D. Katauskas

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21 December 2016
Ref: 1055-A

MCK Architecture & Interiors
Studio 401/ 104 Commonwealth Street
Surry Hills NSW 2010

Attention: Kim Saggers

Dear Kim,

Re: Geotechnical Investigation Pursuant to DA
Proposed Commercial Development
49 - 51 Arthur Street
Forestville NSW

This report presents the results of the above investigation, the purpose of which was to determine the nature of the subsurface soil, rock and groundwater conditions in order to address geotechnical matters pertaining to the proposed development, which is understood to comprise several above-ground levels over a basement carpark.

Comments and recommendations on the following geotechnical matters are presented herein:

- Excavation conditions
- Excavation support requirements
- Earth pressures on basement walls
- Suitable foundation schemes and bearing pressures
- Basement groundwater control

Investigation Method

The subsurface conditions were investigated by augering three boreholes, the locations of which are shown on the attached Figure 1, to practical refusal in the underlying sandstone bedrock. Due to the restricted access conditions, a relatively small and lightweight drill rig was used.

The fieldwork for the investigation was carried out on the 13 December 2016 under the fulltime supervision of the undersigned.

Investigation Findings

The investigation disclosed relatively straightforward subsurface conditions comprised of shallow fill or natural sandy layer ranging in thickness from approximately 0.5 to 0.7 metres, and thereafter sandstone bedrock.

Auger refusal was encountered at each borehole, at depths varying from about 1.6 to 3.0 metres below existing ground surface. Given the size and power capability of the drillrig used for this investigation, auger refusal was interpreted to occur upon encountering sandstone in the medium strength range.

No groundwater was encountered during the investigation.

Reference should be made to the attached Borehole Logs and Explanatory Notes for a detailed description and sequence of the subsurface conditions encountered.

Comments and Recommendations

Excavation Conditions

Following the removal of the relatively shallow sandy soil layer, excavation of the sandstone to an estimated depth of approximately 3.5m to 4m should be achievable, mostly by ripping using a D-10 size dozer or equivalent, assisted by rock sawing at the boundaries and the use of a medium size hydraulic rock breaker for trimming and detailed excavations.

As previously noted, the boreholes were terminated within sandstone bedrock estimated to be of medium strength. The possibility of a stronger layer occurring with depth should not be excluded, as strength variations are considered to be common.

Excavation vibrations are unavoidable and it is recommended that they be monitored. As a guide, it is recommended that a threshold peak particle velocity of 8cm/sec be not exceeded when measured at the site boundaries.

Excavation Support

Unsupported vertical excavation faces may be used for the sandstone, while shoring support will need to be provided to all vertical excavation faces through the soil cover. If s pace permits, temporary batter slopes of 1H:1.5V may be used.

Earth Pressure on Basement Walls

An earth pressure coefficient k of 0.4 may be used for the shallow sandy layer. Any horizontal pressure effects from the sandstone could be ignored; that is, k = 0.

Building Foundations

There appears to be no rational alternative but to transfer the building loads to the sandstone bedrock. For design purposes, an allowable bearing pressure of 3000 kPa may be used.

