PetoMacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
ADDITION AND ALTERATIONS
ROYAL CANADIAN LEGION, BRANCH NO. 350
PORT DALHOUSIE, ONTARIO
FOR
WILLIAMS WOODRUFF ELMES,
ARCHITECTS

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Job No. 87 F 351

August, 1987

Peto MacCallum Ltd.
CONSULTING ENGINEERS

August 20, 1987

Our Ref: 87F351

Williams Woodruff Elmes, Architects
146 James Street
Box 242
St. Catharines, Ontario
L2R 6S4

Attention: Mr. S.D. Woodruff, B.Arch., OAA, MRAIC

Re: Geotechnical Investigation
Addition and Alterations
Royal Canadian Legion, Branch No. 350
Port Dalhousie, Ontario

Gentlemen:

We are pleased to present the results of the geotechnical investigation recently carried out at the above noted project site. Authorization for this assignment was provided by Mr. S. Woodruff in letters dated July 9 and 24, 1987.

It is planned to expand and renovate the existing Royal Canadian Legion, Branch No. 350 in Port Dalhousie, Ontario. The proposed expansion will comprise a two storey addition without basement, as indicated on Drawing 1. The grade level will be for car parking under the second level. One portion of the addition will incorporate an elevator and stairs.

The purpose of the investigation was to define the subsurface conditions at the site in order to provide geotechnical engineering recommendations pertinent to the design of the proposed addition.

45 Burford Road, Hamilton, Ontario L8E 3C6 Telephone (416) 561-2231
OFFICES IN TORONTO, HAMILTON, KITCHENER, BARRIE

FIELD WORK

The field work was carried out on July 21 and 22, 1987. The original drilling program consisted of six (6) boreholes to be drilled to a depth of about 21 ft. However, on encountering relatively poor quality soils during drilling, and following discussion with Mr. S. Woodruff, the actual field work consisted of five (5) boreholes put down to depths ranging from 54.0 to 62.3 ft. below grade at the locations shown on Drawing 1. The boreholes were terminated on assumed bedrock upon refusal to penetration by the drilling equipment. Bedrock was confirmed in borehole 2 by sampling.

The boreholes were advanced using continuous flight hollow stem augers, powered by a truck-mounted CME 55 drillrig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff. Sampling and testing were conducted in all boreholes except borehole 5 and the lower portion of boreholes 1 and 4, where auger probes were conducted to refusal.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration strength tests were conducted simultaneously with the sampling operation in order to assess the strength characteristics of the substrata. In situ vane tests were also conducted to measure the undrained shear strength of the cohesive soils. The ground-water conditions in the boreholes were closely monitored during the course of the field work. A representative sample of the ground water was recovered for laboratory testing.

The locations and ground surface elevations at the boreholes were established in the field by Peto MacCallum Ltd. The following temporary benchmark was used for vertical reference:

TBM: Top of window sill, north side of existing building east of main entrance. Elevation 259.37 Imperial, assumed geodetic (provided by Douglas G. Ure & Sons).

All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. The recovered water sample was tested for soluble sulphate concentration.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for a detailed description of the subsurface conditions including soil and rock classifications, inferred stratigraphy, standard penetration test "N' values, dynamic cone penetration test results, in situ vane shear strength values, ground-water observations and the results of laboratory moisture content determinations.

The subsurface stratigraphy revealed in the boreholes generally comprised a 12.0 to 15.5 ft. layer of fill overlying a major deposit of silt alluvium underlain by bedrock at a depth of about 54 to 62 ft. below grade.

The fill consisted of predominantly silt to clayey silt with localized sand fill. The fill was generally loose/stiff but the upper 5 ft. or so tended to be compact/very stiff. Moisture contents were in the 10 to 18% range.

A major deposit of loose/soft silt alluvium was revealed beneath the fill layer. The alluvium extended down to a depth of about 58 to 60 ft. and overlies bedrock in boreholes 2, 3 and 4. Locally in borehole 1 the alluvium was fully penetrated at the 28.0 ft. depth where a loose to compact sand stratum was revealed. Bedrock was inferred upon auger refusal beneath the sand at the 54.0 ft. depth. Moisture contents in the silt alluvium and discontinuous sand layer were typically in the 25 to 40% range.

