observed) layers of quartz – feldspar – biotite gneiss. There are probably wider zones of this material.

There appears to be no particular pattern to the rock type and mineral distribution. The gneiss (migmatite) material does not appear to be a distinctive different unit and may only be thin lenses within an overall schist belt.

In addition, particularly in Hole 1, there is a moderate percentage of quartz fragments up to eight millimetres across clearly derived from quartz stringers or veins. This quartz is clear and totally free of sulphide minerals. The overall proportion of quartz is quite small.

The mineralogy suggests that the area is underlain by metamorphosed sedimentary rocks similar to and probably belonging to the Chittering Metamorphic Belt. These rocks are not known to contain sulphide minerals and there is no evidence for any sulphide minerals in the microscope work undertaken. These rocks are similar to those exposed elsewhere within the Chittering Belt.

From the mineralogy, it is unlikely that these rocks will contain any metals or sulphur likely to be deleterious.

4.3 LABORATORY TESTING

Table 3 shows the results of the laboratory analysis.

4.3.1 Acid Base Accounting

The acid base accounting approach is used to predict net acidity from the oxidation of sulphidic material. The SPOCAS method is in essence a self-contained ABA. The **TPA** result represents a measure of the net acidity, effectively equivalent to the sum of the soil's potential sulphidic activity and actual acidity (**TAA**) less any neutralising capacity of the sample. Where the pH_{KCl} is <4.5 then the residual acid soluble sulphur (S_{RAS}) component of SPOCAS should be done, since the TPA does not measure **retained acidity**. In soils that are self neutralising (i.e. $\text{TPA}=0$), then the HCL titration step in SPOCAS allows calculation of the **excess acid neutralising capacity** (ANC_{E}) (Chemistry Centre, 2007).

4.3.2 Guide to Interpretation of SPOCAS Work

Interpretation of results from SPOCAS test methods involves determination of action criteria and comparison of the test results with the criteria. The NSW ASSMAC has published Action Criteria as shown in Table 3.

Table 3: NSW ASSMAC Action Criteria

Type of Material			Action Criteria, <1,000 tonnes		Action Criteria, >1,000 tonnes	
Texture	Approx Clay Content (% <0.002 mm)		Sulphur Trail S_{POS} %	Acid Trail TPA mole H^+ /t	Sulphur Trail S_{POS} %	Acid Trail TPA mole H^+ /t
Coarse e.g. sands	≤ 5		0.03	18	0.03	18
Medium e.g. loams/light clays	5 – 40		0.06	36	0.03	18
Fine clays/silts	≥ 40		0.1	62	0.03	18

According to the NSW ASSMAC, exceedance of the action criteria indicates risk of an acid sulphate soil issue and the need for an acid sulphate soil management plan with development approval (Chemistry Centre, 2007).

4.3.3 Interpretation of Results of SPOCAS Tests from This Work

No single method, including SPOCAS, will provide all the answers to the complex chemistry involved in reactions of acid sulphate soils. However results from SPOCAS test procedures will provide guidance to identification of potential ASS issues.

All samples were within guideline values of 18 moles of H^+ per tonne. The fine grinding required for analysis will increase the acid neutralising capacity for acid reducing components of the sample. If present, these components will result in a lower TPA than would be

expected, or a higher excess acid neutralising capacity than in the original material. No management issues arise from these.

Of some interest in the results is that in many of the values, the TPA is lower than the TAA, which is, seemingly, anomalous. This has been explained by the Chemistry Centre as the result of organic acids being present in the soil, which give an initial acidity, but then when oxidised (with peroxide) are consumed, resulting in lower acidity.

