

TEST PIT NO. 1 - 15Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027546 X3174046*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS		Not encountered
0.2		Dry, light brown, slightly cracked, LOOSE, clayey SAND to sandy CLAY		
0.3				
0.4				
0.5				
0.6		VERY SOFT ROCK SHALE		
0.7		Light grey to white, highly weathered, fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as angular 'plates'. Grades into soft rock towards base of test pit.		
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Slow rate of excavation*Groundwater conditions: *Not encountered*General remarks 2: *Near refusal on soft rock*Base of test pit: *1.5m - near refusal*

General remarks 3:

TEST PIT NO. 1 - 16Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027437 X3173977*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, dark brown, cracked, STIFF, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5			Disturbed	
0.6				
0.7		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white, DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel.		Not encountered
0.8				
0.9				
1.0				
1.1				
1.2			Disturbed	
1.3		VERY SOFT ROCK SHALE Dark grey blotched white, completely to highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as dark grey, fine 'chips'.		Not encountered
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 17Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027138 X3174034*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, dark brown, cracked, STIFF, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3		VERY SOFT ROCK SHALE Dark grey blotched white, completely to highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as dark grey, angular 'plates'.		
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Slow rate of excavation*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *1.4m - near refusal*

General remarks 3:

TEST PIT NO. 1 - 18Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027138 X3174034*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		COMPACTED TRANSPORTED SOILS Dry, reddish brown, DENSE, intact, silty to clayey SAND		Not encountered
0.2				
0.3		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white and dark grey, MEDIUM DENSE TO DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel.		
0.4				
0.5				
0.6		VERY SOFT ROCK SHALE Light grey blotched white, completely to highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as light grey, angular 'plates'.		
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Slow rate of excavation*Groundwater conditions: *Not encountered*General remarks 2: *General surface waste in area*Base of test pit: *1.4m - near refusal*

General remarks 3:

TEST PIT NO. 1 - 19Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027022 X3174101*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, reddish brown, cracked, STIFF, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3		VERY SOFT ROCK SHALE Light grey to white, completely to highly weathered, fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as light grey, angular 'plates'.	Bulk	
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on very soft rock or harder*Groundwater conditions: *Not encountered*General remarks 2: *shale/mudstone.*Base of test pit: *0.6m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 2Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027512 X3173218*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, light orange brown, cracked, FIRM, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white and dark grey, MEDIUM DENSE TO DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel and dark grey, highly to completely weathered, angular shale fragments.	Disturbed	
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 20Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027223 X3174132*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, red brown, DENSE, clayey SAND to sandy CLAY		Not encountered
0.2		SOFT ROCK OR HARDER DOLERITE Dark grey streaked white, highly to moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite interlaced with minor, hard calcrete.		
0.3				
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock or harder dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.4m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 21Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027382 X3174105*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS		Not encountered
0.2		Dry, red brown, DENSE, clayey SAND to sandy CLAY		
0.3		VERY SOFT ROCK SHALE		
0.4		Light grey to white, highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as light grey 'plates'.		
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on very soft to soft rock*Groundwater conditions: *Not encountered*General remarks 2: *shale/mudstone*Base of test pit: *1.2m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 22Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027448 X3174186*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, brown, cracked, FIRM, sandy CLAY to clayey SAND CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white, DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel.		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3		RESIDUAL GRADING INTO VERY SOFT ROCK SHALE Dark grey blotched white, densely packed, angular fragments of shale/mudstone grading into highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock with 'pockets' of white calcareous gravel.	Disturbed	
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 23Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027433 X3174284*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, brown, cracked, FIRM, sandy CLAY to clayey SAND		Not encountered
0.2		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white, DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel.		
0.3				
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3		RESIDUAL GRADING INTO VERY SOFT ROCK SHALE Dark grey blotched white, densely packed, angular fragments of shale/mudstone grading into highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock with 'pockets' of white calcareous gravel.		
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 24Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027282 X3174214*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, reddish brown, slightly cracked, DENSE, clayey SAND to sandy CLAY		Not encountered
0.2				
0.3		SOFT ROCK OR HARDER DOLERITE Dark grey streaked white, highly to moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite interlaced with minor, hard calcrete.		
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock or harder dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.7m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 25Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027094 X3174224*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, DENSE, intact, clayey SAND to sandy CLAY. Refuse on soft rock or harder, dark grey, rounded dolerite boulders probably grading into soft rock or harder dolerite.		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on densely packed boulders*Groundwater conditions: *Not encountered*General remarks 2: *and/or soft rock or harder dolerite*Base of test pit: *0.3m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 26Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027042 X3174313*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, reddish brown, DENSE, slightly open-structured, clayey to silty SAND		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6		RESIDUAL DOLERITE GRADING INTO SOFT ROCK DOLERITE Dark grey speckled black, VERY DENSE, coarse GRAVEL grading into highly to moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite.	Bulk	Not encountered
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock or harder dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *1.1m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 27Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027194 X3174299*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, MEDIUM DENSE, slightly open-structured, clayey to silty SAND		Not encountered
0.2				
0.3		RESIDUAL DOLERITE GRADING INTO SOFT ROCK DOLERITE Dark grey speckled black, VERY DENSE, coarse GRAVEL grading into highly to moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite.		Not encountered
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock or harder dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.5m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 28Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027324 X3174339*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS		Not encountered
0.2		Dry, reddish brown, cracked, STIFF, sandy CLAY grading into clayey SAND		
0.3		VERY SOFT ROCK SHALE		
0.4		Light grey, highly weathered, very fine-grained, bedded, very highly fractured, very soft rock shale/mudstone		
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on very soft rock shale/mudstone*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.9m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 29Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027385 X3174435*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS		Not encountered
0.2		Dry, orange brown, cracked, STIFF, sandy CLAY to clayey SAND		
0.3		CALCAREOUS RESIDUAL SHALE/MUDSTONE GRADING INTO FINE, POWDERY CALCRETE		
0.4		Dry, light brown blotched white and dark grey, DENSE, intact, silty to		
0.5		clayey SAND containing 'lenses' of white, fine, calcareous gravel and		
0.6		dark grey, highly to completely weathered, angular shale/mudstone		
0.7		fragments. Grades into white, MEDIUM DENSE, fine powdery	Disturbed	
0.8		calcrete towards base of test pit.		
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 3Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027615 X3173332*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, light orange brown, cracked, FIRM, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5			Disturbed	
0.6		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white and dark grey, DENSE TO VERY DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel and dark grey, highly to completely weathered, angular shale fragments.		
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4		RESIDUAL GRADING INTO VERY SOFT ROCK SHALE/MUDSTONE Dark grey blotched dark orange, completely to highly weathered, fine-grained, very highly fractured, very soft rock		
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.8m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 30Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027213 X3174409*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS		Not encountered
0.2		Slightly moist, reddish brown, LOOSE, open-structured, slightly clayey SAND		
0.3		RESIDUAL DOLERITE GRADING INTO SOFT ROCK DOLERITE		
0.4		Dark grey speckled black and streaked white, VERY DENSE, coarse, gravelly SAND grading into moderately weathered, medium to coarse grained, massive, moderately fractured, very soft rock grading into soft rock or harder dolerite		
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.8m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 31Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027055 X3174412*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, LOOSE, open-structured, slightly clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5		RESIDUAL DOLERITE GRADING INTO SOFT ROCK DOLERITE Dark grey speckled black and streaked white, VERY DENSE, coarse, gravelly SAND grading into moderately weathered, medium to coarse grained, massive, moderately fractured, very soft rock grading into soft rock or harder dolerite		
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *1.0m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 32Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027064 X3174539*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, LOOSE, open-structured, slightly clayey SAND		Not encountered
0.2				
0.3		SOFT ROCK OR HARDER DOLERITE Dark grey speckled black and streaked white, VERY DENSE, coarse, gravelly SAND grading into moderately weathered, medium to coarse grained, massive, moderately fractured, very soft rock grading into soft rock or harder dolerite		
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.4m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 33Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027206 X3174521*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, LOOSE to MEDIUM DENSE, slightly open-structured, slightly clayey SAND		Not encountered
0.2				
0.3		SOFT ROCK OR HARDER DOLERITE Dark grey speckled black and streaked white, VERY DENSE, coarse, gravelly SAND grading into moderately weathered, medium to coarse grained, massive, moderately fractured, very soft rock grading into soft rock or harder dolerite	Bulk	Not encountered
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *1.0m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 34Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027352 X3174526*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, orange brown, FIRM, cracked, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5		CALCAREOUS RESIDUAL SHALE/MUDSTONE Slightly moist, orange brown blotched white, DENSE, slightly clayey SAND containing minor 'lenses' of calcareous gravel.		
0.6				
0.7				
0.8				
0.9		CALCAREOUS RESIDUAL SHALE/MUDSTONE Slightly moist, dark orange blotched dark grey, STIFF, shattered, silty CLAY with minor 'pockets' of white, calcareous gravel. Grades into dark grey, completely to highly weathered, shale/mudstone towards base of test pit.		
1.0				
1.1			Disturbed	
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

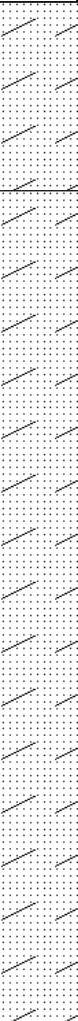
General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 35Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027305 X3174637*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Moist, dark orange, DENSE, intact, clayey SAND to sandy CLAY		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light grey blotched dark orange, DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel and dark grey, highly to completely weathered, angular shale fragments. Gradually gades into dark grey, completely to highly weathered, very fine grained, very highly fractured, very soft rock shale/mudstone	Bulk	
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 36Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027138 X3174630*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, MEDIUM DENSE, clayey SAND to sandy CLAY		Not encountered
0.2				
0.3		SOFT ROCK DOLERITE Dark grey speckled black, moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite		
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.8m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 37Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027109 X3174770*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, MEDIUM DENSE, clayey SAND to sandy CLAY		Not encountered
0.2				
0.3		SOFT ROCK DOLERITE Dark grey speckled black, moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite		
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.5m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 38Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027283 X3174747*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, light brown, DENSE, intact, clayey SAND		Not encountered
0.2				
0.3		RESIDUAL GRADING INTO VERY SOFT ROCK SHALE Light grey stained orange brown along bedding planes, completely to highly weathered, fine-grained, bedded, very highly fractured, very soft rock shale/mudstone. Excavates as light grey, flat 'plates'.	Bulk	Not encountered
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock shale/mudstone*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *1.1m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 39Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027458 X3174773*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, light brown, STIFF, slightly cracked, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5		VERY SOFT ROCK SHALE Dark grey stained orange brown and black along bedding planes, highly weathered, fine-grained, bedded, very highly fractured, very soft rock shale/mudstone. Excavates as dark grey, flat 'plates'.		
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Near refusal on very soft rock*Groundwater conditions: *Not encountered*General remarks 2: *shale/mudstone.*Base of test pit: *2.0m - near refusal*

General remarks 3:

TEST PIT NO. 1 - 4Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027760 X3173433*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, light orange brown, cracked, FIRM, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white and dark grey, DENSE TO VERY DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel and dark grey, highly to completely weathered, angular shale fragments.		
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5		RESIDUAL GRADING INTO VERY SOFT ROCK SHALE/MUDSTONE Dark grey blotched dark orange, completely to highly weathered, fine-grained, very highly fractured, very soft rock		
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*General remarks 2: *Surface cracked*Base of test pit: *2.8m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 40Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027618 X3174775*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, MEDIUM DENSE, clayey SAND to sandy CLAY		Not encountered
0.2				
0.3		SOFT ROCK DOLERITE Dark grey speckled black, moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite		Not encountered
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *0.6m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 41Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027583 X3174899*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, MEDIUM DENSE, clayey SAND to sandy CLAY		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6			Disturbed	
0.7		VERY SOFT ROCK SHALE Light grey grading into dark grey with depth, highly weathered, very fine-grained, bedded, very highly fractured, very soft rock shale/mudstone. Excavates as fine, white, shaly 'flakes'.		
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not at refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.6m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 42Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027403 X3174880*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, MEDIUM DENSE, clayey SAND to sandy CLAY		
0.2				
0.3		VERY SOFT ROCK SHALE Light grey, highly weathered, very fine-grained, bedded, very highly fractured, very soft rock shale/mudstone. Excavates as fine, white, shaly 'flakes'. Approaches very soft to soft rock shale towards base of test pit.		
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Near refusal on very soft to soft rock*Groundwater conditions: *Not encountered*General remarks 2: *shale/mudstone.*Base of test pit: *1.2m - near refusal*

General remarks 3:

TEST PIT NO. 1 - 43Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027157 X3174827*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, reddish brown, LOOSE, slightly open-structured, silty to clayey SAND		Not encountered
0.2				
0.3		VERY SOFT TO SOFT ROCK DOLERITE Dark grey speckled black and streaked white, moderately weathered, medium-grained, massive, moderately fractured, soft rock or harder dolerite. Refuse on soft rock or harder dolerite.		
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

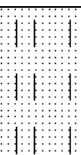
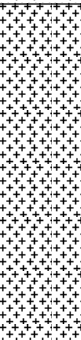
General remarks 2:

Base of test pit: *0.8m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 44Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027076 X3174970*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, LOOSE to MEDIUM DENSE, intact, slightly clayey SAND.		Not encountered
0.2				
0.3				
0.4				
0.5			VERY SOFT TO SOFT ROCK DOLERITE Dark grey speckled black and streaked white, moderately weathered, medium-grained, massive, moderately fractured, soft rock or harder dolerite. Refuse on soft rock or harder dolerite.	
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock dolerite*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *1.3m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 45Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027308 X3174970*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, LOOSE to MEDIUM DENSE, intact, slightly clayey SAND.		Not encountered
0.2				
0.3				
0.4		VERY SOFT TO SOFT ROCK SHALE Dark orange, highly weathered, fine-grained, bedded, very highly fractured, very soft to soft rock shale/mudstone. Excavates as coarse, angular shaly 'chips'.		
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock shale/mudstone*Groundwater conditions: *Not encountered*

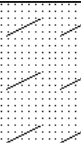
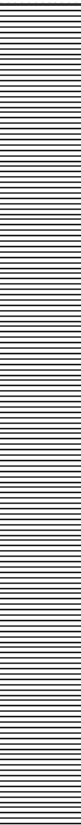
General remarks 2:

Base of test pit: *0.4m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 46Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027497 X3175016*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS		Not encountered
0.2		Dry, reddish brown, slightly cracked, FIRM, clayey SAND.		
0.3				
0.4				
0.5		VERY SOFT ROCK SHALE		
0.6		Light grey stained orange along bedding planes, highly weathered, fine-grained, bedded, very highly fractured, very soft rock shale/mudstone. Excavates as grey, coarse, 'plates' of shale.		
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.6m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 47Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027366 X3175106*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		SOFT ROCK OR HARDER DOLERITE		
0.2		Dark grey speckled black, moderately weathered, medium-grained, massive, moderately fractured, soft rock or harder dolerite. Excavate rounded dolerite boulders.		
0.3				Not encountered
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on soft rock or harder dolerite*Groundwater conditions: *Not encountered*

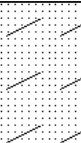
General remarks 2:

Base of test pit: *0.2m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 48Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027184 X3175094*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, dark brown blotched white, MEDIUM DENSE, intact, slightly clayey SAND containing minor 'lenses' of white, calcareous gravel.	<div>Bulk</div>	Not encountered
0.2				
0.3				
0.4				
0.5		VERY SOFT ROCK SHALE Light grey stained dark orange along bedding planes, highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as light grey, 'plates'.		
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.6m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 49Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027146 X3175244*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL	
0.0		Current NGL			
0.1		TRANSPORTED SOILS Slightly moist, dark brown blotched white, DENSE, intact, slightly clayey SAND containing minor 'lenses' of white, calcareous gravel.		Not encountered	
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0		CALCAREOUS RESIDUAL SHALE/MUDSTONE Slightly moist, orange brown blotched white and dark grey, MEDIUM DENSE, silty to clayey SAND containing minor 'lenses' of white, calcareous gravel and pockets of dark grey, completely weathered mudstone.	Disturbed		
1.1					
1.2					
1.3					
1.4					
1.5					
1.6		VERY SOFT ROCK SHALE Dark grey stained dark orange along bedding planes, highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as light grey, 'plates'.			
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					
3.1					

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.6m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 5Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027779 X3173589*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, dark orange brown, cracked, STIFF, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6			Disturbed	
0.7		VERY SOFT ROCK SHALE Light grey, highly weathered, fine-grained, very highly fractured, very soft rock. Excavates as fine 'chips'.		Not encountered
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on VSR shale/mudstone*Groundwater conditions: *Not encountered*General remarks 2: *Surface cracked*Base of test pit: *1.2m - refusal reached*

General remarks 3:

TEST PIT NO. 1 - 50Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027428 X3175236*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, reddish brown, FIRM, cracked, sandy CLAY to clayey SAND.		Not encountered
0.2				
0.3				
0.4				
0.5		TRANSPORTED SOILS Dry, light reddish brown, DENSE, slightly open-structured, silty to clayey SAND		
0.6				
0.7				
0.8				
0.9			Disturbed	
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6			VERY SOFT ROCK SHALE Light grey stained dark orange along bedding planes, highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock. Excavates as thin light grey, 'plates'.	
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.6m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 51Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027276 X3175374*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, dark brown, cracked, FIRM, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5		CALCAREOUS RESIDUAL SHALE/MUDSTONE Slightly moist, light orange brown blotched white, MEDIUM DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel.		
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5	VERY SOFT ROCK SHALE Dark grey blotched white, highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock with 'pockets' of white calcareous gravel.			
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 52Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *10 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027250 X3175461*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Dry, dark brown, cracked, STIFF, sandy CLAY to clayey SAND		Not encountered
0.2				
0.3				
0.4				
0.5			Disturbed	
0.6		CALCAREOUS RESIDUAL SHALE/MUDSTONE Slightly moist, light orange brown blotched white, DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel.		
0.7				
0.8				
0.9				
1.0				
1.1		VERY SOFT ROCK SHALE Dark grey blotched dark orange and white, highly weathered, very-fine-grained, horizontally bedded, very highly fractured, very soft rock with 'pockets' of white calcareous gravel.		
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Not yet refusal*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.7m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 6Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027593 X3173492*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS		Not encountered
0.2		Slightly moist, light brown, slightly cracked, MEDIUM DENSE, clayey SAND		
0.3		VERY SOFT ROCK SHALE Light grey, highly weathered, fine-grained, very highly fractured, very soft rock. Grades into soft rock towards base of test pit.	Bulk	
0.4				
0.5				
0.6				
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Near refusal on VSR shale/mudstone*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *1.6m - near refusal reached*

General remarks 3:

TEST PIT NO. 1 - 7Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027459 X3173350*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, dark reddish brown, cracked, STIFF, sandy CLAY		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6			Disturbed	
0.7		VERY SOFT ROCK SHALE Light grey grading into dark grey with depth, slightly calcified, highly to moderately weathered with depth, fine-grained, very highly fractured, very soft rock grading into soft rock towards base of test pit.		
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Near refusal on VSR shale/mudstone*Groundwater conditions: *Not encountered*General remarks 2: *Slow rate of excavation*Base of test pit: *2.4m - near refusal reached*

General remarks 3:

TEST PIT NO. 1 - 8Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027412 X3173526*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, dark brown, cracked, STIFF, sandy CLAY		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6				
0.7			Disturbed	
0.8		CALCAREOUS RESIDUAL SHALE/MUDSTONE Dry, light orange brown blotched white and dark grey, DENSE, intact, silty to clayey SAND containing 'lenses' of white, fine, calcareous gravel and dark grey, highly to completely weathered, angular shale fragments.		
0.9				
1.0				
1.1				
1.2				
1.3			Disturbed	
1.4				
1.5				
1.6				
1.7				
1.8		VERY SOFT ROCK SHALE/MUDSTONE Light brown, highly weathered, fine-grained, very highly fractured, very soft rock		
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refusal not reached*Groundwater conditions: *Not encountered*

General remarks 2:

Base of test pit: *2.8m - maximum reach*

General remarks 3:

TEST PIT NO. 1 - 9Logged by: *PH Oosthuizen*Project: *Lerato Park Phase 1 area*Date logged: *9 June 2009*Client: *Bigen Africa*Coordinates: *25 Y0027565 X3173605*

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Depth (m)	LEGEND	DESCRIPTION	SAMPLING	GROUND WATER LEVEL
0.0		Current NGL		
0.1		TRANSPORTED SOILS Slightly moist, dark reddish brown, slightly cracked, DENSE/STIFF, clayey SAND to sandy CLAY		Not encountered
0.2				
0.3				
0.4				
0.5				
0.6		VERY SOFT ROCK SHALE Light grey, highly weathered, fine-grained, very highly fractured, very soft rock grading into soft rock towards base of test pit		
0.7				
0.8				
0.9				
1.0				
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
2.0				
2.1				
2.2				
2.3				
2.4				
2.5				
2.6				
2.7				
2.8				
2.9				
3.0				
3.1				

Excavation method: *Test pit with Terex 820 TLB* General remarks 1: *Refuse on very soft rock or harder*Groundwater conditions: *Not encountered*General remarks 2: *shale/mudstone*Base of test pit: *1.5m - refusal reached*

General remarks 3:

APPENDIX B

LABORATORY TEST RESULTS



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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No. 09/0729-09/0728

Page 2 of 2

CLIENT & PROJECT		SOUTHERN GEOTECHNICAL ENGINEERING / LERATO PARK PHASE 1			
HOLE No / KM		1-48			
MATERIAL DEPTH (mm)		1000 - 2500			
SAMPLE / LAB. No.		09/0729			
MATERIAL DESCRIPTION		1-48 1 0-2 5			
IN SITU FIELD MOISTURE (%)		8.0%			
AASHTO CLASSIFICATION		A-2-6			
UNIFIED SOIL CLASSIFICATION		SC			
TRH14 COLTO CLASSIFICATION		G6			
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)					
SIEVE ANALYSIS	63.0 mm	99			
	53.0 mm	98			
	37.5 mm	96			
	26.5 mm	93			
	19.0 mm	90			
	13.2 mm	87			
	4.75 mm	66			
	2.00 mm	45			
	0.425 mm	29			
	0.075 mm	16			
	0.002 mm	1			
SOIL MORTAR	COARSE SAND	36			
	FINE SAND	28			
	MATERIAL <0.075 MM	36			
	GRADING MODULUS (GM)	2.10			
Ph / CONDUCTIVITY Sm ⁻¹					
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425		LL	35		
		PI / LS	13 / 6.18		
POTENTIAL EXPANSIVENESS (mm)					
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A15T)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)	1691		
		OPT MOISTURE (%)	19.5		
		COMP MOISTURE (%)	19.3		
		DRY DENSITY (kg/m ³)	1690		
		CBR (%) / *UCS/ITS (Kpa)	37.91		
		SWELL (%)	0.1		
	NRB	DRY DENSITY (kg/m ³)	1629		
		CBR (%) / *UCS/ITS (Kpa)	32.55		
	PROC-TOR	MAX DRY DENSITY (kg/m ³)	1570		
		OPT MOISTURE (%)			
		CBR (%)	28.62		
CBR / UCS / ITS	100%	38			
	98%	35			
	95%	31			
	93%	29			
	90%	25			

