TABLE 1

ROCK CORE DESCRIPTION

FAIRBANK CREEK CULVERT						
CORE RECOVERY					**CORE DESCRIPTION**	
BOREHOLE NO.	**CORE NO.**	**DEPTH (m)**	**RECOVERY (%)**	**RQD (%)**	**DEPTH (m)**	**DESCRIPTION**
SMR-3	19	23.9 – 24.8	39	25	23.9 – 27.9	ARGILLITE: Dark bluish grey, very fine grained, slight vertical banding, separates readily on vertical schistocity, high strength, unweathered, very close to close spaced dipping partings, rough planar to slickensided planar, tight with occasional green residue on partings, occasional vertical cross joints, poor to fair quality.
	20	24.8 – 25.7	100	50		
	21	25.7 – 27.1	100	62		
	22	27.1 – 27.9	100	53		
HURON CENTRAL RAILWAY OVERHEAD						
SMR-55-2	14	16.5 – 17.8	91	81	16.5 – 19.6	ARGILLITE: Dark bluish grey, very fine grained, slight steeply dipping bands, high strength, unweathered, close spaced flat to dipping partings, smooth to rough planar, tight to oxidized, with occasional metallic mineralization on partings, good quality.
	15	17.8 – 18.6	100	83		
	16	18.6 – 19.6	100	82		

RQD: Rock Quality Designation

Drilled by:	FP
Logged by:	JFW
Checked by:	CN

TABLE 2

ATTERBERG LIMITS AND MOISTURE CONTENT RESULTS

Possible Huron Central Railway Overhead

Soil Type	Depth (m)	Borehole No.	Sample No.	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content (%)	Liquidity Index
Clay (CH)	1.5 - 2.1	55-2	3	59	24	35	37	0.37
Silty Clay (CL)	2.3 - 2.9	55-1	4	49	24	25	34	0.40
Silt (ML)	4.6 - 5.2	55-1	6	25	23	2	24	0.50

Possible Fairbank Creek Bridge

Soil Type	Depth (m)	Borehole No.	Sample No.	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content (%)	Liquidity Index
Clay (CH)	1.5 - 2.1	SMR3-1	3	57	22	35	36	0.40
Silty Clay (CL)	3.1 - 3.7	SMR3-1	5	49	25	24	46	0.88

TABLE 3

SUMMARY OF SUBSURFACE CONDITIONS

BRIDGE SITE	SUMMARY OF SUBSURFACE CONDITIONS
Huron Central Railway Overhead	Boreholes drilled near south abutment and south approach. Soil stratigraphy included a 4.3 m thick cohesive firm to stiff clayey silt and silty clay over cohesionless deposits of silt and silty sand. Cobbles were encountered with the soil matrix near the bedrock surface. Presence of boulders is anticipated in the vicinity. Bedrock surface encountered in borehole 55-2 at 16.5m depth below ground surface, elevation 228.8.
Fairbank Creek Bridge	Soil stratigraphy included 1.2 m of SMR3 roadway fill, 4.6 m thick firm to stiff clay and silty clay, followed by cohesionless deposits of silt, sandy silt and gravelly sand with cobbles and boulders near bedrock surface. Bedrock surface encountered in borehole SMR3-1 at 23.9 m depth, elevation 219.5. Artesian conditions encountered in the borehole.

TABLE 4

ADVANTAGES AND DISADVANTAGES, RELATIVE COSTS AND RISKS/CONSEQUENCES

HURON CENTRAL RAILWAY OVERHEAD

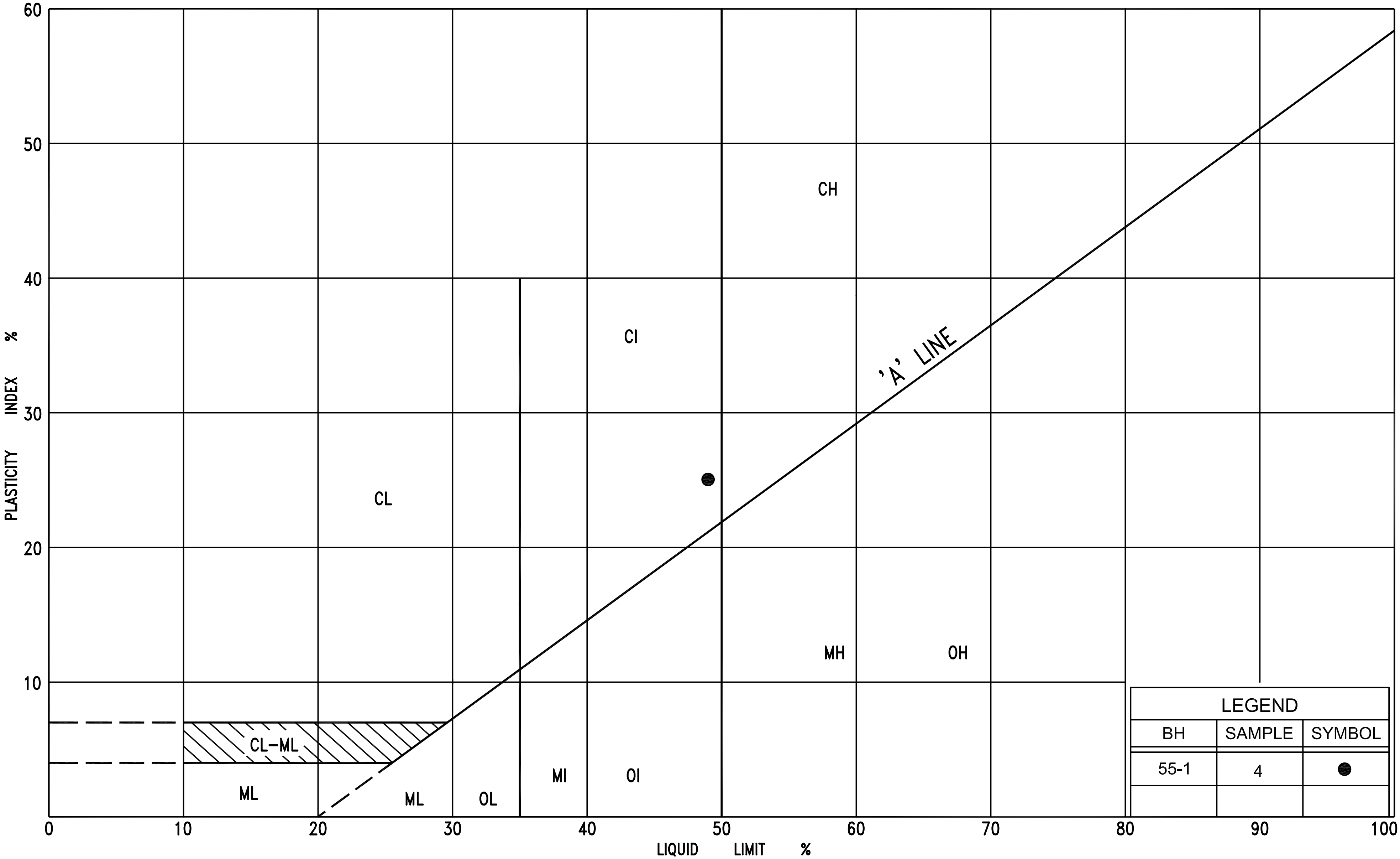
STRUCTURE FOUNDATION TYPE	ADVANTAGES	DISADVANTAGES	RELATIVE COSTS	RISKS/CONSEQUENCES	RANK
Shallow Foundations - Spread footings	• Conventional construction methods • Spread footings on engineered fill may use higher bearing resistances • Semi-integral abutment design is possible	• Low geotechnical resistances requires large footings • Cohesive subgrade soils require surcharge period prior to footing installation • Require schedule considerations for surcharging	• Less costly than deep foundations • Surcharging cost to be considered	• Low risk • Instability may occur due to surcharging	2
Deep Foundations - Steel H-Piles	• High load carrying capacities are obtained on piles to the bedrock • Integral abutment design is possible with pile foundations	• Requires heavy pile driving equipment • Higher cost than shallow foundations • Requires surcharging of site to reduce negative skin friction	• More costly than shallow foundations	• Work with piling equipment near railway track requires special care	1
Deep Foundations - Caissons	• High load bearing capacity	• Low soil resistances require deep installations below water table (<u>not practical</u>)	• More costly than shallow foundations	• Unwatering of caisson holes may not be feasible	3 (not practical)
APPROACH EMBANKMENTS	**ADVANTAGES**	**DISADVANTAGES**	**RELATIVE COSTS**	**RISKS/CONSEQUENCES**	**RANK**
Surcharging without Soil Removal	• Excavation near existing embankment are not required • Post-construction settlements are mitigated	• Requires preloading/surcharging to mitigate long-term settlement of approach embankment	• Lower cost than soil removal option	• Possible post-construction settlements of new roadway may need repair or maintenance	1
Removal of Compressible Soils	• Reduced long-term settlements	• Excavation of cohesive soil is required • Requires possible railway track protection	• Higher cost than surcharge option	• Excavation may cause instability to existing railway embankment	2

TABLE 4

ADVANTAGES AND DISADVANTAGES, RELATIVE COSTS AND RISKS/CONSEQUENCES

FAIRBANK CREEK BRIDGE

STRUCTURE FOUNDATION TYPE	ADVANTAGES	DISADVANTAGES	RELATIVE COSTS	RISKS/CONSEQUENCES	RANK
Shallow Foundations - Spread footings	• Conventional construction methods • Spread footings on engineered fill may use higher bearing resistances • Semi-integral abutment design is possible	• Artesian groundwater condition exists and will cause difficult installations • Low geotechnical resistances requires large footings • Cohesive subgrade soils require surcharge period prior to footing installation • Require schedule considerations for surcharging	• Less costly than deep foundations • Surcharging cost to be considered	• Erosion and instability may occur due to artesian condition	2 (not practical)
Deep Foundations - Steel H-Piles	• High load carrying capacities are obtained on piles to the bedrock • Integral abutment design is possible with pile foundations	• Requires heavy pile driving equipment • Higher cost than shallow foundations • Requires surcharging of site to reduce negative skin friction	• More costly than shallow foundations • Surcharging may require staged construction	• Work with piling equipment • Potential cobble and boulders above the bedrock may cause installation difficulties	1
Deep Foundations - Caissons	• High load bearing capacity	• Low soil resistances require deep installations below water table (<u>not practical)</u>	• More costly than shallow foundations	• Unwatering of caisson holes may not be feasible • Artesian conditions would cause basal instability	3 (not practical)
APPROACH EMBANKMENTS	**ADVANTAGES**	**DISADVANTAGES**	**RELATIVE COSTS**	**RISKS/CONSEQUENCES**	**RANK**
Surcharging without Soil Removal	• Post-construction settlements are mitigated	• Requires preloading/surcharging to mitigate long-term settlement of approach embankment • Surcharging may require staged construction • Possible installation of wick drains for schedule considerations	• Lower cost than soil removal option	• Possible post-construction settlements of new roadway may need repair or maintenance	1
Removal of Compressible Soils	• Reduced long-term settlements	• Excavation of cohesive soil is required	• Higher cost than surcharge option	• Excavation not practical due to existing artesian condition	2



