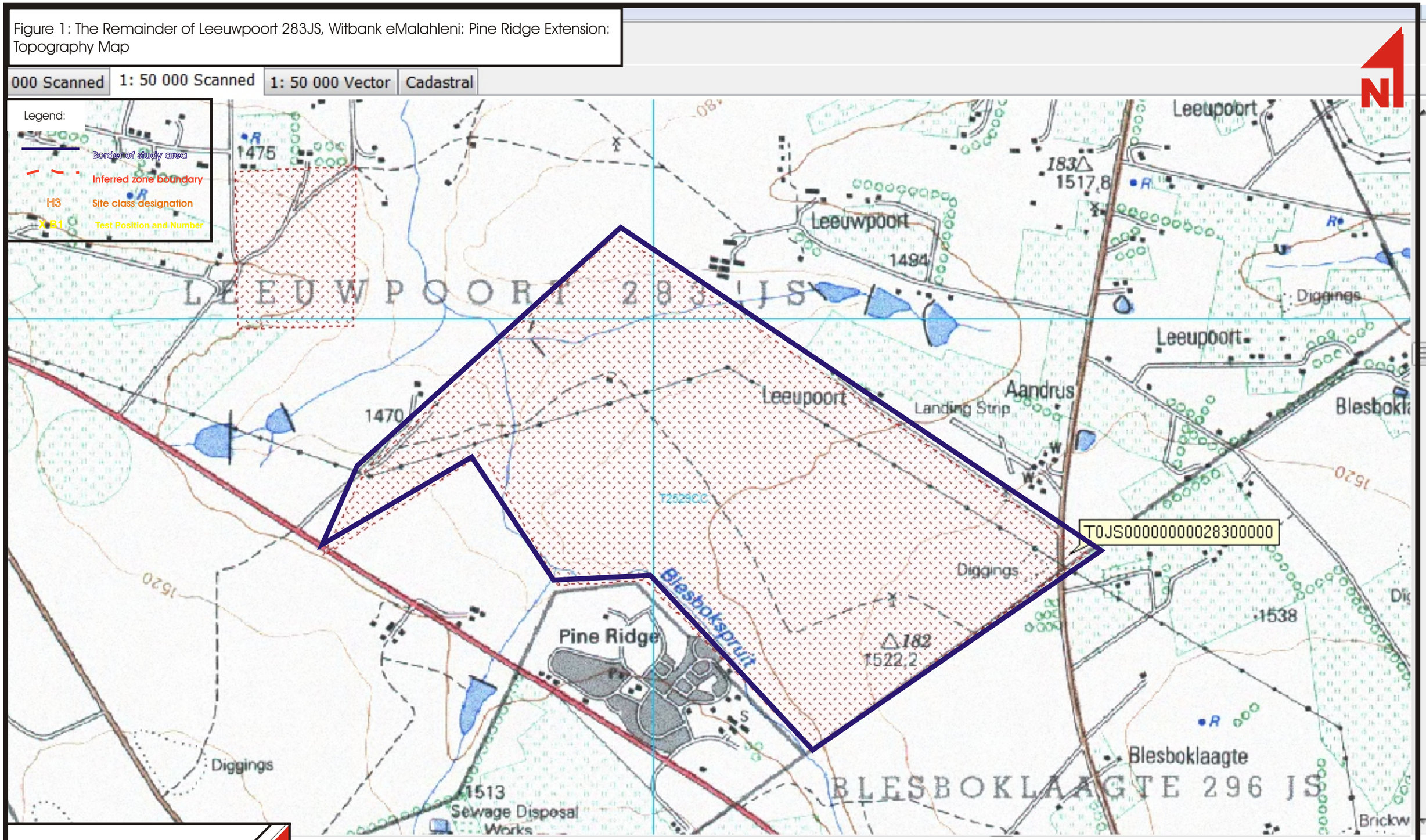
Figure 1: The Remainder of Leeuwpoort 283JS, Witbank eMalahleni: Pine Ridge Extension: Topography Map



GEOSET CC

CK 1999/65610/23

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Ingenieursgeoloog
Engineering Geologist

David S. van der Merwe
Bsc.(Hons.)(Eng. Geol.), Pr.Sci.Nat.; MSAIEG; MEESG.

ENGINEERING GEOLOGICAL SURVEY:

As shown on plan and described in report

Engineering Geological Investigation to determine the potential for Township Development on the Remainder of the farm Leeuwpoort 283JS, Witbank eMalahleni, Mpumalanga.

Scale: App. 1: 50 000
REPORT NUMBER: GS201405L DATED: May 2014

GEOREFERENCE: 2529CC Witbank

Geology: The site is underlain by shale and tillite of the Dwyka Formation, Karoo Supergroup, and sandstone, quartzitic sandstone and conglomerate of the Wilge River Formation, Waterberg Group.

GEOSET BK CC

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FIGURE 2: Geology Map:
The remainder of Leeuwpoort 386JS,
Witbank, eMalahleni, Mpumalanga

Georeference: 2529CD Middelburg

Legend

di	dolerite (diabase)
Pe	Ecca Formation, Karoo Supergroup: shale and shaly sandstone, grit, sandstone, conglomerate with coal
Pd	Dwyka Formation, karoo Supergroup Shale, tillite.
Mw	Waterberg Group, Wilgerivier Formation Sandstone, quartzitic sandstone & conglomerate
Vls	Loskop Formation shale, sandstone, conglomerate, volcanic rocks
Vs	Selons River Formation, Rooiberg Group Volcanic rocks, quartzite xenolith, sandstone & quartzite