The elevation of the bedrock, based on auger refusal criteria, was at typically elevation 194 to 196, and locally elevation 203 in borehole 1.

Ground water was first encountered during drilling at depths of 9 to 12 ft., typically elevation 244 to 245. Upon completion of augering the free water was noted at 9 to 22 ft. below existing grade inside the augers.

ENGINEERING CONSIDERATIONS

Foundations

The boreholes drilled at the site revealed some 12 to 15.5 ft. of generally loose fill overlying an extensive deposit of relatively weak and compressible silt alluvium, extending down to a depth of 58 to 60 ft. (locally 28 ft. depth).

Based on this information the use of individual strip footings founded on the existing fill would not be recommended due to the potential for extensive total and differential settlements. However, it is our understanding that the existing building may be supported on spread footings. Considering that the existing

structure is performing relatively satisfactorily, then further investigation is warranted that may permit the use of special footings for the addition. This would involve verification of the existing footing geometry and loading.

Several geotechnical feasible foundation schemes are available to support the proposed addition depending on the tolerable settlements and economic considerations.

Provided the finished floor level and exterior grades are established no more than 12 in. above the present ground grade (that is minimal surcharging due to fill placement), then it is considered that the building addition may be supported on spread footings founded at the normal 4 ft. depth on an engineered fill.

The engineered fill should be constructed by subexcavation of the existing fill down to a depth of at least 10 ft. and replacement with select imported granular material (Granular "B" or equivalent) placed in uniform 8 in. thick lifts and compacted to at least 98% Standard Proctor maximum dry density.

A maximum net allowable bearing capacity of 3000 psf is recommended for proportioning footings founded on the engineered fill. Total settlement is estimated at about 1 to 2 in. with about 75% differential settlement. In this regard, the footing should be more rigid than normal by using a thicker section and reinforcing steel to minimize the effects of differential settlements.

The proposed addition may be supported on a rigid reinforced concrete mat foundation founded at nominal depth on the existing fill and imposing a maximum bearing pressure of 500 psf. Based on this imposed pressure, settlement is estimated to be about 2 in. for a rigid concrete mat founded about 2 ft. below existing grade.

The use of construction joists is recommended to minimize the effects of differential settlement between the new addition and the existing structure.

The magnitude of post construction settlement in the mat foundation can be virtually eliminated by incorporating a basement level below the existing ground grade. For instance, if a 5 ft. deep basement is incorporated, the stress released due to the soil excavation is about 500 psf. Therefore, there will be virtually no net pressure increase imposed on the underlying soils due to construction of the mat foundation.

The silt fill subgrade is sensitive and becomes loosened by excessive construction traffic, particularly during wet weather. In this regard, a minimum 6 in. thick layer of free-draining material or a 2 in. thick skim coat of concrete is recommended as a working layer over the silt fill subgrade.

In general, excavation side slopes should be at 45^{o}. The existing building foundation type and geometry should be determined to assess the need for bracing and/or underpinning of the existing structure.

Ground water is not expected to pose any major difficulties. Conventional sump pumping should readily handle any nuisance seepage.

Consideration was given to supporting the proposed addition on a deep foundation system to transfer the building loads to the underlying bedrock. Installation of drilled caissons is not practical due to the high ground-water table and relatively pervious sand and silt alluvium which would cause caving and basal instability in the augerhole.

The use of non-displacement steel "H" piles is recommended to minimize disturbance to the existing structure. The following working loads are recommended for various pile sections:

HP 10 X 42	70 tons
HP 12 X 53	90 tons
HP 12 X 89	150 tons

The piles should be driven to practical refusal using a hammer with a rated energy of at least 30,000 ft.lb. It is anticipated that practical refusal will be encountered typically at about elevation 200, some 65 ft. below grade.

The pile driving should be carefully controlled to minimize vibration transmission to the existing structure.

Floor Slab

A concrete floor slab may be constructed on grade over the existing fill subgrade in the case of the pile foundation system or on engineered fill as discussed earlier, provided some cracking of the slab is tolerable. The following procedures are recommended with the intent of minimizing post construction settlements of the concrete floor slab:

1. The finished floor level should be established no more than 12 in. above the existing ground grade. This action would reduce the surcharging effect of addition fill placement.