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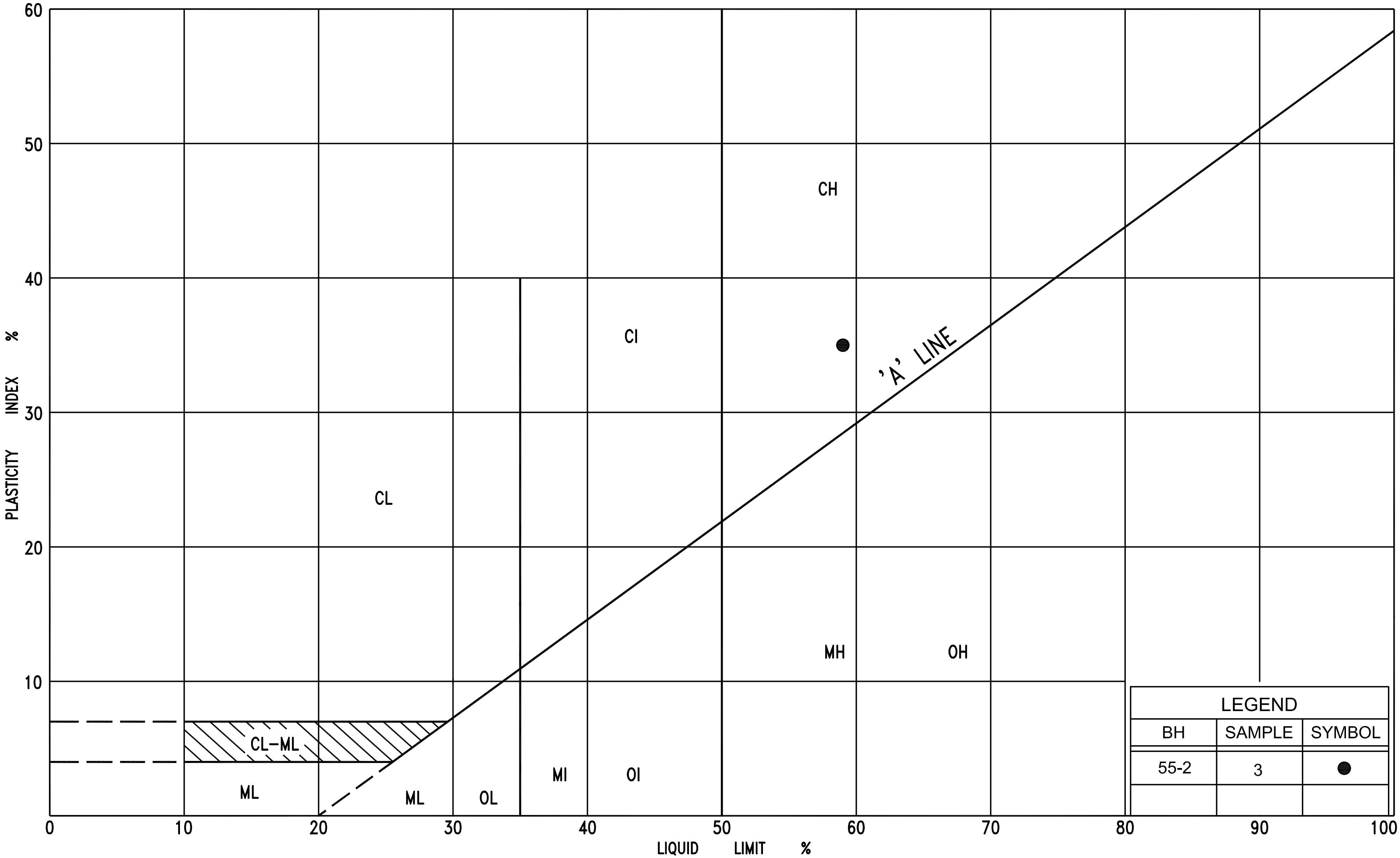
PLASTICITY CHART

SILTY CLAY, trace sand

FIG No.	PC-55-1
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



LEGEND

BH	SAMPLE	SYMBOL
55-2	3	●

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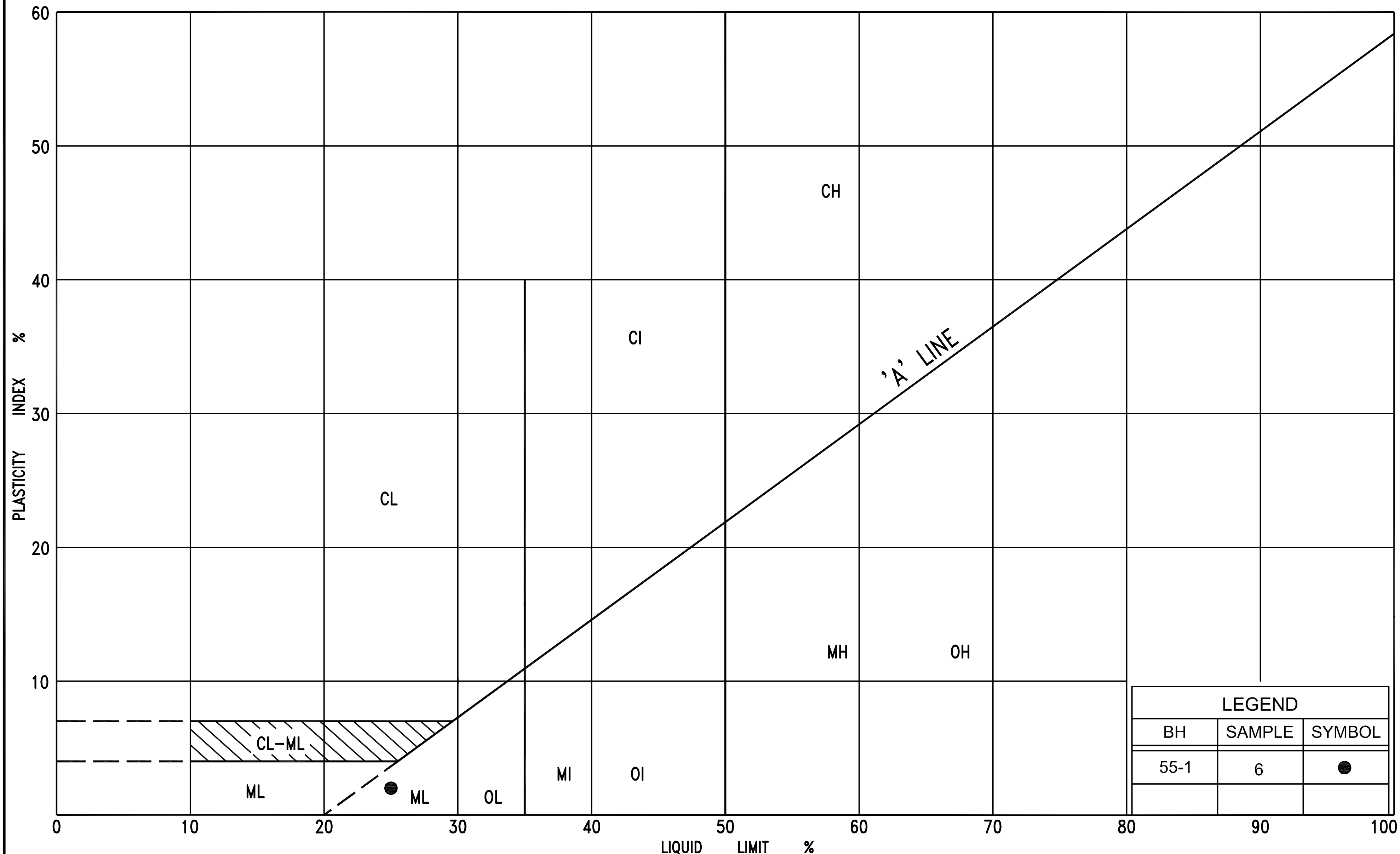
PLASTICITY CHART

CLAY, trace sand

FIG No. PC-55-2

HWY: SMR 55 (Realigned)

G.W.P. No. 156-98-00



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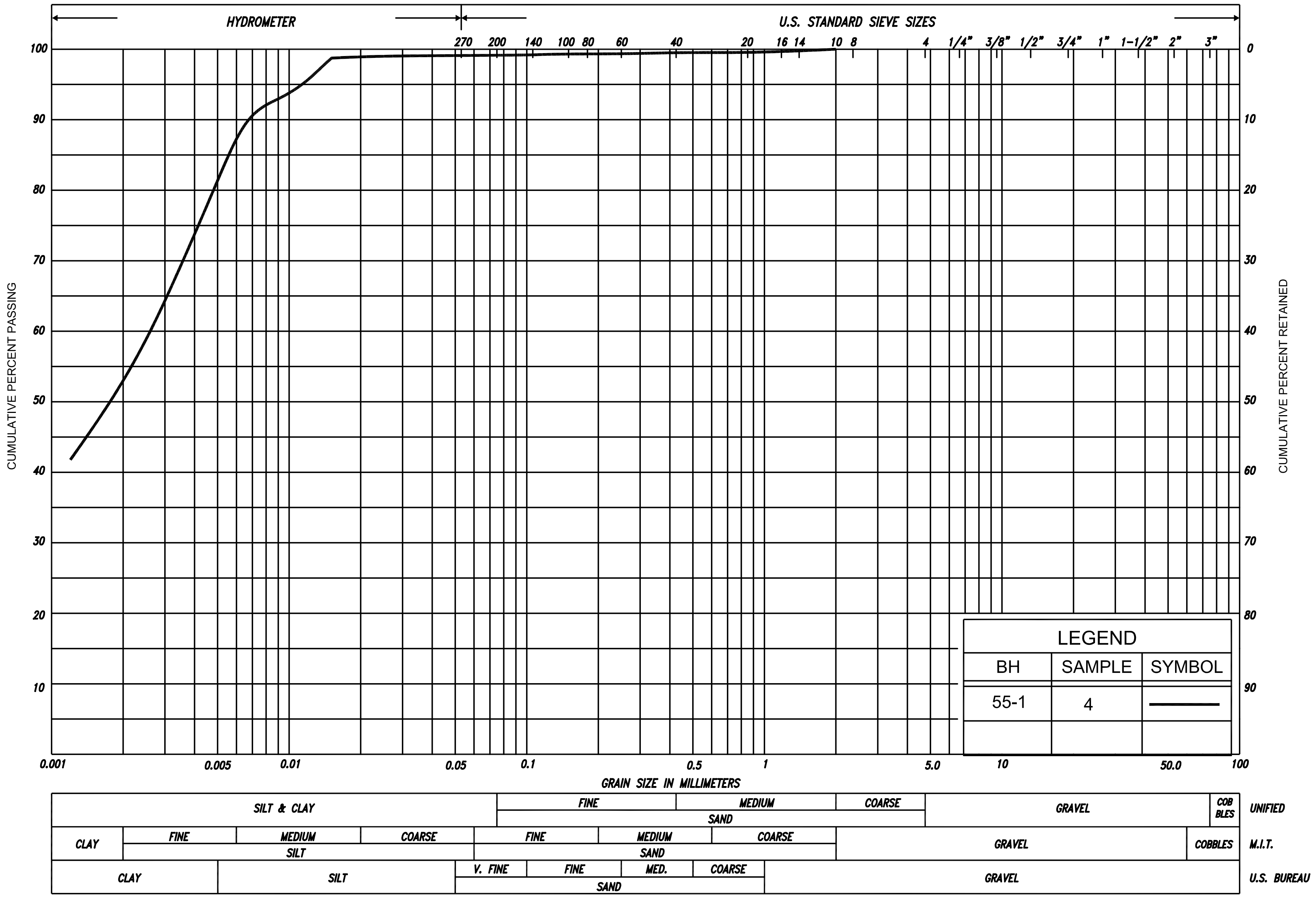
PLASTICITY CHART

