ADAMAYVIEW: BULK OUTFALL SEWER PIPELINE: A GEOTECHNICAL REPORT TO INSTRATIN FOR 3.7km OF THE ALIGNMENT

IR1448

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	IR1448	AUGUST 2017

ADAMAYVIEW: BULK OUTFALL SEWER PIPELINE: A GEOTECHNICAL REPORT TO INSTRATIN FOR 3.7KM ALIGNMENT

SUMMARY

This report presents the results of near surface geotechnical investigations carried out along 3.7m of the proposed pipeline alignment. Near surface conditions have been assessed using existing geological mapping, airphoto imagery and trial hole data from positions roughly 200m apart along the alignment. The route follows the floodplain of the Palmietspruit. Groundwater seepages occurred at around 1.8m bgl in many of the trial holes opened in the dry season (August 2017). Greater groundwater inflows should be anticipated in other seasons of the year. Typical near surface profiles are provided for sections along the route with commentaries given on the excavatability and potential trench side wall stability. Laboratory test results on soil samples recovered from the opened trial holes are evaluated for potential re-use in the works. The potential aggressiveness of interparticular groundwaters in the soil samples are assessed and evaluated.

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1. INTRODUCTION

This report presents the results of near surface geotechnical investigations carried out along the proposed bulk outfall sewer pipeline at Adamayview, Klerksdorp. This new pipeline is approximately 3.7km in length and crosses the tarred N12 at a proposed pipe jack point (Figure 1). It also falls in the floodplain of the Palmietspruit. Trenchworks may become inundated with groundwaters during the rainy seasons.

The report documents the terms of reference, available data used in this study, investigative procedures, geology, commentary on the recovered Trial hole profiles, and assessment of the laboratory test results of soil samples collected in the field. The field investigations were carried out at the end of August 2017.

2. TERMS OF REFERENCE AND SCOPE OF WORK

Intraconsult was invited to provide technical and budget cost proposals to Instratin Properties and Intraconsult's scope of work was outlined in IR1448p providing a near surface geotechnical report which inter alia:-

- Described to local geology
- Describes the soil profiles at each TP point by Site Classification unit.
- Provides a geotechnical evaluation of each soil unit uncovered in Terms of select granular bedding and select fill for possible re-use, and also potential corrosive properties.
- Materials and excavation characteristics.
- Identification of conditions and constraints, such as areas of outcrop, slope stability, contaminated lands, etc.

3. AVAILABLE INFORMATION

Information sources include:

- Geological Map 1:250 000 scale series issued by the Geological Survey of South Africa, sheet2626 Wes-Rand.
- Topographical Map 1: 50 000 scale issued by the Surveyor General.
- Various google images of the site.
- Drawing of the alignment provided by Messrs Instratin (which serves as the base plan for the Figure 3 trial hole position map.

4. PROCEDURES USED IN THESE INVESTIGATIONS

4.1 Assimilation of available data

This investigation was initiated by gathering, assimilating and reviewing readily available geological data pertaining to the proposed pipeline alignment.

4.2 Trial Holes

Trial holes were opened along the alignment at approximately 200 metre intervals using a 75kW TLB machine. Each trial hole was entered by a Geospecialist who also described the soil profiles using the visual and tactile procedures advocated by Jennings et al (1973).

Detailed descriptions of the Trial holes are provided in Appendix 1 and the positions shown on Figure 3.

4.2.1 Thickness and depth concepts

In the context of this report the thickness and depths are used as follows:

Depths	
Range in m	**Appellation**
0-2/4	Near Surface
2/4 – 8/12	Shallow

Thickness	
Range in m	**Appellation**
0-1/12	Thin
8/12 – 16/24	Intermediate

4.3 Soil sampling and testing

For accurate classifications and identification purposes, particle size distributions and Atterberg Limit tests have been carried out on disturbed samples recovered from the various soil unit horizons uncovered during these investigations. Select soil samples were also tested for chemistry values.

