62-F-277M

Hwy. 44

PROCTOR & REDFERN

BA 1858

H. Q. GOLDER & ASSOCIATES LTD.

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STRUCTURE SITE No. 15-45

REPORT

TO

PROCTOR & REDFERN

ON

SITE INVESTIGATION

PROPOSED BRIDGES

HIGHWAY 44

ALMONTE ONTARIO

62-F-277M

Distribution:

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ABSTRACT

The results of an investigation carried out at two bridge sites on the Mississippi River in the Town of Almonte, Ontario, are reported.

It was found that the banks of the north and south channel crossings are covered by a thin layer of granular approach fill to the existing bridges. Limestone bedrock underlies the shallow fill cover on the river banks, is exposed on the near vertical sides of the south channel crossing and forms the creek bed at both crossings. The upper few feet of the bedrock on the river banks and where it is exposed on the south channel face is weathered and jointed. Below the upper weathered zone, the bedded limestone bedrock is fairly sound but contains fractures.

Recommendations are made for founding the piers and abutments for each bridge in the sound portion of the bedrock using an allowable design bearing pressure of up to 20 tons per square foot.

Possible construction problems due to seepage of water into bedrock excavations through fractures are discussed in the report.

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Figure 1 - Site and Boring Plan

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INTRODUCTION

H. Q. Golder & Associates Ltd. have been retained by Proctor & Redfern to carry out a site investigation at two bridge sites on the Mississippi River in the Town of Almonte, Ontario. The purpose of this work was to determine the soil and bedrock conditions at each of the sites and to provide information for foundation design and construction of the new bridges which are to replace the existing structures.

PROCEDURE

The field work for this investigation was carried out during the period October 31 to November 7, 1962. A total of eight boreholes were put down in BX casing size using a trailer-mounted machine drillrig. Each borehole was taken down to bedrock and bedrock was cored in AXT size for depths ranging between 10 to 20 feet. Water pressure packer tests were carried out in the lower portion of each borehole following completion to assess the permeability or soundness of the bedrock.

The locations of the boreholes put down in this investigation are shown on Figure 1. A detailed log for each borehole is given on the Records of Boreholes at the end of this report. A schematic section along the centreline of Highway 44 showing the inferred soil and bedrock stratigraphy is given on Figure 2.

The elevations given in this report are referred to Geodetic datum and were supplied by Proctor & Redfern.

SITE AND GEOLOGY

The two bridge sites under investigation are located in the Town of Almonte, Ontario, where Highway 44 crosses the north and south channels of the Mississippi River, as shown on Figure 1. The main flow of the river follows the south channel while the north channel, which joins the south channel several hundred feet downstream and to the west of the site, serves as an overflow. The river bed at the north channel crossing is about 10 feet below the river bank level. At the south or main channel crossing, the river bed is some 30 feet below the top of the banks and is about 30 feet lower in elevation than the north channel river bed. This difference in elevation is caused by an abrupt drop in the river bed resulting in falls located upstream of the south channel crossing in the vicinity of the Almonte Electric Plant.

The river bottom at both crossings and at the falls is directly underlain by bedrock. Bedrock also forms the near vertical sides of the south channel crossing.

The Town of Almonte is situated about 10 to 12 miles south and a few miles east of the Precambrian Canadian Shield. Three major faults, running in a northwest to southeast direction, have been defined in an area 4 to 12 miles north of Almonte. No major faults are known to exist in the immediate area of the site.

The Almonte area is underlain by a complex series of sandstones and limestones of the Nepean, Beekmantown and Ottawa Formations from the Ordovician Period. The upper portion of the bedrock at the site, however, belongs to the Black River - Trenton member of limestone and is generally exposed at ground surface along the river banks and in cuts. The limestone bedrock is comprised of relatively flat lying beds or layers and is weathered and jointed where it is exposed.

SOIL AND BEDROCK CONDITIONS

The detailed soil and bedrock stratigraphy encountered in each borehole put down in this investigation is given on the Records of Boreholes. The stratigraphy along the centreline of Highway 44 has been inferred from this data and is presented on Figure 2. Following is an account of the soil and bedrock encountered at the site.

The banks of the river are covered by a layer of roadway approach fill to the existing bridges. The thickness of the fill at the boring locations ranges generally between about 1 and 4 feet, except on the west side of the north channel crossing where it reaches a maximum of about 9 feet. The fill is essentially comprised of dark brown to grey brown silty sand and gravel with a trace to some organic matter. The fill contains angular limestone fragments or slabs dispersed throughout together with some cobbles and boulders at depth on the west side of the north channel.

Based on the results of standard penetration tests, which gave 'N' values ranging between 1 and 35 blows per foot, the fill is very loose to compact.