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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No. 09/0716-09/0719

Page 2 of 2

CLIENT & PROJECT		SOUTHERN GEOTECHNICAL ENGINEERING / LERATO PARK PHASE 1				
HOLE No / KM		1-1	1-6	1-11	1-13	
MATERIAL DEPTH (mm)		300-900	500-1600	1100-2800	1000-1800	
SAMPLE / LAB. No.		09/0716	09/0717	09/0718	09/0719	
MATERIAL DESCRIPTION		1-1 0 3-0.9	1-6 0.5-1.6	1-11 1 1 - 2.8	1-13 1 0-1.8	
IN SITU FIELD MOISTURE (%)		5.2%	1.7%	5.9%	5.1%	
AASHTO CLASSIFICATION		A-2-6	A-2-6	A-2-6	A-2-6	
UNIFIED SOIL CLASSIFICATION		SC	SC	SC	sp/sc	
TRH14 th COLTO CLASSIFICATION		G6	G6	<G10	G10	
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)						
SIEVE ANALYSIS	63.0 mm	100				
	53.0 mm	97	100		100	
	37.5 mm	96	98		97	
	26.5 mm	94	96	100	93	
	19.0 mm	91	94	99	88	
	13.2 mm	75	86	97	78	
	4.75 mm	56	74	82	54	
	2.00 mm	42	56	63	35	
	0.425 mm	26	33	39	21	
	0.075 mm	16	19	22	8	
	0.002 mm	1	2	2	1	
SOIL MORTAR	COARSE SAND	37	41	38	39	
	FINE SAND	24	26	27	38	
	MATERIAL <0.075 MM	40	33	35	23	
GRADING MODULUS (GM)		2 15	1.92	1.77	2 15	
Ph / CONDUCTIVITY Sm ⁻¹						
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)						
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425		L.L	34	33	37	37
		P.I. / L.S	43 / 8.7	44 / 3.36	16 / 9.19	16 / 8.1
POTENTIAL EXPANSIVENESS (mm)						
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A9)						
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)						
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)	1864	1733	1917	1888
		OPT MOISTURE (%)	14.3	16.1	13.4	13.8
		COMP MOISTURE (%)	14	16.4	13.5	13.9
		DRY DENSITY (kg/m ³)	1845	1702	1925	1990
		CBR (%) / *UCS/ITS (Kpa)	41.98	69.69	4.31	10.95
		SWELL (%)	0.1	0.0	0.9	0.4
	NRB	DRY DENSITY (kg/m ³)	1793	1649	1848	1927
		CBR (%) / *UCS/ITS (Kpa)	33	68.58	3.08	10.44
	PROC. TOR	MAX DRY DENSITY (kg/m ³)	1649	1586	1712	1840
		OPT MOISTURE (%)				
		CBR (%)	18.88	41.91	2.13	7.63
CBR / UCS / ITS	100%	45	70	4	10	
	98%	39	70	4	8	
	95%	31	67	3	6	
	93%	27	53	3	5	
	90%	22	31	2	3	

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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No.: 09/0731-09/0734

Page 2 of 2

CLIENT & PROJECT		SOUTHERN GEOTECHNICAL ENGINEERING - LERATO PARK PHASE 1			
HOLE No. / KM		1-2	1-3	1-5	1-7
MATERIAL DEPTH (mm)		1000	400	500	500
SAMPLE / LAB. No.		09/0731	09/0732	09/0733	09/0734
MATERIAL DESCRIPTION		1-2 1.0	1-2 0.4	1-5 0.5	1-7 0.5
IN SITU FIELD MOISTURE (%)		9.9%	7.8%	12.5%	7.6%
AASHTO CLASSIFICATION		A-7-6	A-6	A-6	A-6
UNIFIED SOIL CLASSIFICATION		SC	SC	SC	SC
TRH14: COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm				
	13.2 mm	100	100	100	100
	4.75 mm	95	98	96	99
	2.00 mm	91	94	92	98
	0.425 mm	72	78	85	94
	0.075 mm	46	44	45	41
	0.002 mm	5	5	8	6
SOIL MORTAR	COARSE SAND	20	17	7	4
	FINE SAND	29	37	44	54
	MATERIAL <0.075 MM	50	46	49	42
	GRADING MODULUS (GM)	0.91	0.84	0.78	0.91
	Ph / CONDUCTIVITY Sm ⁻¹	7.2 / 0.0049	7.64 / 0.0058	7.95 / 0.0054	7.72 / 0.0036
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L.	45	35	38	28
	P.I. / L.S.	18 / 10.71	15 / 9.17	20 / 10.03	14 / 6.23
POTENTIAL EXPANSIVENESS (mm)					
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
	NRB	DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
	PROC-TOR	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		CBR (%)			
CBR / UCS / ITS		100%			
		98%			
		95%			
		93%			
		90%			
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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No.: 09/0735-09/0739

Page 2 of 2

CLIENT & PROJECT:		SOUTHERN GEOTECHNICAL ENGINEERING / LERATO PARK PHASE 1			
HOLE No. / KM		1-8	1-8	1-11	1-12
MATERIAL DEPTH (mm)		600	1200	500	600
SAMPLE / LAB. No.		09/0735	09/0736	09/0737	09/0739
MATERIAL DESCRIPTION		1-8 0.6	1-8 1.2	1-11 0.5	1-12 0.6
IN SITU FIELD MOISTURE (%)		11.5%	34.3%	12.2%	14.2%
AASHTO CLASSIFICATION		A-6	A-6	A-7-6	A-7-6
UNIFIED SOIL CLASSIFICATION		CL	SC	SC	CL
TRH14/ COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm				
	13.2 mm		100	100	
	4.75 mm	100	99	98	100
	2.00 mm	99	96	96	99
	0.425 mm	96	87	77	79
	0.075 mm	53	41	38	55
	0.002 mm	7	5	7	6
SOIL MORTAR	COARSE SAND	4	9	20	20
	FINE SAND	43	48	41	25
	MATERIAL <0.075 MM	53	43	39	55
	GRADING MODULUS (GM)	0.52	0.76	0.89	0.52
	Ph / CONDUCTIVITY Sm ⁻¹	7.73 / 0.0057	8.17 / 0.0035	8.22 / 0.0045	8.31 / 0.005
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L.	38	38	42	46
	P.I. / L.S.	18 / 10.17	18 / 8.7	20 / 10.91	22 / 12.21
POTENTIAL EXPANSIVENESS (mm)					
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
	NRB	SWELL (%)			
		DRY DENSITY (kg/m ³)			
	PROC. TOR	CBR (%) / *UCS/ITS (Kpa)			
		MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
CBR / UCS / ITS		CBR (%)			
		100%			
		98%			
		95%			
		93%			
		90%			
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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No. 09/0720-09/0724

Page 2 of 2

CLIENT & PROJECT:		SOUTHERN GEOTECHNICAL ENGINEERING / LERATO PARK PHASE 1				
HOLE No. / KM		1-14	1-19	1-26	1-33	
MATERIAL DEPTH (mm)		1000-1800	200-600	500-1100	400-1000	
SAMPLE / LAB No.		09/0720	09/0721	09/0723	09/0724	
MATERIAL DESCRIPTION		1-14 1.0-1.8	1-19 0.2-0.6	1-26 0.5-1.1	1-33 0.4-1.0	
IN SITU FIELD MOISTURE (%)		3.9%	6.8%	1.4%	8.1%	
AASHTO CLASSIFICATION		A-2-7	A-2-6	A-2-4	A-2-4	
UNIFIED SOIL CLASSIFICATION		SC	SC	sp/sc	SC	
TRH14/ COLTO CLASSIFICATION		G8	G8	G5	G6	
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)						
SIEVE ANALYSIS	63.0 mm		93	100	100	
	53.0 mm	100	92	99	95	
	37.5 mm	99	87	98	89	
	26.5 mm	96	84	94	88	
	19.0 mm	90	80	89	84	
	13.2 mm	80	69	82	75	
	4.75 mm	63	61	60	60	
	2.00 mm	47	47	43	46	
	0.425 mm	36	29	23	24	
	0.075 mm	20	16	10	16	
SOIL MORTAR	0.002 mm	3	1	1	1	
	COARSE SAND	24	38	46	48	
	FINE SAND	34	27	30	18	
	MATERIAL <0.075 MM	42	34	24	34	
GRADING MODULUS (GM)		1.97	2.08	2.23	1.97	
Ph / CONDUCTIVITY Sm ⁻¹						
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)						
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	LL	51	40	26	29	
	PI / LS	25 / 9.7	18 / 6.68	10 / 3.97	10 / 2.94	
POTENTIAL EXPANSIVENESS (mm)						
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)						
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)						
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)	1906	1836	2223	2084
		OPT MOISTURE (%)	13.3	15.1	8	10.8
		COMP MOISTURE (%)	13.1	15.4	7.8	10.5
		DRY DENSITY (kg/m ³)	1858	1839	2224	2084
		CBR (%) / *UCS/ITS (Kpa)	34.44	40.29	93.59	64.94
		SWELL (%)	0.3	0.8	0.0	0.0
	NRB	DRY DENSITY (kg/m ³)	1822	1779	2111	1980
		CBR (%) / *UCS/ITS (Kpa)	28.53	35.42	89.12	40
	PROC-TOR	MAX DRY DENSITY (kg/m ³)	1667	1709	2045	1917
		OPT MOISTURE (%)				
CBR / UCS / ITS	CBR (%)	8.02	35.02	46.25	23.19	
	100%	42	40	94	65	
	98%	36	37	92	57	
	95%	27	35	89	40	
	93%	22	35	61	29	
	90%	14	35	17	12	
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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No.: 09/0725-09/0728