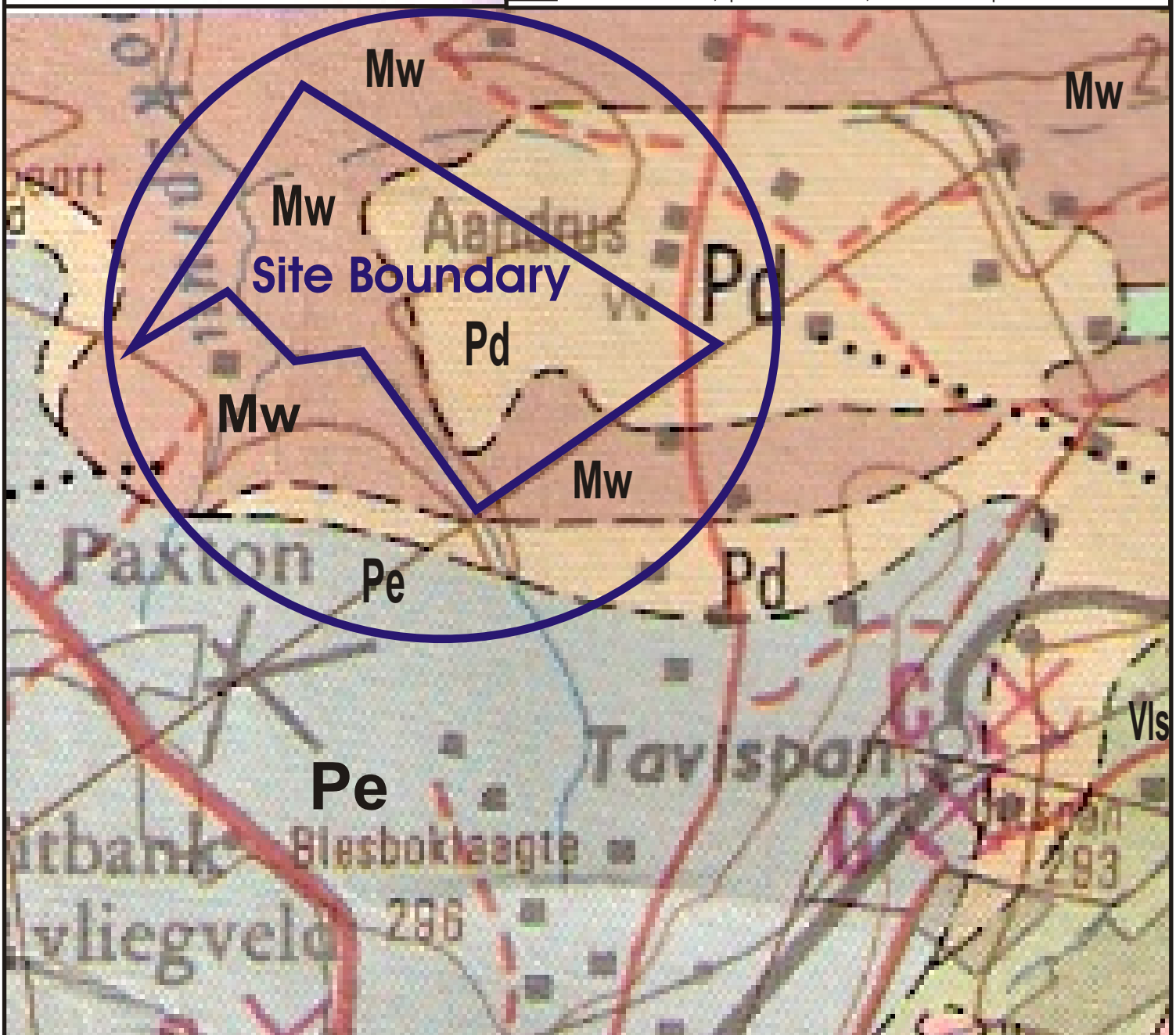
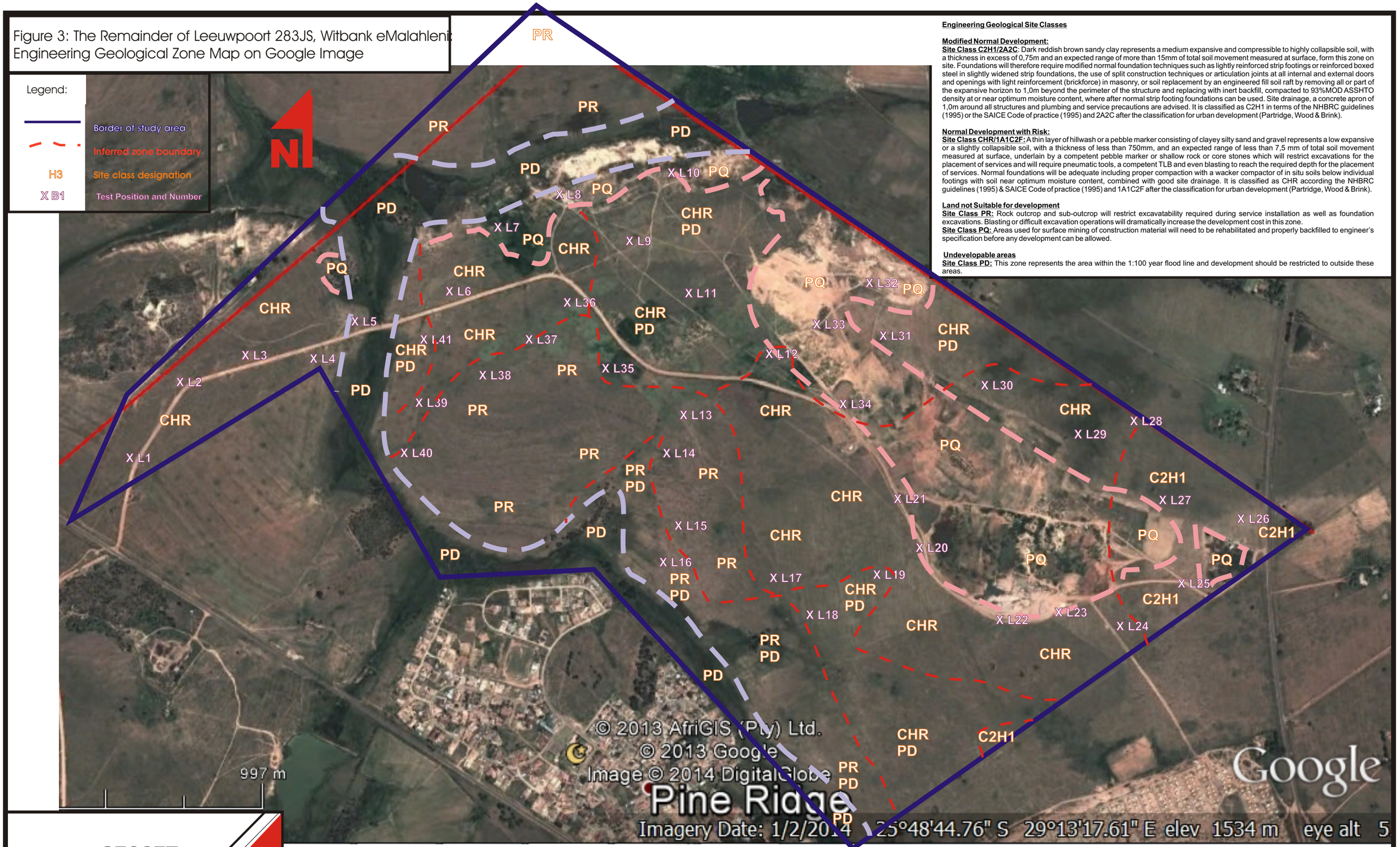


Figure 3: The Remainder of Leeuwpoort 283JS, Witbank eMalahleni
Engineering Geological Zone Map on Google Image



Engineering Geological Site Classes

Modified Normal Development:
Site Class C2H1/2A2C: Dark reddish brown sandy clay represents a medium expansive and compressible to highly collapsible soil, with a thickness in excess of 0,75m and an expected range of more than 15mm of total soil movement measured at surface, form this zone on site. Foundations will therefore require modified normal foundation techniques such as lightly reinforced strip footings or reinforced boxed steel in slightly widened strip foundations, the use of split construction techniques or articulation joints at all internal and external doors and openings with light reinforcement (brickforce) in masonry, or soil replacement by an engineered fill soil raft by removing all or part of the expansive horizon to 1,0m beyond the perimeter of the structure and replacing with inert backfill, compacted to 93%MOD ASSHTO density at or near optimum moisture content, where after normal strip footing foundations can be used. Site drainage, a concrete apron of 1,0m around all structures and plumbing and service precautions are advised. It is classified as C2H1 in terms of the NHBRC guidelines (1995) or the SAICE Code of practice (1995) and 2A2C after the classification for urban development (Partridge, Wood & Brink).

Normal Development with Risk:
Site Class CHR/1A1C2F: A thin layer of hillwash or a pebble marker consisting of clayey silty sand and gravel represents a low expansive or a slightly collapsible soil, with a thickness of less than 750mm, and an expected range of less than 7,5 mm of total soil movement measured at surface, underlain by a competent pebble marker or shallow rock or core stones which will restrict excavations for the placement of services and will require pneumatic tools, a competent TLB and even blasting to reach the required depth for the placement of services. Normal foundations will be adequate including proper compaction with a wacker compactor of in situ soils below individual footings with soil near optimum moisture content, combined with good site drainage. It is classified as CHR according the NHBRC guidelines (1995) & SAICE Code of practice (1995) and 1A1C2F after the classification for urban development (Partridge, Wood & Brink).

Land not Suitable for development
Site Class PR: Rock outcrop and sub-outcrop will restrict excavatability required during service installation as well as foundation excavations. Blasting or difficult excavation operations will dramatically increase the development cost in this zone.
Site Class PQ: Areas used for surface mining of construction material will need to be rehabilitated and properly backfilled to engineer's specification before any development can be allowed.

Undevelopable areas
Site Class PD: This zone represents the area within the 1:100 year flood line and development should be restricted to outside these areas.

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Scale: App. 1: 30 000
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GEOREFERENCE: 2529CC Witbank

