

# **APPENDIX B**



**Geotechnical Engineering  
Come Work**

Val-County, New Brunswick  
March 7, 2013

Prepared for PWGSC  
**Project No. 1000.1 R1**





# GEMTEC

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File: 6489.17 R01

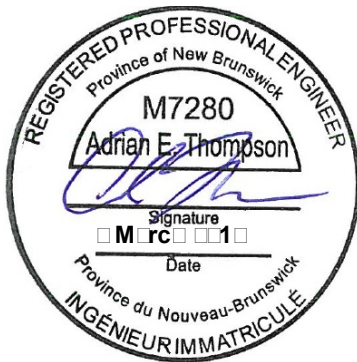
Public Works and Government Services Canada  
1045 Main Street Unit 100  
Moncton, NB  
E1C 1H1

Attention: Garth Holder, Project Manager

Re: **Geotechnical Report for the Val-County Water  
Supply Project**

Enclosed is our geotechnical report for the above noted project in Val-County, New Brunswick.

Contact the undersigned if you have any questions or comments concerning this report.



Adrian Thompson, M.Sc.E, P.Eng

GEMTEC Limited

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Enclosures

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**Geotechnical Investigation  
Come W  
Come New Brw**

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- A Descriptive Terms and Detailed Borehole Logs
- B Rock Core Photos

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**Geotechnical Investigation**  
**Val-Caseau Wharf**  
**Val-Caseau New Brunswick**

## 1. Introduction

GEMTEC Limited was retained by Public Works and Government Services Canada to undertake a geotechnical investigation at the Val-Caseau Wharf in Val-Caseau, New Brunswick. We understand that wharf improvements to Structures 401, 402 and 405 will include the incorporation of a Berlin wall along the face of the wharf as proposed for this location. We further understand the following:

- We understand that the proposed HP 310 x 79 steel H piles will require a finalized depth into bedrock of about 1.0 metres, with pre-cast concrete panels between the piles on 2.4 metre centres.
- Based on drawing provided to us by VALRON Engineers Inc., we understand that the upper portion of the existing timber cri wharf 1.3 metres ± will be removed.
- The remaining cribs will be filled with crushed rock fill to the underside of slab-on-grade deck.

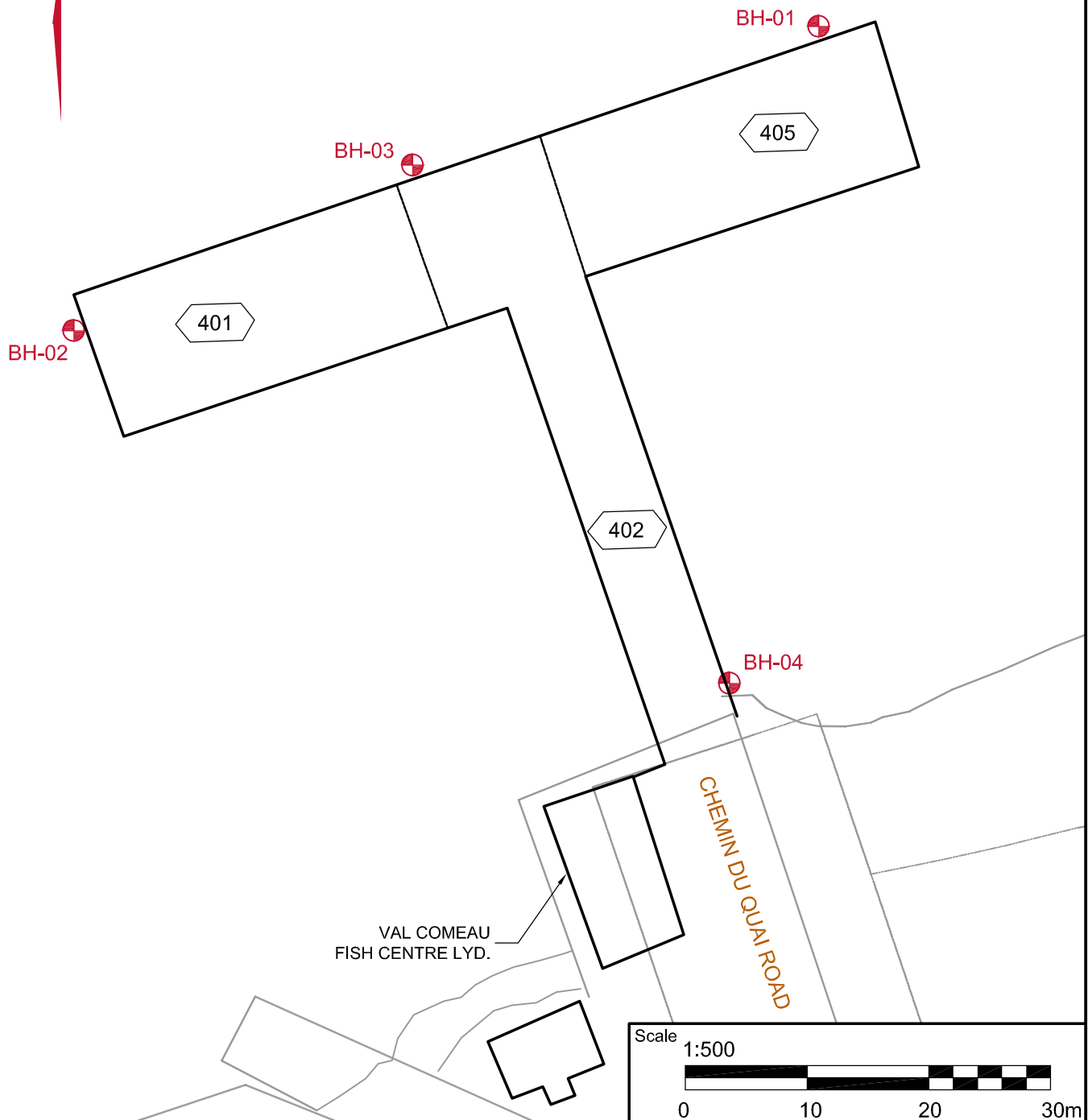
In order to assess the existing soil and bedrock conditions, four boreholes (BH) were put down on February 12, 2013 using a geotechnical drill rig subcontracted to MEG Drilling. Boreholes were put down to depths ranging from 4.6 to 5.9 metres in the presence of one of our geotechnical engineers. Bedrock was cored at each borehole location. Detailed borehole logs (Appendix A) and bedrock core photos (Appendix B) are appended.