Page 2 of 2

CLIENT & PROJECT:		SOUTHERN GEOTECHNICAL ENGINEERING : LERATO PARK PHASE 1				
HOLE No. / KM		1-35	1-38	1-42	1-44	
MATERIAL DEPTH (mm)		500-2700	400-1100	0-1200	400-1300	
SAMPLE / LAB. No.		09/0725	09/0726	09/0727	09/0728	
MATERIAL DESCRIPTION		1-35 0.5-2.7	1-38 0.4-1.1	1-42 0-1.2	1-44 0.4-1.3	
IN SITU FIELD MOISTURE (%)		11.2%	4.8%	8.2%	2.6%	
AASHTO CLASSIFICATION		A-2-6	A-2-6	A-2-6	A-2-4	
UNIFIED SOIL CLASSIFICATION		sp/sc	SC	SC	SC	
TRH14/" COLTO CLASSIFICATION		G6	G6	G6	G5	
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING						
SIEVE ANALYSIS	63.0 mm	100	99	99	100	
	53.0 mm	95	98	97	100	
	37.5 mm	91	95	95	97	
	26.5 mm	89	92	92	93	
	19.0 mm	84	89	88	91	
	13.2 mm	72	77	77	86	
	4.75 mm	55	61	68	79	
	2.00 mm	39	51	52	66	
	0.425 mm	24	35	29	35	
	0.075 mm	12	17	17	17	
	0.002 mm	1	2	1	2	
SOIL MORTAR	COARSE SAND	38	31	45	46	
	FINE SAND	32	35	22	28	
	MATERIAL <0.075 MM	30	35	33	26	
	GRADING MODULUS (GM)	2.25	1.97	2.02	2.25	
Ph / CONDUCTIVITY Sm ⁻¹						
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)						
ATTERBER LIMITS PASSING SIEVE (mm) >0.425	L.L	40	35	38	27	
	P.I / L.S	16 / 6.7	14 / 4.81	13 / 4.55	10 / 4.31	
POTENTIAL EXPANSIVENESS (mm)						
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)						
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)						
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)	1721	1850	1745	2116
		OPT MOISTURE (%)	19.1	16.2	16.8	9.1
		COMP MOISTURE (%)	19	16.5	16.7	9.0
		DRY DENSITY (kg/m ³)	1717	1851	1726	2128
		CBR (%) / *UCS/ITS (Kpa)	31.32	64.95	49.3	86.14
		SWELL (%)	0.1	0.1	0.9	0.0
	NRB	DRY DENSITY (kg/m ³)	1680	1780	1684	2072
		CBR (%) / *UCS/ITS (Kpa)	33.47	59.34	41.39	70.03
	PROC. TOR	MAX DRY DENSITY (kg/m ³)	1557	1743	1554	2026
		OPT MOISTURE (%)				
		CBR (%)	27.4	54.47	13.25	64.02
CBR / UCS / ITS	100%	31	65	53	83	
	98%	33	62	46	70	
	95%	31	56	36	62	
	93%	30	52	28	56	
	90%	27	44	17	48	

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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No.: 09/0740-09/0743

Page 2 of 2

CLIENT & PROJECT		SOUTHERN GEOTECHNICAL ENGINEERING / LERATO PARK PHASE 1			
HOLE No. / KM		1-16	1-22	1-29	1-34
MATERIAL DEPTH (mm)		700	600	600	1000
SAMPLE / LAB. No.		09/0740	09/0741	09/0742	09/0743
MATERIAL DESCRIPTION		1-16 0.7	1-22 0.6	1-29 0.6	1-34 1.0
IN SITU FIELD MOISTURE (%)		11.4%	9.9%	9.5%	12.6%
AASHTO CLASSIFICATION		A-7-6	A-7-6	A-6	A-7-6
UNIFIED SOIL CLASSIFICATION		SC	ML	SC	SC
TRH14" COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm		100		100
	13.2 mm	100	99	100	99
	4.75 mm	99	97	99	97
	2.00 mm	98	90	94	91
	0.425 mm	81	74	77	63
	0.075 mm	49	54	46	45
	0.002 mm	7	6	7	5
SOIL MORTAR	COARSE SAND	17	17	18	31
	FINE SAND	33	23	33	20
	MATERIAL <0.075 MM	50	60	49	49
	GRADING MODULUS (GMI)	0.73	0.82	0.83	0.73
	Ph / CONDUCTIVITY Sm ⁻¹	8.43 / 0.0084	7.82 / 0.0071	8.4 / 0.0032	8.46 / 0.0208
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L L	42	48	38	47
	P.L. / L.S.	19 / 11.06	19 / 10.37	20 / 9.05	26 / 11.4
POTENTIAL EXPANSIVENESS (mm)					
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
		SWELL (%)			
	NRB	DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
	PROC. TOR	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		CBR (%)			
CBR / UCS / ITS		100%			
		98%			
		95%			
		93%			
		90%			

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Page 2 of 2

CLIENT & PROJECT		SOUTHERN GEOTECHNICAL ENGINEERING / LERATO PARK PHASE 1			
HOLE No. / KM		1-41	1-49	1-50	1-51
MATERIAL DEPTH (mm)		500	1000	800	1000
SAMPLE / LAB. No		09/0744	09/0745	09/0746	09/0747
MATERIAL DESCRIPTION		1-41 0.5	1-49 1.0	1-50 0.8	1-51 1.0
IN SITU FIELD MOISTURE (%)		4.9%	15.2%	14.5%	19.0%
AASHTO CLASSIFICATION		A-2-4	A-7-6	A-6	A-7-6
UNIFIED SOIL CLASSIFICATION		sm/sc	CL	CL	CH
TRH14/ COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm	100			
	13.2 mm	99	100		
	4.75 mm	99	97	100	
	2.00 mm	98	94	99	100
	0.425 mm	92	78	96	96
	0.075 mm	29	65	57	79
	0.002 mm	5	4	8	9
SOIL MORTAR	COARSE SAND	6	17	3	4
	FINE SAND	65	14	40	17
	MATERIAL <0.075 MM	29	69	57	80
GRADING MODULUS (GM)		0.81	0.62	0.48	0.81
Ph / CONDUCTIVITY Sm ⁻¹		8.84 / 0.0012	6.14 / 0.0215	8.41 / 0.0091	8.5 / 0.0269
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L.	19	46	39	51
	P.I. / L.S.	4 / 1.91	23 / 10.76	22 / 11.63	28 / 12.52
POTENTIAL EXPANSIVENESS (mm)					
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
		SWELL (%)			
	NRB	DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
	PROC. TOR	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		CBR (%)			
CBR / UCS / ITS		100%			
		98%			
		95%			
		93%			
		90%			
Results reported relate only to the materials tested					
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(PTY) LIMITED GEOTECHNICAL SERVICES

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***PAGE CONTINUES FROM PAGE 1

DOCUMENT No. 09/0748

Page 2 of 2

CLIENT & PROJECT		SOUTHERN GEOTECHNICAL ENGINEERING		LERATO PARK PHASE 1	
HOLE No. / KM		1-52			
MATERIAL DEPTH (mm)		400			
SAMPLE / LAB. No		09/0748			
MATERIAL DESCRIPTION		1-52 0.4			
IN SITU FIELD MOISTURE (%)		14.4%			
AASHTO CLASSIFICATION		A-7-6			
UNIFIED SOIL CLASSIFICATION		CL			
TRH14/ COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075MM SIEVE (TMH 1, Method A1 (a), A5 - % PASSING)					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm				
	13.2 mm	100			
	4.75 mm	99			
	2.00 mm	97			
	0.425 mm	91			
	0.075 mm	62			
SOIL MORTAR	0.002 mm	8			
	COARSE SAND	6			
	FINE SAND	31			
	MATERIAL <0.075 MM	64			
GRADING MODULUS (GM)		0.51			
Ph / CONDUCTIVITY S _m ⁻¹		8.84 / 0.0012			
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3 & A4)					
ATTERBER LIMITS PASSING SIEVE (mm) >0.425		LL	48		
		P.I. / L.S.	23 / 12.18		
POTENTIAL EXPANSIVENESS (mm)					
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A13T, A14 & A16T)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
	NRB	DRY DENSITY (kg/m ³)			
		CBR (%) / *UCS/ITS (Kpa)			
	PROC-TOR	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		CBR (%)			
CBR / UCS / ITS	100%				
	98%				
	95%				
	93%				
	90%				

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APPENDIX C

DRAWINGS



Client:

LERATO PARK PHASE 1
GEOTECHNICAL INVESTIGATION

APPROXIMATE TEST PIT POSITIONS

Approved:

Drawing Number: 358/01Revision Number:



Google

elev 1190 m

28°40'59.91" S 24°43'12.04" E

INFERRED BOUNDARY...
MUST BE INTERPRETED AS A GRADUAL
TRANSITION AND NOT A FIXED LINE

AREAS OF PROMINENT DOLERITE
OUTCROP AND SURFACE
BOULDERS

DEEPER EXCAVATION CONDITIONS:
REFUSAL PROBABLE DEEPER THAN 2.0m DEEP.



SITE CLASS H1:
EXPANSIVE FOUNDATION CONDITIONS
7.5 TO 15mm SOIL MOVEMENTS

SITE CLASS R:
STABLE FOUNDATION CONDITIONS
NEGLECTIBLE SOIL MOVEMENTS

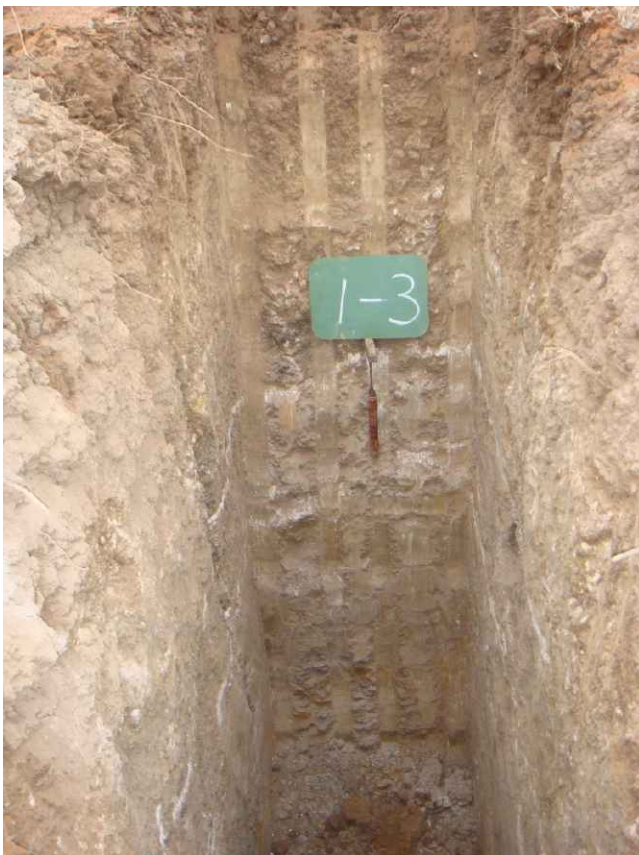
SIGNATURE	NAME	DATE
		
Telephone: (012) 430 2081 Fax: (086) 649 9349 P.O. Box 1887 Brooklyn Square Pretoria South Africa 0075 www.sge.co.za		
Website:		Checked: PHO
Drawn: PHO		Approved:
Date: July 2009		
Drawing Number: 358/03		
Revision Number: 0		