SILT, trace to some clay, trace sand, trace gravel

FIG No.	PC-55-3
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



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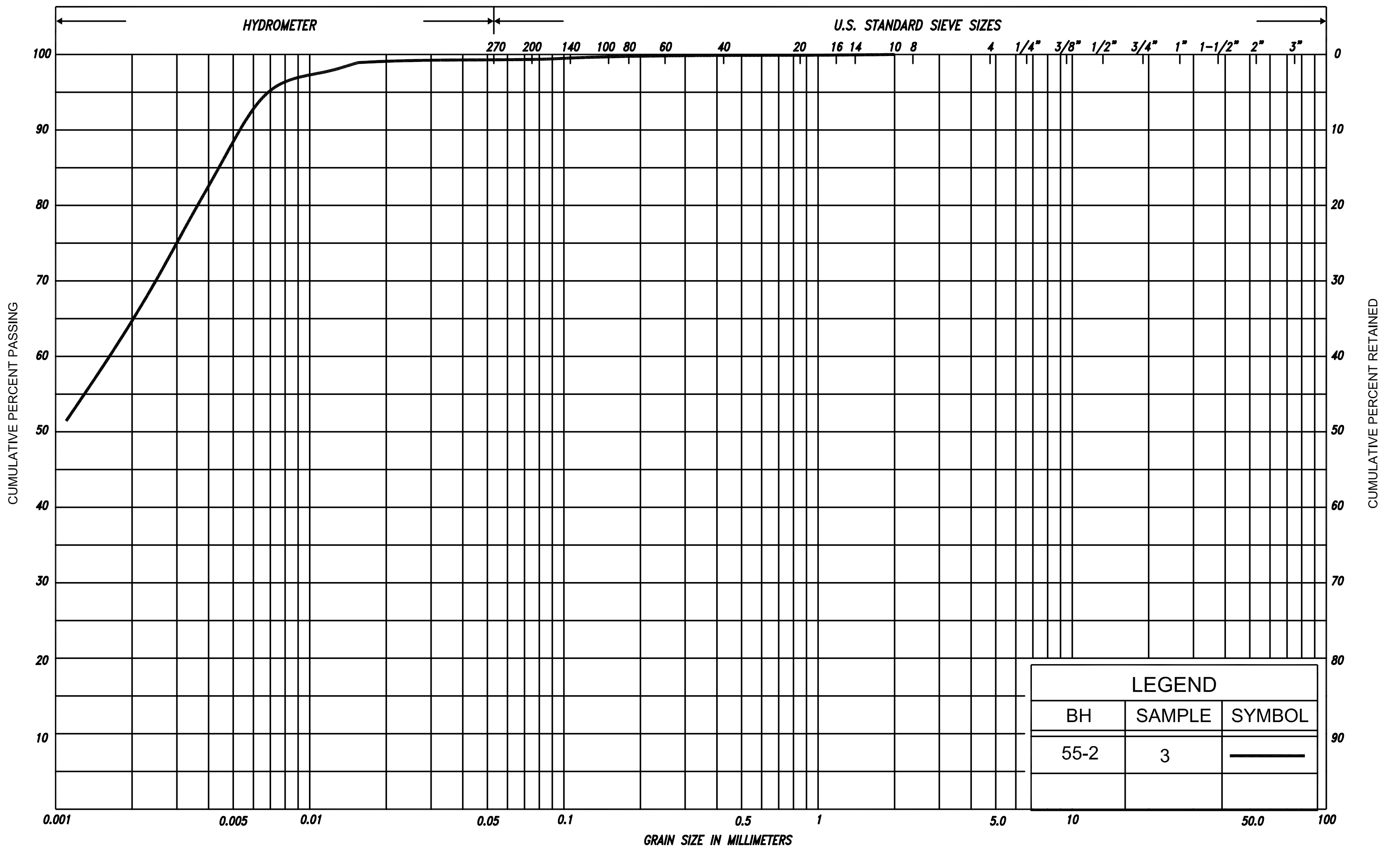
GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand

FIG No.	GS-55-1
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



SILT & CLAY				FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	M.I.T.
CLAY	SILT	V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND		GRAVEL		U.S. BUREAU

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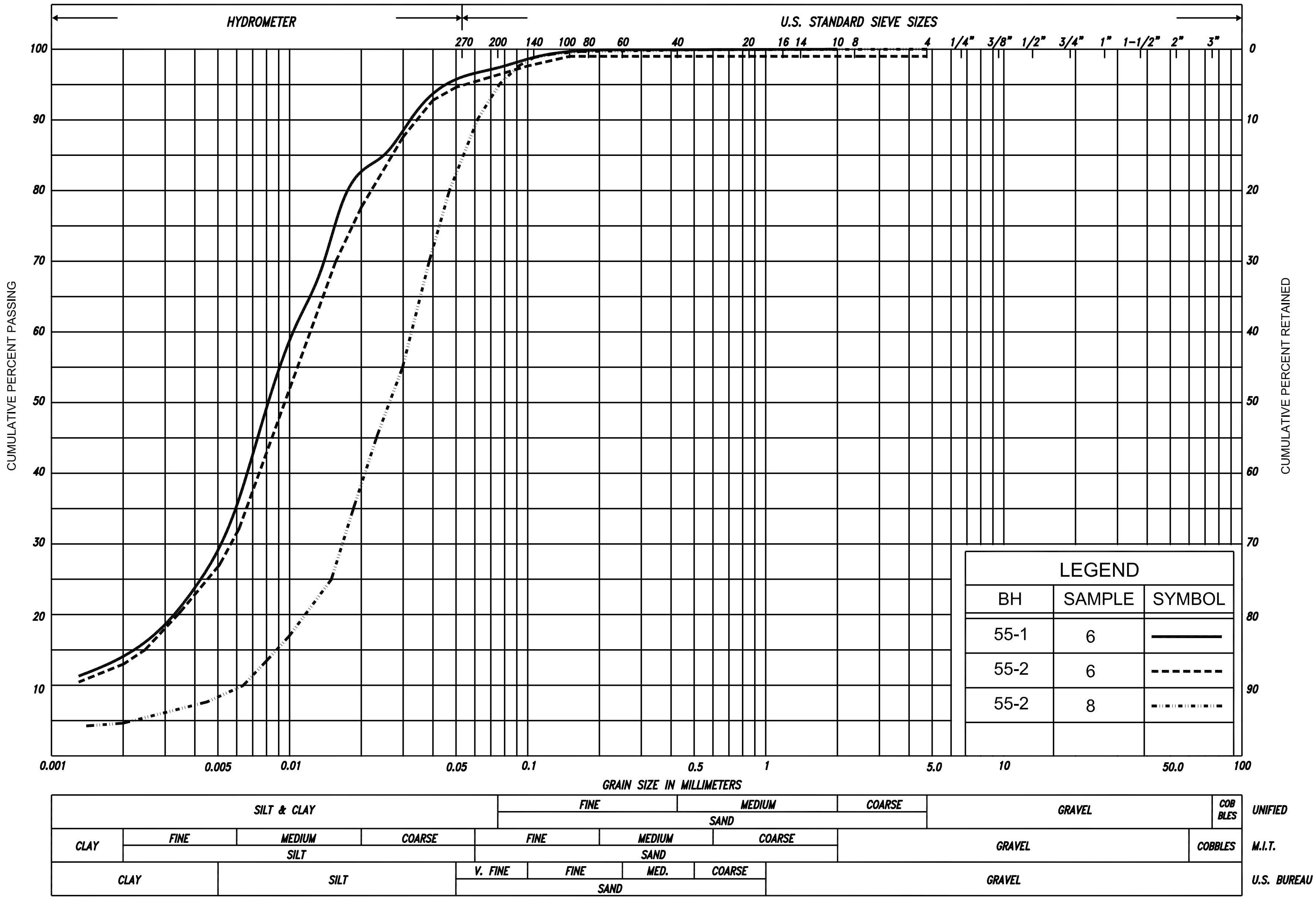
GRAIN SIZE DISTRIBUTION