Basement Drainage

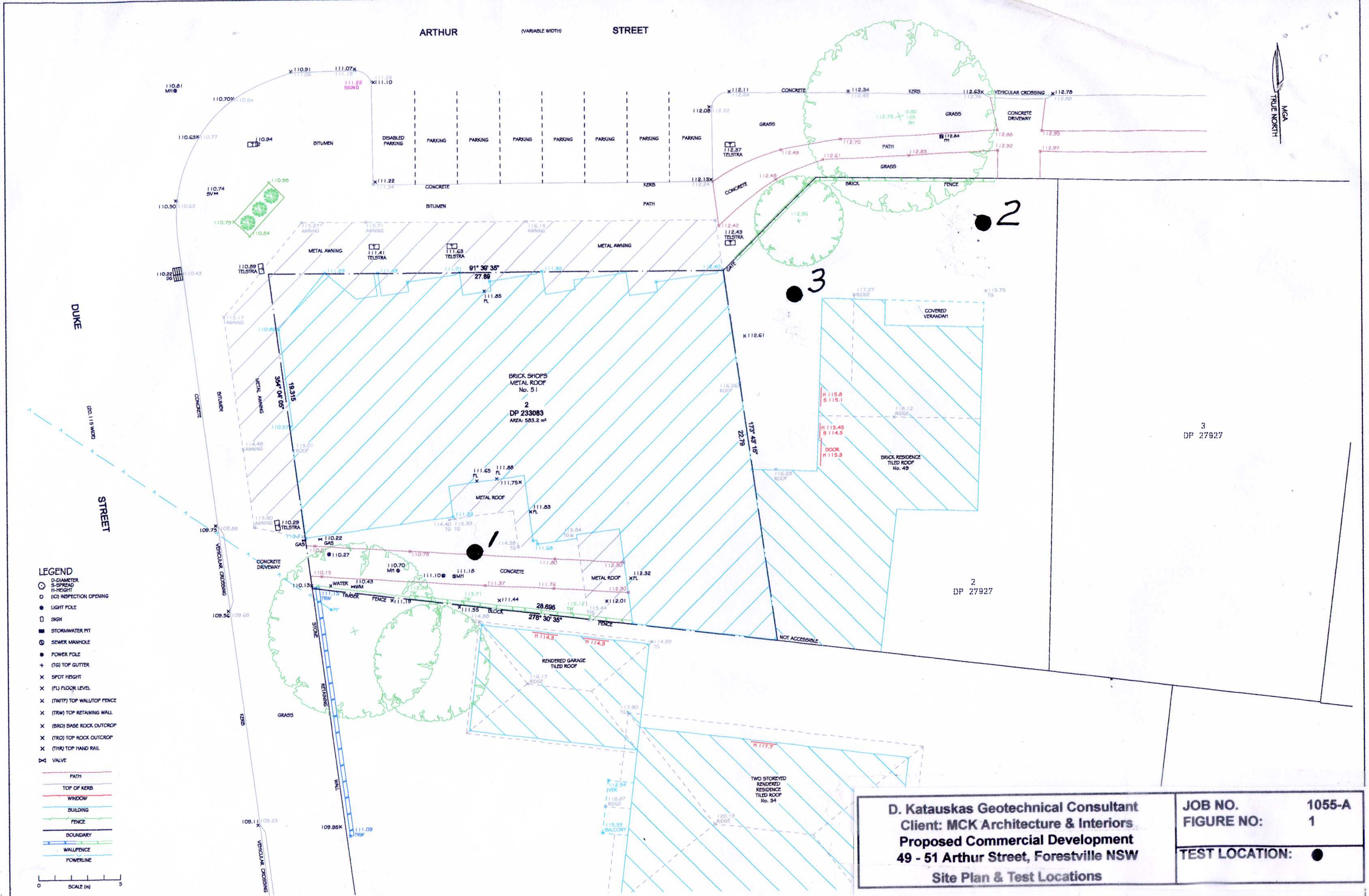
Some groundwater seepage into the basement should be expected, and such seepage may be controlled by normal sump and pump operations.

If you have any queries regarding the above, please do not hesitate to call me.

Regards,

Don Katauskas

encl: Figure 1 – Site Plan & Test Locartions
Borehole Logs 1 and 2
Explanatory Notes



D. Katauskas Geotechnical Consultant
Client: MCK Architecture & Interiors
Proposed Commercial Development
49 - 51 Arthur Street, Forestville NSW
Site Plan & Test Locations

JOB NO.	1055-A
FIGURE NO:	1
TEST LOCATION:	●

AMENDMENTS:

POSITION OF IMPROVEMENTS RELATIVE TO BOUNDARIES ARE SHOWN DIAGRAMMATICALLY AND HAVE BEEN SURVEYED FOR DA PURPOSES ONLY.
ALL BOUNDARY DIMENSIONS & AREA HAVE BEEN COMPILED FROM TITLE INFORMATION ONLY AND ARE SUBJECT TO FINAL SURVEY.
THE POSITION AND LEVELS OF ADJOINING BUILDINGS, WINDOWS, RIDGE, GUTTERS AND TREES HAVE BEEN SURVEYED REMOTELY.
NO INVESTIGATION OF UNDERGROUND SERVICES HAS BEEN MADE. RELEVANT AUTHORITIES ARE TO BE NOTIFIED PRIOR TO ANY DEVELOPMENT.
SERVICES SHOWN HEREON HAVE BEEN DETERMINED FROM VISUAL EVIDENCE ONLY.
AUSTRALIAN HEIGHT DATUM WAS ESTABLISHED FROM SSM 1345 (RL 113.866) AHD.
IT IS ADVISED, FOR CONSTRUCTION WORKS NEAR BOUNDARIES, THAT BOUNDARIES BE MARKED ON THE GROUND PRIOR TO CONSTRUCTION.
THE BOUNDARY DIMENSIONS ON THIS PLAN HAVE BEEN COMPILED FROM LAND & PROPERTY INFORMATION PLAN DP 233083