Table 3: Laboratory Analysis Results*

Date	Sample Depth (m)	Description	Field Results					Laboratory Results							
			pH (F)	Peroxide Reaction	pH (FOX)	pH(F) - pH(FOX)	pH gap >4	pH (KCl)	pH(H OX)	Sp (%)	SKCl (%)	Spos (%)	ANCe	TAA	IPA
11/09/2007	1	Strong brown plastic clay	7.94	xxx	5.8	2.14	No	7.2	7.2	0.01	<0.01	<0.01	43	<2	<2
11/09/2007	4	Reddish yellow clay-silt	6.71	None	4.74	1.97	No	4.8	6.6	0.01	0.01	<0.01	4	13	<2
11/09/2007	10	Reddish yellow clay-silt	7.10	x	6.15	0.95	No	6.1	7.9	<0.01	<0.01	<0.01	31	<2	<2
11/09/2007	1	Yellowish brown clay	6.05	xx	4.54	1.51	No	5.4	5	0.01	<0.01	<0.01	<2	7	9
11/09/2007	3	Bright yellowish brown clay	7.04	x	5.54	1.50	No	5.1	6.9	<0.01	<0.01	<0.01	8	7	<2
11/09/2007	1	Strong brown clay	7.42	xxxx	5.4	2.02	No	5.1	7	0.01	<0.01	0.01	20	12	<2
11/09/2007	3	Yellowish brown clay	7.46	xxxx	6.9	0.56	No	4.6	7.6	<0.01	<0.01	<0.01	12	13	<2
12/09/2007	1	Strong brown clay	7.65	x	5.81	1.84	No	5	5.9	0.01	<0.01	<0.01	<2	11	15
12/09/2007	9	Reddish yellow clay	6.21	xxx	7.75	-1.54	No	5.4	8.7	<0.01	<0.01	<0.01	29	6	<2
12/09/2007	12	Red clay with rock	8.05	x	6.53	1.52	No	6.9	7.9	<0.01	<0.01	<0.01	67	<2	<2
12/09/2007	3	Reddish yellow clay	8.82	None	5.97	2.85	No	6.4	7.2	0.01	0.01	<0.01	26	<2	<2
12/09/2007	7	Yellowish brown clay	8.37	x	6.65	1.72	No	5.8	8.2	<0.01	<0.01	<0.01	54	3	<2
12/09/2007	10	Bright brown clay	9.26	x	6.55	2.71	No	6.9	7.9	<0.01	<0.01	<0.01	67	<2	<2
12/09/2007	2	Strong brown clay	8.35	x	6.15	2.20	No	5.7	7.2	<0.01	<0.01	<0.01	34	3	<2
12/09/2007	5	Yellowish brown clay	8.77	xx	6.78	1.99	No	5.7	8.1	<0.01	<0.01	<0.01	44	3	<2

*Field tests that correspond with laboratory tests are also shown

5. CONCLUSIONS

Tests for the presence of PAF materials on this site included the following:

- pH testing of open water on the site.
- Field oxidation tests on 45 freshly drilled samples.
- Microscopic examination of the soil samples.
- Laboratory (SPOCAS) testing on 15 of the above samples.

None of the results from this range of tests indicates that the potential for PAF conditions exists on this site.

The materials have a low hydraulic conductivity and no ground water was detected within 30 metres from the surface. Any accumulation of water within the pit will be from direct rainfall. Due to the low permeability of materials, discharge of this water will take place by evaporation.

Even though no PAF conditions were detected from this study, it is recommended that, during mining, regular testing of the pit water and of the clay stockpiles be undertaken. If this testing indicates that any PAF conditions are developing, then a management plan in this regard should be drawn up.