CLAY, trace sand

FIG No.	GS-55-2
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



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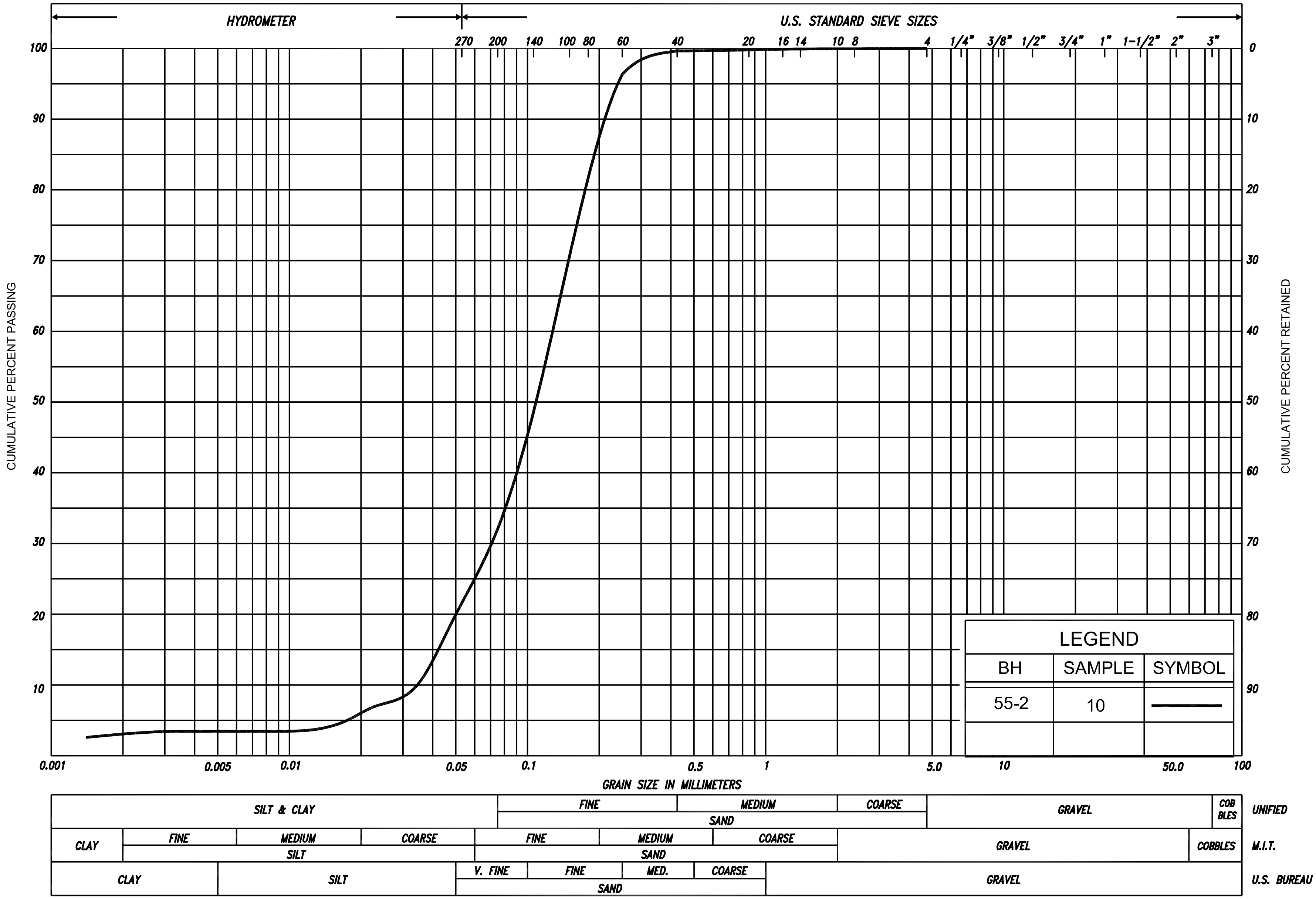
GRAIN SIZE DISTRIBUTION

SILT, trace to some clay, trace sand, trace gravel

FIG No.	GS-55-3
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



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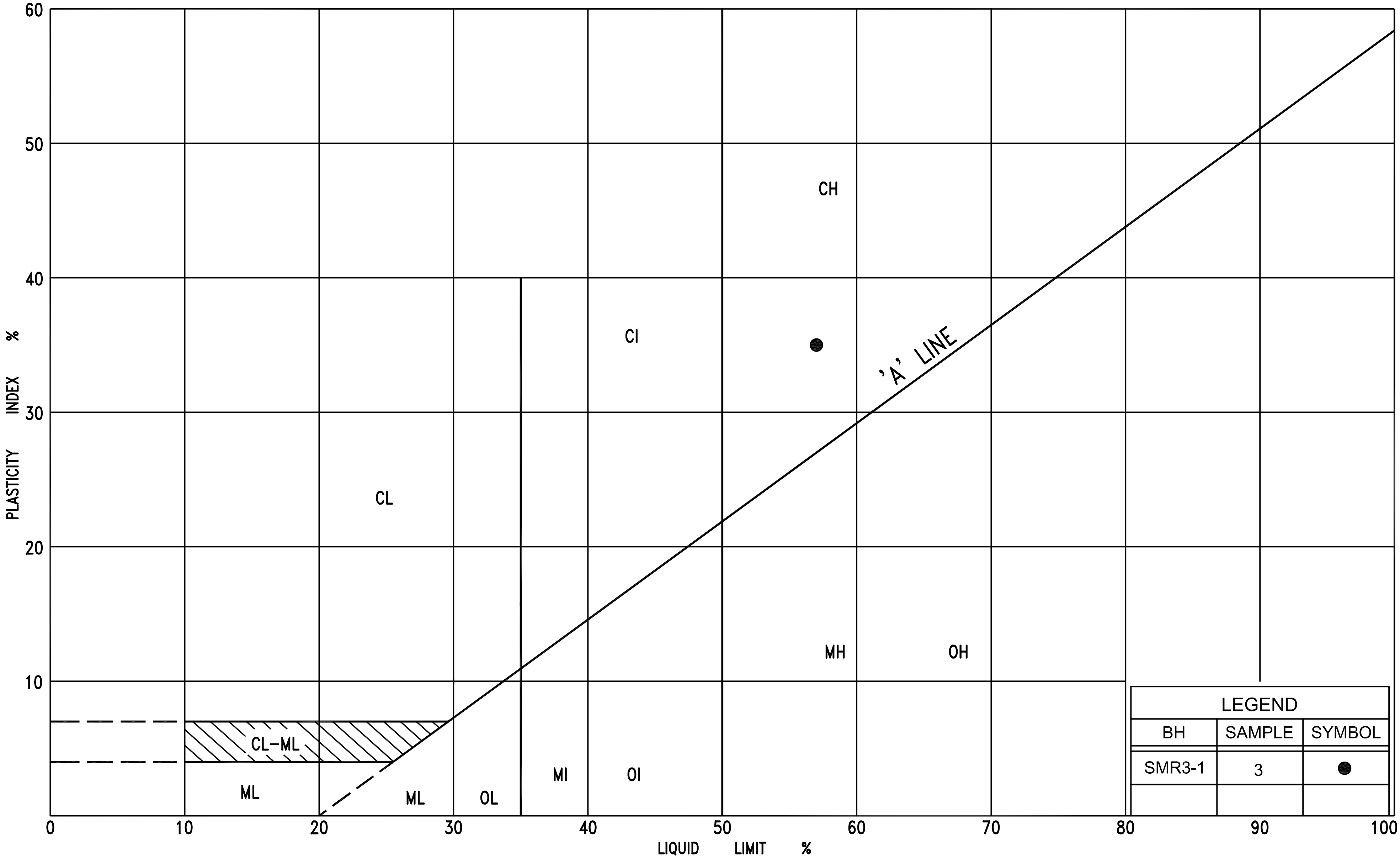
GRAIN SIZE DISTRIBUTION

SAND, with silt, trace clay

FIG No.	GS-55-4
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



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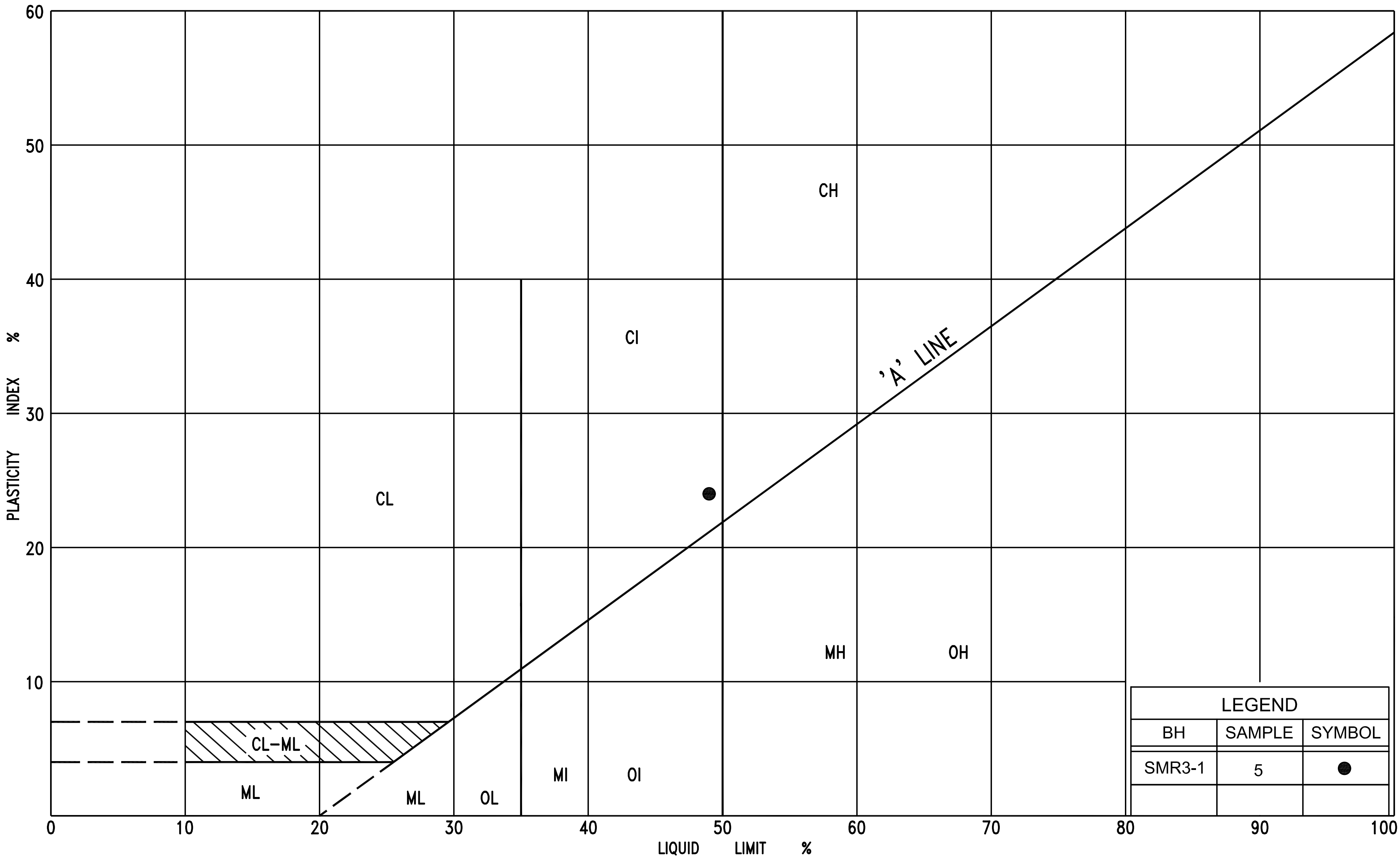
PLASTICITY CHART