5. GEOLOGY

According to the geological map for this region the pipeline alignment is underlain by bedrocks of the contact zone between the Ventersdorp and Witwatersrand Supergroups. These comprise amygdaloidal lava, agglomerates and tuffs as well as quartzite, conglomerates and shales, see the Geological Map, Figure 2. The thickness of soils residual from these materials are usually thin, with thin to intermediate thickness of transported soils mantling them.

6. NEAR SURFACE SOIL CONDITIONS

6.1 General

Detailed soil profiles from the trial holes are recorded in Appendix 1 and summarised profiles given in Table 2. This tabulated summary provides our commentaries on rock outcrop and excavatablity (to 2.0 metres depth).

6.2 General notes

TP1-(TP3) – No accessibility at actual TP3 position [This is the potential pipe jacking location]

0.0-1.0m (Moist) Dark brown, soft, silty clay; colluvium.

1.0-2.8m+ (Very moist) Light grey, firm but with slightly slickensided, sandy clay with sub-rounded quartzite gravels; alluvium.

Notes: Slicken sided – trench wall likely to become unstable with time. No groundwater seepage to 2.8m bgl.

TP4-TP7

0.0-1.6m (Moist) Dark grey, firm but with slight slicken sliding, sandy clay; colluvium.

1.6-2.8m (Wet) Orange brown mottled grey, dense, clay sand with up to 30% quartzite gravels; Residual quartzite.

Notes: Slickenside materials likely to become unstable in excavation works. Moderate groundwater seepage for around 2m bgl.

TP7-TP15

0.0-0.9m (Moist) Dark grey, firm but with slight slicken sliding, sandy clay; colluvium.

0.9-2.0m (Very moist) Light grey, loose to medium dense, clayey sand; alluvium.

2.0-2.6m (Wet) Orange brown mottled grey, dense, clayey sand with up to 30% quartzite gravels; Residual quartzite.

Notes: Slickenside materials likely to become unstable in excavation works. Slight to moderate groundwater seepage at 1.8m bgl.

6.3 Evaluation of laboratory test results

6.3.1 Soils uncovered that can change in volume with changes in moisture condition – potentially active soils

Seasonal variations in the moisture content of the fine and very fine soils can induce volume changes which would translate into vertical movement under pipelines placed on these particular soil unit profiles. Weston's empirical swell equation has been adopted to provide an indication of the 'swell difference' between the pressured 'driest' and 'wettest' moisture conditions anticipated in the field, see Footnote[1]. The laboratory testing of samples from the various soil units uncovered across the site provides values for the median Liquid Limit (whole) values. These values together with the potential volume changes from 'driest' to 'wettest' are tabulated below:

SOIL UNIT	MEAN LL WHOLE	MOISTURE CONTENT		SWELL DIFF. VOL. CHANGE %
		'DRIEST'	'WETTEST'	
Fill				
Colluvium				
Alluvium				
Res. Quartzite				

Footnote 1: Weston's swell per cent = $0{,}000411L^{+4{,}17} \times p^{-0{,}386} \times Wi^{2{,}33}$

where L = Liquid Limit (whole) (ie. Liquid Limit x % passing 425 microns)

P = overburden pressure (10kPa adopted for this report)

Wi = initial moisture content.

From CSIR research experience (for 'red' soils), the 'driest' field moisture condition has been taken as 0,4 L, and the 'wettest' field moisture condition as 0,8 L : For the 'dark grey' and 'black' soils 'driest' and 'wettest' conditions have been taken at 0,2L and 0,7L respectively.

6.3.2 Evaluation of near surface soils for possible use for pipe bedding: SABS 1200 DB & LB)

(i) Select Granular Bedding – i.e, naturally occurring non-cohesive singularly graded gravel. Soils between 0.6 to 19.0mm are not available on this site and will need to be imported.

(ii) Select Fill - The laboratory tests confirm that natural soils with a PI less than 6 are not available on the site and will need to be imported.