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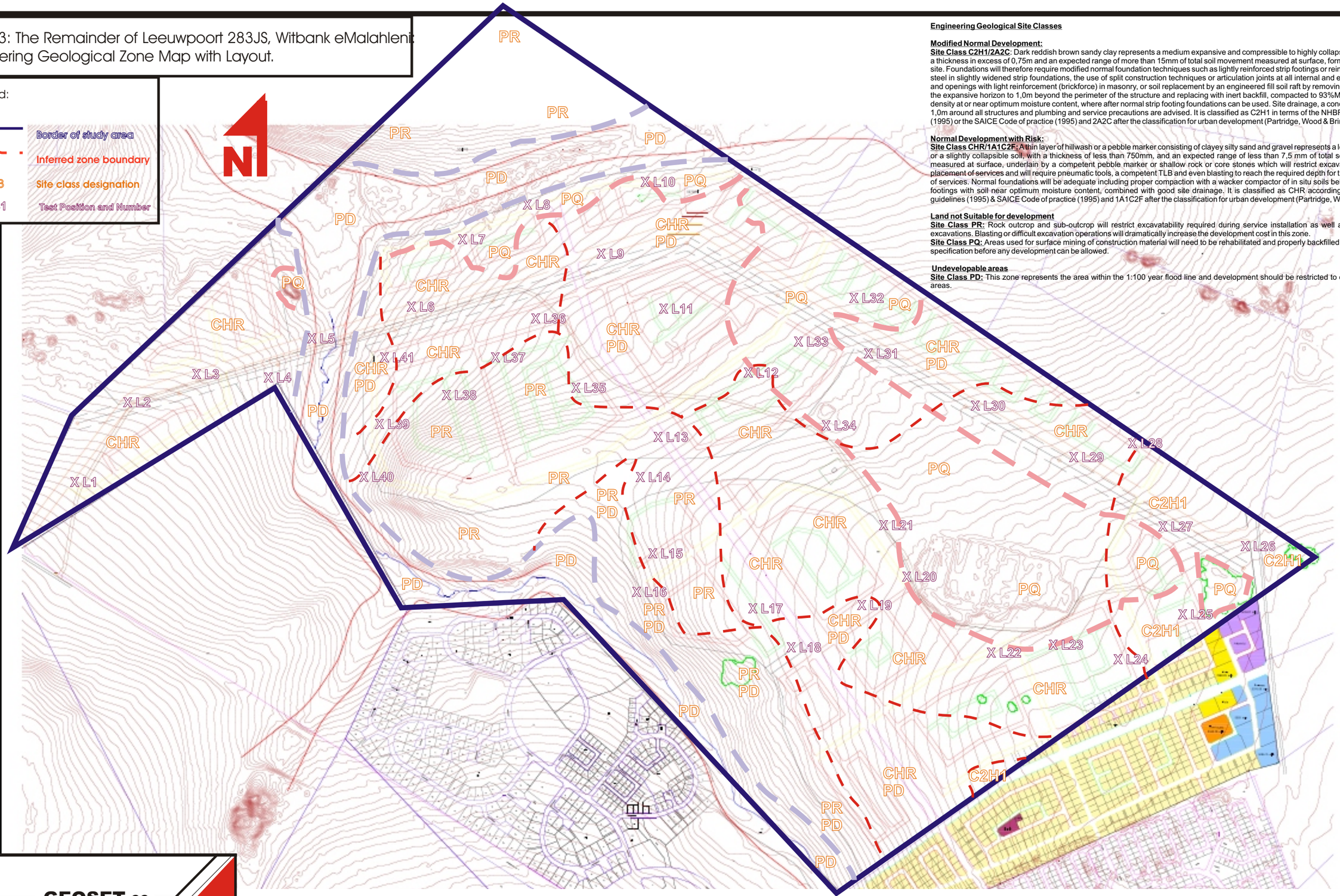
Figure 3: The Remainder of Leeuwpoort 283JS, Witbank eMalahleni Engineering Geological Zone Map with Layout.

Legend:

- Border of study area
- Inferred zone boundary
- H3 — Site class designation
- X B1 — Test Position and Number



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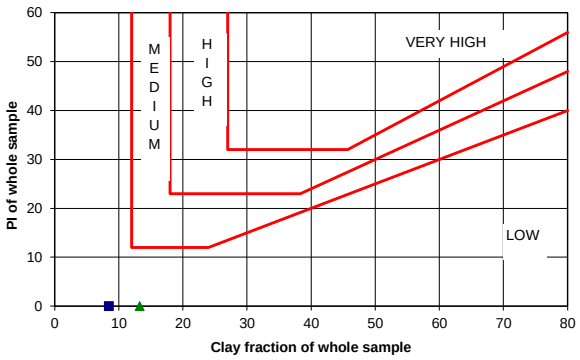
PARTICLE SIZE ANALYSIS

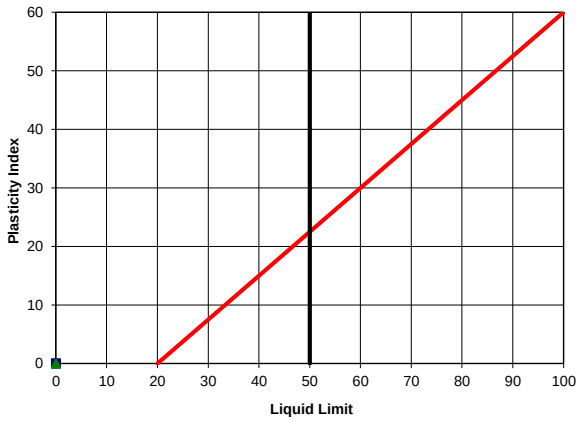
Sample No.		
Soillab sample no.	S14-0429-1	S14-0429-2
Depth (m)	0.4	2.5
Position	L9	L 26
Material Description	DARK RED BROWN FERRICRETE GRAVELLY SAND	DARK Y ORANGE FERRICRETE SILTY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	100
4.75 mm	92	100
2.00 mm	83	99
0.425 mm	70	83
0.075 mm	18	30
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	16	23
0.027 mm	13	20
0.013 mm	11	17
0.005 mm	10	15
0.002 mm	8	13
% Clay	8	13
% Silt	8	14
% Sand	66	72
% Gravel	17	1
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	NP	SP
Linear Shrinkage (%)	0.0	1.0
Grading Modulus	1.29	0.88
Uniformity coefficient	55	-
Coefficient of curvature	7.6	-
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SM	SM
Chart Reference		

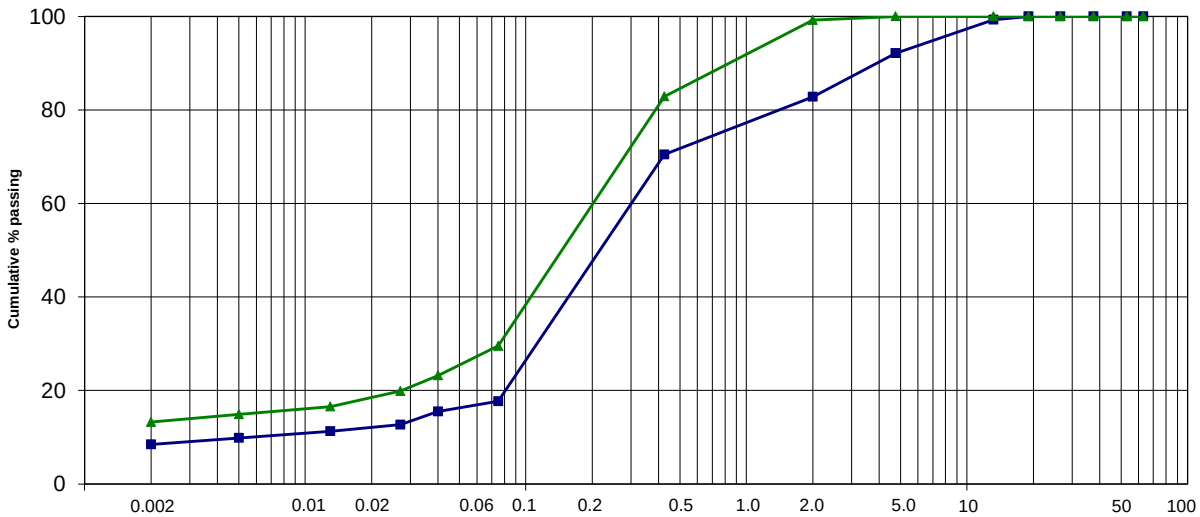
PROJECT : LEEUPOORT
JOB No. : S14-0429
DATE : 02/05/2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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PARTICLE SIZE ANALYSIS

Sample No.		
Soillab sample no.	S14-0429-3	S14-0429-4
Depth (m)	0.3	0.4
Position	L 34	L 27
Material Description	DARK BROWN SANDSTONE,SHALE GRAVELLY SAND	LIGHT BROWN FERRICRETE CLAYEY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	94	100
2.00 mm	84	99
0.425 mm	74	84
0.075 mm	20	29
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	15	22
0.027 mm	12	19
0.013 mm	10	17
0.005 mm	9	15
0.002 mm	7	13
% Clay	7	13
% Silt	10	12
% Sand	66	73
% Gravel	16	1
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	NP	SP
Linear Shrinkage (%)	0.0	1.0
Grading Modulus	1.22	0.88
Uniformity coefficient		-
Coefficient of curvature		-
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SM	SM
Chart Reference		