CLAY, trace sand

FIG No. PC-SMR3-1
HWY: SMR 55 (Realigned)
G.W.P. No. 156-98-00



LEGEND		
BH	SAMPLE	SYMBOL
SMR3-1	5	●

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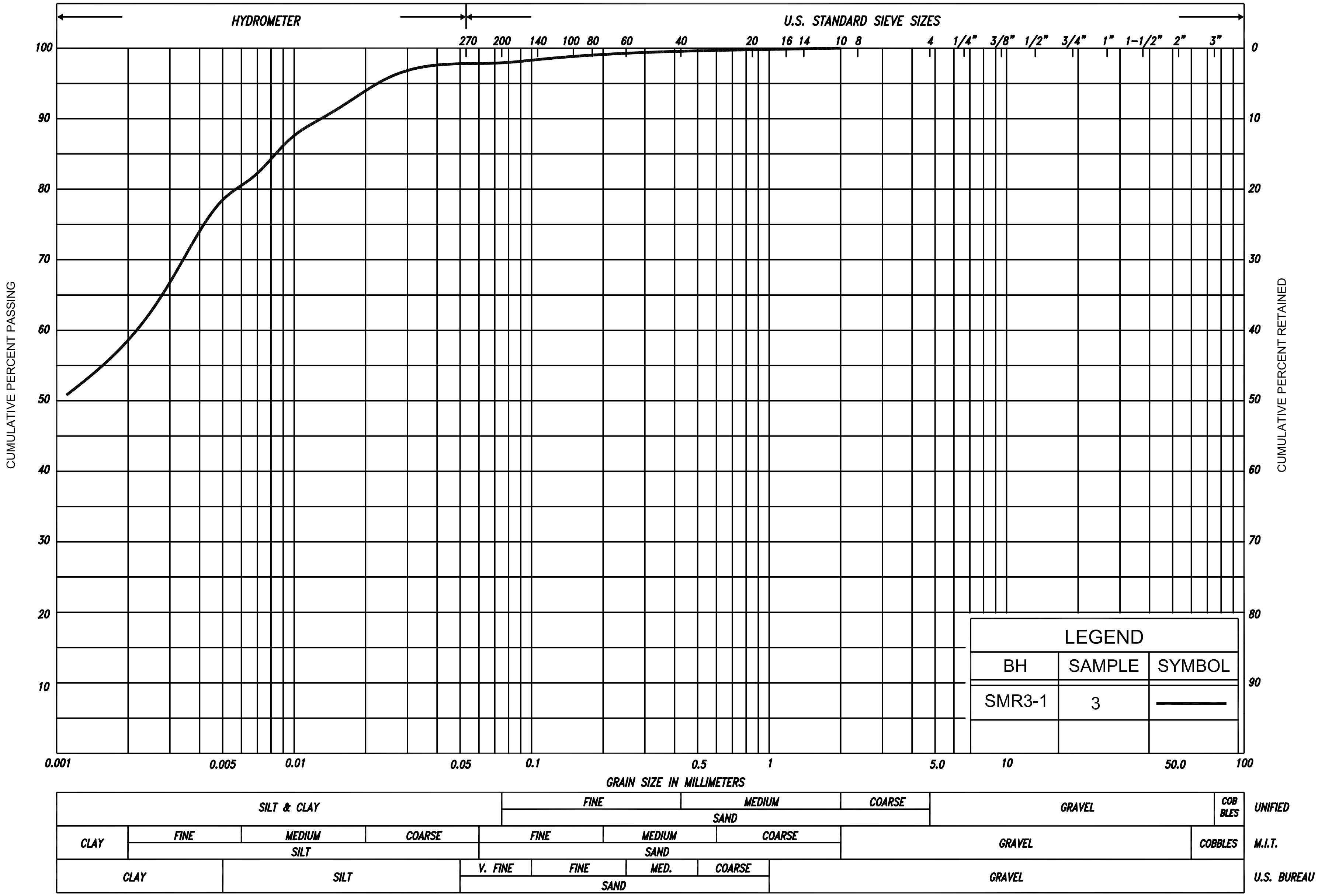
PLASTICITY CHART

SILTY CLAY, trace sand

FIG No.	PC-SMR3-2
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



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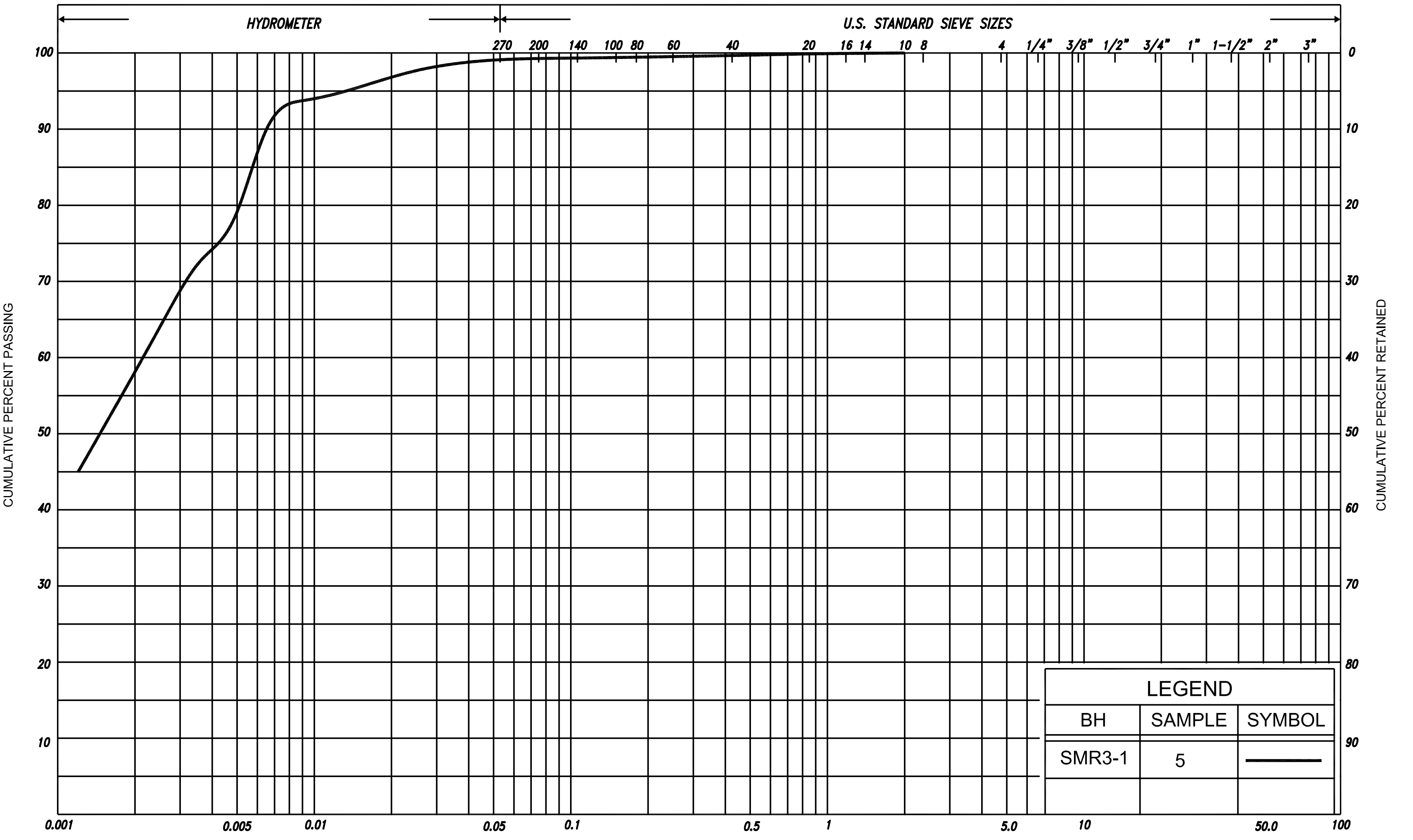
GRAIN SIZE DISTRIBUTION

CLAY, trace sand

FIG No.	GS-SMR3-1
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



SILT & CLAY		FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL			COBBLES	UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	M.I.T.
CLAY	SILT	V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND	GRAVEL			U.S. BUREAU

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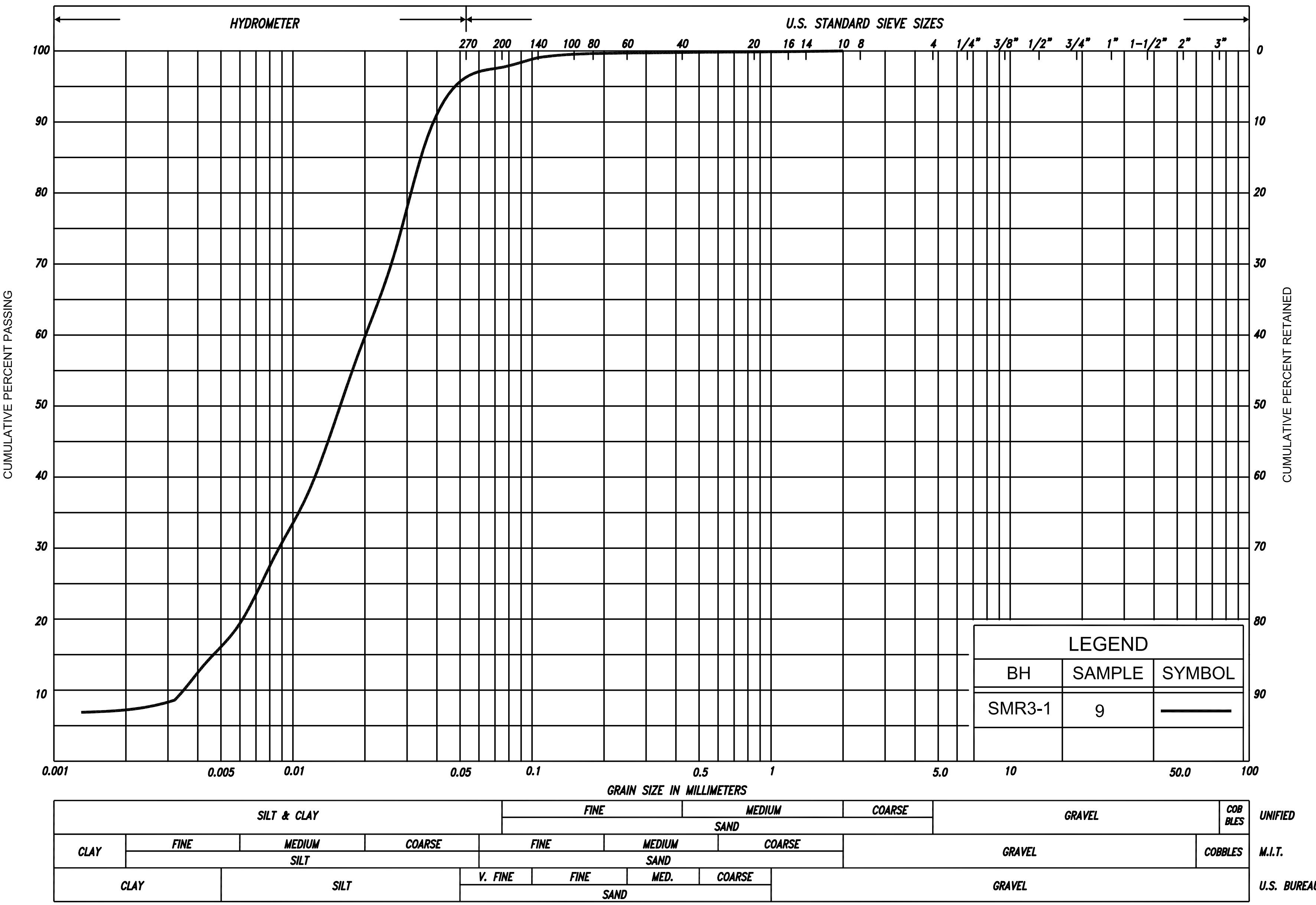
GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand

FIG No.	GS-SMR3-2
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



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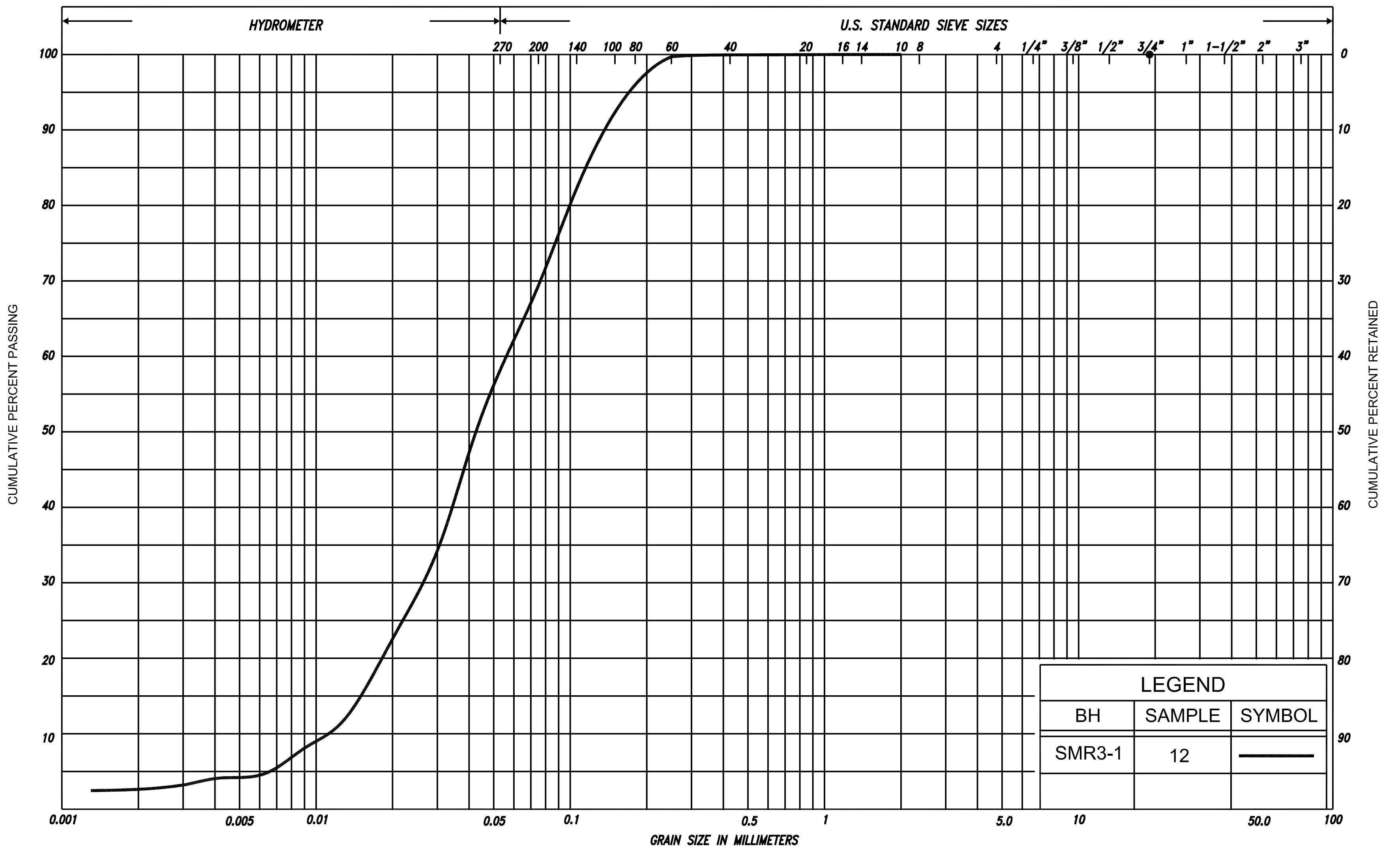
GRAIN SIZE DISTRIBUTION

SILT trace sand, trace clay

FIG No.	GS-SMR3-3
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



SILT & CLAY		FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES		UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	COBBLES	M.I.T.
CLAY	SILT	V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND	GRAVEL		U.S. BUREAU

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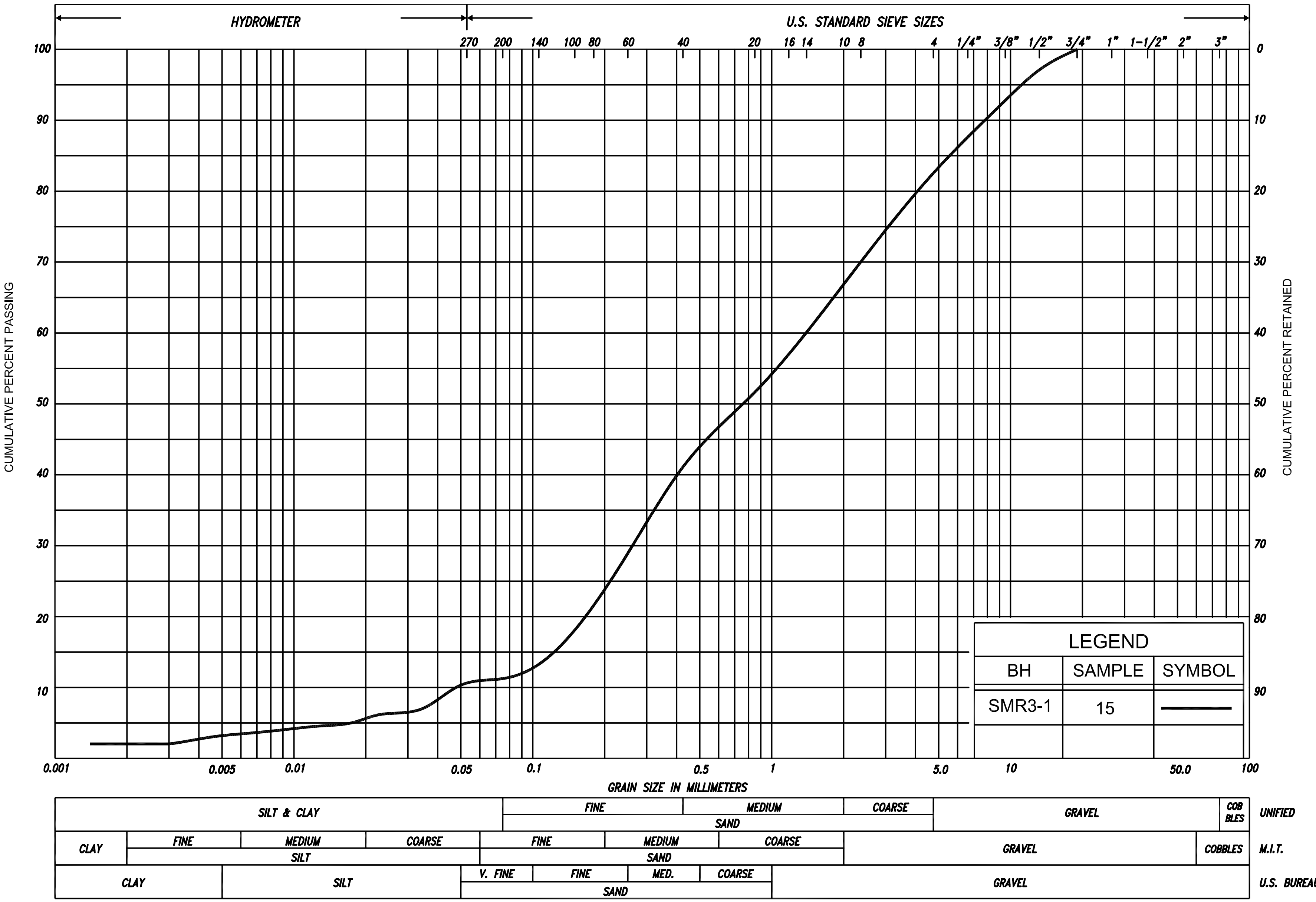
GRAIN SIZE DISTRIBUTION

SANDY SILT, trace clay

FIG No.	GS-SMR3-4
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00



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GRAIN SIZE DISTRIBUTION

SAND, some gravel, trace silt, trace clay

FIG No.	GS-SMR3-5
HWY:	SMR 55 (Realigned)
G.W.P. No.	156-98-00

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY $= \frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL
e	1,%	VOID RATIO

n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX $= w_L - w_P$
I_L	1	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
DTPL		DRIER THAN PLASTIC LIMIT
APL		ABOUT PLASTIC LIMIT
WTPL		WETTER THAN PLASTIC LIMIT

e_{max}	1,%	VOID RATIO IN LOOSEST STATE
e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_u	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

Ministry of Transportation Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 55-1

METRIC

G.W.P. 156-98-00 | LOCATION Co-ords: 5 137 578 N; 279 983 E | ORIGINATED BY A.S.

DIST 54 HWY SMR 55 (Realigned) | BOREHOLE TYPE Continuous Flight Solid Stem Augers | COMPILED BY N.R.

DATUM Geodetic | DATE April 23, 2008 | CHECKED BY C.N.

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
245.4	Ground Surface					
0.0 / 245.1	Topsoil					
0.3	Clayey silt, trace sand. Stiff, Brown, Moist	1	SS	13		
		2	SS	10		
244.2 / 1.2	Silty clay, trace sand. Stiff to firm, Brown, Moist	3	SS	10		
	clayey silt seams	4	SS	9	▼*	0 1 46 53
		5	SS	4		
			FV		▽*	
241.1 / 4.3	Silt, some clay, trace sand. Compact to loose, Grey, Wet	6	SS	11		0 3 83 14
		7	SS	4		
		8	SS	8		
236.9 / 8.5	Silty sand. Loose, Grey, Wet	9	SS	8		
235.6 / 9.8	End of borehole					

Elevation scale: 245, 244, 243, 242, 241, 240, 239, 238, 237, 236

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE: 20 40 60 80 100

Field vane: + 4 (sensitivity)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

* 2008 04 23

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

+7, ×5 : Numbers refer to Sensitivity; 20 / 15–○–5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 55-2

METRIC

G.W.P. 156-98-00 LOCATION Co-ords: 5 137 599 N; 279 957 E ORIGINATED BY A.S.