6. REFERENCES

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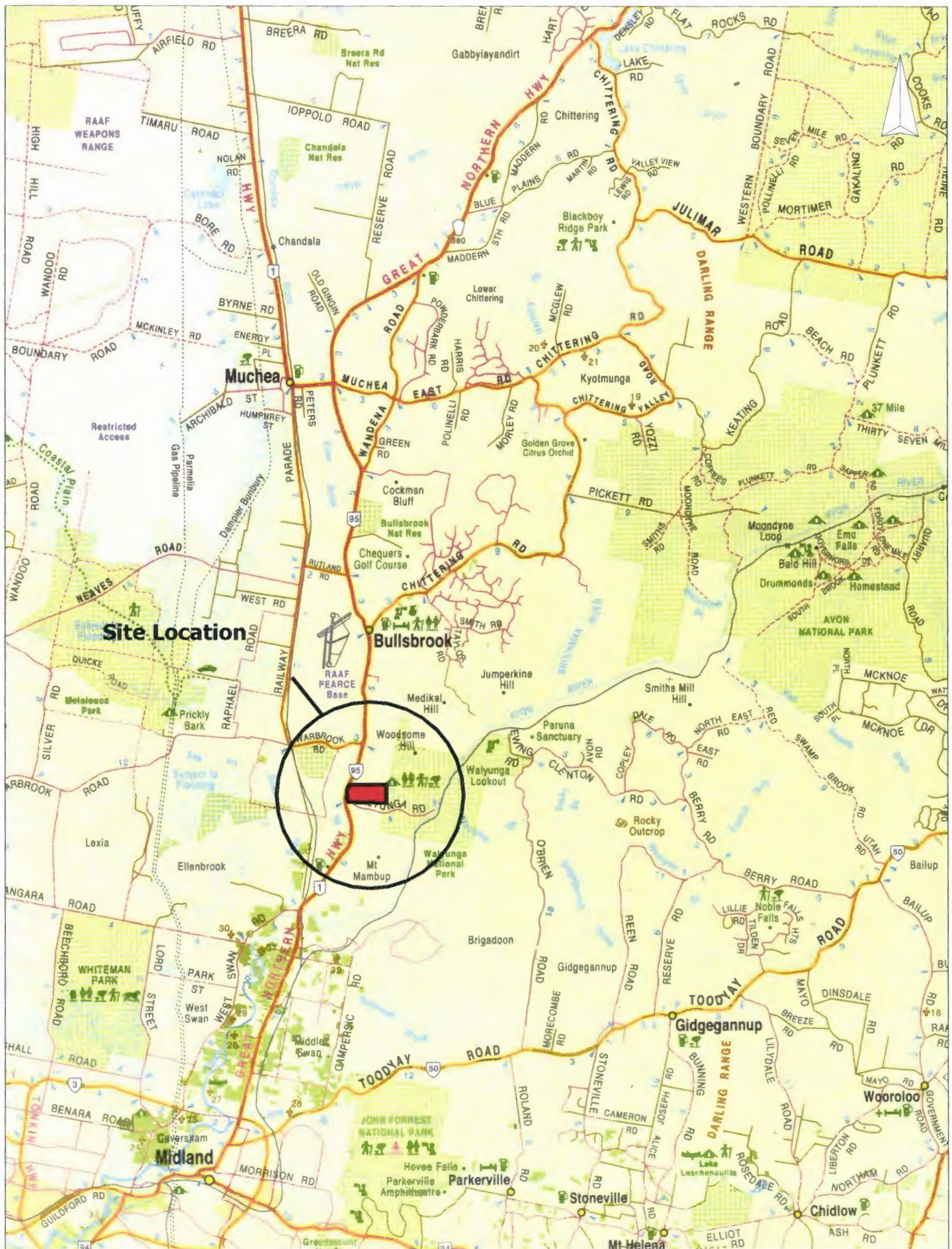
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Western Australian Planning Commission (2003). *Planning Bulletin No. 64: Acid Sulphate Soils*.