PROJECT : LEEUPOORT
JOB No. : S14-0429
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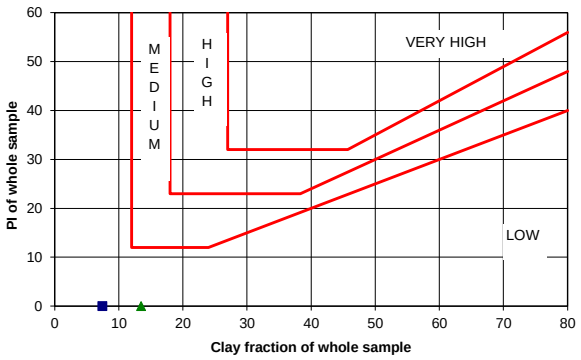
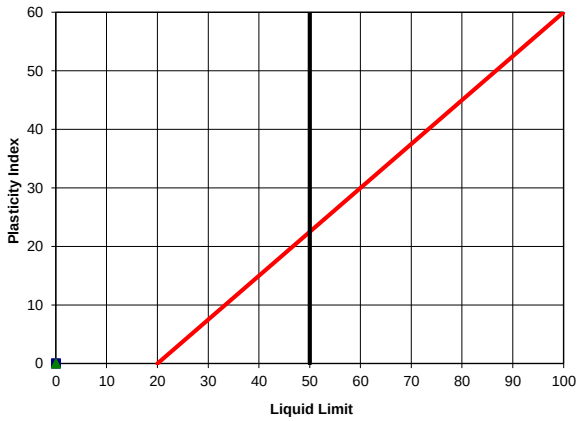
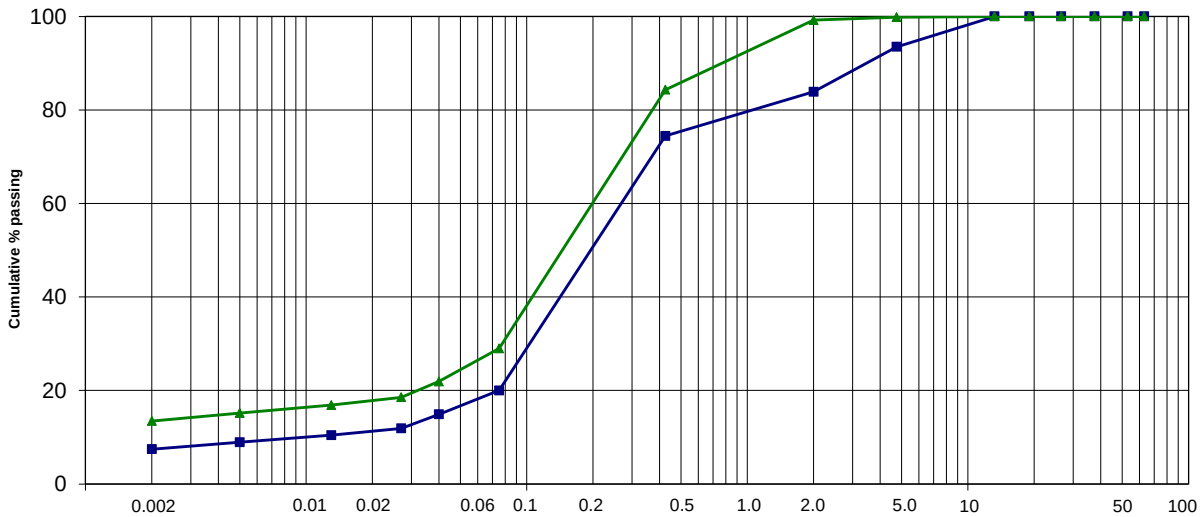
POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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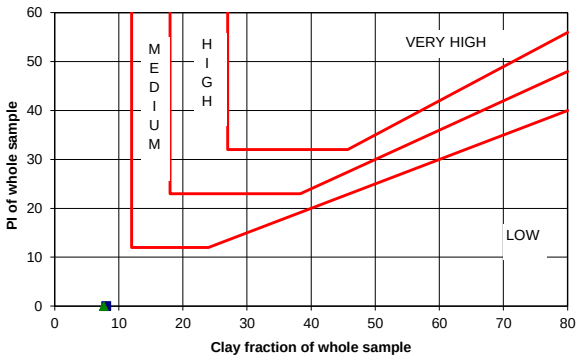
PARTICLE SIZE ANALYSIS

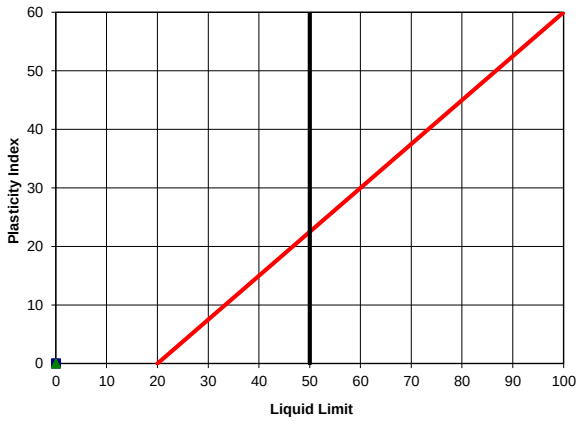
Sample No.		
Soillab sample no.	S14-0429-5	S14-0429-6
Depth (m)	1.0	0.2
Position	L 7	L 6
Material Description	DARK BROWN LIMONITE GRAVELLY SAND	DARK BROWN SANDSTONE GRAVELLY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	97	100
13.2 mm	96	96
4.75 mm	74	91
2.00 mm	61	90
0.425 mm	50	77
0.075 mm	16	20
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	14	14
0.027 mm	12	12
0.013 mm	10	11
0.005 mm	9	9
0.002 mm	8	8
% Clay	8	8
% Silt	7	10
% Sand	46	73
% Gravel	39	10
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	NP	NP
Linear Shrinkage (%)	0.0	0.0
Grading Modulus	1.73	1.13
Uniformity coefficient	140	31
Coefficient of curvature	1.1	5.0
Classification	A-1-b (0)	A-2-4 (0)
Unified Classification	SM	SM
Chart Reference		

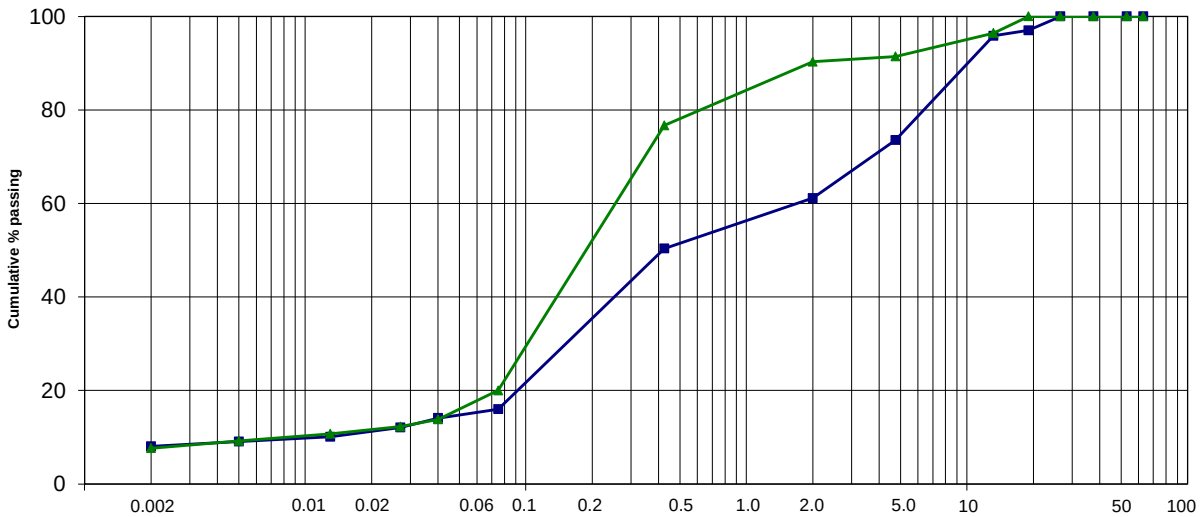
PROJECT : LEEUPOORT
JOB No. : S14-0429
DATE : 02/05/2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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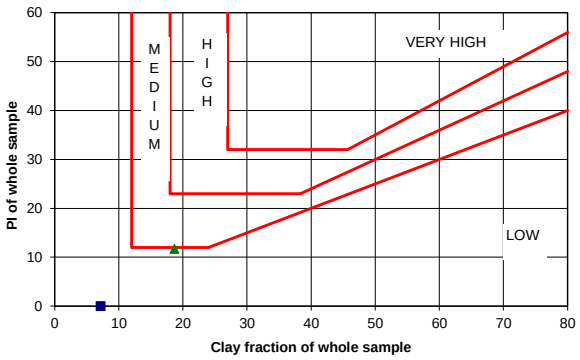
PARTICLE SIZE ANALYSIS

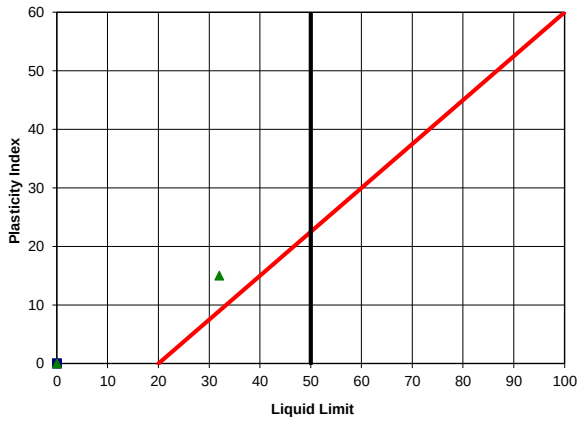
Sample No.		
Soillab sample no.	S14-0429-7	S14-0429-8
Depth (m)	0.5	2
Position	L 4	L 41
Material Description	DARK RED BROWN SANDSTONE SILTY SAND	DARK RED QUARTZ,FERRICRETE SILTY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	96	100
4.75 mm	90	99
2.00 mm	88	95
0.425 mm	72	78
0.075 mm	27	44
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	19	34
0.027 mm	16	31
0.013 mm	13	26
0.005 mm	9	23
0.002 mm	7	19
% Clay	7	19
% Silt	16	21
% Sand	65	55
% Gravel	12	5
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		32
Plasticity Index	NP	15
Linear Shrinkage (%)	0.0	7.0
Grading Modulus	1.13	0.83
Uniformity coefficient	40	-
Coefficient of curvature	3.9	-
Classification	A-2-4 (0)	A-6 (3)
Unified Classification	SM	SC
Chart Reference		