APPENDIX D

PHOTOGRAPHS

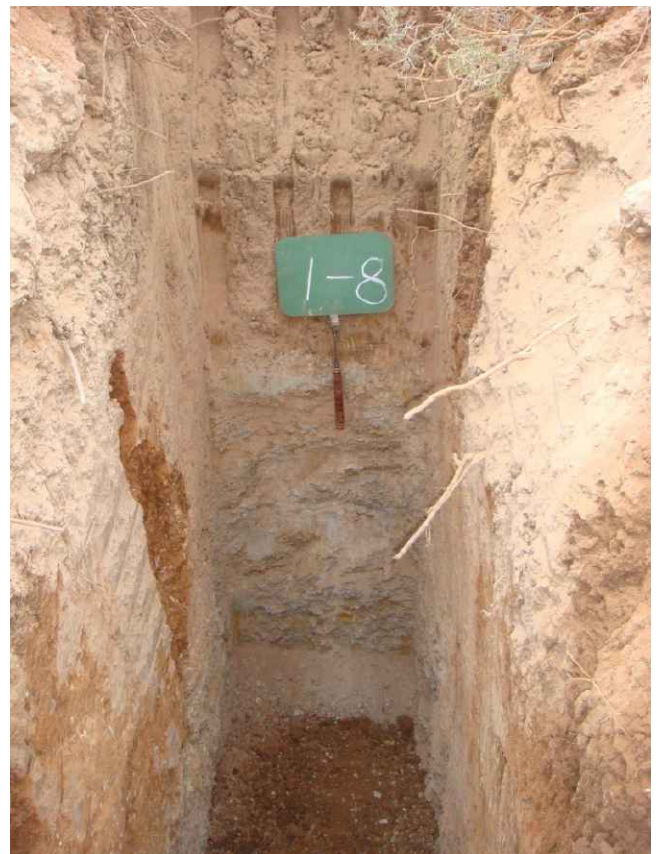
LERATO PARK PHASE 1

9 JUNE 2009



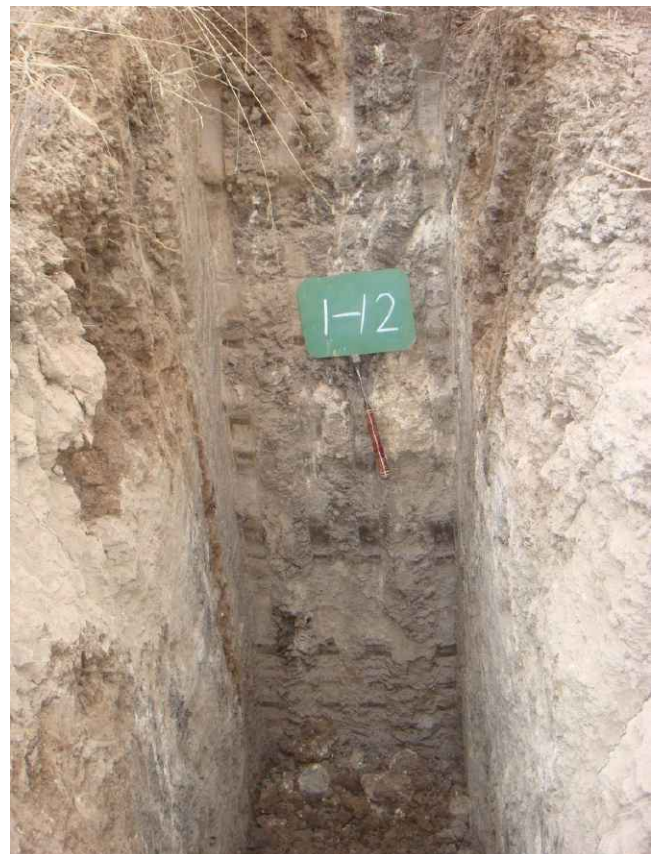
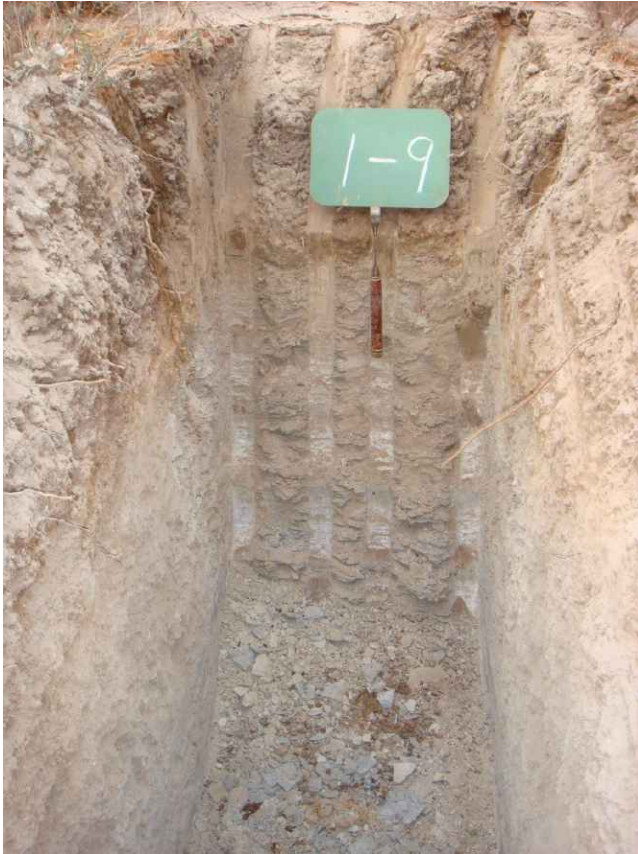
LERATO PARK PHASE 1

9 JUNE 2009



LERATO PARK PHASE 1

9 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



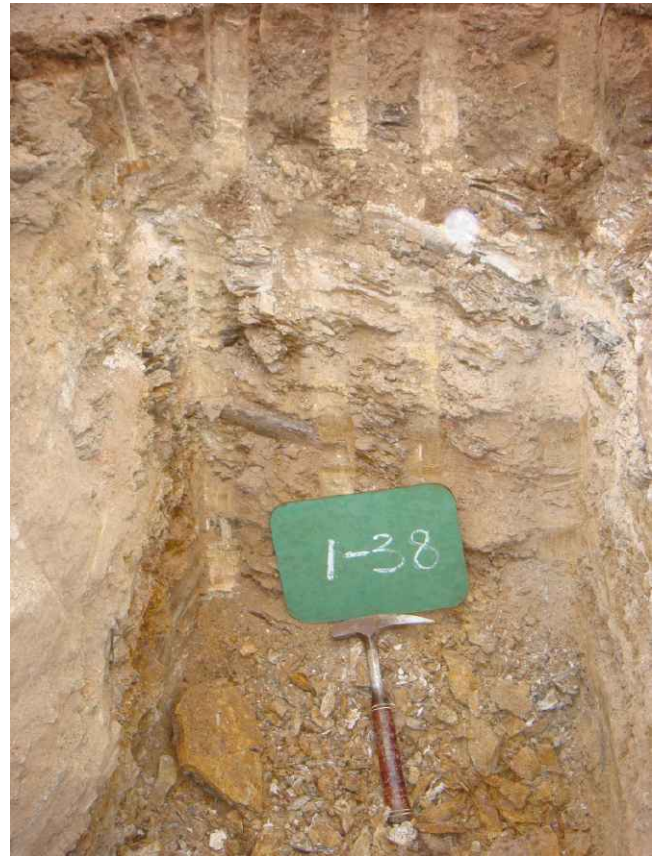
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LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 1

10 JUNE 2009



LERATO PARK PHASE 2

Geotechnical investigation report



Southern Geotechnical Engineering
Report Number 358/03
August 2009

TITLE	LERATO PARK PHASE 2 SITUATED WITHIN THE SOL PLAATJE LOCAL MUNICIPALITY Geotechnical Investigation Report
CLIENT	BIGEN AFRICA SERVICES (PTY) LTD P.O. Box 29 The Innovation Hub Persequor 0087
PREPARED BY :	SOUTHERN GEOTECHNICAL ENGINEERING P.O. Box 1687 BROOKLYN SQUARE 0075
DATE	25 August 2009
REFERENCE NUMBER	358/03
PROJECT TEAM	
Fieldwork and reporting:	Pieter Oosthuizen _____ <i>Pr.Eng.</i> <i>Geotechnical Engineer</i>
STATUS	<i>Draft for comment</i>

EXECUTIVE SUMMARY

1. *Southern Geotechnical Engineering was appointed by Bigen Africa Services (Pty) Ltd, to undertake a geotechnical investigation, for township establishment purposes, of the proposed Lerato Park Phase 2 area which is situated within the Sol Plaatjes Local Municipality area in the Northern Cape Province.*
2. *The Phase 2 area constitutes a surface area of 91.9 hectares which is largely undeveloped.*
3. *The field investigation comprised the excavation of 48 test pits with a TLB-type excavator. All the test pits were entered and profiled by a geotechnical engineer according to current methods and procedures (Brink and Bruin, 1990).*
4. *According to published information the site is underlain by shale of the Prince Albert Formation, Eccu Group, Karoo Supergroup. The shale has been extensively intruded by post Karoo dolerite, especially along the southern portions of the study area.*
5. *The Phase 2 area can be divided into two broad geological zones namely:*
 - *Areas underlain by shallow, very soft rock shale and minor mudstone and,*
 - *Areas underlain by shallow, soft rock or harder dolerite rock.*
6. *The majority of the study area is covered by a thin, surface layer of potentially expansive, transported soils. Within areas underlain by very soft rock shale or mudstone at depth, the transported soils are underlain by calcareous, residual shale or mudstone. Calcareous residual shale/mudstone soils are in turn typically underlain by highly weathered, very highly fractured, soft rock or harder shale.*
7. *A relatively small proportion of the study area is underlain by shallow, soft rock or harder dolerite formations.*
8. *No standing groundwater levels or evidence of earlier groundwater levels were encountered within any of the test pit excavations.*
9. *Over the majority of the site relatively 'deep' excavation conditions will be encountered with possible refusal on shale or dolerite rock generally at depths exceeding 2.0m below the existing ground level. Only within relatively minor areas will shallow refusal conditions be encountered on very soft rock shale or soft rock or harder dolerite formations.*
10. *All of the soils tested were rated as LOW in potential expansiveness with associated low plasticity index and liquid limit values. Maximum heave values of around 4.5mm and 14mm were calculated for the transported and calcareous residual soil layers, respectively.*

11. *Very soft rock shale materials recorded 'average' strength and compaction characteristics and where generally rated as G6 to G7 quality. Weathered dolerite recorded 'good' strength and compaction characteristics and were rated as G6 quality.*
12. *The majority of soils tested were rated as not corrosive.*
13. *The entire area was divided into two residential site classes namely:*
 - *Site class R implying stable foundation conditions with negligibly movements for areas mostly underlain by either very soft rock shale or soft rock dolerite and,*
 - *Site class H1 implying expansive soils with expected soil movements around 7.5mm to 15mm for areas mostly underlain by calcareous residual soils, residual shale and minor areas of shallow mudstone.*
14. *'Modified normal' construction procedures are recommended for the Site Class H1 areas, typically consisting of lightly reinforced strip footings, articulation joints at all internal/external doors and openings, light reinforcement in masonry and adequate site drainage and service/plumbing precautions.*
15. *'Normal' construction procedures are recommended for Site Class R areas, typically consisting of unreinforced strip or slab-on-the-ground type foundations and adequate site drainage and service/plumbing precautions.*
16. *The following allowable bearing capacities are recommended :*
 - *Upper surface layer of transported soils:* NOT *to be used as a founding layer.*
 - *Calcareous residual shale/mudstone:* *100kPa*
 - *Very soft rock shale:* *200kPa*
 - *Soft rock or harder dolerite:* *650kPa*
17. *It will be required to remove the upper, surface layer of transported soils over the entire footprint areas to be covered by surface beds and fills. Suitable fill material must be placed in thin layers (typically 150mm thick), and each layer compacted to at least 93% Mod. AASHTO at OMC.*
18. *The following generic steps are recommended in the construction of the access roads.*
 - *Remove all vegetation and the upper, surface layer of transported soils over the entire road footprint area.*
 - *If rock is exposed, clean the surface and place road layerworks directly onto rockhead. The shale/mudstone rockhead must be covered as soon as possible after exposing to the atmosphere*

as this material is prone to 'slaking'. If the base of the undercut excavation is situated within soil, rip the exposed, in-situ subgrade to a minimum depth of 150mm and re-compact to a density of at least 90% Mod AASHTO at a moisture content close to optimum.