DIST 54 HWY SMR 55 (Realigned) BOREHOLE TYPE C.F.H.S.A. + Rotary Diamomnd Coring COMPILED BY N.R.

DATUM Geodetic DATE April 24 and 25, 2008 CHECKED BY C.N.

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
245.3	Ground Surface
0.0 / 244.9	Topsoil
0.4 / 244.1	Clayey silt, trace sand organic inclusions. Stiff Brown Moist
1.2 / 241.0	Clay, trace sand. Stiff to firm Brown Moist; silty clay seams, Grey
4.3 / 235.2	Silt, some clay trace sand, trace gravel. Loose Grey Wet; thin layers of sandy silt; trace clay; sand layers very loose
10.1 / 230.3	Sand with silt, trace clay. Very loose to compact Grey Wet; trace gravel cobbles. Cont'd

SAMPLES

NUMBER	TYPE	"N" VALUES	Remarks / plot notes	Grain size GR SA SI CL (%)
1	SS	3	water content 163	
2	SS	11		
3	SS	11		0 1 34 65
4	SS	9		
5	SS	5		
	FV		field vane, sensitivity 4	
6	SS	8	Non-plastic	1 3 83 13
7	SS	7		
8	SS	5		0 5 90 5
9	SS	1		
10	SS	3		0 68 29 3
11	SS	14		
12	SS	22		

Ground water level symbol ∇* at approx. elev. 241.

Elevation scale: 245 to 231.

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100

PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

+7, ×5 : Numbers refer to Sensitivity; 20 / 15–○–5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 55-2

METRIC

G.W.P. 156-98-00 LOCATION Co-ords: 5 137 599 N; 279 957 E ORIGINATED BY A.S.

DIST 54 HWY SMR 55 (Realigned) BOREHOLE TYPE C.F.H.S.A. + Rotary Diamomnd Coring COMPILED BY N.R.

DATUM Geodetic DATE April 24 and 25, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
230.3											
15.0	trace gravel cobbles		13	SS	15		230				
228.8							229				
16.5	ARGILLITE Bedrock Unweathered High strength Good quality		14	RC NQ	REC 91%		228				RQD 81%
			15	RC NQ	REC 100%		227				RQD 83%
			16	RC NQ	REC 100%		226				RQD 82%
225.7 / 19.6	End of borehole										

Legend: Plastic limit w_P, Natural moisture content w, Liquid limit w_L; DCP and shear strength scale 20 40 60 80 100; water content scale 20 40 60; ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

* 2008 04 24

∇ Water level observed during drilling

■ Penetrometer test

C.F.H.S. A. Denotes Continuous Flight Hollow Stem Augers

+7, ×5 : Numbers refer to Sensitivity

20 / 15 –○– 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Peto MacCallum Ltd.
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RECORD OF BOREHOLE No SMR3-1 — METRIC

G.W.P.	156-98-00	LOCATION	Co-ords: 5 137 971 N; 279 431 E	ORIGINATED BY	F.P.
DIST 54	HWY SMR 55 (Realigned)	BOREHOLE TYPE	C.F.H.S.A. + Rotary Diamomnd Coring	COMPILED BY	N.R.
DATUM	Geodetic	DATE	May 02, 2008	CHECKED BY	C.N.

Soil Profile

ELEV / DEPTH	DESCRIPTION
243.4	Ground Surface
0.0	Sand and gravel, asphalt inclusions. Compact to loose, Brown (FILL)
242.2 / 1.2	Clay, trace sand. Stiff to very stiff, Brown/grey, Moist
240.4 / 3.0	Silty clay, trace sand. Firm to stiff, Brown/grey, Wet; clayey silt seams, Grey
237.6 / 5.8	Silt, trace clay, trace sand, thin clayey silt seams to 8.2m. Loose, Grey, Wet; Compact; Loose
230.6 / 12.8	Sandy silt, trace clay. Compact, Grey, Wet
228.9 / 14.5	Sand, trace silt, trace clay, trace gravel. Cont'd

Samples

NUMBER	TYPE	"N" VALUES	Remarks / Grain size distribution (%) GR SA SI CL
1	SS	19	
2	SS	8	
3	SS	8	0 2 40 58
4	SS	10	
5	SS	4	0 1 41 58
	FV		
6	SS	2	
	FV		
7	SS	9	
8	SS	5	
9	SS	10	0 2 91 7
10	SS	11	
11	SS	4	
12	SS	12	0 30 68 2

Elevation scale: 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233, 232, 231, 230, 229

Dynamic cone penetration resistance plot (20, 40, 60, 80, 100); 125 at elevation about 241.
Shear strength kPa: ○ Unconfined, + Field vane, ● Quick triaxial, × Lab vane (20, 40, 60, 80, 100). Field vane values with sensitivity 7 and 5.
Plastic limit w_P, Natural moisture content w, Liquid limit w_L; Water content (%) 20, 40, 60. Non-plastic (sample 9).
Unit weight γ kN/m³

+7, ×5 : Numbers refer to Sensitivity. 20 / 15 –○– 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No SMR3-1 METRIC

G.W.P. 156-98-00 LOCATION Co-ords: 5 137 971 N; 279 431 E ORIGINATED BY F.P.

DIST 54 HWY SMR 55 (Realigned) BOREHOLE TYPE C.F.H.S.A. + Rotary Diamomnd Coring COMPILED BY N.R.

DATUM Geodetic DATE May 02, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
228.4	Loose to very loose Grey Wet				228		
		13	SS	9		~22	
					227		
		14	SS	3		~17	
	some gravel				226		
	Compact						
		15	SS	17	225	~17	17 72 9 2
224.2 / 19.2	Gravelly sand, Dense Grey Wet				224		
					223		
		16	SS	19/25cm	222	~15	
221.1 / 22.3	cobbles and boulders	17	RC NQ		221		
		18	RC NQ		220		
219.5 / 23.9	ARGILLITE Bedrock, Unweathered, High strength, Poor to fair quality	19	RC NQ	REC 39%	219		RQD 25%
		20	RC NQ	REC 100%	218		RQD 50%
		21	RC NQ	REC 100%	217		RQD 62%
		22	RC NQ	REC 100%	216		RQD 53%
215.5 / 27.9	End of borehole						
	Sample 16: Sampler bouncing						
	Cont'd						

Legend: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH kPa: ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 20 40 60; UNIT WEIGHT γ kN/m³

+7, ×5: Numbers refer to Sensitivity; 20 / 15 – 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

Peto MacCallum Ltd. Foundation Design

RECORD OF BOREHOLE No SMR3-1

METRIC

G.W.P. 156-98-00 LOCATION Co-ords: 5 137 971 N; 279 431 E ORIGINATED BY F.P.

DIST 54 HWY SMR 55 (Realigned) BOREHOLE TYPE C.F.H.S.A. + Rotary Diamomnd Coring COMPILED BY N.R.

DATUM Geodetic DATE May 02, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
213.4											

* 2008 05 02

∇ Artesian condition observed below 12m depth during drilling (Artesian flow is about 2L/minute)

Hole plugged with 15 bags of bentonite and 2 bags of portland cement

■ Penetrometer test

C.F.H.S. A. Denotes Continuous Flight Hollow Stem Augers

Rock coring was carried out through cobbles and boulders from 22.4m to 23.9m depth

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

METRIC

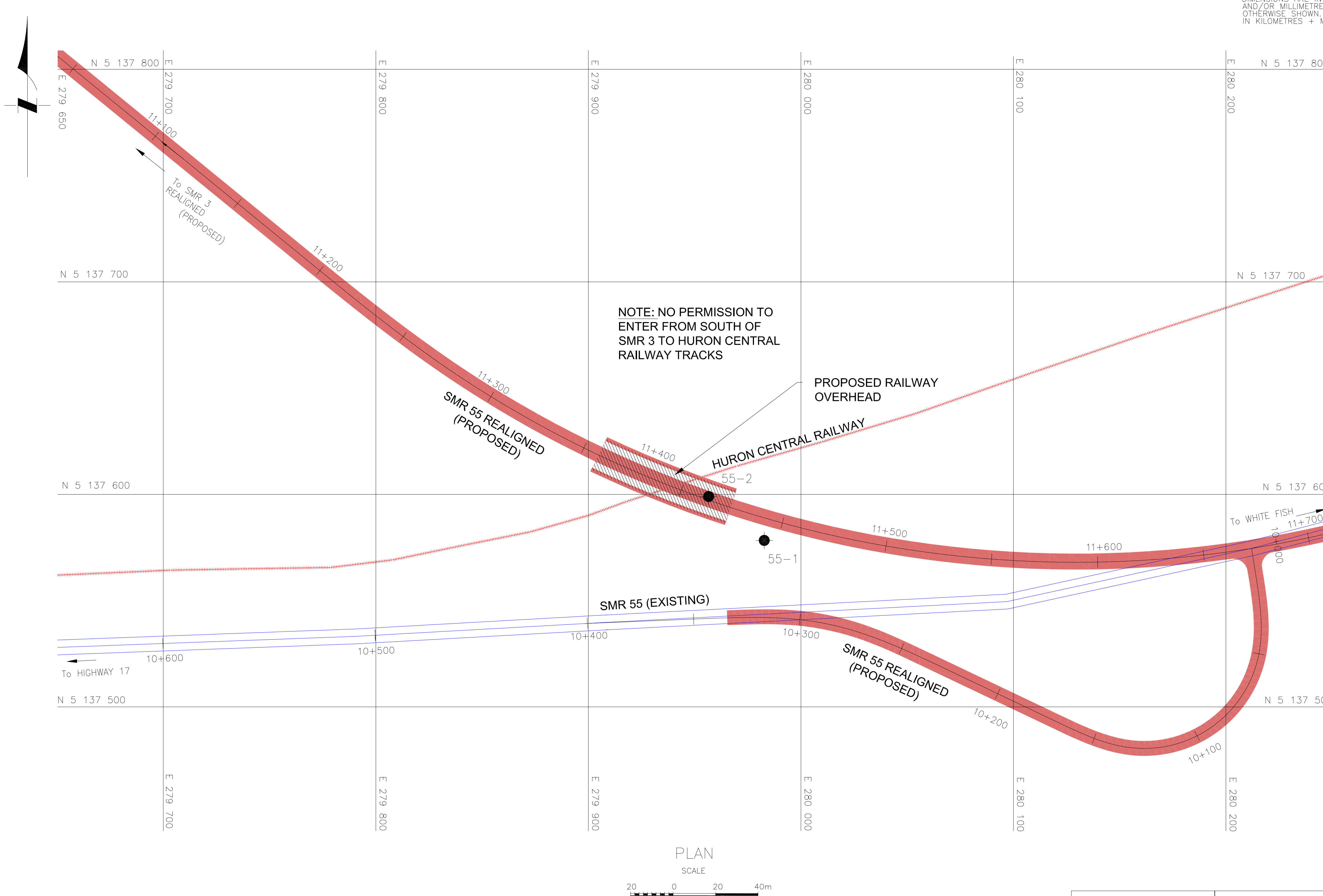
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