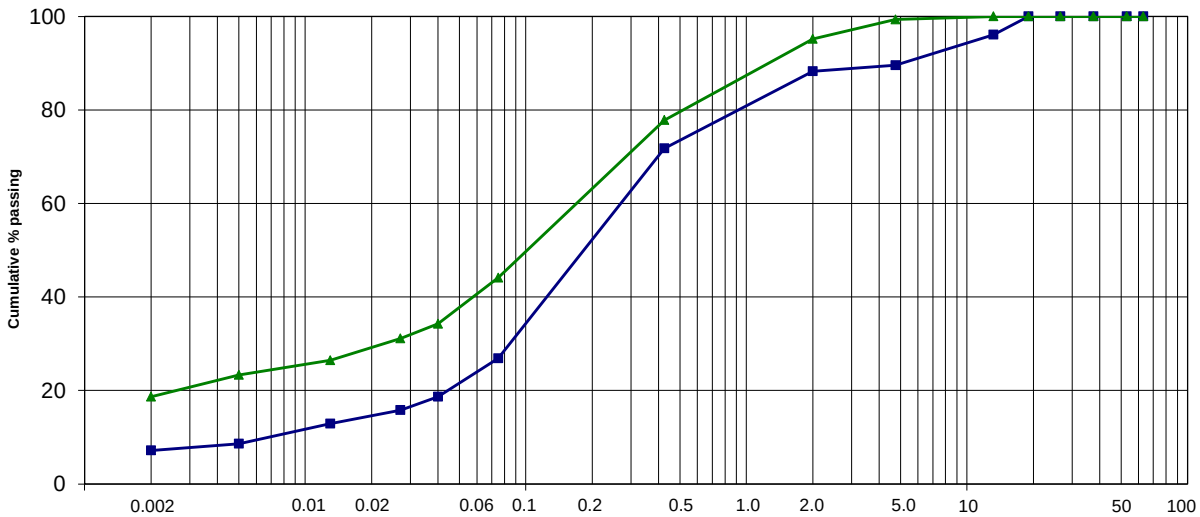
PROJECT : LEEUPOORT
JOB No. : S14-0429
DATE : 02/05/2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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PARTICLE SIZE ANALYSIS

Sample No.		
Soillab sample no.	S14-0429-9	S14-0429-10
Depth (m)	0.1	0.5
Position	L 3	L 10
Material Description	DARK BROWN S/STONE,FERRICRETE SANDY GRAVEL	LIGHT BROWN FERRICRETE SILTY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	83	100
26.5 mm	73	100
19.0 mm	65	100
13.2 mm	62	100
4.75 mm	53	100
2.00 mm	51	98
0.425 mm	42	86
0.075 mm	10	24
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	8	15
0.027 mm	6	12
0.013 mm	5	9
0.005 mm	4	7
0.002 mm	3	3
% Clay	3	3
% Silt	6	17
% Sand	42	77
% Gravel	49	2
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	NP	NP
Linear Shrinkage (%)	0.0	0.0
Grading Modulus	1.98	0.92
Uniformity coefficient	138	12
Coefficient of curvature	0.1	2.2
Classification	A-1-b (0)	A-2-4 (0)
Unified Classification	GP - GM	SM
Chart Reference		

PROJECT : LEEUPOORT
JOB No. : S14-0429
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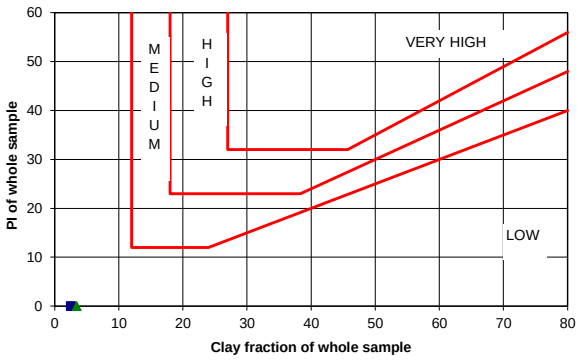
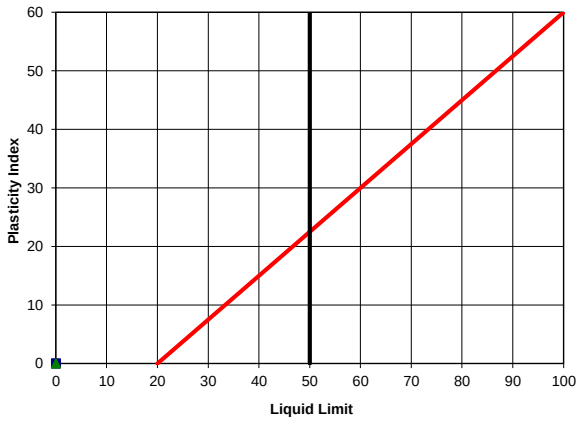
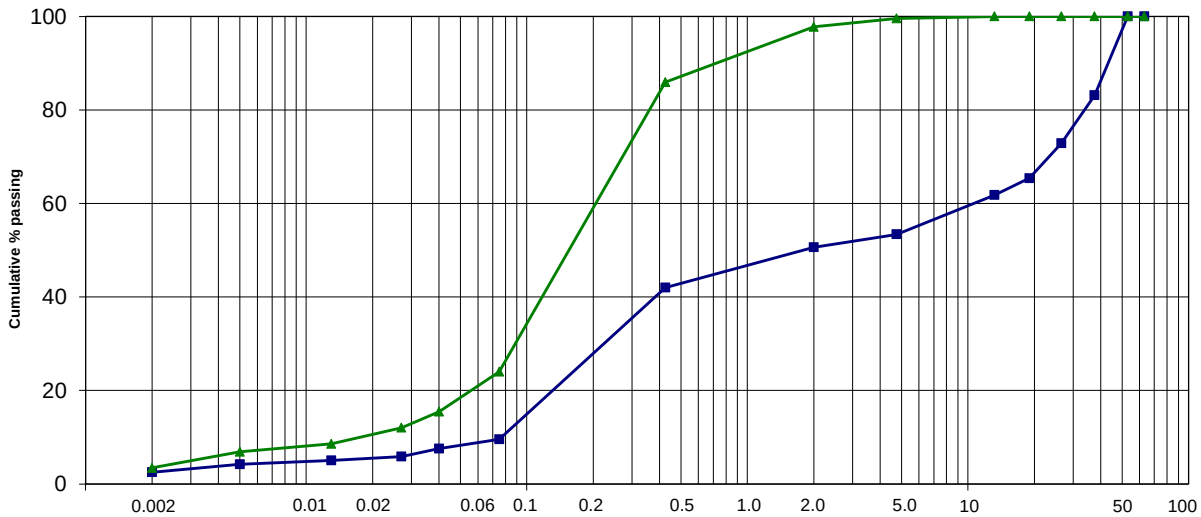


PLASTICITY CHART





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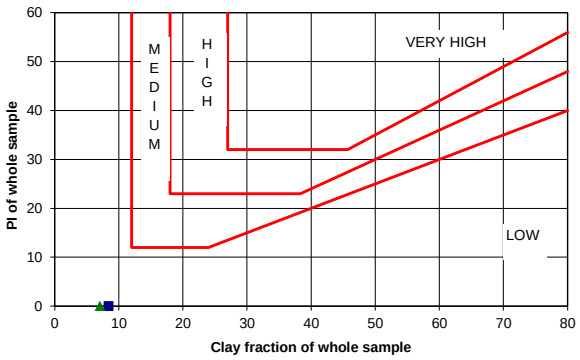
PARTICLE SIZE ANALYSIS