(iii) General Fill – materials recovered from the trench excavation works may be considered for General Fill once all the larger size fractions have been removed or reduced.

6.3.3 Evaluation of Potential Aggressiveness of interparticular groundwaters

Disturbed samples of transported and residual soils encountered in the open trial holes have been subjected to chemical testing. The test results are summarized in Table 3 and assessed as follows:

Soil Unit	pH	Comment	Resistivity Ohm.m	Comment[1]
Fill				
Colluvium				
Alluvium				
Res.Quartzite				

Comment: ref Messrs ARMCO 1977

6.3.4 Assessment of permeabilities of near surface soils

The near surface soils uncovered along the alignment have been subjected to weathering, erosion, pedogenic and other processes in the geological past. The near surface soil profiles consist of layers of transported soils and unweathered and weathered residual (insitu) materials. This range of materials with a variety of physical properties can significantly impact on special permeability values.

The following table is provided for the purpose of estimating the potential saturated hydraulic conductivities of the USCS soil group profiled and tested in these investigations.

USCS Soil Group (identified in the Atterberg tests)	Hydraulic conductivity m/s (after Badenhorst 1998)
SM	$10^{-9} – 10^{-5}$
SC	$10^{-10} – 10^{-6}$
CL	$10^{-10} – 10^{-8}$

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 The pipeline alignment investigated crosses insitu quartzite bedrock; near surface transported and residual soils generally have high shrinkage/heave characteristics when subjected to changes in moisture regime.

7.2 The near surface transported and residual soils are not suitable for either Select Granular Bedding or Select Fill.

7.3 Interparticulate groundwater in the near surface transported and residual soils are potentially corrosive to ferrous metals.

7.4 A detailed section-by-section analysis of conditions along the pipeline alignment is provided in Table 2. It is recommended that trenching should be widened and stepped in sections where trench wall stability is suspect.