A site plan showing borehole locations and general site layout is presented in Figure 1. Boreholes were surveyed by GEMTEC Limited and reference control point 88B9001 with a published chart datum (CD) elevation +1.929 metres.

## 2. Site Conditions

The Val-Caseau Wharf is located in Val-Caseau, New Brunswick. Structures 401, 402 and 405 consist of a timber crib structure with a concrete panel deck. The existing concrete deck elevation ranges from about +1.4 to +1.7 metres CD. The harbour bottom elevation adjacent to the wharf varied at the borehole locations from 1.8 to 2.3 metres CD. The structure shows signs of deterioration throughout the visible timber crib structure.

At the time of our investigation the harbour was ice covered and snow covered much of the concrete deck. Therefore we were unable to visually assess the overall condition of the existing timber wharf structure and measure the harbour bottom around the entire wharf.



Project  
GEOTECHNICAL INVESTIGATION,  
STRUCTURES 401, 402 & 405  
VAL COMEAU WHARF, VAL COMEAU, NB.

Drawing  
BOREHOLE LOCATION PLAN

Drawn By  
CHG

Date  
FEB 2013

File No.  
64891701

Drawing No.  
FIGURE 1

Revision No.  
0



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AND SCIENTISTS

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## 2.2 Proposed Bedrock Conditions

The soil and bedrock conditions encountered at the four borehole locations consist of a relatively thin layer of overburden fill to sandstone bedrock.

The overburden soils generally consist of deposited material over brown silty sand. The overburden soils ranges in thickness from 0.3 to 0.4 metres, averaging 0.3 metres.

Sandstone bedrock was encountered at all four borehole locations. The bedrock surface elevation ranges from -2.10 (BH-02) to -2.59 metres (CD (BH-01)) averaging elevation -2.33 metres (CD). On this basis the bedrock elevation is relatively flat across the site. The rock quality designation (RQD) ranges between 0 and 35% therefore the bedrock quality is generally very poor.

Unconfined compressive strength tests were not performed on the bedrock cores, as the retrieved bedrock core samples did not have sufficient lengths.

## 2.3 Design and Recommendations

We understand that the Berlin wall design will consist of HP 130 x 79 steel H piles with a penetration depth into bedrock of about 1 metre, with pre-cast concrete panels placed between the piles. Based on drawing provided to us by VALRON Engineers Inc., we understand that the upper portion of the existing timber crib wharf 1.3 metres ± will be removed. The remaining cribs will be filled with crushed rock fill to the underside of slab-on-grade deck.