FIGURES

FIGURE 1
LOCATION PLAN



Environmental + Water
Resource Consultants

4 Cook St
West Perth WA 6005
Telephone: + 615 9226 3196
Facsimile: + 615 9226 3177
info@mbsenvironmental.com.au

Original Size: A4
Map Date: 2006

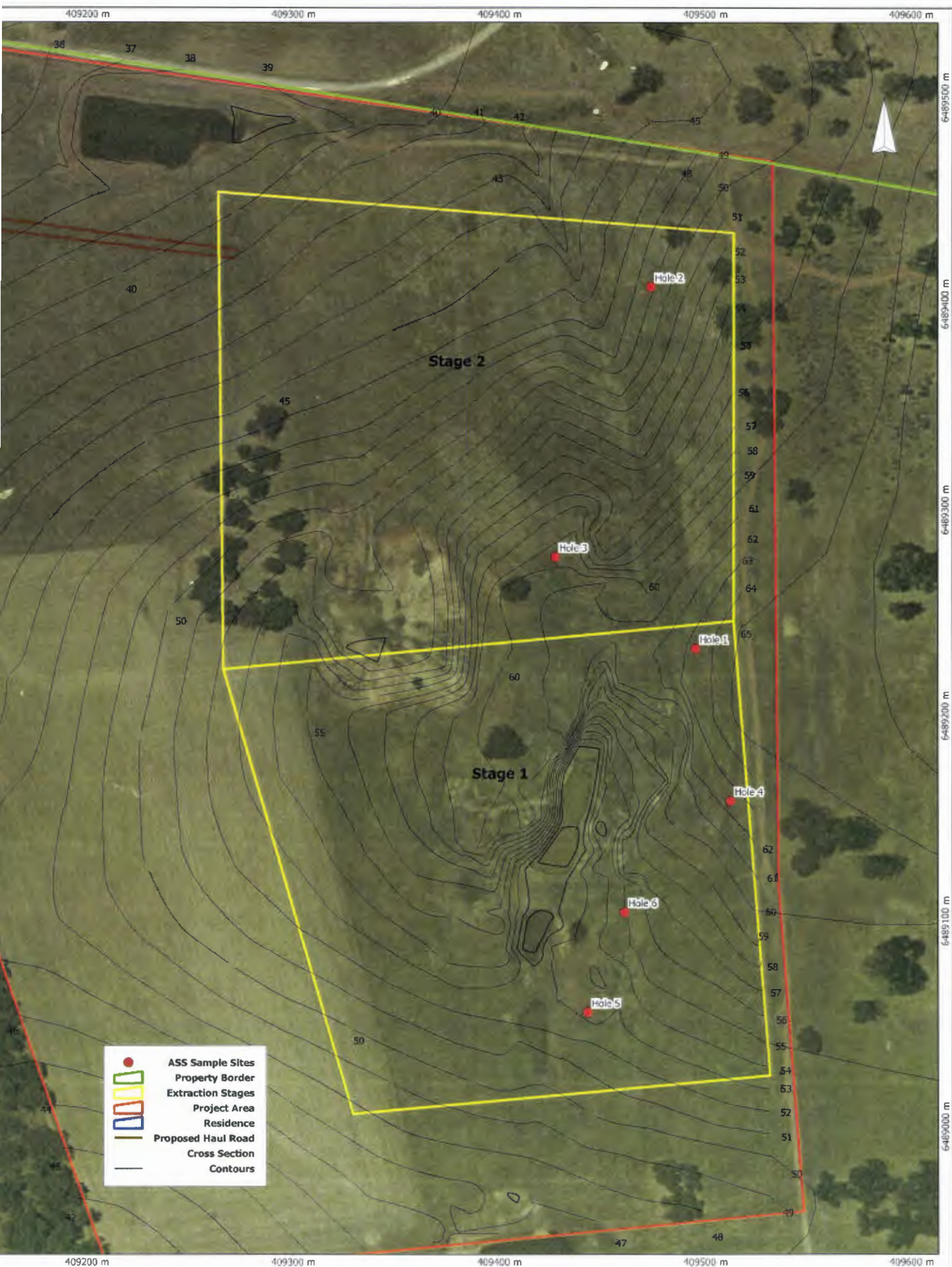
BGC Clay Products
Lot 5 Walyunga Road
Bullsbrook

Locality Plan

Figure - 1

FIGURE 2

SITE PLAN



Environmental + Water
Resource Consultants
4 Cook St
West Perth WA 6005
Telephone: + 818 9226 3166
Facsimile: + 818 9226 3177
info@mcshenvironmental.com.au

Scale: 1:1700
Original Size: A3
Air Photo Date: 2003
Datum: Australian Geocentric 1994 (GDA94)

0 100 m

BGC Clay Products
Lot 5 Walyunga Road
Bullsbrook

ASS Sampling

Figure - 2



FIGURE : Proposed Extraction Site Layout



SERS
Site Environmental and
Remediation Services

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Job No: Walyunga Road
Client: Stargaze Asset Pty Ltd
Address: Lot 5 (91) Walyunga Road

Scale: 1:8,000
Original size: A3
Imagery from: 09/10/13
Source: Nearmap

Date drawn: 11/05/16
Revision: 0
Drawn by: K.S.
Checked by: A.R.



Legend

Lot Boundary Operational Cells

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File: N:\A SERS\GIS\Projects\ Walyunga Road clay pit fill\MXD\Fig 2