ERIC SCERRI & ASSOCIATES PTY LTD
LAND SURVEY CONSULTANTS
P.O. BOX 3018 TAMARAMA 2026
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Ph (02) 9386 4161 Mob: 0417 452 852 Fax: (02) 9386 4171

CLIENT:	SAM GABRIELIAN C/- MCK ARCHITECTURE	SURVEYED:	MB/EW	SCALE: A1 @ 1:100	
PLAN SHOWING:	DETAIL & LEVEL SURVEY	DRAWN:	MB	PLAN REFERENCE: 3045/16	
PROPERTY:	51 ARTHUR STREET FORESTVILLE	DATUM:	AHD	DATE OF SURVEY: 23 MAY 2016	
LGA:	NORTHERN BEACHES	SITE AREA:	583.2 m²	SHEET 1 OF 1	COPYRIGHT

BOREHOLE LOG

No: 1

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Consulting Geotechnical Engineer

Client: MCK Architecture & Interiors		**Date:** 13/ 12/ 2016	
Project: Proposed Development		**Job No:** 1055	
Location: 49-51 Arthur Street, Forestville NSW			
Method: Landcruiser Drill Rig	**RL:** 111.2m Approx. **Datum:** AHD	**Logged:** DK	**Checked :** DK

Groundwater Record	Sample	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	~~Moisture Condition~~ / Weathering	Strength/ ~~Relative Density~~	Hand Penetrometer Readings (kPa)	Remarks
DRY						FILL: gravelly sand grey				
			1			SANDSTONE: light grey	DW	VL to L		
			2			as above light brown		L to M		
			3							
						END BH@ 3.0m (Refusal)				
			4							
			5							
			6							
			7							
			8							

BOREHOLE LOG

D. Katauskas
Consulting Geotechnical Engineer

No: 2

Client:	MCK Architecture & Interiors	**Date:**	13/ 12/ 2016
Project:	Proposed Development	**Job No:**	1055
Location:	49-51 Arthur Street, Forestville NSW		
Method:	Landcruiser Drill Rig	**RL:**	113.0m Approx.
		Datum:	AHD
Logged:	DK	**Checked :**	DK

Groundwater Record	Sample	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition / Weathering	Strength/ Relative Density	Hand Penetrometer Readings (kPa)	Remarks
Dry					SP	Topsoil over sand light grey then light brown	D	L		
			1			SANDSTONE: light grey	DW	L to M		
			2							
						End BH@2.0m (Refusal)				
			3							
			4							
			5							
			6							
			7							
			8							

BOREHOLE LOG

No: 3

D. Katauskas
Consulting Geotechnical Engineer

Client:	MCK Architecture & Interiors	**Date:**	13/ 12/ 2016
Project:	Proposed Development	**Job No:**	1055
Location:	49-51 Arthur Street, Forestville NSW		
Method:	Landcruiser Drill Rig	**RL:** 113.0m Approx. **Datum:** AHD	**Logged:** DK **Checked :** DK

Groundwater Record	Sample	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition / Weathering	Strength/ Relative Density	Hand Penetrometer Readings (kPa)	Remarks
DRY					SP	SAND: fine to medium grained brown		L		
			1			SANDSTONE: light brown	DW	L to M		
			2			END BH@1.5m (Refusal)				
			3							
			4							
			5							
			6							
			7							
			8							

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LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record	▼	Standing water level. Time delay following completion of drilling may be shown.
	►	Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated
	DS	Small disturbed bag sample taken over depth indicated.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' noted below
	N_c = 5 . 7 . 3R	Dynamic Cone Penetration Test performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength
	PID = 100	Photoionization detector reading in ppm (Soil sample headspace test)
Moisture Condition (Cohesive Soils)	MC > PL	Moisture content estimated to be greater than plastic limit.
	MC = PL	Moisture content estimated to be approximately equal to plastic limit.
	MC < PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY - runs freely through fingers
	M	MOIST - does not run freely but no free water visible on soil surface
	W	WET - free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25 kPa.
	S	SOFT - Unconfined compressive strength 25 – 50 kPa.
	F	FIRM - Unconfined compressive strength 50 – 100 kPa
	St	STIFF - Unconfined compressive strength 100 – 200 kPa
	VSt	VERY STIFF - Unconfined compressive strength 200 – 400 kPa
	H	HARD - Unconfined compressive strength greater than 400 kPa.
	( )	Bracketted symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative density (Cohesionless Soils)		Density Index (I_D) / Range (%) / SPT 'N' Value range (Blows/ 300mm)
	VL	Very loose / <15 / 0 – 4
	L	Loose / 15 – 35 / 4 – 10
	MD	Medium Dense / 35 – 65 / 10 – 30
	D	Dense / 65 – 85 / 30 – 50
	VD	Very Dense / >85 / >50
	( )	Bracketted symbol indicates estimated density based on ease of drilling or other tests
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' bit
	'TC' bit	Tungsten carbide wing bit
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