Based on required steel H piles penetration depths in the order of 1 metre into bedrock and the bedrock quality encountered at the site, it is our opinion that driven piles would be able to penetrate into the bedrock a depth of 1 metre provided that the hammer and piles are properly sized. While it is our opinion that H piles could be advanced to a depth of 1 metre, rock socketing may be required if more competent zones of bedrock are encountered along the proposed alignment of the Berlin wall.

We understand that a nearby structure was carried out using the rock socket method. This may be an indication that more competent rock zones exist within the area.

In order to drive the piles into the bedrock, we offer the following recommendations:

- It is our opinion that the proposed H Pile 310x79 pile section should be reviewed, and possibly increased, if driving piles into bedrock is the selected method of installation. Due to the shallow bedrock depth, there will be a high transfer of energy directly to the pile toe. Pile stresses at the toe will be of concern.

- Driving shoes, such as Standard Titus HHP-S pile points or approved alternate, are recommended.
- The estimated rated hammer energy used for finalization shall be at least 2,000 ft-lbs/in<sup>2</sup>.
- GEMTEC would be pleased to carry out a drivability analysis once the hammer and pile specifics have been finalized.
- Should the penetration depth increase beyond 1 metre into bedrock, GEMTEC should be consulted to reassess the recommendations for pile installation.

We are also providing the following design recommendations:

- The passive resistance of the bedrock may be computed using a friction angle of 45 degrees.
- The Berlin wall should be backfilled using NBDOT 75 mm minus crushed rock or gravel subbase placed in 300 mm thick lifts and compacted to 95% of the maximum dry density as determined by ASTM D698 (Standard Proctor).
- A 150 mm thick layer of NBDOT 31.5 mm minus crushed rock or gravel base should be placed directly below the slab-on-grade. This layer should be compacted to 95% of standard Proctor.
- The friction angle and bulk unit weight of the compacted crushed rock backfill may be taken as 35 degrees and 22 kN/m<sup>3</sup>, respectively. Therefore, the active  $K_a$ , passive  $K_p$  and at-rest  $K_o$  pressure coefficients may be taken as  $K_a = 0.27$ ,  $K_p = 3.69$  and  $K_o = 0.43$ .
- During construction, an engineer should assess the status of timber crib wharf excavation to ensure that the retaining timber crib and sandstone fill is suitable to support the new granular backfill. Some isolated settlement may occur if voids are present within the existing sandstone fill or if the retaining timber crib decays significantly over the years. The reinforced concrete slab-on-grade deck should be designed to bridge some minor localized settlements.



## 4.4 Geotechnical

This report solely addresses the geotechnical aspects of the site and cannot be regarded as an environmental assessment of the site.

Boreholes put down on this site were widely separated and bedrock conditions may vary from those determined at the borehole locations. Although representative samples have been collected throughout the site, GEMTEC Limited should be contacted immediately if the bedrock encountered during excavation differs from those encountered in our geotechnical investigation in order to reassess our recommendations.

# DESCRIPTIVE TERMS- BOREHOLE/TEST PIT LOG

SOILS

GRAIN SIZE

0.01

0.1

1.0

10

100

1000mm

SILT CLAY

SAND

GRAVEL

Cobble

BOULDER

0.08

0.4

2

5

80

200

DESCRIPTIVE TERMINOLOGY

0

10

20

35

weight. % of material

TRACE	SOME	ADJECTIVE	and > 35% noun > 35% and main fraction
trace clay, etc.	some gravel, etc.	silty, etc.	sand and gravel, etc.