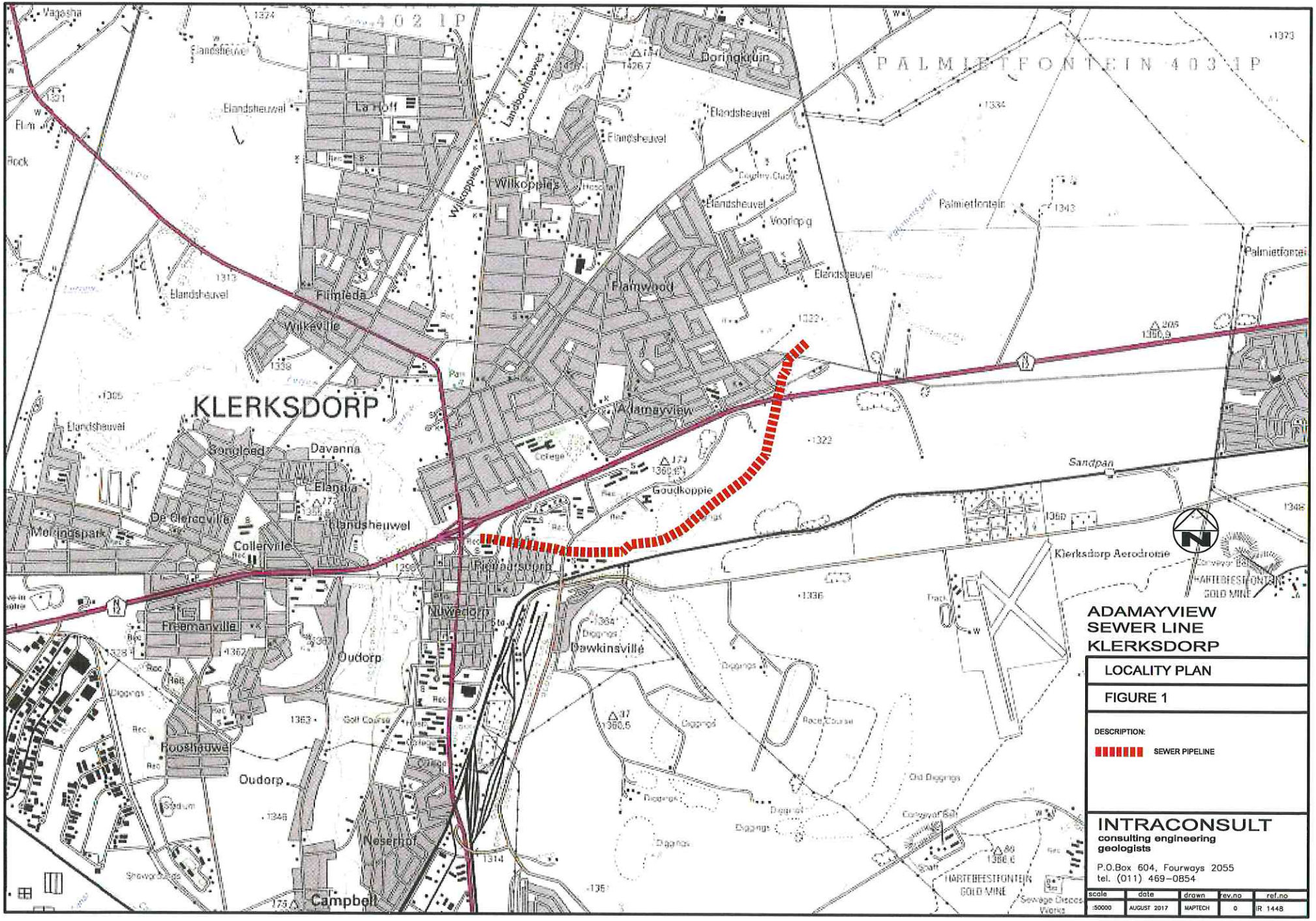
8. GENERAL

These findings are based on our interpretation of the data recovered during these investigations. While every effort has been made to determine ovcerall ground conditions along the alignment, poorer sub-sections may have been missed. For this reason, it is recommended that the Resident Engineer on site should inspect excavation works in order to confirm, in particular, the trench wall stability prior to pipe installation.