Bedrock underlies the shallow fill cover on the river banks, is exposed on the near vertical sides of the south channel crossing and forms the creek bed at both crossings. The bedrock is a layered or bedded limestone, fine grained in size and light grey in colour. In boreholes 1, 3 and 4 at the north channel crossing the limestone, in localized zones, is interbedded with dark green shale. The shale occurs as thin partings or bands which are generally horizontally bedded. Scattered throughout the limestone bedrock are small pockets of calcite crystals.

In general the layered bedrock at the two crossings is fairly sound; however, the upper few feet of the limestone on the river banks and where it is exposed, as on the sides of the south channel, are weathered and jointed. The weathered nature and jointed structure of the bedrock generally results in poor rock core recovery during drilling. In addition to the surface jointing, vertical and inclined fractures are present in the drill cores obtained. These fractures seldom exist for more than a few feet in any one core. In some instances the fractures are healed with calcite, in others only partly healed and in some they are open.

Occasional thin clay or sand seams were encountered in the bedrock during drilling. These seams represent solution channels which result when percolating water dissolves out the relatively soluble limestone. The solution channels are probably not persistant for more than a few feet along any one bed; in general the water tends to move on top of a bed then drop down a few inches along a joint or fracture to the next lower bed.

The results of the water pressure packer tests given on the Records of Boreholes generally confirm that the bedrock at depth is fairly sound, with the jointing becoming more pronounced near the surface as would be expected due to weathering.

Site photographs showing bedrock exposed on the banks of the south channel crossing and at the falls are given on Figures 3 and 4.

WATER CONDITIONS

Readings taken in the north channel crossing boreholes after completion showed that the water level within the bedrock was at river level. The river water level at this location was at elevation 375.4 during the time of the investigation.

The boreholes at the south channel crossing, which were terminated above the river water level at elevation 343.3, were dry after completion of drilling.

It is probable that the water level in the bedrock is in communication with the river water level through cracks and fractures in the bedrock.

DISCUSSION

General

It is understood that it is proposed to replace the existing north and south channel bridges over the Mississippi River on Highway 44 in the Town of Almonte, Ontario. For convenience the foundation conditions at each of the proposed bridge sites are discussed separately below.

North Channel Crossing

The proposed structure at this crossing is to be a three-span continuous pre-stressed reinforced concrete bridge. The bridge piers and abutments are to be founded on spread footings imposing a maximum loading of 4 tons per square foot. It is proposed to place the footings on bedrock.

The results of the field investigation indicate that the limestone bedrock underlying the site, although containing fissures and fractures, is fairly sound throughout at this crossing. Because of the bedded or layered structure of the limestone, it is recommended that the footings be carried down and keyed into the bedrock for a depth of at least 2 feet below the surface of the rock. This in particular should be done for the bridge pier foundations in the river, where the bedrock forms the river bottom. With the generally shallow depth of water in the river, freezing and thawing of the river bed over the years could loosen and break up the upper portion of the bedrock to tabular slabs. It is for this reason that the footings for the piers should be placed below existing bedrock surface to ensure that the base of the footing is not eventually undermined by possible river erosion and scour of the slabs.

Footings imposing a loading of about 4 tons per square foot and founded in the bedrock as discussed above should not experience any settlement detrimental to the proposed continuous structure.

In the computation of sliding resistance between a rough concrete footing base and the limestone bedrock, taking into consideration the presence of interbedded shale, a coefficient of friction of 0.3 may be used. Because of the bedded nature of the bedrock, it is suggested that the passive resistance of the bedrock to pier foundations not be included in the design computations of sliding resistance.

It is recommended that free draining granular backfill, compacted in 9 inch lifts, be placed behind the abutments of the structure. The granular backfill should extend horizontally from the back face of the abutment walls for a minimum distance of 5 feet.

Excavation for foundations in bedrock below the river water level could be made inside a relatively impermeable earth dyke constructed around the perimeter of the proposed excavation area. However, once foundation grade is reached water seepage from the base of the rock excavation may take place due to the presence of fractures in the bedrock. The pouring of mass foundation concrete directly on bedrock, where this base condition exists, could result in a poor quality concrete due to upward seepage of water washing out the fine cement sizes.

If water seepage is observed at the base of a foundation excavation, it is suggested that the forms for the footing be placed and the water level inside the excavation be allowed to rise to river level. A tremie seal could then be placed over the base and after it has set up the water could be pumped out from inside the cofferdammed excavation. The remainder of the concrete for the footing and pier may then be poured in the dry thus eliminating vertical seepage effects on the concrete.

South Channel Crossing

A reinforced concrete arch bridge is proposed for this crossing. The arch face is to be in concrete throughout and the inside of the arch is to be filled with compacted gravel. The footings supporting the arch or the arch support blocks are to be founded between about elevation 355 and 350 back of the channel face some 10 feet above creek bed level.