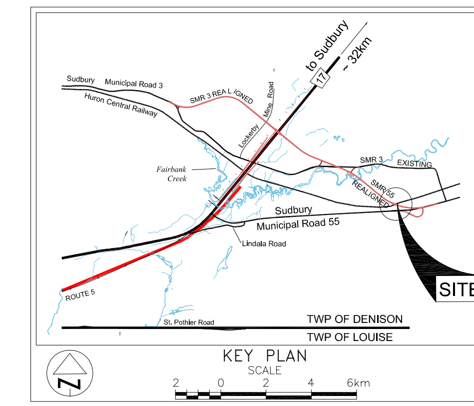
CONT No
GWP No 156-98-00

SHEET

HURON CENTRAL RAILWAY OVERHEAD
SMR 55 REALIGNED (PROPOSED)
BOREHOLE LOCATIONS PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS





LEGEND

- ● Borehole
- ⊕ Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation April, 2008
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	CO-ORDINATES NORTHINGS	CO-ORDINATES EASTINGS
55-1	245.4	5 137 578	279 983
55-2	245.3	5 137 599	279 957

– NOTE –

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS

DATE	BY	DESCRIPTION

Geocres No. 41I-230

HWY No 17			DIST 54
SUBM'D NR	CHECKED MN	DATE MAR. 03, 2009	SITE --
DRAWN NA	CHECKED CN	APPROVED BRG	DWG 1

NOTE:

1. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

REF No. STANTEC Drawing; 581_smr3_East_Jan24_08.dwg; Dated FEB. 6, 2008

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No

GWP No 156-98-00

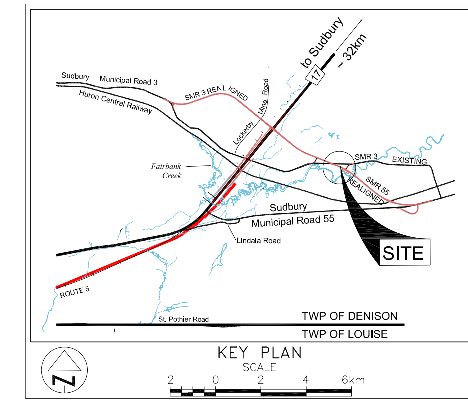
SHEET

FAIRBANK CREEK BRIDGE

SMR 55 REALIGNED (PROPOSED)

BOREHOLE LOCATIONS PLAN

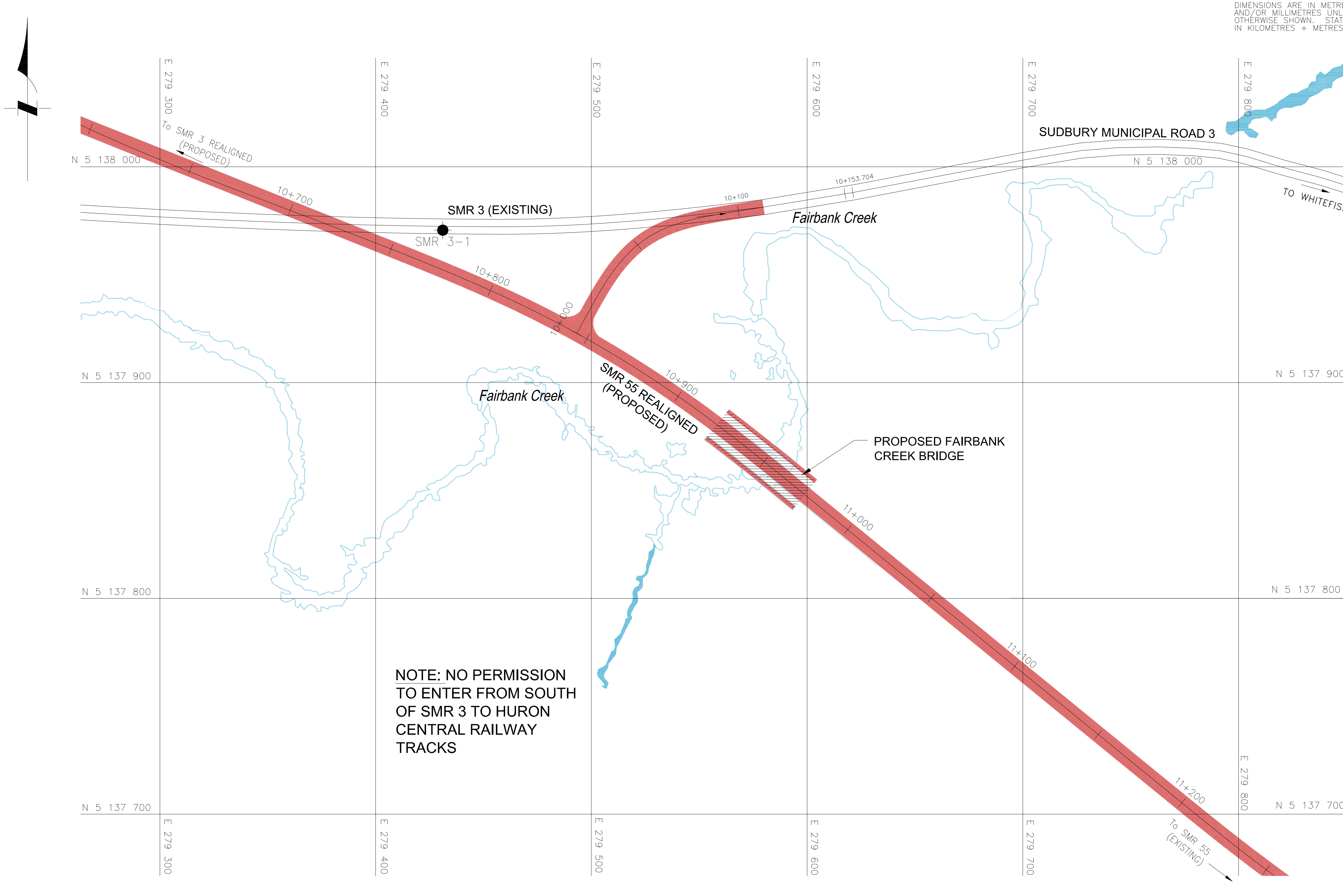
Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN

SCALE

2 0 2 4 6km



LEGEND

Symbol	Description
●	Borehole
⊕	Dynamic Cone Penetration Test (Cone)
◐	Borehole & Cone
N	Blows/0.3m (Std. Pen Test, 475 J/blow)
CONE	Blows/0.3m (60° Cone, 475 J/blow)
▼	W L at time of investigation May 2008
▽	Head ARTESIAN WATER Encountered
ǀ	PIEZOMETER

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS
SMR 3-1	243.4	5 137 971	279 431

– NOTE –

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REF No. STANTEC Drawing; 581_smr3_East_Jan24_08.dwg; Dated FEB. 6, 2008

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 41I-230

HWY No 17			DIST 54
SUBM'D NR	CHECKED NM	DATE MAR. 03, 2009	SITE --
DRAWN NA	CHECKED CN	APPROVED BRG	DWG 2

NOTE:

1. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

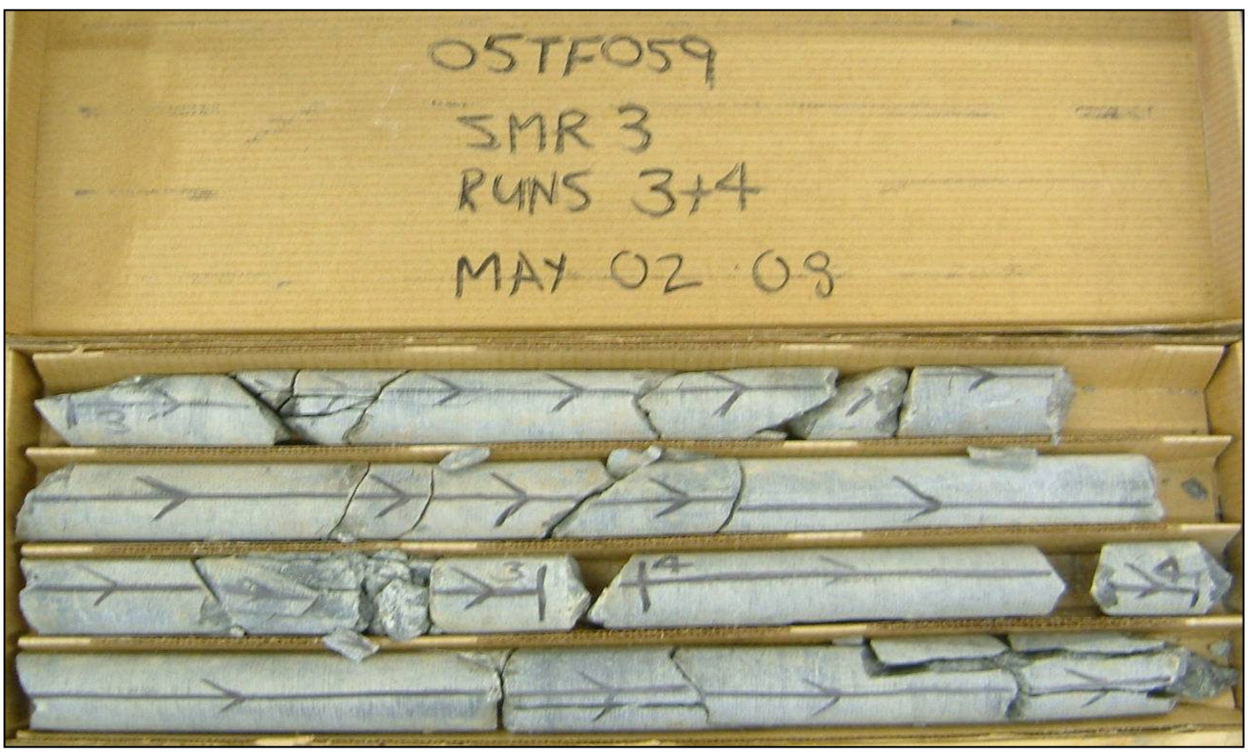
APPENDIX A

Rock Core Photographs

Photograph 1: Rock core from borehole 55-2.

Photograph 2: Rock core from borehole 55-2.

Photograph 3: Rock core from borehole SMR3-1.



Photograph 4: Rock core from borehole SMR3-1.