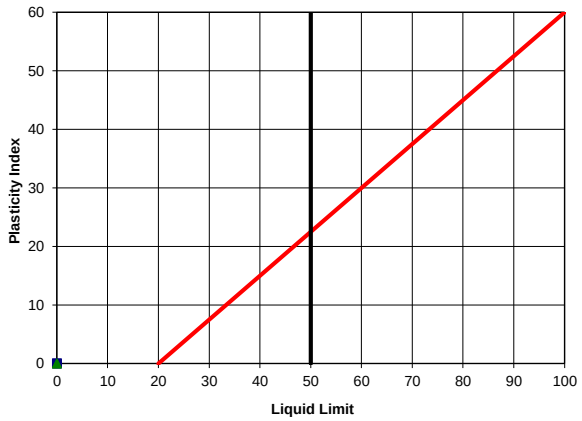
Sample No.		
Soillab sample no.	S14-0429-11	S14-0429-12
Depth (m)	0.3	0.6
Position	L 11	L 19
Material Description	DARK GREY FERRICRETE SILTY SAND	DARK BROWN FERRICRETE GRAVELLY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	96	98
4.75 mm	94	79
2.00 mm	92	68
0.425 mm	84	59
0.075 mm	32	20
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	22	13
0.027 mm	17	11
0.013 mm	13	9
0.005 mm	12	8
0.002 mm	8	7
% Clay	8	7
% Silt	19	10
% Sand	64	51
% Gravel	8	32
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	NP	NP
Linear Shrinkage (%)	0.0	0.0
Grading Modulus	0.92	1.53
Uniformity coefficient	62	28
Coefficient of curvature	7.4	1.5
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SM	SM
Chart Reference		

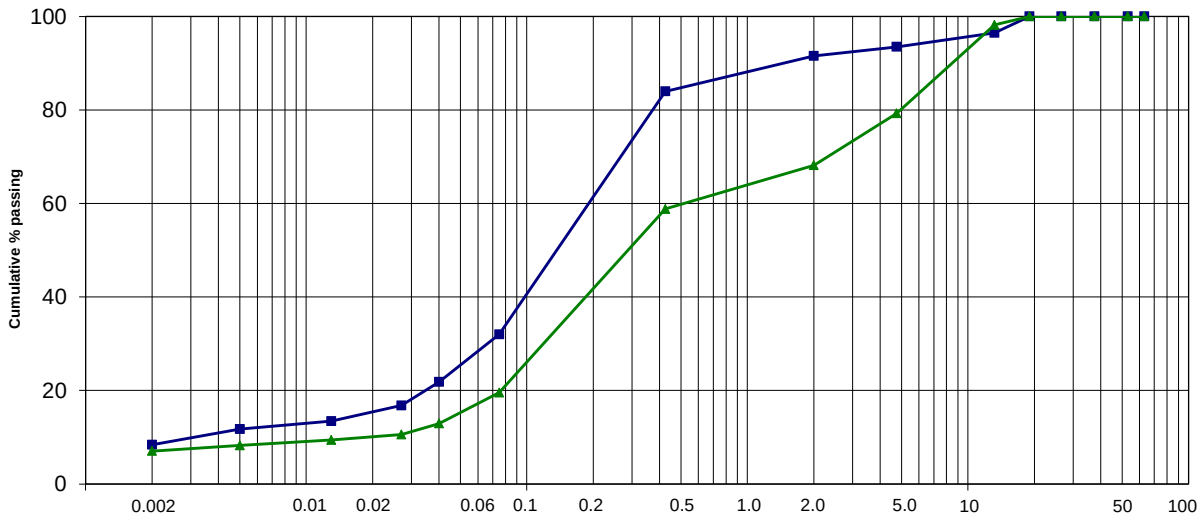
PROJECT : LEEUPOORT
JOB No. : S14-0429
DATE : 02/05/2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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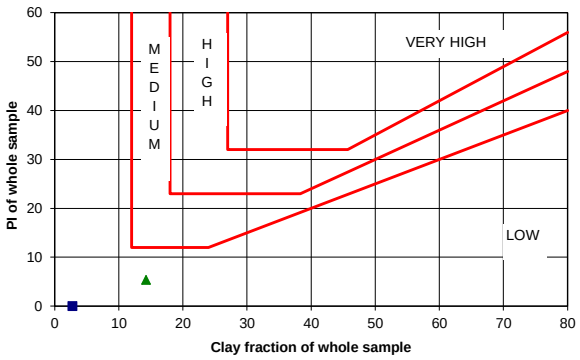
PARTICLE SIZE ANALYSIS

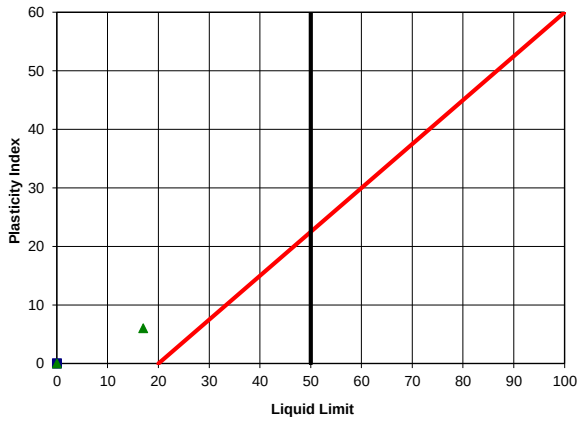
Sample No.		
Soillab sample no.	S14-0429-13	S14-0429-15
Depth (m)	1.6	0.8
Position	L 39	L 33
Material Description	PALE RED SANDSTONE GRAVELLY SAND	DARK RED CLAYEY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	91	100
2.00 mm	80	100
0.425 mm	69	89
0.075 mm	30	29
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	8	23
0.027 mm	6	20
0.013 mm	6	18
0.005 mm	6	16
0.002 mm	3	14
% Clay	3	14
% Silt	18	12
% Sand	59	73
% Gravel	20	0
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		17
Plasticity Index	SP	6
Linear Shrinkage (%)	1.0	2.0
Grading Modulus	1.21	0.82
Uniformity coefficient	7	-
Coefficient of curvature	0.5	-
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SM	SM & SC
Chart Reference		

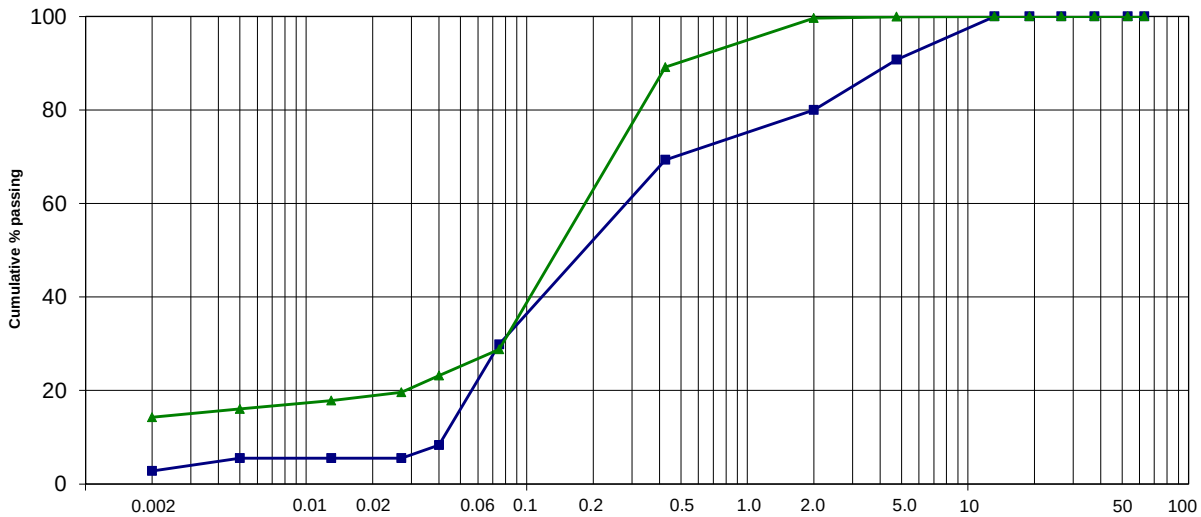
PROJECT : LEEUPOORT
JOB No. : S14-0429
DATE : 02/05/2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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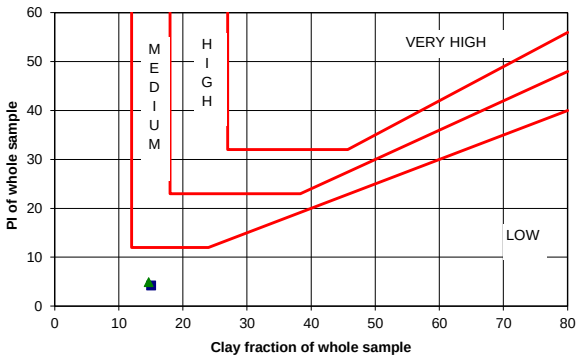
PARTICLE SIZE ANALYSIS