The results of the field investigation indicate that the upper portion of the bedrock above about elevation 365 is weathered and jointed. Based on visual examination the bedrock exposed on the steep sides of the channel at the crossing is similarly weathered and jointed. The lower portion of the channel sides above the creek bed is covered by limestone slab debris which has fallen down from the bedrock face above.

It is recommended that the arch support blocks be founded in sound bedrock back of the weathered and jointed portion along the channel face. It is estimated that the horizontal zone of weathering may extend for a distance of as much as 10 feet from the bedrock face. The front portion of the arch support footing should therefore be placed 10 feet back of the existing bedrock face. This distance will provide an allowance for some further unavoidable weathering and spalling at the bedrock face around the sides of the arch without affecting the bedrock supporting the arch footings. To minimize spalling and to prevent erosion undermining the bedrock below footing level, the limestone slab debris could be replaced as a protective cover to the bedrock face following completion of the arch foundations.

With the arch support blocks founded in the bedrock as discussed above, an allowable vertical pressure of 20 tons per square foot may be used in design. Considering the layered structure of the limestone bedrock, the lateral pressures should similarly be limited to 20 tons per square foot. Settlement of the arch structure designed using the allowable foundation loading given above would be negligible, provided erosion undermining of the footings does not take place. It is recommended that periodic inspections be made after the structure is completed to check that adequate bedrock support for the arch footings is maintained.

No major construction problems are envisaged at this crossing, as the water level is below the proposed footing grade. It should be noted that if blasting is used care should be taken to prevent shattering of the layered and jointed rock beyond the excavation limits and to prevent damage to adjacent structures, particularly the electric plant to the northeast of the existing bridge. Possible procedures to minimize detrimental effects from blasting could be discussed with you prior to construction.

REGISTERED PROFESSIONAL ENGINEER
J. L. SEYCHUK
PROVINCE OF ONTARIO

JLS/jb
6257

J. L. Seychuk, P. Eng.

for

December, 1962

V. Milligan, P. Eng.

LIST OF STANDARD ABBREVIATIONS

The standard abbreviations commonly employed on each "Record of Borehole", on the figures, and in the text of the report are as follows:

SAMPLE TYPES

A.S. – Auger Sample
C.S. – Chunk Sample
D.O. – Drive Open
D.S. – Denison Type Sample
F.S. – Foil Sample
R.C. – Rock Core
S.T. – Slotted Tube
T.O. – Thin-walled, Open
T.P. – Thin-walled, Piston
W.S. – Wash Sample

PENETRATION RESISTANCES

Dynamic Penetration Resistance – The energy required to drive a 2 inch diameter, 60 degree cone attached to the end of the drilling rods into the ground: expressed in blows per foot, where each blow represents 4,200 inch-pounds of energy.

Standard Penetration Resistance, N – The number of blows by a 140 pound hammer dropped 30 inches required to drive a 2 inch drive open sampler one foot into the ground.

Sampler advanced by static weight – weight, hammer – Wh
Sampler advanced by pressure – pressure,hydraulic – Ph
Sampler advanced by pressure – pressure,manual – Pm

SOIL DESCRIPTION

The standard terminology for the descriptions of the relative density of cohesionless soils and the consistency of cohesive soils is as follows:

Relative Density	N, Blows/ft.	Consistency	c, lb/sq. ft.
Very Loose	0 to 4	Very Soft	Less than 250
Loose	4 to 10	Soft	250 to 500
Compact	10 to 30	Firm	500 to 1,000
Dense	30 to 50	Stiff	1,000 to 2,000
Very Dense	over 50	Very Stiff	2,000 to 4,000
		Hard	over 4,000

SOIL TESTS

C – Consolidation Test
H – Hydrometer Analysis
M – Sieve Analysis
MH – Combined Analysis, Sieve and Hydrometer
Q – Undrained Triaxial
Qc – Consolidated Undrained Triaxial
S – Drained Triaxial
U – Unconfined Compression
V – Field Vane Test

Note: Undrained triaxial tests in which pore pressures are measured are shown as Q' or Q'c.

SOIL PROPERTIES

γ – Total Unit Weight
γ_d – Dry Unit Weight
γ_b – Submerged Unit Weight
L_L – Liquid Limit
P_L – Plastic Limit
W – Natural Water Content
G – Specific Gravity
e – Void Ratio
K – Coefficient of Permeability
c – Undrained Shear Strength (½ Compressive Strength)
St – Sensitivity
Ø' – Effective Angle of Shearing Resistance
c' – Effective Cohesion Intercept
Cc – Compression Index
Cv – Coefficient of Consolidation