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GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CH)
- SILTY CLAY (CL, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML)
- PEAT AND ORGANIC SOILS

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE
- SILTSTONE, MUDSTONE, CLAYSTONE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

DEFECTS AND INCLUSIONS

- CLAY SEAM
- SHEARED OR CRUSHED SEAM
- BRECCIATED OR SHATTERED SEAM/ZONE
- IRONSTONE GRAVEL
- ORGANIC MATERIAL

OTHER MATERIALS

- CONCRETE
- BITUMINOUS CONCRETE, COAL
- COLLUVIUM

Rock Description

Explanatory Sheet

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Classification of Weathering

Term	Abbr:	Definition
Residual Soil	RS	Soil derived from rock weathering; mass structure & substance no longer evident. Large change in volume, soil not significantly transported.
Extremely Weathered	XW	Weathered to the extent of having soil properties i.e. disintegrates or can be remoulded in water. Original rock fabric still visible.
Distinctly Weathered	DW	Rock strength usually changed by weathering. May be highly discoloured, usually by iron staining. Porosity may be increased by leaching or decreased bydeposition of weathering productsin pores.
Slightly Weathered	SW	Rock slightly discoloured; shows little or no change in strength from fresh rock.
Fresh Rock	FR	Shows no evidence of decomposition or staining.

Notes:
The unconfined compressive strength is typically 10 to 25 times the point load index for homogeneous isotropic rocks.
The ratio may vary for different rock types

Rock Substance Strength Terms

Term	Abbr:	Point Load Index I_s50 (Mpa)	Strength Field Guide
Very Low	VL	less than 0.1	Crumbles under firm blows with sharp end of pick;can be peeled with knife. Too hard to cut triaxial sample by hand. Pieces up to 30mm thick, can be broken by finger pressure.
Low	L	0.1 to 0.3	Easily scored with a knife, indentations 1mm to 3 mm show in specimen with firm blows of the pick point, has dull sound under hammer. A piece of core, 150mm long by 50mm diameter, may be broken by hand. Sharp edges of core may be friable.
Medium	M	0.3 to 1	Readily scored with knife.Core 150mm by 50mm diameter can be broken by hand with difficulty.
High	H	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by a pick with a single firm blow. Rock rings under hammer.
Very High	VH	3 to 10	Hand specimen breaks with pick after more than one blow. Rock rings under hammer.
Extremely High	EH	More than 10	Specimen requires many blows with geological pick to break through intact material. Rock rings under hammer.

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UNIFIED SOIL CLASSIFICATION TABLE

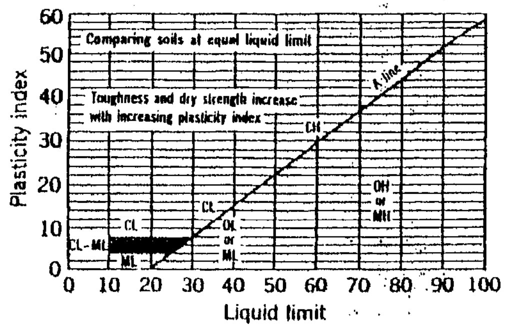
(The 75 μm sieve size is about the smallest particle visible to naked eye)

Major division	Subdivision	Fines	Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)	Group Symbols [a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils More than half of material is *larger* than 75 μm sieve size	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		Atterberg limits below "A" line, or *PI* less than 4 / Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Atterberg limits above "A" line, with *PI* greater than 7
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand*, gravelly; about 20 % hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15 % non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5 / Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7

Laboratory classification criteria, coarse-grained soils: Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows:
Less than 5% — *GW, GP, SW, SP*
More than 12% — *GM, GC, SM, SC*
5% to 12% — *Borderline* cases requiring use of dual symbols

Identification Procedures on Fraction Smaller than 380 μm Sieve Size

Major division	Subdivision	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols [a]	Typical Names	Information Required for Describing Soils
Fine-grained soils More than half of material is *smaller* than 75 μm sieve size	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).

2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.