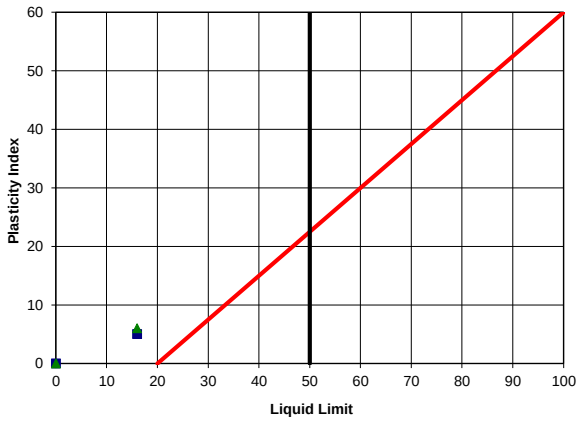
Sample No.		
Soillab sample no.	S14-0429-16	S14-0429-17
Depth (m)	0.5	0.6
Position	L 4	L 25
Material Description	DARK RED BROWN FERRICRETE CLAYEY SAND	LIGHT BROWN CLAYEY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	99	100
2.00 mm	99	99
0.425 mm	84	81
0.075 mm	30	27
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	23	24
0.027 mm	20	21
0.013 mm	18	18
0.005 mm	17	16
0.002 mm	15	15
% Clay	15	15
% Silt	12	11
% Sand	72	73
% Gravel	1	1
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	16	16
Plasticity Index	5	6
Linear Shrinkage (%)	2.0	2.0
Grading Modulus	0.88	0.92
Uniformity coefficient	-	-
Coefficient of curvature	-	-
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SM & SC	SM & SC
Chart Reference		

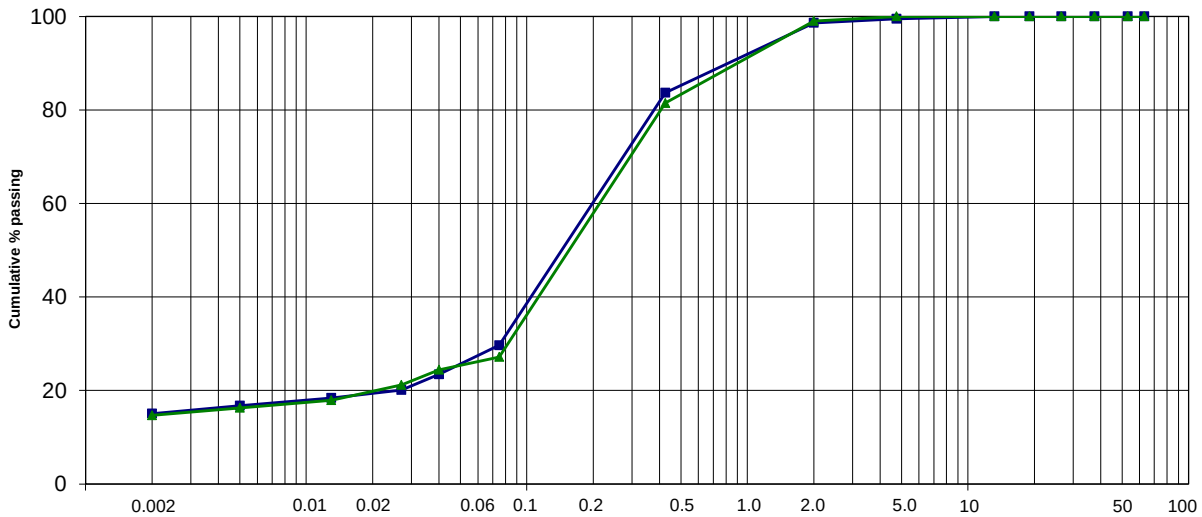
PROJECT : LEEUPOORT
JOB No. : S14-0429
DATE : 02/05/2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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PARTICLE SIZE ANALYSIS

Sample No.		
Soillab sample no.	S14-0429-18	S14-0429-19
Depth (m)	0.5	0.4
Position	L 20	L 37
Material Description	DARK RED BROWN SHALE,SANDSTONE GRAVELLY SAND	DARK BROWN FERRICRETE SILTY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	100
4.75 mm	85	99
2.00 mm	63	98
0.425 mm	48	82
0.075 mm	20	19
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	14	13
0.027 mm	12	10
0.013 mm	10	7
0.005 mm	9	5
0.002 mm	8	3
% Clay	8	3
% Silt	10	13
% Sand	45	82
% Gravel	37	2
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		
Plasticity Index	SP	NP
Linear Shrinkage (%)	0.5	0.0
Grading Modulus	1.69	1.01
Uniformity coefficient	143	8
Coefficient of curvature	1.3	1.6
Classification	A-1-b (0)	A-2-4 (0)
Unified Classification	SM	SM
Chart Reference		

PROJECT : LEEUPOORT
JOB No. : S14-0429
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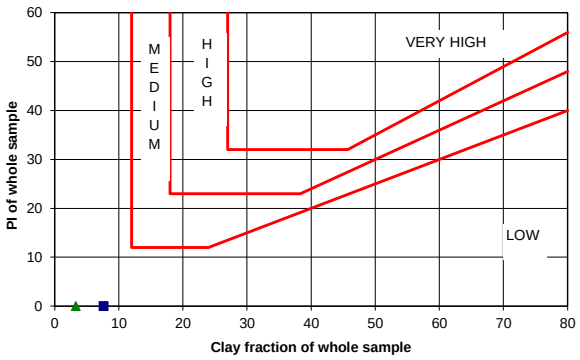
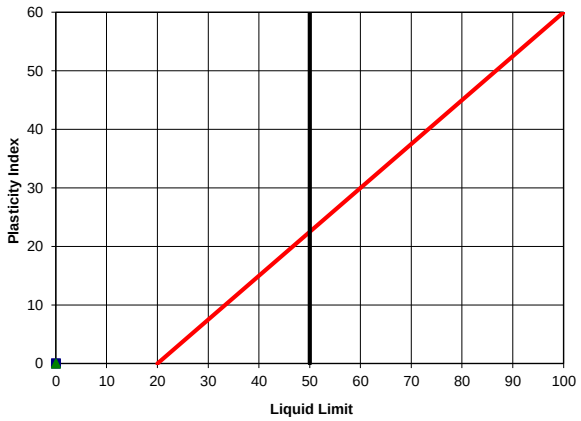
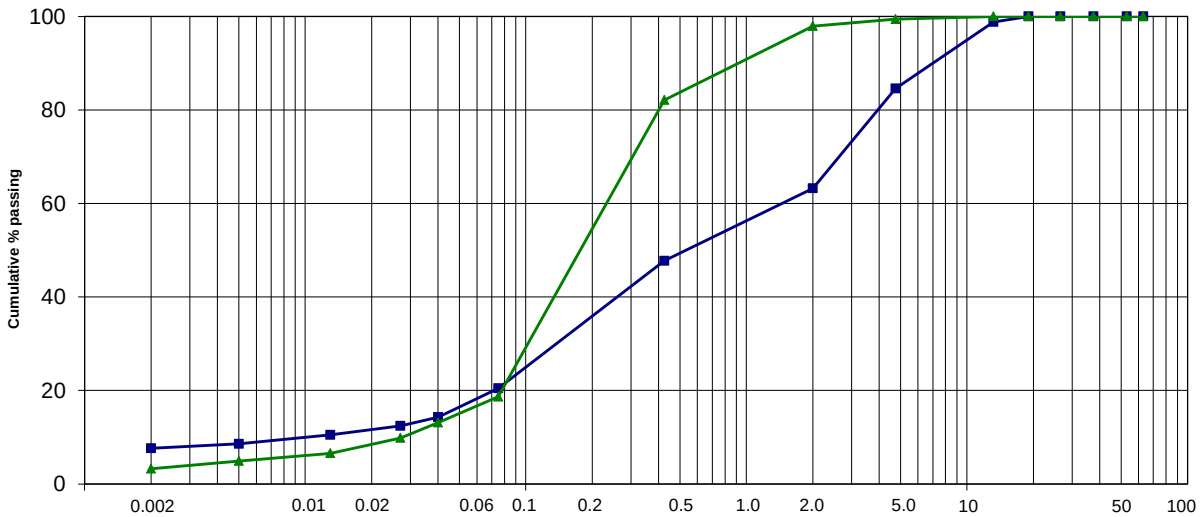
POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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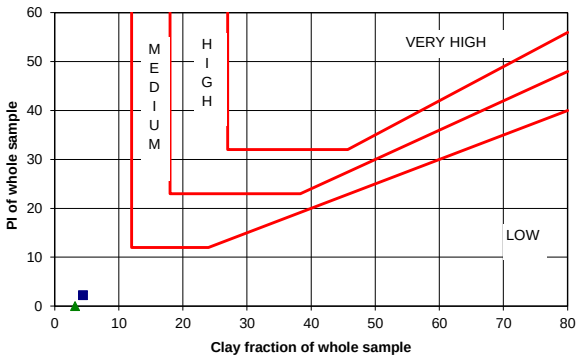
PARTICLE SIZE ANALYSIS