- Subsequent layerworks must be placed on a moist (and not dry), compacted soil surface.*
- As surfacing it may be considered to use either an asphalt application, concrete slab on stabilised subbase or interlocking paving blocks.*

19. The following guidelines pertain to possible sources of construction materials that will be encountered on site:

- Very soft rock mudstone and its weathering products should NOT be used as a construction material.*
- Very soft rock or harder shale formations is deemed potentially suitable for use within lower and upper selected, subgrade layers as well as general fill material.*
- Soft rock or harder dolerite formations are expected to have varied application as a construction material, both within road layerworks as well as fills. The primary problem foreseen with the use of this source is the excavability of the material.*

Table of contents

	Page
1. TERMS OF RERERENCE.....	1
2. SOURCES OF INFORMATION	1
3. SITE DESCRIPTION	2
3.1. GENERAL SITE LOCALITY	2
4. METHOD OF INVESTIGATION	4
5. RESULTS OF THE INVESTIGATION	4
5.1. PUBLISHED REGIONAL GEOLOGY	4
5.2. SITE SPECIFIC GEOLOGY.....	5
5.3. GROUND AND SURFACE WATER CONDITIONS	9
5.4. EXCAVATION CONDITIONS.....	10
5.5. LABORATORY TEST RESULTS.....	12
5.6. COMPACTION AND STRENGTH PROPERTIES	15
5.7. SOIL CORROSIVITY	17
6. RESIDENTIAL SITE CLASSES.....	19
7. RECOMMENDATIONS	21
7.1. FOUNDATIONS FOR ONE TO TWO STOREY STRUCTURES	21
7.2. ALLOWABLE BEARING CAPACITIES.....	22
7.3. CONSTRUCTION OF SURFACE BEDS AND FILLS.....	22
7.4. PAVEMENT LAYERWORKS.....	23
7.5. SOURCES OF CONSTRUCTION MATERIALS	24
8. REERENCES.....	25
 APPENDIX A	 Test pit profiles
APPENDIX B	Laboratory test results
APPENDIX C	Drawings
APPENDIX D	Photographs

List of figures

Figure 1: General site locality map for the Phases 1 and 2 areas of Lerato Park	3
Figure 2: Phases 1 and 2 areas of the proposed Lerato Park Development	3

List of tables

Table 1: Summary of geological conditions across the Phase 2 area	8
Table 2: Summary of excavation conditions encountered at each test pit	11
Table 3: Expansiveness parameters within the Phase 2 area	12
Table 4: Average parameters used in heave calculations (Van der Merwe 1964).....	14
Table 5: Average parameters used in heave calculations (Weston 1979).....	15
Table 6: Strength and compaction characteristics of near-surface soils in Phase 2 area	16
Table 7: Soil corrosivity of in-situ soils within the Phase 2 area	17
Table 8: Expected foundation behaviour and corresponding site classes	19
Table 9: Residential site classes according to test pit excavations.....	20

1. TERMS OF REFERENCE

Southern Geotechnical Engineering c.c. (SGE) was requested by Bigen Africa Services (Pty) Ltd, to submit a cost estimate for a geotechnical investigation of both the proposed Phases 1 and 2 areas of the Lerato Park Integrated Housing Development. The proposed Development is situated within the Sol Plaatjes Local Municipality area, Kimberley, Northern Cape Province. A cost estimate was prepared and submitted to Bigen Africa. Confirmation to proceed with the geotechnical investigation was received from Bigen Africa via a letter of appointment with reference number 7801-21-12, dated 25 May 2009.

The Phase 2 geotechnical investigation, which is the subject of this report, was undertaken for township establishment purposes and in particular aimed at supplying information on the soil conditions in terms of:

- Published and site-specific geology,
- Groundwater conditions,
- General excavation conditions applicable to foundations and buried services,
- Depth to rock (if encountered) and anticipated excavation conditions,
- The potential use of in situ materials available on site as construction materials,
- Assigning residential site classes with proposed foundation systems for each class,
- Any other constraining geological/geotechnical aspects that may influence the proposed development.

The Phase 2 area constitutes a sub-portion of a larger area, the remainder of which is covered under the Lerato Park Phase 1 geotechnical investigation with report number 358/02.

2. SOURCES OF INFORMATION

The following sources of information were consulted during this investigation:

- 1:250 000 scale geological map, 2824 Kimberley,

- Geotechnical investigation report prepared by SGE (Ref. No. 358/01, dated 6 July 2009)
“Lerato Park, Kimberley, Fast Track Road construction – Geotechnical Investigation”.
- Geotechnical investigation report prepared by SGE (Ref. No. 358/02, dated 27 July 2009)
“Lerato Park Phase 1 situated within the Sol Plaatje Local Municipality - Geotechnical Investigation Report”.
- Geotechnical investigation report prepared by Simlab (Ref. No. SL/1575 dated Jan. 2006)
“Sol Plaatjes Municipality – Proposed Housing Development on the Remainder or Portion 59 of the Farm Roodepan No. 70 Kimberley - Geotechnical Investigation”.
- Google Earth images obtained from www.earth.google.com.

3. SITE DESCRIPTION

3.1. General site locality

A general site locality map for both the Phases 1 and 2 areas are given in Figure 1 below. The Phases 1 and 2 areas are situated approximately 8 kilometres north-west of the Kimberley CBD in the Northern Cape Province.

As indicated in Figure 2 below, the Phase 2 area constitutes a surface area of 91.9 hectares.

The site is bordered by:

- North: Eagle Street of the Roodepan Township and open fields,
- South: Informal settlement and Barkley road,
- East: Lerato Park Phase 1 area.
- West: Open, undeveloped fields (outside of Lerato Park Development area).

The entire Phase 2 study area is relatively flat with only minor gradients, largely undeveloped and constitutes an open to medium dense distribution of thorny shrubs and grass fields. Some minor encroachment of the informal settlement has occurred along the southernmost extremity of the Phase 2 study area. Apart from a few instances where small, scattered dolerite boulders were observed at surface, no other salient geological features were observed within the Phase 2 area.



Figure 1: General site locality map for the Phases 1 and 2 areas of Lerato Park

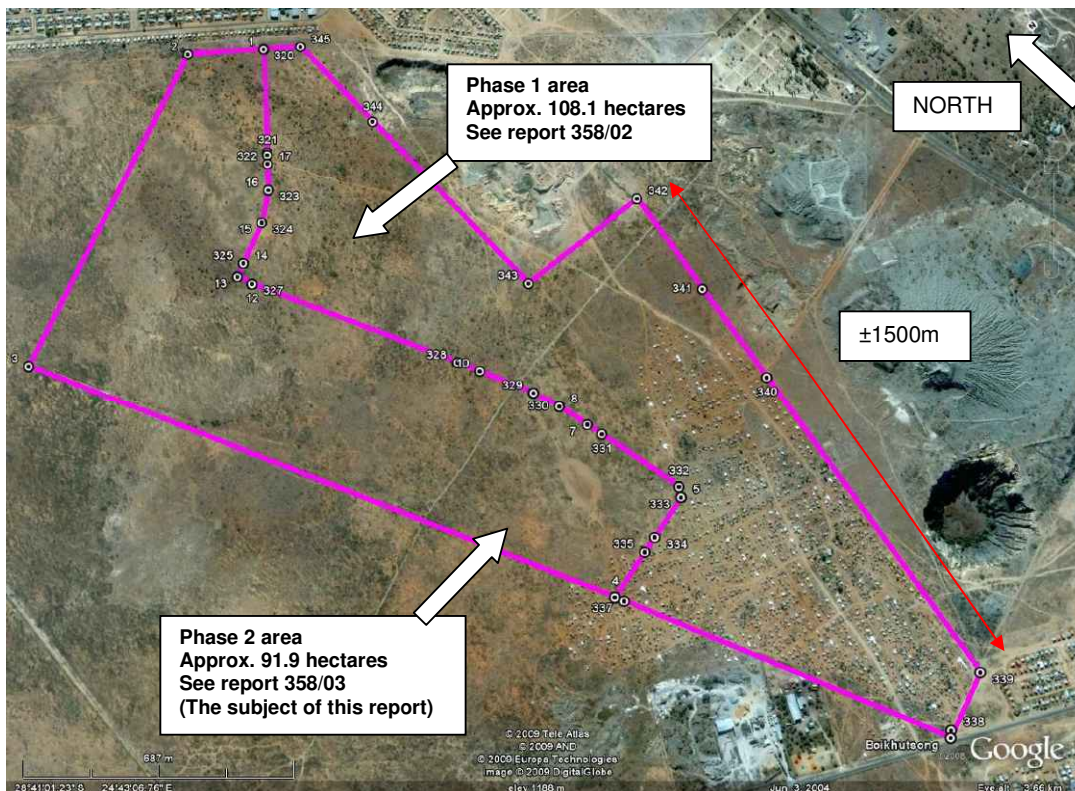


Figure 2: Phases 1 and 2 areas of the proposed Lerato Park Development

4. METHOD OF INVESTIGATION

The field investigation for the Phase 2 area was undertaken on 23 and 24 June 2009. A total of 48 test pits were excavated with a Terex 820 TLB-type excavator. Test pits were numbered 2-1 to 2-48 to distinguish them from test pits excavated within the Phase 1 area (which were numbered 1-1 onwards). Test pits were excavated to the maximum depth reach of the TLB (around 2.6 to 2.8m deep), or until reaching refusal conditions. All the test pits were entered and profiled by a geotechnical engineer according to current methods and procedures (Brink and Bruin, 1990). The detailed soil profiles are included in Appendix A. Test pit positions were determined with a hand-held GPS unit to an accuracy of better than 5m. The approximate test pit positions are indicated in Appendix C.

Representative samples were tested in a commercial soils laboratory for the following:

- Soil moisture content (total of 44 samples),
- Sieve and hydrometer analysis (total of 44 samples),
- Atterberg Limits (total of 44 samples),
- Maximum dry density / optimum moisture content (total of 14 samples),
- California Bearing Ratio (CBR) test (total of 14 samples),
- pH value (total of 30 samples),
- Electrical conductivity (total of 30 samples).

The results of the laboratory testing are included in Appendix B.

5. RESULTS OF THE INVESTIGATION

5.1. Published regional geology

According to the 1:250 000 scale geological map **2824 KIMBERLEY**, the site is underlain by shale of the Prince Albert Formation, Eccu Group, Karoo Supergroup. The shale has been

extensively intruded by post Karoo dolerite, especially along the southern portions of the study area.

The Eccra Group, which follows concordantly on the Dwyka, consist almost exclusively of deep-water, fine-grained clastic sediments and the lithological monotony of the sequence is only interrupted by the characteristic black, carbonaceous shale of the Whitehill Formation which is underlain and overlain respectively by dark-grey mudstone and shale of the Prince Albert and Tierberg Formations (Explanation: Sheet 2824, Kimberley).

The Prince Albert Formation has a maximum thickness of approximately 90m in the general area of Kimberley. The Formation is characterised by weathered outcrops of shale, mostly covered by wind-blown sands. Kleynhans (1979) is of the opinion that the so-called '*shale*' is in fact '*mudstone*'. At the contact zones with intrusive dolerite formations, the Prince Albert shale is typically altered to a dense, black hornfels or dark blue to black, baked shale. Dolerite occurs widely spread as dykes, sills and funnel-shaped bodies in the area (Explanation: Sheet 2824, Kimberley).

Economically the area is of considerable importance due to the diamonds mined in kimberlite pipes and fissures occurring around Kimberley. In some areas limestones are quarried for the manufacture of cement. Salt is extracted from groundwater in the vicinity of pans. Considerable reserves of gypsum are present in the area (Taken from Explanation: Sheet 2824, Kimberley).

5.2. Site specific geology

The Phase 2 area can be divided into two broad geological zones namely:

- Areas underlain by shallow shale and/or mudstone and,
- Areas underlain by shallow dolerite rock.

5.2.1. Areas underlain by shale and/or mudstone

The following typical soil layers were predominantly encountered within the area underlain by shallow shale/mudstone formations.