2. Following rough grading the subgrade should be proof rolled with a heavy roller to ensure uniformity of support. Any localized wet, soft zones that become evident should be subexcavated and replaced with well compacted select material. A minimum 6 in. thick bedding thickness of well compacted Granular "A" material should be provided beneath the floor slab for drainage and levelling purposes. It is recommended that the concrete floor slab be nominally reinforced to minimize the effects of cracking due to potential differential settlements.

3. Service pipes installed under the floor slab should be supported by hangers connected to the concrete floor slab or in service ducts in the concrete floor. Flexible service connections should be provided at the entry to the building.

Consideration should be given to the use of an asphaltic concrete paved floor for the at-grade parking area under the second level, where some surface distortion may be acceptable. Underground utilities, however, should be supported on an improved subgrade comprising a minimum 2 ft. of well compacted granular material.

Sulphate Attack on Buried Concrete

Laboratory tests carried out on a sample of ground water show a pH value of 6.9 and soluble sulphate concentrations of 20 ppm. The results indicate a negligible relative degree of sulphate attack on buried concrete structures and therefore normal Portland cement may be used.

We trust the information presented in this report is sufficient for your present purposes. It is recommended that the design be submitted for review when the foundation scheme is selected to ensure compatibility with the site conditions and recommendations contained in this report. Please do not hesitate to contact our office if you have any questions, or if we may be of assistance in determining details of the existing foundations.

Yours very truly,

PETO MacCALLUM LTD.



Marco D. Coccia, B.Eng.
Engineer-in-Training

MDC/TLB/rp

Turney Lee-Bun, P.Eng.
Project Engineer

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.
VERY SOFT	0 - 2	0 - 250
SOFT	2 - 4	250 - 500
FIRM	4 - 8	500 - 1000
STIFF	8 - 15	1000 - 2000
VERY STIFF	15 - 30	2000 - 4000
HARD	> 30	> 4000

DENSENESS	'N' BLOWS / FT.
VERY LOOSE	0 - 4
LOOSE	4 - 10
COMPACT	10 - 30
DENSE	30 - 50
VERY DENSE	> 50

W.T.P.L. WETTER THAN PLASTIC LIMIT

D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		

▲, △ - Undisturbed and remoulded undrained shear strength determined from insitu vane test.

■ - Undrained shear strength determined from pocket penetrometer test.

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LOG OF BOREHOLE No. 1

JOB NAME: ADDITION AND ALTERATIONS TO ROYAL CANADIAN LEGION BRANCH NO. 350
JOB No.: 87 F 351
LOCATION: Port Dalhousie, Ontario
BORING DATE: July 21/87
ENGINEER: M. Coccia
BORING METHOD: Continuous Flight Hollow Stem Augers
TECHNICIAN: M. Rapsey

GROUND ELEVATION: 256.8

DEPTH	DESCRIPTION	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/FOOT N-VALUES
	SAND FILL: Reddish brown, silty fine to medium sand, some gravel	255			
2.5					
	SILT FILL: Compact/very stiff, olive brown, mottled grey clayey silt, trace of sand, non to slightly plastic, becoming loose/firm with oc. splinters of wood		1	SS	23
		250	2	SS	7
			3	SS	6
		245	4	SS	7
14.5			5	SS	9
	SILT ALLUVIUM: Loose/firm, black to dark greyish brown, fine sandy to clayey silt, medium organic, occ. thin layers of clay and fine sand	240	6	SS	5
			7	SS	6
	one 6 in. layer of fine to coarse sand and rounded gravel, waterbearing		8	SS	5
		235			
			9	SS	4
28.0		230			
	SAND: Loose to compact, grey silty fine sand, saturated		10	SS	5
		225			
			11	SS	12
		220			
	AUGER PROBE				
		215			
		210			
	harder augering, possible clay till	205			
54.0					
	Borehole terminated at 54.0 ft. upon practical refusal to split spoon penetration on assumed bedrock.		12	SS	50/0 in.
		200			

SHEAR STRENGTH C_u
DYNAMIC CONE PENETRATION
STANDARD PENETRATION TEST - •
BLOWS/FOOT 20 40 60 80

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % 10 20 30

GROUNDWATER OBSERVATIONS AND REMARKS

After Sample 8 free water at 12.0 ft.