COMPACTNESS  
gravels, sands, tills

N, RANGE	0 - 4	4 - 10	10 - 30	30 - 50	> 50
DENSITY	V. LOOSE	LOOSE	MEDIUM	DENSE	V. DENSE

CONSISTENCY  
silt, clay

S, KPa	< 12.5	12.5 - 25	25 - 50	50 - 100	100 - 200
CONSISTENCY	V. SOFT	SOFT	MEDIUM	STIFF	V. STIFF

ROCK

RQD

0 - 25

25 - 50

50 - 75

75 - 90

90 - 100

OVERALL QUALITY

VERY POOR

POOR

FAIR

GOOD

EXCELLENT

FRACTURE SPACING

VERY CLOSE 20 - 60 mm

CLOSE 60 - 200 mm

MODERATE 200 - 600 mm

WIDE 600 - 2000 mm









VERY WIDE 2 - 6 m

COMP. STR. MPa	1 - 5	5 - 25	25 - 50	50 - 100	100 - 250
DESCRIPTION	V. WEAK	WEAK	MODERATE	STRONG	V. STRONG





## SAMPLE TYPES (location to scale on log)

S SPLIT TUBE	G SHOVEL
T SHELBY TUBE	H CARVED BLOCK
P PISTON	K SLOTTED
F AUGER	V IN SITU VANE
W WASH	NR NO RECOVERY

## LOG SYMBOLS

			
GRAVEL	SAND	SILT	CLAY
			
ORGANIC	BOULDER	ROCK	TILL

## ROCK CORES A(30mm); B(41mm); N(54mm)

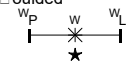
			
SCREEN WITH SAND	PIPE WITH SAND	PIPE WITH BENTONITE	PIPE WITH BACKFILL

## WELL SYMBOLS

- N - standard penetration test; blows by 475 J drop hammer to advance Std. 50mm O.D. split tube sampler 0.3m  
 RQD - percent of core consisting of hard, sound pieces in excess of 100mm long (excluding machine breaks)  
 RECOVERY - sample recovery expressed as percent or length  
 S - shear strength, kPa; vane  $\oplus$ ; penetrometer  $\blacksquare$ ; unconfined  $\circ$ ; U<sub>c</sub> unconfined compressive strength  
 S<sub>r</sub> - shear strength, remoulded; vane  $\otimes$ ; penetrometer  $\square$   
 D<sub>d</sub> - dry density; t/m<sup>3</sup>  
 W - natural moisture content, percent \*  
 PL - plastic limit, percent —  
 LL - liquid limit, percent —  
 ND - non detect, total petroleum hydrocarbons (TPH) not detected in soil  
 Groundwater Level  $\nabla$  ; Seepage  $\nabla$

[illegible]

[illegible]

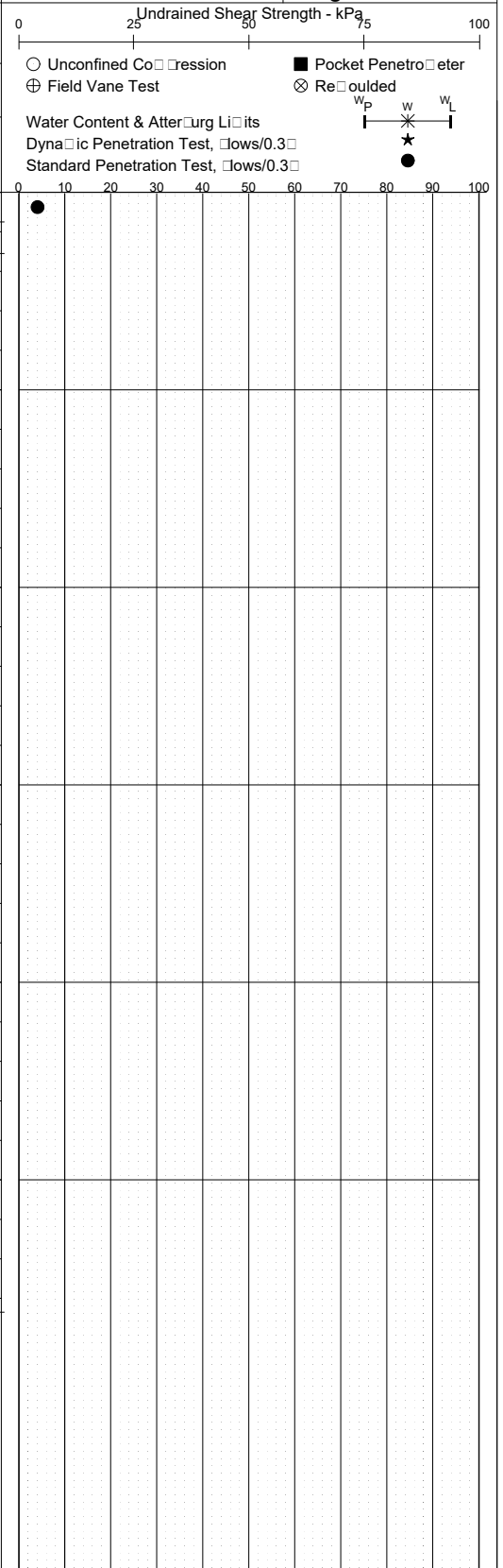
Client      Public Works and Government Services Canada						Proj No.      6489.17		<b>BOREHOLE</b> <b>BH-03</b> Page 1 of 1	
Project      Structure 401, 402 and 405						Date Drilled      12Feb2103			
Location      Val Cartier Wharf, Val Cartier, NB						<div style="display: flex; justify-content: space-between;"> <div>           0      25      50      75      100            Undrained Shear Strength - kPa         </div> <div>           0      10      20      30      40      50      60      70      80      90      100            Water Content &amp; Atterberg Limits            Dynamic Penetration Test, blows/0.3m            Standard Penetration Test, blows/0.3m         </div> </div> <div style="margin-top: 10px;"> <div style="display: flex; justify-content: space-between;"> <div>           ○ Unconfined Compression            ⊕ Field Vane Test         </div> <div>           ■ Pocket Penetrometer            ⊗ Reconstituted         </div> </div> <div style="text-align: right; margin-top: 5px;"> <math>w_p</math>      <math>w</math>      <math>w_L</math>   </div> </div>			
Ground Level,      -1.93		Datum:      Chart		Logged By      RB					