5.2.1.1. Transported surface layer (cohesive soils)

The area is covered by a thin (avg. 0.45m; max. 0.8m; min. 0.2m), surface layer of transported soils that were typically described as:

Slightly moist, light to dark brown, FIRM TO STIFF, slightly cracked to cracked, sandy CLAY to clayey SAND.

This particular layer was visually assessed as potentially expansive. The assessment of the potentially expansive nature of this layer was further strengthened by the observation of a cracked soil surface in certain areas. This particular layer was NOT visually assessed as open-structured and hence potentially collapsible.

5.2.1.2. Calcareous residual shale/mudstone

The thin layer of transported soils as described above is mostly underlain (not encountered at all test pits), by a layer that was termed (for the sake of consistency), as a '*calcareous residual shale/mudstone*'. The average thickness of this particular layer is around 1.2m (min. 0.5m; max. 2.2m). This particular layer was typically described as:

Dry to slightly moist, light orange brown blotched white and dark grey, MEDIUM DENSE TO DENSE, intact, silty to clayey SAND containing minor 'pockets' of white, fine, calcareous gravel and dark grey, highly to completely weathered, angular shale/mudstone fragments.

This particular layer was not visually assessed as highly expansive and/or collapsible.

5.2.1.3. Residual shale/mudstone

A few test pits were characterised by a deeper weathered profile where the calcareous soils described above are typically underlain by residual shale.

Slightly moist, dark orange blotched grey and white, STIFF, clayey SILT grading into highly fractured, highly weathered, very-fine grained shale.

5.2.1.4. Weathered, very soft rock shale

The *calcareous residual shale/mudstone* or *residual shale* layers described above are typically underlain by highly weathered, very highly fractured, soft rock or harder shale/mudstone. This material was typically described as:

Light to dark grey stained orange along bedding planes, highly weathered, very fine to fine-grained, horizontally bedded, very highly fractured, very soft rock shale/mudstone.

Weathered shale rock with a hardness approaching 'very soft rock' (UCS between 700kPa and 3.0MPa), were encountered at an average depth around 0.7m below the existing ground level. The depth to rock however varies considerably from a shallow as 0.2m to as deep as 1.8m.

5.2.2. Areas underlain by shallow dolerite rock

The following typical soil layers were predominantly encountered within the area underlain by shallow dolerite rock formations.

5.2.2.1. Transported surface layer (non cohesive)

The area is covered by a thin (typically 200mm to 300mm thick) surface layer of low-cohesive, transported soils that were typically described as:

Slightly moist, dark reddish brown, MEDIUM DENSE TO DENSE, silty to clayey SAND.

5.2.2.2. Soft rock or harder dolerite

The thin, transported layer described above is underlain by dolerite rock that was typically described as:

Dark grey streaked white, highly to moderately weathered, medium to coarse-grained, massive, moderately fractured, soft rock or harder dolerite rock sometimes interlaced with minor, hard calcrete.

5.2.3. Summary of geological conditions encountered within test pits.

A summary of the geological conditions encountered at every test pit is given in Table 1 below. The information in this Table is used to delineate the site into various geological and geotechnical zones that are eventually related to residential site classes and ultimately recommended foundation layouts for the housing units.

Table 1: Summary of geological conditions across the Phase 2 area

0.9 Indicates depth of refusal or near-refusal (defined by very slow rate of excavation).

TP. No.	DEPTH RANGE ENCOUNTERED (m below existing ground level)				
	Transported Soils	Calcareous residual shale / mudstone	Residual shale / mudstone	Very soft rock shale	Soft rock or harder dolerite
2-1	0 – 0.3			0.3 – 2.7	
2-2	0 – 0.5	0.5 – 2.7			
2-3	0 – 0.7	0.7 – 1.6	1.6 – 2.7		
2-4	0 – 0.5	0.5 – 1.4	1.4 – 2.7		
2-5	0 – 0.6	0.6 – 1.4	1.4 – 2.7		
2-6	0 – 0.6	0.6 – 1.5	1.5 – 2.7		
2-7	0 – 0.6	0.6 – 1.4	1.4 – 2.7		
2-8	0 – 0.5	0.5 – 1.0	1.0 – 2.7		
2-9	0 – 0.6	0.6 – 1.2	1.2 – 2.7		
2-10	0 – 0.5	0.5 – 1.0		1.0 – <u>2.0</u>	
2-11	0 – 0.6	0.6 – 2.7			
2-12	0 – 0.4				0.4 – <u>0.5</u>
2-13	0 – 0.2				0.2 – <u>1.2</u>
2-14	0 – 0.3	0.3 – 1.6	1.6 – 2.7		
2-15	0 – 0.4	0.4 – 1.3	1.3 – 2.7		
2-16	0 – 0.5	0.5 – <u>2.4</u>			
2-17	0 – 0.5	0.5 – <u>2.4</u>			
2-18	0 – 0.5	0.5 – 2.7			
2-19	0 – 0.5	0.5 – 2.7			
2-20	0 – 0.5	0.5 – 1.5	1.5 – 2.7		
2-21	0 – 0.5	0.5 – 1.5	1.5 – 2.7		
2-22	0 – 0.2			0.2 – <u>2.1</u>	
2-23	0 – 0.5	0.5 – 2.0		2.0 – 2.7	
2-24	0 – 0.5			0.5 – <u>1.2</u>	
2-25	0 – 0.2			0.2 – <u>1.1</u>	
2-26	0 – 0.2			0.2 – <u>1.5</u>	
2-27	0 – 0.8	0.8 – 1.2		1.2 – 2.7	

TP. No.	DEPTH RANGE ENCOUNTERED (m below existing ground level)				
	Transported Soils	Calcareous residual shale / mudstone	Residual shale / mudstone	Very soft rock shale	Soft rock or harder dolerite
2-28	0 – 0.3			0.3 – <u>1.6</u>	
2-29	0 – 0.2			1.1 – <u>1.6</u>	0.2 – 1.1
2-30	0 – 0.25			0.25 – <u>1.0</u>	
2-31	0 – 0.5	0.5 – 1.8		1.8 – 2.6	
2-32	0 – 0.3			0.3 – <u>1.5</u>	
2-33	0 – 0.4			0.4 – <u>1.8</u>	
2-34	0 – 0.3				0.3 – <u>0.4</u>
2-35	0 – 0.3			0.3 – <u>1.9</u>	
2-36	0 – 0.5	0.5 – 1.5	1.5 – 2.7		
2-37	0 – 0.3				0.3 – <u>0.5</u>
2-38	0 – 0.3			0.3 – <u>2.2</u>	
2-39	0 – 0.5	0.5 – 1.4		1.4 – 2.7	
2-40	0 – 0.5			0.5 – <u>2.5</u>	
2-41	0 – 0.3				0.3 – <u>0.6</u>
2-42	0 – 0.6			0.6 – <u>2.5</u>	
2-43	0 – 0.6	0.6 – 1.5	1.5 – 2.6		
2-44	0 – 0.6	0.6 – 1.5	1.5 – 2.6		
2-45	0 – 0.3			0.3 – <u>1.1</u>	
2-46	0 – 0.6	0.6 – 1.2	1.2 – 2.7		
2-47	0 – 0.6	0.6 – 1.2	1.2 – 2.6		
2-48	0 – 0.3				0.3 – <u>0.4</u>

0.9 Indicates premature refusal or near-refusal conditions (as suggested by slow rate of excavation).

5.3. Ground and surface water conditions

No standing groundwater levels were encountered within any of the test pit excavations. It is thus not expected that large volumes of groundwater will be encountered during excavations on this site. The formation of seasonal; (perched), groundwater levels, especially forming after

heavy rainfall events, cannot be excluded completely (although thought to be unlikely).

Accumulation or ponding of precipitation on top of the cohesive, relatively impermeable, surface layer will probably be more of a consideration during the detailed design stage. Possible accumulation and ponding is exacerbated by the very flat gradients within the study area. It is thus recommended that all roads, parking areas and surface beds be elevated slightly above the surrounding ground levels to prevent ponding against these structures. As good construction practice it is also recommended that all structures be protected against rising damp.

5.4. Excavation conditions

Table 2 below summaries the average excavation conditions that were encountered at every test pit excavation. The information contained in Table 2 was plotted graphically to get an overview of the expected, average excavation conditions (see Appendix C). From this figure it can be seen that:

- **Deeper** excavation conditions (excavated to the maximum reach of the TLB or refusal reached in excess of 2.0m below existing ground level), can generally be expected over the majority of the site. Around two thirds of the test pit excavations falls within this excavation class.
- **Shallow** excavation conditions ('refusal' expected between 1.0m and 2.0m below current ground level), can generally be expected along a central strip of the site. Around 23% of the test pit excavations fall within this excavation class.
- **Very shallow** excavation conditions ('refusal' expected within the upper 1.0m below current ground level), are only expected in isolated, small areas, mostly underlain by shallow dolerite rock. Around 10% of the test pit excavations fall within this excavation class.

Table 2: Summary of excavation conditions encountered at each test pit

'Very shallow' excavation conditions ¹	'Shallow' excavation conditions ²	'Deeper' excavation conditions ³
2-12; 2-34; 2-37; 2-41; 2-48	2-13; 2-24; 2-25; 2-26; 2-28; 2-29; 2-30; 2-32; 2-33; 2-35; 2-45	2-1; 2-2; 2-3; 2-4; 2-5; 2-6; 2-7; 2-8; 2-9; 2-10; 2-11; 2-14; 2-15; 2-16; 2-17; 2-18; 2-19; 2-20; 2-21; 2-22; 2-23; 2-27; 2-31; 2-36; 2-38; 2-39; 2-40; 2-42; 2-43; 2-44; 2-46; 2-47

Notes:

1. **Very shallow** excavation conditions.
'Refusal' expected within upper 1.0m below current ground level.
2. **Shallow** excavation conditions.
'Refusal' expected between 1.0m and 2.0m below current ground level.
3. **Deeper** excavation conditions.
'Refusal' expected in excess of 2.0m below current ground level.

Two important provisos are relevant to the information given in this section namely:

- It must be considered that the excavation of test pits with a TLB is essentially a 'restricted' type of excavation and
- The highly fractured and horizontally bedded nature of shale and mudrock formations will greatly assist with the excavation effort (even if ripping is required), into these formations.

It can thus generally be expected that open, bulk excavations in areas underlain by shale/mudrock formations will be able to penetrate substantially deeper than the depths indicated in this report. In some areas it may however be required to assist in the excavation effort with more powerful excavation equipment, ripping and/or hydraulic hammering.

In areas underlain by shallow dolerite formations, 'boulder' and 'hard' excavation conditions are expected, probably requiring, in addition to conventional excavation equipment, also ripping, hydraulic hammering and possibly even blasting.

5.5. Laboratory test results

5.5.1. Expansive soil conditions

Table 3 below summarises the relevant engineering properties relating to the potential expansiveness of the various soils tested.