PROJECT No. 6257

RECORD OF BOREHOLE 1

LOCATION SEE FIGURE 1 **BORING DATE** NOV. 2, 1962 **DATUM** GEODETIC

BOREHOLE TYPE WASH BORING **BOREHOLE DIAMETER** BX CASING

SAMPLER HAMMER WEIGHT 140 **LB. DROP** 30 **INCHES** **PEN. TEST HAMMER WEIGHT** - **LB. DROP** - **INCHES**

ELEVN. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLES – NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	PERCENT CORE RECOVERY	REMARKS
					390		
389.0	GROUND LEVEL						
0.0	LOOSE TO COMPACT DARK GREY TO GREY BROWN SILTY SAND TO SANDY SILT WITH SOME GRAVEL AND ANGULAR LIMESTONE FRAGMENTS, TRACE OF ORGANIC MATTER (FILL)	1	2" DO	8			
		2	"	6			
384.7 / 4.3		3	"	27	385		
	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK BECOMING INTERBEDDED GREY LIMESTONE AND DARK GREEN SHALE BELOW ELEV. 374.5 (SILT SEAM IN INCLINED FRACTURE BETWEEN ABOUT ELEV. 382.0 AND 381.7. FISSURED BETWEEN ELEV. 378 AND 377.1)	4	AX RC	—		100	
		5	"	—	380	100	W.L. IN BOREHOLE AFTER COMPLETION AT RIVER LEVEL ELEV. 375.4
373.8 / 15.2		6	"	—	375	75	
	END OF HOLE						
					370		

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

COEFFICIENT OF PERMEABILITY (CMS./SEC.) 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}

LIQUID LIMIT L_L PLASTIC LIMIT P_L WATER CONTENT W — P_L W L_L

WATER CONTENT, PER CENT

STRAT. PLOT

VERTICAL SCALE 1 INCH TO 5'-0"

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PROJECT No. 6257

RECORD OF BOREHOLE 2

LOCATION SEE FIGURE 1 BORING DATE NOV. 5, 1962 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT - LB. DROP - INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	PERCENT CORE RECOVERY	COEFFICIENT OF PERMEABILITY (CMS./SEC.)	WATER CONTENT, PER CENT	REMARKS
						380				W.L. IN BOREHOLE AFTER COMPLETION AT RIVER LEVEL ELEV. 375.4
375.4	RIVER LEVEL									
0.0	WATER					375				
373.4 2.0	RIVER BOTTOM									
	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK (THIN SILT SEAM AT ELEV. 370.6)		1	AX RC	–	370	25			
			2	AX RC	–	365	95			
363.5 11.9	END OF HOLE									
						360				

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

COEFFICIENT OF PERMEABILITY (CMS./SEC.): 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}

LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W

VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

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CHECKED JOR

PROJECT No. 6257

RECORD OF BOREHOLE 3

LOCATION SEE FIGURE I   BORING DATE NOV. 6, 1962   DATUM GEODETIC

BOREHOLE TYPE WASH BORING   BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES   PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; COEFFICIENT OF PERMEABILITY (CMS./SEC) 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}	LIQUID LIMIT L_L, PLASTIC LIMIT P_L, WATER CONTENT W; WATER CONTENT, PER CENT	REMARKS
						380			W.L. IN BOREHOLE AFTER COMPLETION AT RIVER LEVEL ELEV. 375.4
375.4	RIVER LEVEL								
0.0	WATER					375			
373.5 / 1.9	RIVER BOTTOM								
	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK (THIN HORIZONTAL DARK GREEN SHALE BANDS BETWEEN ELEV. 366.5 & 364.5. OPEN VERTICAL FRACTURE BETWEEN ELEV. 368.2 & 367.9)		1	AX RC	—	370	PERCENT CORE RECOVERY 100		
			2	AX RC	—	365	PERCENT CORE RECOVERY 100		
362.9 / 12.5	END OF HOLE								
						360			

VERTICAL SCALE
1 INCH TO 5'-0"

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RECORD OF BOREHOLE 4

LOCATION SEE FIGURE 1 BORING DATE NOV. 1, 1962 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	PERCENT CORE RECOVERY	REMARKS
383.2	GROUND LEVEL					
0.0	VERY LOOSE TO COMPACT DARK GREY TO BROWN SILTY SAND WITH GRAVEL TRACE OF ORGANIC MATTER OCCASIONAL COBBLES AND BOULDERS (FILL)	1	2" DO	4		W.L. IN BOREHOLE AFTER COMPLETION AT RIVER LEVEL ELEV. 375.4
		2	"	1		
		3	"	11		
		4	"	13		
373.9 / 9.3	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK BECOMING INTERBEDDED GREY LIMESTONE & BLACK SHALE BETWEEN ELEV. 366.8 & 363.9 (SMALL INCLINED FRACTURES AT ABOUT ELEV. 368.5 & 364.0)	5	AX RC	–	100	
		6	AX RC	–	70	
		7	AX RC	–	90	
		8	AX RC	–	100	
358.6 / 24.6	END OF HOLE					

ELEVATION SCALE: 385, 380, 375, 370, 365, 360, 355

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

COEFFICIENT OF PERMEABILITY (CMS./SEC.) 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}