Upon completion of augering, free water at 22.0 ft. inside borehole.

Sample of ground water obtained for laboratory testing.

NOTES:

CHECKED BY: M. C.

PML 504

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LOG OF BOREHOLE No. 2

JOB NAME ADDITION AND ALTERATIONS TO ROYAL CANADIAN LEGION BRANCH NO. 350 — JOB No. 87 F 351
LOCATION Port Dalhousie, Ontario — BORING DATE July 21/87 — ENGINEER M. Coccia
BORING METHOD Continuous Flight Hollow Stem Augers — TECHNICIAN M. Rapsey

DEPTH	SOIL PROFILE: DESCRIPTION (GROUND ELEVATION: 253.1)	LEGEND	ELEVATION	SAMPLES: NUMBER	TYPE	BLOWS/FOOT N-VALUES
	SILT FILL: Compact, reddish brown sandy silt, trace of clay and gravel					
3.0			250			
	SILT FILL: Loose/stiff, olive brown, mottled grey clayey silt, some sand, non to slightly plastic, D.T.P.L.			1	SS	16
				2	SS	9
			245			
				3	SS	4*
				4	SS	12
12.0	occ. softened zones					
	SILT ALLUVIUM: Soft, dark greyish brown organic clayey silt, trace of sand, slightly plastic, W.T.P.L., medium organic with fine leafy organics		240	5	SS	4
				6	SS	3
			235		FV	
					3"	
				7	TW	PH
			230		FV	
				8	SS	4
			225		FV	
				9	SS	4
			220			
				10	SS	4
			215			
				11	SS	4
			210			
				12	SS	3
			205			
	with occ. pieces of decayed wood, occ. inclusions of silty clay			13	SS	8
			200			
				14	SS	2
57.5			195			
	SHALE: Red weathered shale					
60.5	Borehole terminated at 60.5 ft.			15	SS	100/6 in.

SHEAR STRENGTH C_u ksf (1 2 3 4) ▲
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST •
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUNDWATER OBSERVATIONS AND REMARKS

*no recovery

After SS4 free water at 12.0 ft.

43

Upon completion of augering, free wate at 16.0 ft. inside borehole.

NOTES:

Elev ~ 1 hole 283 reversed.

CHECKED BY: M.C.

PMI 1504

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LOG OF BOREHOLE No. 3

JOB NAME ADDITION AND ALTERATIONS TO ROYAL CANADIAN LEGION BRANCH NO. 350
LOCATION Port Dalhousie, Ontario — JOB No. 87 F 351
BORING METHOD Continuous Flight Hollow Stem Augers — BORING DATE July 22/87 — ENGINEER M. Cocc
TECHNICIAN M. Ra

DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N-VALUES
	GROUND ELEVATION: 255.1 (253')					
0	SILT FILL: Compact, olive brown silt, trace of clay and sand, mottled reddish brown, non-plastic, moist			1	SS	16
5			250	2	SS	7
	becoming loose, reddish brown with occ. small particles of weathered shale					
10			245	3	SS	4
				4	SS	3
15	15.3 / 15.5 SAND: Very loose, dark brown fine to coarse sand, some silt and rounded gravel		240	5	SS	5
				6	SS	2
20	SILT ALLUVIUM: Very soft, dark greyish brown organic clayey silt, occ. decayed woody and leafy organics		235	7	SS	3
					FV	
25			230	8	SS	3
	28.0				FV	
30	becoming fine sandy silt, very low organic		225	9	SS	2
35			220	10	SS	2
40			215	11	SS	6
45			210			
50	becoming compact with numerous pieces of decayed wood to 2 in. thick with zones of organic fine sand		205	12	SS	10
55			200			
	Sampled borehole terminated at 60.0 ft. due to excessive heave inside auger of sands.					
60	60.0 / 60.6 DYNAMIC CONE PENETRATION TEST		195			100/7 in.
	Dynamic cone penetration test terminated at 60.6 ft., upon practical refusal to cone penetration on assumed bedrock					

SHEAR STRENGTH C_u ksf (1 2 3 4) ▲
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST-•
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUNDWA OBSERVATI AND REMAR

After SS5 fre water at 11.0

Upon completion augering, free w at 15.0 ft. insi borehole.