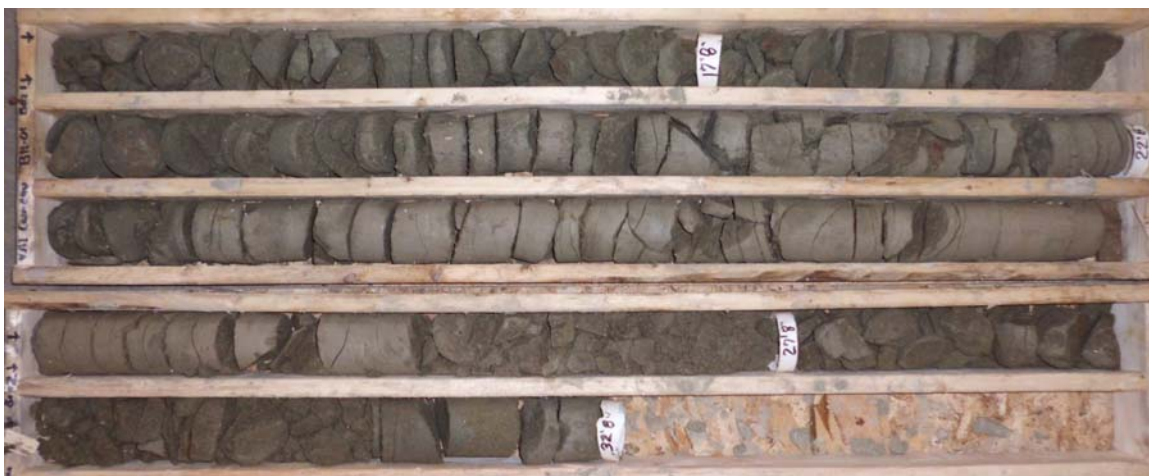
DEPTH	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N	REC		
0	1	SS	16	585		0.15 Very loose black silty sand 0.45 Coarse sandstone conglomerates -2.08 -2.38 Fractured Sandstone BEDROCK
1	2	H	35	86		
2	3	H	13	80		
3	4	H	17	95		
4						
						4.60 -6.53 End of BH-03 at 4.60 metres below hard bottom

Client	Public Works and Government Services Canada	Proj No.	6489.17	BOREHOLE
Project	Structure 401, 402 and 405	Date Drilled	12Feb2103	BH-04
Location	Val Courbeau Wharf, Val Courbeau, NB			Page 1 of 1

Ground Level, ☐ -1.97      Datum: ☐ Chart      Logged By ☐ RB

DEPTH <input type="checkbox"/>	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N	REC		
0	1	SS	4	75	F F F	0.15 Black wood/tier pieces -2.12
	2	SS	55/75	230		0.31 Very loose brown to green brown silty SAND SM with some clay and sandstone conies -2.28
	3	H	10	100		Green brown fractured Sandstone BEDROCK
1						
	4	H	22	98		
2						
3	5	H	35	95		
4						
	6	H	28	80		
5						
						5.67 -7.64
						End of BH-04 at 5.67 metres below harbour bottom





**Photo 1 - Borehole 1**



**Photo 2 - Borehole 2**



**Photo 3 - Borehole 3**



**Photo 4 - Borehole 4**