LIQUID LIMIT L_L PLASTIC LIMIT P_L WATER CONTENT W

WATER CONTENT, PER CENT

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

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PROJECT No. 6257

RECORD OF BOREHOLE 5

LOCATION: SEE FIGURE 1 | BORING DATE: NOV. 3, 1962 | DATUM: GEODETIC

BOREHOLE TYPE: WASH BORING | BOREHOLE DIAMETER: BX CASING

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES | PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION (SOIL PROFILE)	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	PERCENT CORE RECOVERY	REMARKS
						380		
378.0	GROUND LEVEL							
0.0 / 0.5	TOPSOIL							
	WEATHERED AND PARTLY FRACTURED GREY LIMESTONE BEDROCK		BX CASING DRILLED			375		BOREHOLE DRY AFTER COMPLETION OF DRILLING
369.7 / 8.3	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK (FRACTURES BETWEEN ELEV. 367.0 TO 366.7, 365.8 TO 365.6 AND 363.0 TO 362.0)		1	AX RC	-	370	96	
			2	AX RC	-	365	87	
			3	AX RC	-	360	79	
357.1 / 20.9	END OF HOLE							
						355		

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

COEFFICIENT OF PERMEABILITY (CMS./SEC.) 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} — test interval plotted at 10^{-4} between approx. elev. 362.5 and 357.5

LIQUID LIMIT L_L / PLASTIC LIMIT P_L / WATER CONTENT w (P_L — w — L_L)

WATER CONTENT, PER CENT

VERTICAL SCALE 1 INCH TO 5'-0"

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PROJECT No. 6257

RECORD OF BOREHOLE 6

LOCATION: SEE FIGURE 1 | BORING DATE: NOV. 3 - 5, 1962 | DATUM: GEODETIC

BOREHOLE TYPE: WASH BORING | BOREHOLE DIAMETER: BX CASING

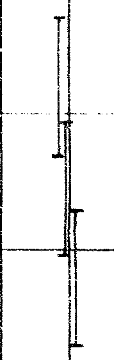
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	PERCENT CORE RECOVERY	REMARKS
370.6	GROUND LEVEL					
0.0	COMPACT GREY ANGULAR LIMESTONE GRAVEL AND FRAGMENTS WITH TRACE TO SOME SILT AND SAND (FILL)	1	2" DO	12		BOREHOLE DRY AFTER COMPLETION OF DRILLING
367.1		2	"	35		
3.5	WEATHERED AND PARTLY FRACTURED GREY LIMESTONE BEDROCK	2A	BX CA	—		
362.6 / 8.0	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK (THIN CALCITE HEALED TO OPEN VERTICAL FRACTURE THROUGHOUT MOST OF CORE. CEMENTED SAND SEAM BETWEEN ELEV. 349.7 & 349.3)	3	AX RC	—	60	
		4	AX RC	—	97	
		5	AX RC	—	100	
		6	AX RC	—	100	
346.6 / 24.0	END OF HOLE					

ELEVATION SCALE: 370, 365, 360, 355, 350, 345

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

COEFFICIENT OF PERMEABILITY (CMS./SEC.) 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}



LIQUID LIMIT L_L | PLASTIC LIMIT P_L | WATER CONTENT W (P_L — W — L_L)

WATER CONTENT, PER CENT

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

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PROJECT No. 6257

RECORD OF BOREHOLE 7

LOCATION SEE FIGURE 1 BORING DATE NOV. 6, 1962 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT.	PERCENT CORE RECOVERY	REMARKS
377.0	GROUND LEVEL					
0.0 / 375.5 / 1.5	ASPHALT PAVEMENT OVERLYING COMPACT BROWN SAND AND GRAVEL (FILL)	1	2" DO	18		
		1A	BX SA	—		
	WEATHERED AND PARTLY FRACTURED GREY LIMESTONE BEDROCK (CLAYEY SEAMS BETWEEN ELEV. 374.4 TO 373.8 AND 373.0 TO 372.6)	2	AX RC	—	100	BOREHOLE DRY AFTER COMPLETION OF DRILLING
370.5 / 6.5		3	AX RC	—	75	
	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK (THIN OXIDIZED ZONES AT ABOUT ELEV. 368.6, 367.6 AND 367.2)	4	AX RC	—	100	
364.5 / 12.5	END OF HOLE					

Elevation scale: 380, 375, 370, 365, 360

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

COEFFICIENT OF PERMEABILITY (CMS./SEC) 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}