NOTES:

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LOG OF BOREHOLE No. 4

JOB NAME ADDITION AND ALTERATIONS TO ROYAL CANADIAN LEGION BRANCH NO. 350 — JOB No. 87 F 351

LOCATION Port Dalhousie, Ontario — BORING DATE July 22/87 — ENGINEER M. Coccia

BORING METHOD Continuous Flight Hollow Stem Augers — TECHNICIAN M. Rapsey

GROUND ELEVATION: 253.5

DEPTH	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES
0	SILT FILL: Stiff/loose olive brown clayey silt, trace of sand, mottled grey, non to slightly plastic, D.T.P.L., oxidized stains	250	1	SS	8
			2	SS	7
		245	3	SS	7
	with softened/wet zones		4	SS	4
13.0		240	5	SS	3
	SILT ALLUVIUM: Soft, dark greyish brown organic clayey silt with fine leafy organics, pieces of wood			3"	
			6	TW	PH
		235		FV	
	becoming fine sandy, clayey silt		7	SS	2
		230		FV	
		225			
		220			
		215			
			8	SS	9
		210			
	AUGER PROBE	205			
		200			
	gravelly	195			
59.5	Borehole terminated upon refusal to auger at 59.5 ft., bedrock assumed.				

SHEAR STRENGTH C_u ksf (1 2 3 4)

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST- •
BLOWS/FOOT (20 40 60 80)

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % (10 20 30)

GROUNDWATER OBSERVATIONS AND REMARKS

After SS4 free wat at 9.0 ft.

Upon completion of augering, free wat at 9.5 ft. inside borehole.

NOTES:

CHECKED BY: M-C.

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LOG OF BOREHOLE No. 5

JOB NAME ADDITION AND ALTERATIONS TO ROYAL CANADIAN LEGION BRANCH NO. 350 JOB No. 87 F 351

LOCATION Port Dalhousie, Ontario BORING DATE July 21/87 ENGINEER M. Coccia

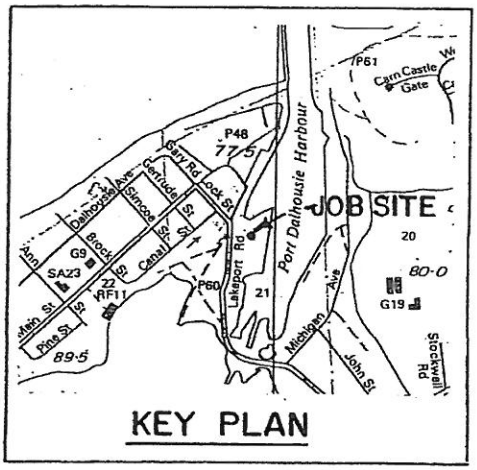
BORING METHOD Continuous Flight Hollow Stem Augers TECHNICIAN M. Rapsey

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/FOOT N - VALUES	DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST • BLOWS/FOOT 20 40 60 80	W_P W W_L WATER CONTENT % 10 20 30	
	GROUND ELEVATION: 256.1								
	UNSAMPLED AUGER PROBE		255						
5			250						
10			245						
15			240						
20			235						
25			230						
30			225						
35			220						
40			215						
45			210						
50			205						
55			200						
60			195						
62.3									Initial

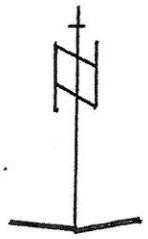
Borehole terminated at 62.3 ft. upon refusal to auger on assumed bedrock.