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FIGURES

LOCALITY PLAN	FIGURE 1
GEOLOGICAL MAP	FIGURE 2
TEST PIT POSITIONS	FIGURE 3



ADAMAYVIEW SEWER LINE KLERKSDORP

LOCALITY PLAN

FIGURE 1

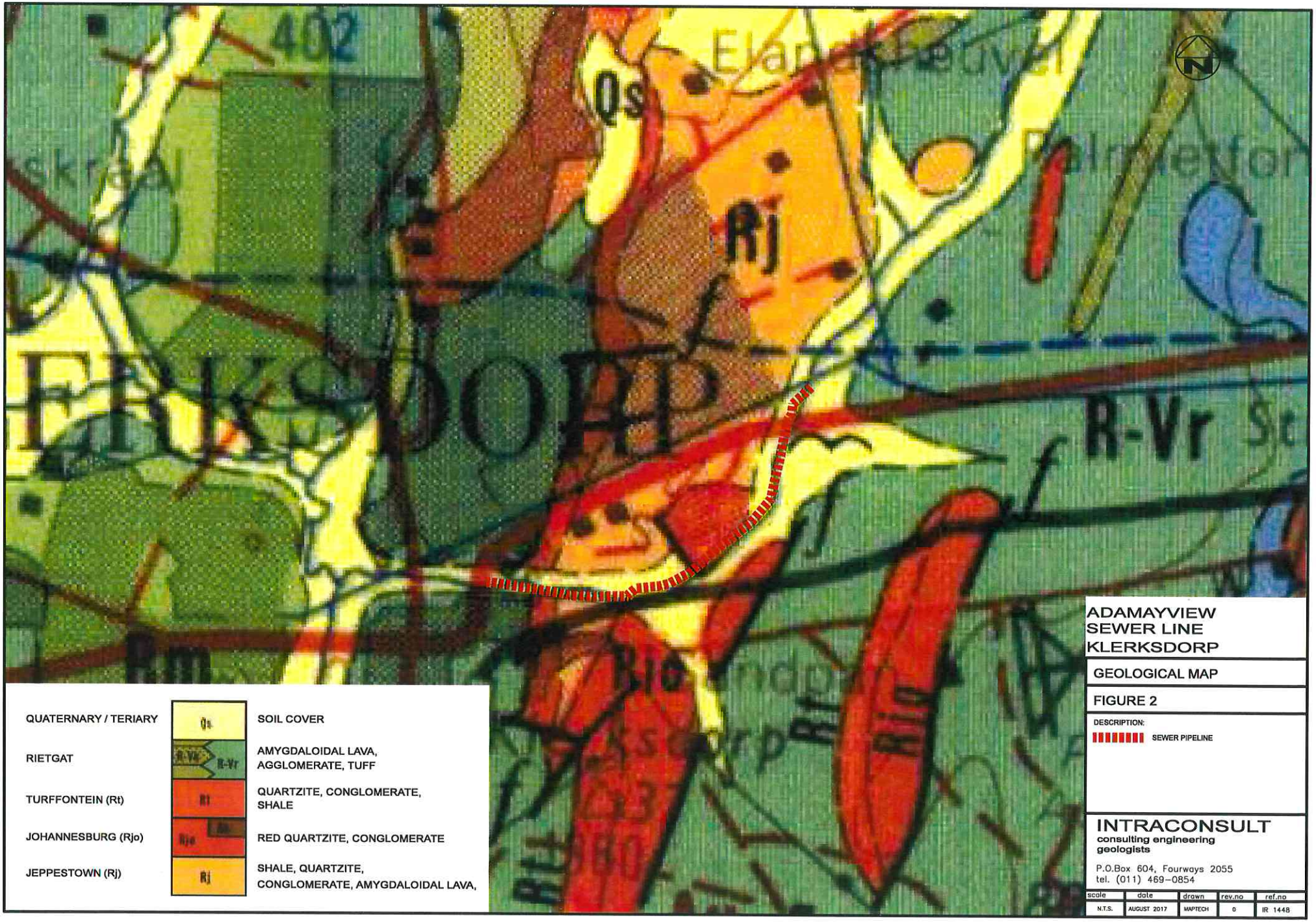
DESCRIPTION:

SEWER PIPELINE

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scale	date	drawn	rev.no	ref.no
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QUATERNARY / TERIARY	Qs	SOIL COVER
RIETGAT	R-Vr	AMYGDALOIDAL LAVA, AGGLOMERATE, TUFF
TURFFONTEIN (Rt)	Rt	QUARTZITE, CONGLOMERATE, SHALE
JOHANNESBURG (Rjo)	Rjo	RED QUARTZITE, CONGLOMERATE
JEPPESTOWN (Rj)	Rj	SHALE, QUARTZITE, CONGLOMERATE, AMYGDALOIDAL LAVA,

ADAMAYVIEW
SEWER LINE
KLERKSDORP

GEOLOGICAL MAP

FIGURE 2

DESCRIPTION:

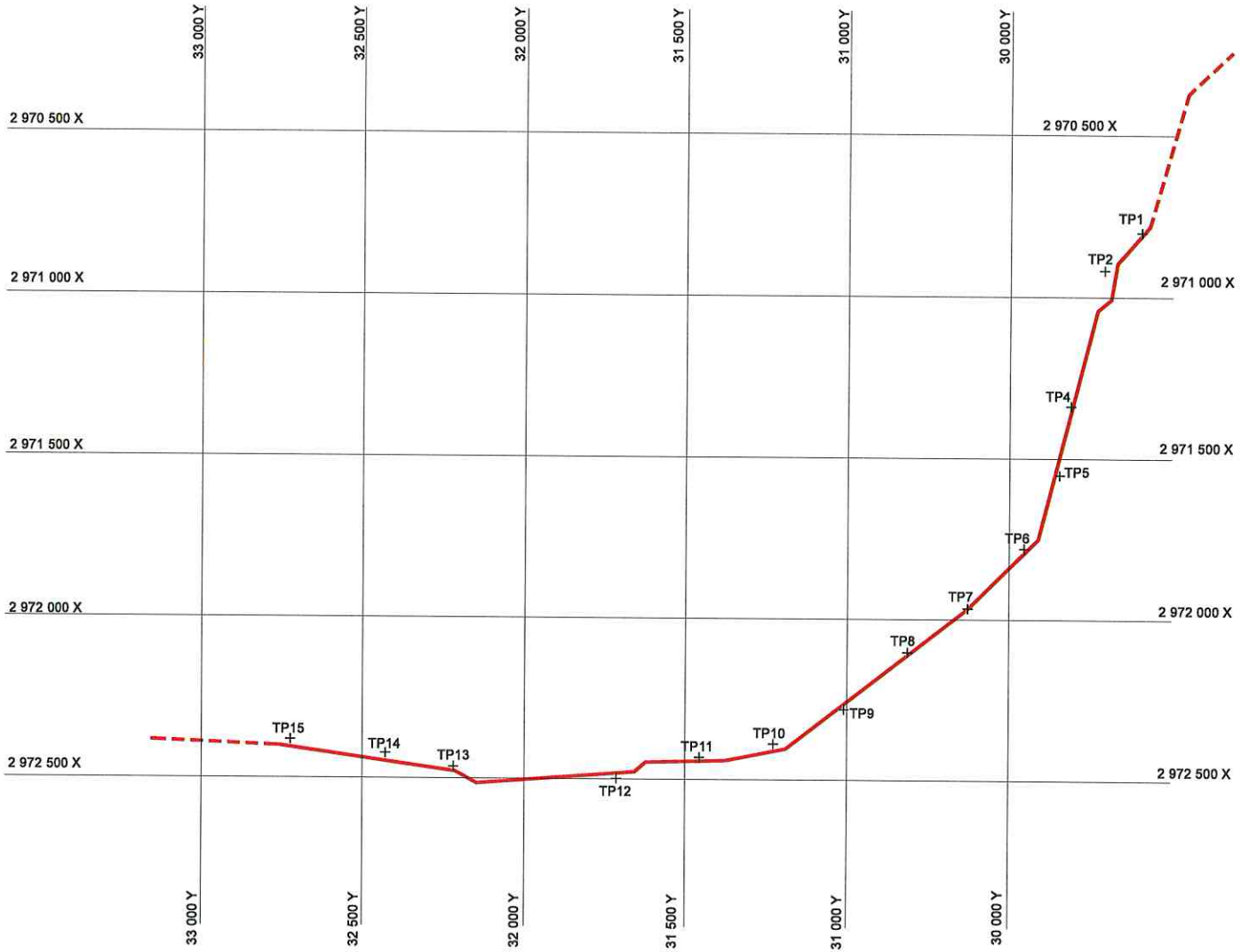
SEWER PIPELINE

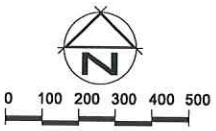
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scale	date	drawn	rev.no	ref.no
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Test Pit positions
TP1-TP15
Legend
Feature 1
Feature 2
Feature 3
Feature 4
Adamayview
Irenepark
Klerksdorp New Town
Pienaarsdorp
TP1
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
TP11
TP12
TP13
TP14
TP15
Lily Ave
May Ave
Rose Ave
Smit Ave
Mina Ave
Connie St
Platan Ave
Central Ave
Poppy Ave
Violet Ave
Ada Ave
Joseph Ave
Benroy St
Elm St
Gould St
Horwitz Dr
Louw St
Henry St
Jacklin St
Hurter St
Mooiman St
Margarieta Prinsloo St
Chari De Klerk St
Botha St
Bard St
Viljoen St
12
Google Earth
©2017 Google
©2017 AfriGIS (Pty) Ltd.
Image © 2017 CNES / Airbus
1 km
N