LIQUID LIMIT L_L PLASTIC LIMIT P_L WATER CONTENT W

WATER CONTENT, PER CENT

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

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PROJECT No. 6257

RECORD OF BOREHOLE 8

LOCATION SEE FIGURE 1 BORING DATE NOV. 7, 1962 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION (SOIL PROFILE)	NUMBER	TYPE	BLOWS / FT.	PERCENT CORE RECOVERY	REMARKS
370.4	GROUND LEVEL					
0.0	LOOSE TO COMPACT DARK BROWN TO GREY BROWN SILTY SAND WITH GRAVEL AND ANGULAR LIMESTONE FRAGMENTS TRACE OF ORGANIC MATTER (FILL)	1	2" DO	10		
		2	"	6		
		3	"	13		
366.1 / 4.3	FAIRLY SOUND GREY BEDDED LIMESTONE BEDROCK (CLAYEY SEAM BETWEEN ELEV. 363.9 & 363.3)	4	AX RC	—	100	BOREHOLE DRY AFTER COMPLETION OF DRILLING
		5	AX RC	—	63	
		6	AX RC	—	100	
358.4 / 12.0	END OF HOLE					

ELEVATION SCALE: 370, 365, 360, 355

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

COEFFICIENT OF PERMEABILITY (CMS./SEC) 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}

LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W
P_L W L_L

WATER CONTENT, PER CENT

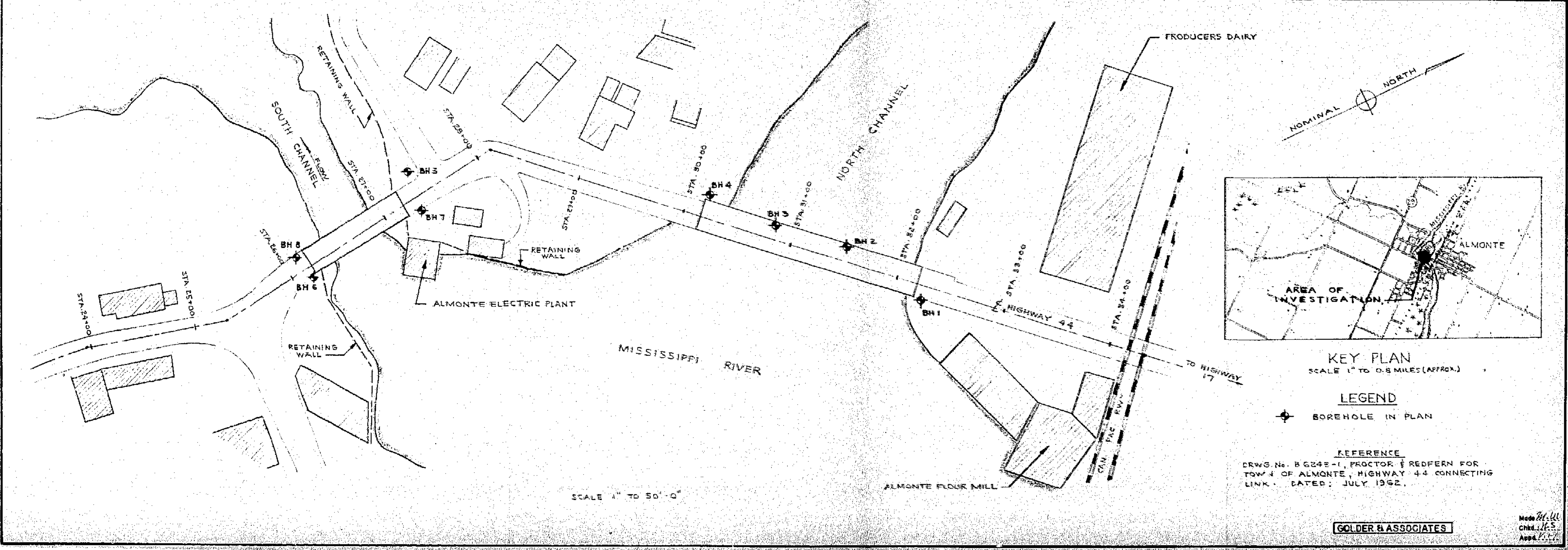
VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED [illegible]