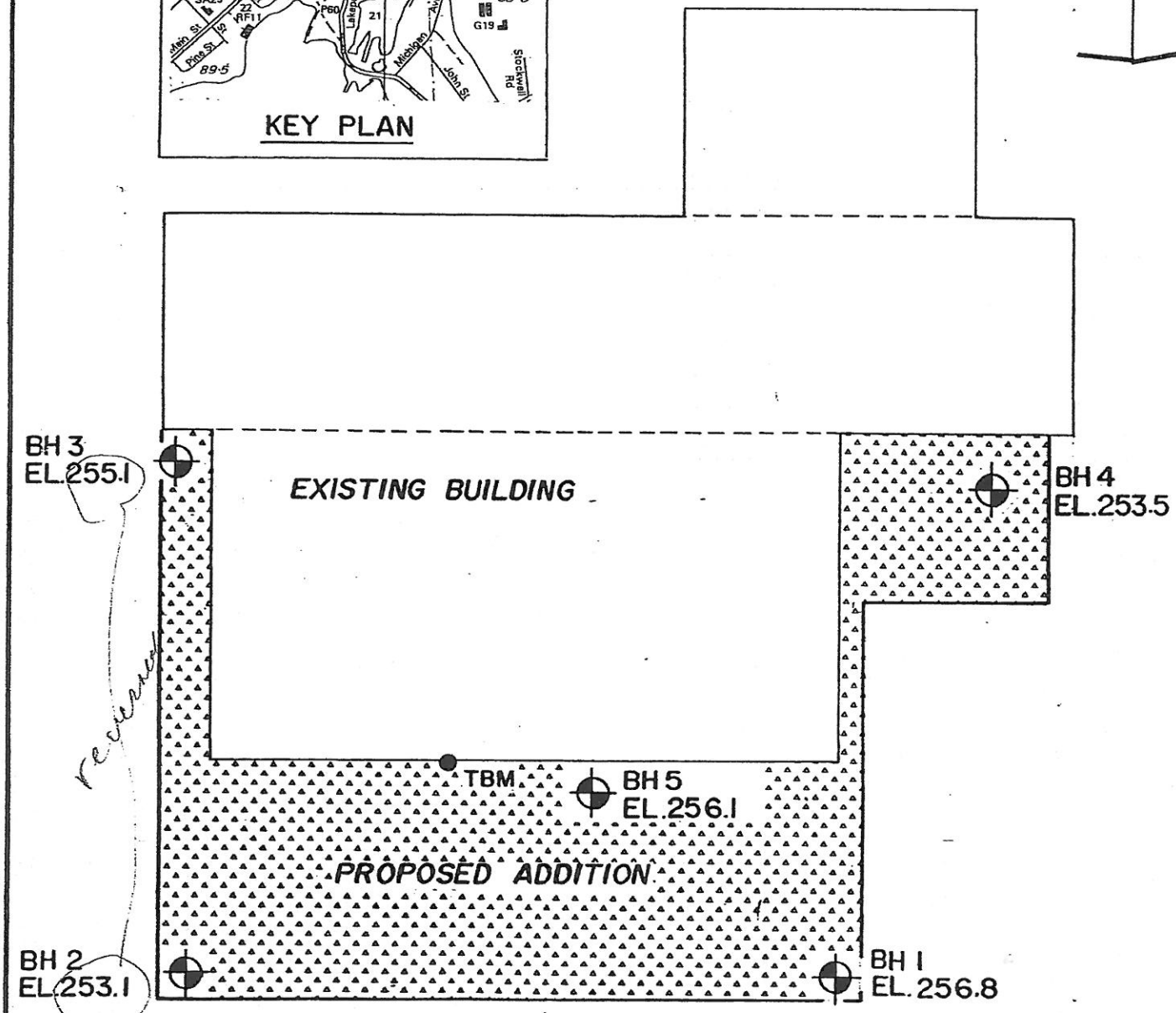
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CRANE





TBM. TOP OF CONCRETE WINDOW SILL. EL. 259.37 IMP. (ASSUMED GEODETIC)
(SUPPLIED BY G. DOUGLAS URE & SONS.)

REFERENCE: REPRODUCED FROM SITE PLAN SUPPLIED BY CLIENT.

WILLIAMS WOODRUFF and ELMES

PROPOSED ADDITION & ALTERATIONS TO ROYAL CANADIAN LEGION, BRANCH 350
57 LAKEPORT ROAD, ST. CATHARINES, ONT.

BOREHOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DATE	SCALE	JOB NO.	DRAWING NO.
AUG. 1987	1"=20'	87 F 351	1