ADAMAYVIEW SEWER LINE KLERKSDORP

DESCRIPTION:

SEWER PIPELINE

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TABLES

SUMMARY OF REFUSAL AND GROUNDWATER DATA	TABLE 1
SUMMARY OF LABORATORY TEST RESULTS	TABLE 2

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TABLE1: SUMMARY OF REFUSAL AND GROUNDWATER AND DETAILS FROM TRAIL HOLES

Test Pit No	Depth (m)	Depth of Groundwater Perched/Seepage (m)	Depth to the base of (m)		Hard rock Excavation from (m)	Boulder Encountered in Profile	Material at base of Test Pit
			Soft Excavation	Intermediate Excavation			
TP01	2.8	-	2.8	-	-	-	Alluvium
TP02	2.8	-	2.8	-	-	-	Alluvium
TP04	2.8	-	2.8	-	-	-	Alluvium
TP05	2.8	-	2.8	-	-	-	Alluvium
TP06	2.3	-	2.3	+2.3	-	-	Soft rock Quartzite
TP07	2.8	2.0	2.8	-	-	-	Soft rock Quartzite
TP08	2.9	-	2.9	-	-	-	Alluvium
TP09	1.8	-	1.8	+1.8	-	-	Soft rock Quartzite
TP10	2.3	1.8	2.3	+2.3	-	-	Soft rock Quartzite
TP11	2.5	-	2.5	+2.5	-	-	Soft rock Quartzite
TP12	2.8	-	2.8	-	-	-	Alluvium
TP13	1.8	1.8	1.8	+1.8	-	-	Soft rock Quartzite
TP14	2.8	-	2.8	-	-	-	Alluvium
TP15	2.8	-	2.8	-	-	-	Alluvium

APPENDICES

TRIAL HOLE PROFILES	APPENDIX 1
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APPENDIX 1
Trial Hole Profiles

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Date logged: 22/08/2017

TP01 (27 Y0030097 X2970801)

0-1.0m: Moist dark brown soft ~silty ~CLAY; COLLUVIUM

1.0-2.8m: Very moist light grey firm slight ~~sickensiding~~ slickensiding ~sandy ~CLAY with 20% sub-rounded quartzite pebbles; ALLUVIUM

Notes:

Small bag samples taken between 0-1.0m and 1.0-2.8m.

Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)

No Groundwater intercepted

Maximum reach of TLB

TP02 (27 Y0030211 X2970918)

0-0.9m: Moist dark brown soft ~silty ~CLAY; COLLUVIUM

0.9-2.8m: Very moist light grey firm slight ~~sickensiding~~ slickensiding ~sandy ~CLAY with 20% sub-rounded quartzite pebbles; ALLUVIUM

Notes:

No samples taken

Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)

No Groundwater intercepted

Maximum reach of TLB

TP03 (no accessibility)



TP04 (27 Y0030312 X2971338)

0-0.5m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM

0.5-2.8m: Very moist light grey firm slight sickensiding ~sandy ~CLAY with 20% sub-rounded quartzite pebbles; ALLUVIUM

Notes:

No samples taken

Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)

No Groundwater intercepted

Maximum reach of TLB

TP05 (27 Y0030346 X2971552)

0-1.0m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM

1.0-2.8m: Very moist light grey firm slight sickensiding ~sandy ~CLAY with 20% sub-rounded quartzite pebbles; ALLUVIUM

Notes:
No samples taken
Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
No Groundwater intercepted
Maximum reach of TLB

TP06 (27 Y0030454 X2971780)
0-1.8m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM
1.8-2.3m: Moist orange brown mottled grey dense ~clayey ~SAND with 30% highly weathered quartzite gravel; RESIDUAL QUARTZITE
+2.3m: Refusal on soft rock ~QUARTZITE.