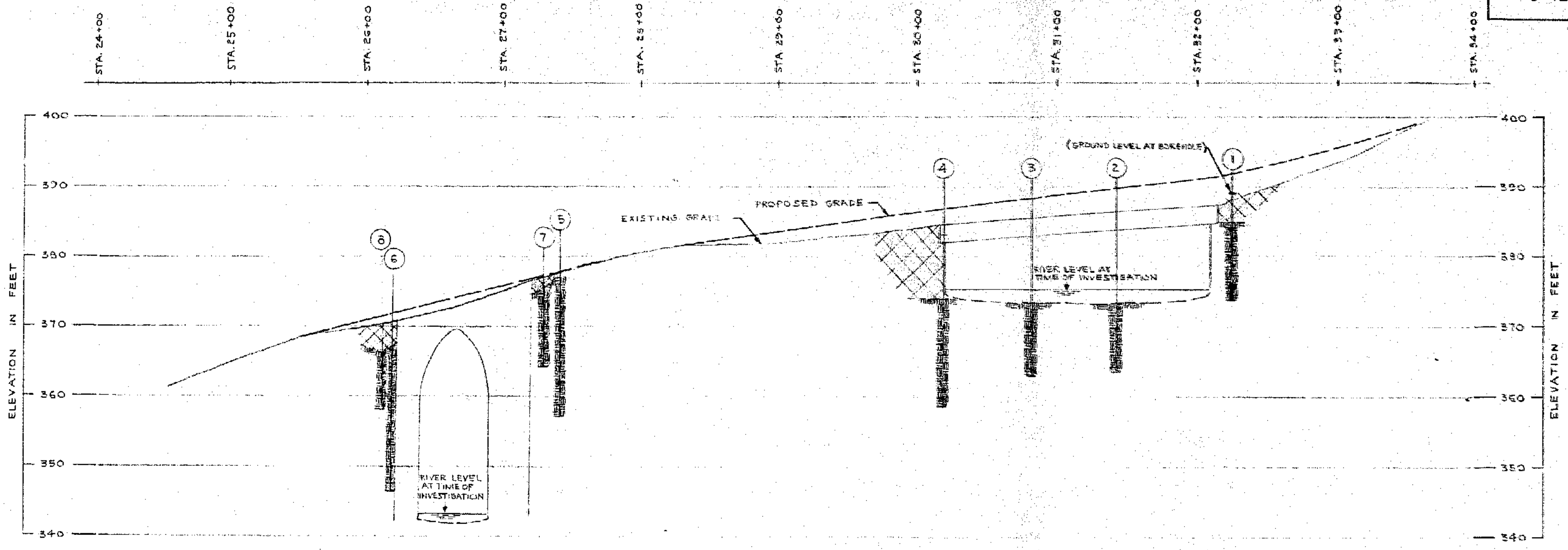
BORING PLAN

FIGURE 1



SOIL STRATIGRAPHY

FIGURE 2



SCHEMATIC SECTION ALONG CENTRELINE HIGHWAY 44

LEGEND

BOREHOLE IN ELEVATION

STRATIGRAPHY

FILL - VERY LOOSE TO COMPACT DARK GREY TO GREY BROWN SILTY SAND WITH GRAVEL AND ANGULAR LIMESTONE FRAGMENTS, TRACE OF ORGANIC MATTER.

BEDROCK - WEATHERED, PARTLY FRACTURED GREY BEDDED LIMESTONE BECOMING FAIRLY SOUND WITH DEPTH, SOME INTERBEDDED DARK SHALE, OCCASIONAL SILT SEAMS, FRACTURES, FISSURES AND THIN OXIDIZED ZONES.

REFERENCE

DRWG. No. B6243-1, PROCTOR & REDFERN FOR TOWN OF ALMONTE, HIGHWAY 44 CONNECTING LINK. DATED: JULY 1962

SCALES

HORIZONTAL 1" TO 50'-0"

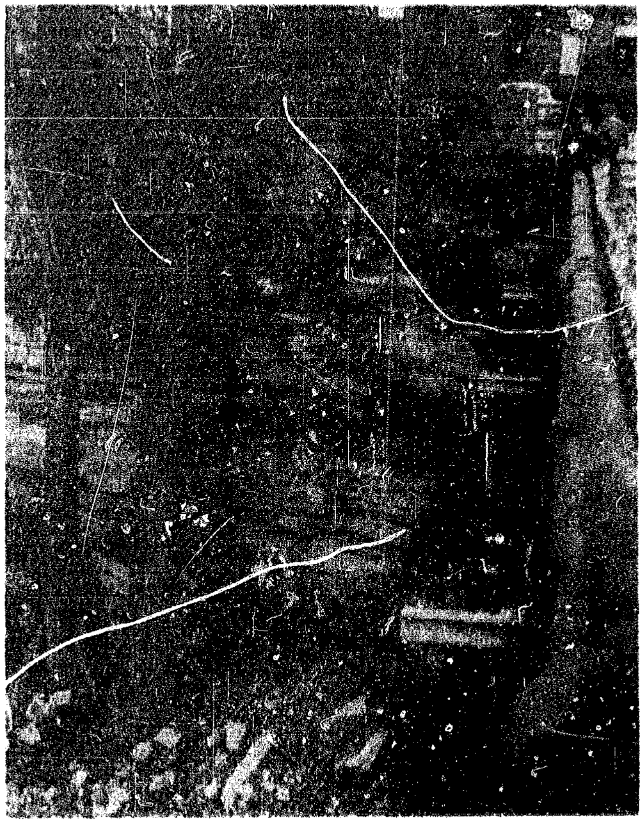
VERTICAL 1" TO 10'-0"

GOLDER & ASSOCIATES

Made
Chkd.
Appd.