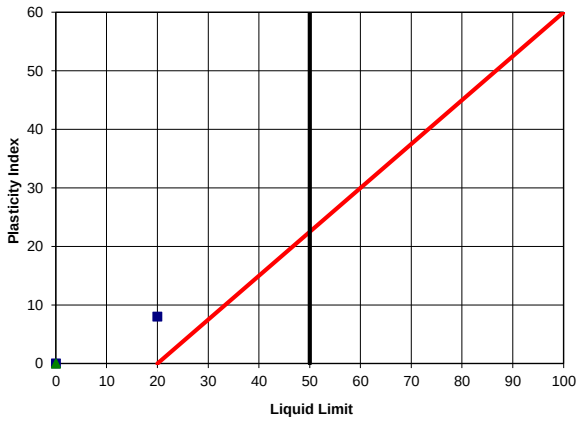
Sample No.		
Soillab sample no.	S14-0429-20	S14-0429-21
Depth (m)	0.6	0.3
Position	L 30	L 8
Material Description	DARK BROWN FERRICRETE SANDY GRAVEL	LIGHT BROWN FERRICRETE SILTY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	60	95
2.00 mm	40	91
0.425 mm	28	79
0.075 mm	13	15
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	9	11
0.027 mm	8	8
0.013 mm	7	6
0.005 mm	6	6
0.002 mm	4	3
% Clay	4	3
% Silt	7	10
% Sand	29	78
% Gravel	60	9
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	20	
Plasticity Index	8	NP
Linear Shrinkage (%)	4.0	0.0
Grading Modulus	2.19	1.14
Uniformity coefficient	106	7
Coefficient of curvature	1.5	1.4
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SC	SM
Chart Reference		

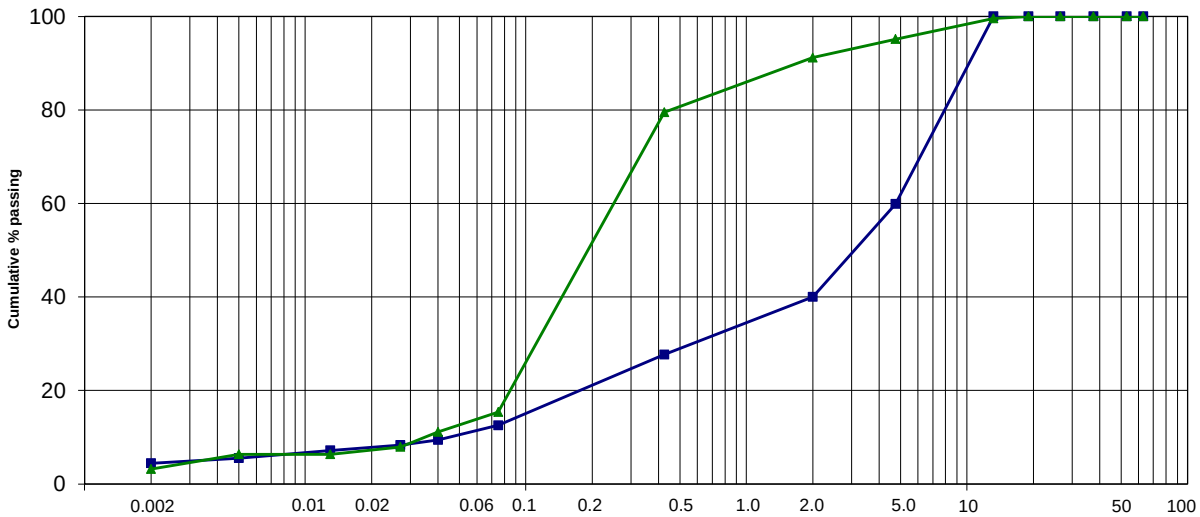
PROJECT : LEEUPOORT
JOB No. : S14-0429
DATE : 02/05/2014

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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HYDROMETER/04-S14-0429-10

PARTICLE SIZE ANALYSIS

Sample No.		
Soillab sample no.	S14-0429-14	S14-0429-22
Depth (m)	0.3	1
Position	L 36	L 26
Material Description	DARK BROWN QUARTZ GRAVELLY SAND	DARK BROWN CLAYEY SAND
Moisture (%)		
Dispersion (%)		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	97	100
4.75 mm	88	100
2.00 mm	77	100
0.425 mm	59	83
0.075 mm	31	24
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	30	18
0.027 mm	25	17
0.013 mm	21	15
0.005 mm	19	13
0.002 mm	14	12
% Clay	14	12
% Silt	16	10
% Sand	47	78
% Gravel	23	0
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	29	
Plasticity Index	15	NP
Linear Shrinkage (%)	7.0	0.0
Grading Modulus	1.32	0.93
Uniformity coefficient	-	-
Coefficient of curvature	-	-
Classification	A-2-6 (1)	A-2-4 (0)
Unified Classification	SC	SM
Chart Reference		

PROJECT : LEEUPOORT
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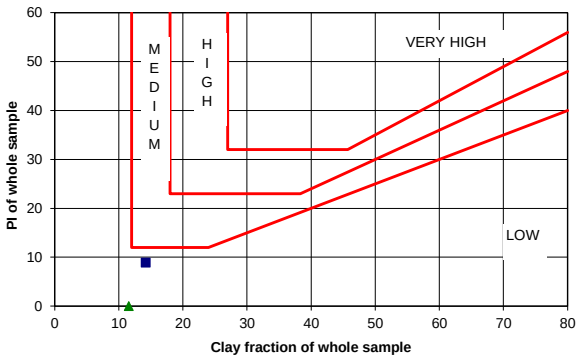
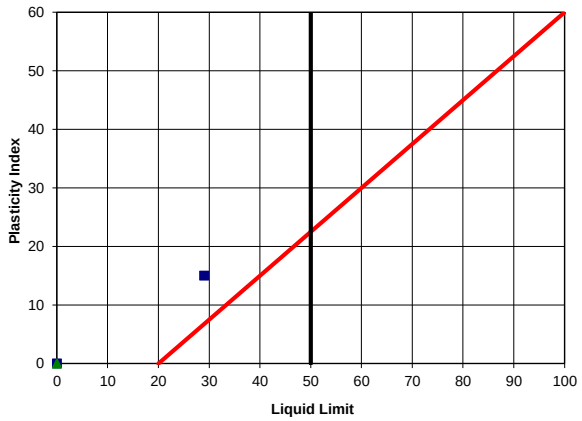
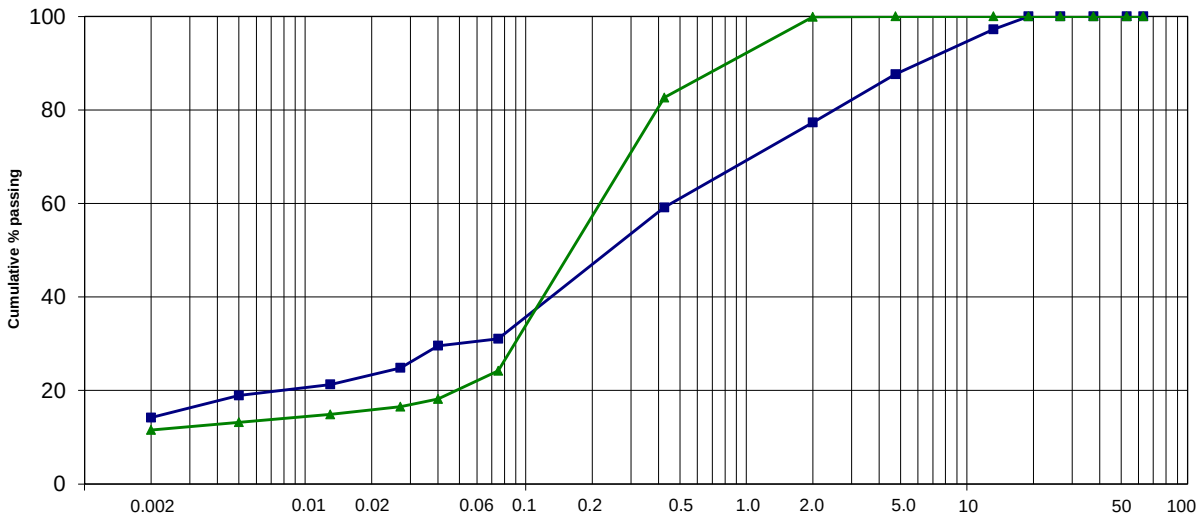
POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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