Notes:
Small bag samples taken between 0-1.8m and 1.8-2.3m.
Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
No Groundwater intercepted

TP07 (27 Y0030627 X2971966)
0-2.0m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM
2.0-2.8m: Wet orange brown mottled grey dense ~clayey ~SAND with 30% highly weathered quartzite gravel; RESIDUAL QUARTZITE
+2.8m: Refusal on soft rock ~QUARTZITE.

Notes:
No samples taken
Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
Moderate groundwater seepage at 2.0m

TP08 (27 Y0030813 X2972103)
0-0.7m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM
0.7-2.9m: Very moist light grey medium dense ~clayey ~SAND with 20% sub-rounded quartzite pebbles; ALLUVIUM
Notes:
No samples taken
Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
No Groundwater intercepted

TP09 (27 Y0031010 X2972281)

0-0.5m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM

0.5-1.8m: Wet light grey medium dense ~clayey ~SAND; ALLUVIUM

+1.8m: Refusal on soft rock ~QUARTZITE.

Notes:

No samples taken

Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)

No Groundwater intercepted

TP10 (27 Y0031227 X2972389)

0-0.8m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM

0.8-2.3m: Wet light grey medium dense ~clayey ~SAND; ALLUVIUM

+2.3m: Refusal on soft rock ~QUARTZITE.

Notes:

No samples taken

Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)

Slight groundwater seepage at 1.8 m

TP11 (27 Y0031456 X2972431)

0-0.5m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM

0.5-2.1m: Very moist light grey loose to medium dense ~clayey ~SAND; ALLUVIUM

2.1-2.5m: Wet orange brown mottled grey dense ~clayey ~SAND with 30% highly weathered quartzite gravel; RESIDUAL QUARTZITE

+2.5m: Refusal on soft rock ~QUARTZITE.

Notes:

Small bag samples taken between 0.5-2.1m and 2.1-2.5m.

Unstable sidewalls

No Groundwater intercepted

TP12 (27 Y0031714 X2972498)

0-1.1m: Moist dark grey firm slight slickensiding ~sandy ~CLAY; COLLUVIUM

1.1-2.8m: Very moist light grey firm slight sickensiding ~silty ~CLAY; ALLUVIUM

Notes:

Small bag samples taken between 0-1.1m and 1.1-2.8m.

Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
No Groundwater intercepted
Maximum reach of TLB

TP13 (27 Y0032218 X2972463)
0-0.7m: Very moist brown medium dense ~clayey ~SAND; COLLUVIUM
0.7-1.6m: Very moist light grey firm slight sickensiding ~sandy ~CLAY; ALLUVIUM
1.6-1.8m: Wet light grey firm ~sandy ~CLAY with 20% sub-rounded quartzite cobbles and pebbles; ALLUVIUM
+1.8m: Refusal on light brown to brown ~QUARTZITE.

Notes:
Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
Moderate groundwater seepage intercepted at 1.8m

TP14 (27 Y0032428 X2972422)
0-0.5m: Very moist brown medium dense ~clayey ~SAND; COLLUVIUM
0.5-2.8m: Very moist light grey firm slight sickensiding ~sandy ~CLAY; ALLUVIUM
Notes:
No samples taken
Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
No Groundwater intercepted
Maximum reach of TLB

TP15 (27 Y0032723 X2972381)
0-0.9m: Moist light brown firm ~sandy ~SILT with 20% mixed gravel; FILL
0.9-1.5m: Very moist brown medium dense ~clayey ~SAND; COLLUVIUM
1.5-2.8m: Very moist light grey firm slight sickensiding ~sandy ~CLAY; ALLUVIUM
Notes:
Small bag samples taken between 0-0.9m, 0.9-1.5m and 1.5-2.8m.
Slightly Stable sidewalls (with long term exposure sidewalls can become unstable)
No Groundwater intercepted
Maximum reach of TLB

APPENDIX 2
Laboratory Test Results