SITE PHOTOGRAPHS

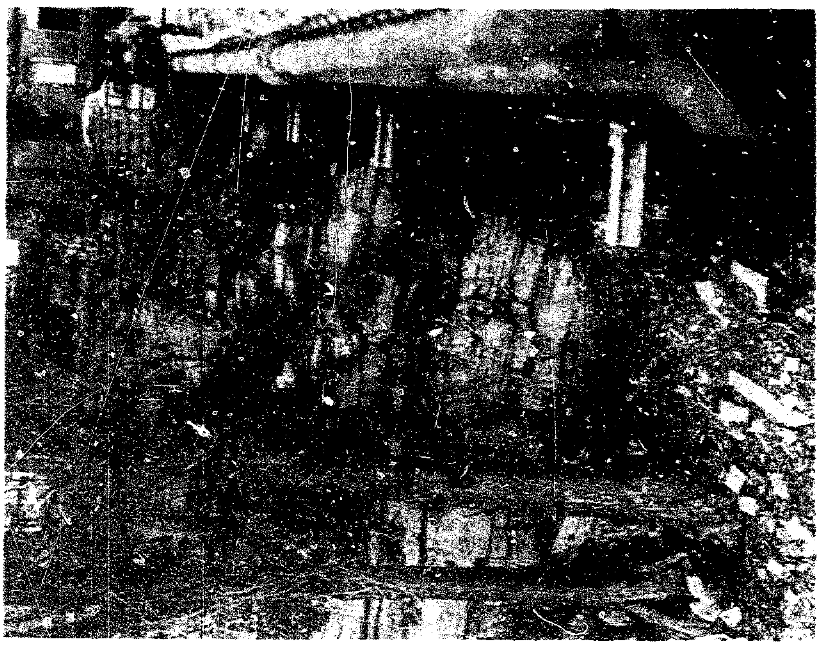
FIGURE 3



View looking north showing the weathered and jointed exposed limestone bedrock face on the north side of the south channel crossing. West side of existing arch bridge shown on the right. Drillrig in background at borehole 5.

GOLDER & ASSOCIATES

SITE PHOTOGRAPHS | FIGURE 3



View looking north showing the weathered and jointed exposed limestone bedrock face on the north side of the south channel crossing. West side of existing arch bridge shown on the right. Drillrig in background at borehole 5.

GOLDER & ASSOCIATES

SITE PHOTOGRAPHS

FIGURE 4

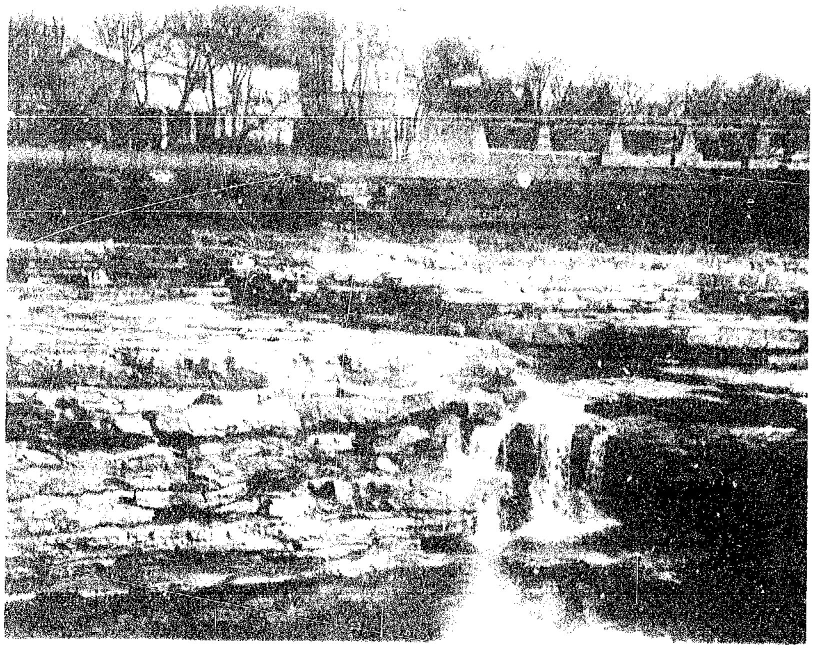
View looking east upstream of south channel crossing showing bedded structure of the limestone bedrock at the falls. Almonte flour mill and railway bridge in background.

View looking south - east showing south-west corner of existing arch bridge at south channel crossing and limestone slabs which have fallen down from the bedrock face above.

GOLDER & ASSOCIATES

SITE PHOTOGRAPHS

FIGURE 4



View looking east upstream of south channel crossing showing bedded structure of the limestone bedrock at the falls. Almonte flour mill and railway bridge in background.

View looking south - east showing south-west corner of existing arch bridge at south channel crossing and limestone slabs which have fallen down from the bedrock face above.