Table 3: Expansiveness parameters within the Phase 2 area

TP NO.	DEPTH (m)	MATERIAL TYPE	PI ¹	LL ²	% PASSING 0.425mm SIEVE	% PASSING 0.002mm SIEVE	HEAVE CLASSIFICATION (After vd Merwe)
2-2	0.5	Transported soils	14	34	91	5	Low
2-2	0.8	Calcareous residual	15	35	85	8	Low
2-3	0.7	Calcareous residual	18	34	92	8	Low
2-4	0.7	Calcareous residual	19	36	84	9	Low
2-5	0.5	Transported soils	21	43	87	9	Low
2-6	2.0	Residual shale	22	47	76	4	Low
2-7	0.5	Transported soils	22	44	95	7	Low
2-8	1.2	Residual shale	20	43	60	5	Low
2-8	2.2	Residual shale	21	44	60	3	Low
2-11	0.6	Calcareous residual	16	35	95	9	Low
2-14	1.0	Calcareous residual	19	44	60	5	Low
2-16	0.3	Transported soils	14	32	99	5	Low
2-16	0.8	Calcareous residual	17	36	83	7	Low
2-18	0.4	Transported soils	15	35	93	7	Low
2-20	0.6	Calcareous residual	15	39	73	5	Low

TP NO.	DEPTH (m)	MATERIAL TYPE	PI ¹	LL ²	% PASSING 0.425mm SIEVE	% PASSING 0.002mm SIEVE	HEAVE CLASSIFICATION (After vd Merwe)
2-21	0.5	Transported soils	18	40	96	7	Low
2-23	0.8	Calcareous residual	20	41	63	6	Low
2-24	0.4	Transported soils	17	35	62	4	Low
2-27	0.7	Transported soils	29	39	75	5	Low
2-27	1.1	Calcareous residual	19	43	60	4	Low
2-31	0.8	Calcareous residual	17	35	91	6	Low
2-36	0.4	Transported soils	14	34	82	4	Low
2-36	1.0	Calcareous residual	19	48	42	3	Low
2-39	0.4	Transported soils	18	40	79	4	Low
2-43	0.6	Calcareous residual	25	49	82	7	Low
2-44	0.6	Transported soils	18	40	90	7	Low
2-46	0.5	Transported soils	20	42	90	7	Low
2-46	1.5	Residual shale	20	46	76	4	Low
2-47	0.5	Transported soils	21	44	90	6	Low
2-47	1.2	Residual shale	23	50	77	6	Low

1 *PI = Plasticity index value;* 2 *LL = Liquid limit value*

From the information contained in the Table above it can be seen all the soil samples tested were rated as **LOW** in heave potential. Plasticity index and liquid limit values are generally low and range from 14 to 29 and 32 to 50, respectively.

5.5.1.1. Illustrative heave values based on the Van der Merwe (1964) method

The following 'typical' soil profile is derived from the average layer thicknesses reported in the test pit profiles and are used in the heave calculations:

- 0 – 0.45m Transported soils,
- 0.45 – 1.65m Calcareous residual shale/mudstone (average layer thickness 1.2m),
- 1.65m and deeper Very soft rock shale and/or mudstone.

Table 4: Average parameters used in heave calculations (Van der Merwe 1964).

MATERIAL	Average layer thickness	Average Plasticity index	Average % passing 0.425mm sieve	Average % passing 0.002mm sieve
Transported soils	450mm	19	89	6
Calcareous residual soils	1200mm	18	79	7

Based on the values explained above as well as the Van der Merwe (1964) method, maximum 'theoretical' heave values of 5mm (upper, transported soils) and 8mm (underlying calcareous residual soils), can be calculated for a total, maximum theoretical heave of 13mm.

5.5.1.2. Illustrative heave values based on the Weston (1979) method

Calculated heave values using the Weston method are based on the same typical soil profile as stated in section 5.5.1.1. above. In addition the following average values were used:

Table 5: Average parameters used in heave calculations (Weston 1979).

MATERIAL	Average layer thickness	Average initial moisture content	Average weighted liquid limit	Percentage vertical swell under 60kPa¹ pressure
Transported soils	450mm	12%	39	1%
Calcareous residual soils	1200mm	13%	40	1.2%

1 60kPa used as 'average' soil pressure exerted by single storey residential structure.

From the Table above the transported and calcareous residual soils are predicted to have vertical swell values of 1% and 1.2% respectively (under 60kPa UDL pressure applied by the structure). Based on the average layer thickness and percentage heave, total heave of around 4.5mm plus 14.4mm = 19mm, is predicted.

5.5.1.3. Illustrative heave values for areas underlain by dolerite

Assuming that foundations will be placed on soft rock or harder dolerite (which will generally be encountered near-surface), negligible foundation movements are expected.

5.5.2. Collapsible and compressible soils

No potential collapsible soils were identified during the field investigation. Potentially collapsible soils are thus not seen as a major geotechnical constraint for the development of the site. It is similarly not expected that any highly compressible soils will be encountered on site.

5.6. Compaction and strength properties

Table 5 below summarises the results of the laboratory testing programme that was undertaken that consisted of California Bearing Ration (CBR), Maximum Dry Density (MDD) / Optimum Moisture Content (OMC) and Foundation Indicator testing.

Table 6: Strength and compaction characteristics of near-surface soils in Phase 2 area

TP NO	SAMPLE DEPTH (m)	MATERIAL TYPE	LL	GM	PI	CBR VALUES AT % MOD AASHTO			COLTO
						93%	95%	98%	
2-1	0.5 – 2.7	Very soft rock shale	44	2.55	17	33	38	45	G7 ¹
2-4	1.4 – 2.7	Residual shale	55	0.79	25	1	1	2	Less than G9
2-6	0.6 – 1.5	Calcareous residual soil	46	0.58	25	1	1	2	Less than G9
2-9	1.5 – 2.6	Residual shale	56	2.55	28	1	2	3	Less than G9
2-13	0.2 – 1.2	Weathered dolerite	33	2.39	14	48	67	109	G6
2-18	0.5 – 1.5	Calcareous residual soil	46	0.66	23	2	3	3	Less than G9
2-22	0.2 – 2.1	Very soft rock shale	52	2.17	22	18	20	26	Less than G9 ²
2-25	0.2 – 1.1	Very soft rock shale	36	2.39	10	28	34	43	G6 ³
2-28	0.3 – 1.6	Very soft rock shale	39	2.52	14	17	20	25	G7
2-31	1.8 – 2.6	Very soft rock shale	52	2.47	17	28	32	38	G7
2-35	0.3 – 1.9	Very soft rock shale	39	2.21	16	19	24	33	G7
2-40	0.5 – 2.5	Very soft rock shale	38	2.52	16	27	41	51	G7 ⁴
2-45	0.3 – 1.1	Very soft rock shale	36	2.57	13	45	53	59	G6
2-48	0.3 – 0.4	Weathered dolerite	32	2.3	12	57	72	76	G6

LL = Liquid limit; GM = Grading Modulus; P.I = Plasticity Index; COLTO = Standard Specifications for Road and Bridge Works for State Road Authorities; Committee of Land Transport Officials.

Notes:

- 1) Laboratory rated this sample incorrectly as G6 quality.
- 2) Laboratory rated this sample incorrectly as G8 quality.
- 3) Laboratory rated this sample incorrectly as G7 quality.
- 4) Laboratory rated this sample incorrectly as G6 quality.

The information contained in Table 5 above suggests the following:

5.6.1. Very soft rock shale (typically light grey in colour)

'Average' strength and compaction characteristics generally resulted in a material with a G6 to G7 classification. The results thus suggest that very soft rock shale can potentially be utilised as G6 to G7 quality material but careful selection of materials will be required on site (so as not to use mudrock which has much poorer strength and compaction characteristics). The suitability of candidate materials out of this geological group must be confirmed during the construction stage with appropriate laboratory testing.

5.6.2. Weathered dolerite

Samples of weathered dolerite that were tested recorded 'good' strength and compaction characteristics and were rated as G6 quality. This material can thus be recommended as a potential construction material. The biggest potential problem foreseen with the use of this source is the excavability of the material, partly due to soft rock or harder formations that will be encountered near surface and/or the presence of abundant hard rock dolerite boulders.

5.7. Soil corrosivity

Table 6 below summarises the pH and conductivity values that were measured to assess the potential corrosivity of the in situ soils.

Table 7: Soil corrosivity of in-situ soils within the Phase 2 area.

TP NO.	DEPTH (m)	MATERIAL	pH	ELEC. CONDUCTIVITY (μS/m)	RATED CORROSIVITY ¹
2-2	0.5	Transported soils	8.1	5.4	Not corrosive
2-2	0.8	Calcareous residual	8.13	3.7	Not corrosive
2-3	0.7	Calcareous residual	8.24	5.3	Not corrosive
2-4	0.7	Calcareous residual	8.17	4.2	Not corrosive
2-5	0.5	Transported soils	8.23	8.5	Not corrosive

TP NO.	DEPTH (m)	MATERIAL	pH	ELEC. CONDUCTIVITY (μS/m)	RATED CORROSIVITY ¹
2-6	2.0	Residual shale	8.05	27.0	Corrosive
2-7	0.5	Transported soils	7.75	12.1	Mildly corrosive
2-8	1.2	Residual shale	8.19	13.4	Mildly corrosive
2-8	2.2	Residual shale	8.06	27.0	Corrosive
2-11	0.6	Calcareous residual	8.27	5.2	Not corrosive
2-14	1.0	Calcareous residual	8.35	4.9	Not corrosive
2-16	0.3	Transported soils	8.65	4.4	Not corrosive
2-16	0.8	Calcareous residual	8.07	6.6	Not corrosive
2-18	0.4	Transported soils	8.05	56.0	Very corrosive
2-20	0.6	Calcareous residual	8.44	2.0	Not corrosive
2-21	0.5	Transported soils	8.02	5.9	Not corrosive
2-23	0.8	Calcareous residual	8.11	6.7	Not corrosive
2-24	0.4	Transported soils	7.06	7.9	Not corrosive
2-27	0.7	Transported soils	8.05	6.6	Not corrosive
2-27	1.1	Calcareous residual	8.09	5.5	Not corrosive
2-31	0.8	Calcareous residual	8.01	5.1	Not corrosive
2-36	0.4	Transported soils	7.96	4.8	Not corrosive
2-36	1.0	Calcareous residual	8.07	3.8	Not corrosive
2-39	0.4	Transported soils	8.15	6.5	Not corrosive
2-43	0.6	Calcareous residual	8.13	26.5	Corrosive
2-44	0.6	Transported soils	8.04	7.8	Not corrosive
2-46	0.5	Transported soils	8.14	9.3	Not corrosive
2-46	1.5	Residual shale	8.32	24.8	Corrosive
2-47	0.5	Transported soils	8.09	7.0	Not corrosive
2-47	1.2	Residual shale	8.37	14.3	Mildly corrosive

1 Low cost housing, CSIR Division of building technology 1987.

The majority of samples are rated as *not corrosive* with low electrical conductivity values. Only a few samples tested as *mildly corrosive* to *corrosive*. The measured pH values indicate that the in-situ soils are slightly alkaline.

It is generally expected that none of the in-situ soils that will be encountered on site can be regarded as highly corrosive, such as to necessitate extensive remedial measures. The present land use in certain regions of the study area may however result in localised areas where this aspect may be problematic.

6. RESIDENTIAL SITE CLASSES

The residential site classes are derived from the publication: “Code of Practice – Foundations and Superstructures for single storey residential buildings of masonry construction” The Joint Structural Division of SAICE and IstructE, 1995.

The different founding horizons, their expected foundation behaviour and expected range of soil movements (corresponding to a particular site class), are summarised in Table 8 below.

Table 8: Expected foundation behaviour and corresponding site classes

Soil/rock type	Principal character of founding material	Expected range of soil movement	Site class
Transported soils ¹	Expansive	Less than 7.5mm	H
Calcareous residual shale/mudstone	Expansive	7.5mm to 15.0mm	H1
Very soft rock shale ²	Stable	Negligible	R
Soft rock or harder dolerite	Stable	Negligible	R