

Appendix 7.3

Log of Drillhole

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GEOLOGIC LOG OF DRILL HOLE

PROJECT	HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-1	SHEET 1 OF 7	
LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	70.00 m	COMMECED	2001/12/1
ELEVATION	208.84 m	DEPTH OF OVERBURDEN	2.05 m	COMPLETED	2001/12/5
COORDINATE	N 305 093 m E 569 624 m	LENGTH OF ROCK DRILLING	67.95 m	DRILLED BY	SWISSBORING
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	70.00 m	LOGGED BY	L Perez
BEARING OF ANGLE HOLE		CORE RECOVERY	100%	SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE	DESCRIPTION	WATER TARI F	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
1	COLLUVIAL DEPOSIT			CASING NW	Light Brown					Colluvial material low to medium consistency, low water content, low plasticity, low to moderate, dry strength consists of basalt and andesite fragments, up to 40 mm in diameter					m
2								3 to 4	2.05 m						
3								1		Basalt fine to medium grained, igneous, from 2.05 m to 4.50 with abundant voids, joints are planar, rough and some joints contains very thin iron oxides films and some joints contain clay minerals from 4.85 to 5.33 m ; exhibit vertical joints and contains clay minerals, joints dip 20°, 30° and 90°					
4			38%		Light Gray	1 to 2	2 to 3	2							
5						1		3 to 4	5.75 m			Permeability test was suspended by water leakage at 3psi 3.00-5.00 m			203.84
6	BASALT			CASING NQ	Brown to Reddish Brown	2 to 3	3 to 4	2		Basalt, joints are planar, rough and contains clay minerals from 8.00 m to 8.80 m, exhibit vertical joint, joints dip 50°, 70° and 90°					
7			69%					4					1.2 L.U.		
8												2.8 m dic 2 Hole depth 8.00 m			
9			15%		Light Gray	2	2 to 3	3							
10								4	10.00 m			2.20 m, dic 2, Hole depth 10.00 m			198.84

The recovery value will only be shown if it is below 100%.

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GEOLOGIC LOG OF DRILL HOLE

PROJECT	HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER	CDB-1	SHEET 2 OF 7
LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	70.00 m
ELEVATION	208.84 m	DEPTH OF OVERBURDEN	2.05 m
COORDINATE	N 305 093 m E 569 624 m	LENGTH OF ROCK DRILLING	67.95 m
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	70.00 m
BEARING OF ANGLE HOLE		CORE RECOVERY	100%
		COMMECED	2001/12/1
		COMPLETED	2001/12/5
		DRILLED BY	SWISSBORING
		LOGGED BY	L Perez
		SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION	
									DESCRIPTION	LUGEON VALUE					
11	BASALT	[Pattern]	37%		Light Gray	2 to 3	4	3	Basalt in some places exhibit spheroidal weathered, joints are planar, rough, and some joints contains clay minerals, joints dip 50° to 70°				11		
12			31%		Light Gray	2 to 3	4	3 to 4						12	
13			62%		Light Gray with Brown	2 to 3	4	3 to 4	14.00 m					13	
14			62%		Light Gray with Brown	2 to 3	4	3 to 4	1					14	
15			62%		Light Gray with Brown	2 to 3	4	3 to 4	2	Basalt joints are planar, stepped rough, and contains very thin iron oxide films, from 15.70 m to 16.50 m exhibit vertical joint		7.2 LU	5.60 dic 2 Hole depth 15.00 m	15	193.84
16			32%		Light Gray	2 to 3	3	2 to 3	4	16.30 m				16	
17			60%		Light Gray	3	3	2 to 3	2					17	
18			47%		Light Gray w/ Reddish Brown	2 to 3	3	2 to 3	4	Basalt exhibit abundant voids, joints are planar, rough and contains clay minerals, joints dip 60° and 70°		14.8 LU		18	
19			56%		Light Gray w/ Reddish Brown	2 to 3	3	2 to 3	3					19	
20			38%		Dark Gray	2	2	2 to 3	2 to 3	20.00 m			5.93 dic 2 Hole depth 20.00 m	20	188.84

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GEOLOGIC LOG OF DRILL HOLE

PROJECT	HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER	CDB-1	SHEET 3 OF 7
LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	70 00 m
ELEVATION	208 84 m	DEPTH OF OVERBURDEN	2 05 m
COORDINATE	N 305 093 m E 569 624 m	LENGTH OF ROCK DRILLING	67 95 m
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	70 00 m
BEARING OF ANGLE HOLE		CORE RECOVERY	100%
		SUPERVISION BY Walter Hernandez	

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	OBSERVATION OF CORE				DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
				KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS							
21	BASALT	[Pattern]	45 %	Light Gray	3	3	4	Basalt joints are planar, rough and contains clay minerals, from 20 00 to 20 65 m exhibit vertical joint, joints dip 60°, 70° and 90°	18 LU	18 45 dic 03	Hole depth 25 00 m	21	m	
22			D B	2	2	21 30 m	22							
23			Light Gray	3	3	Basalt exhibit abundant voids, contains scattered joints and contains clay minerals, joints dip 40° to 60°	23							
24			D B	4	4	25 60 m	24							
25			40 %	Light Gray	2 to 3	2	3	Basalt joints are planar, rough and contains clay minerals, joints dip 40° to 70°	3 1 LU	11 35 dic 03	Hole depth 30 00 m	25	183 84	
26	26 %	Light Gray	2 to 3	2	4	28 50 m	26							
27	61 %	Light Gray	2 to 3	2	3	3	27							
28	28 %	Light Gray	2 to 3	2	3	4	28							
29			100 %	Reddish Brown	2 to 3	3	1 to 2	Basalt Brecciaceous, consists of basaltica clasts up to 0 10m in length, the matrix is tuffaceous, hard, joints are planar, close, joint dip 0°, 10° and 30°				29		
30												30	178 84	

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GEOLOGIC LOG OF DRILL HOLE

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PROJECT · HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER

CDB-1 SHEET 4 OF 7

LOCATION · CHAPARRAL DAM SITE	DEPTH OF HOLE 70 00 m	COMMECED 2001/12/1
ELEVATION · 208 84 m	DEPTH OF OVERBURDEN 2 05 m	COMPLETED 2001/12/5
COORDINATE N 305 093 m E 569 624 m	LENGTH OF ROCK DRILLING · 67 95 m	DRILLED BY SWISSBORING
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 70 00 m	LOGGED BY L. Perez
BEARING OF ANGLE HOLE ·	CORE RECOVERY 100%	SUPERVISION BY Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION	
									DESCRIPTION	LUGEON VALUE					
31	BASALT	[Patterned]	53 %		Light Gray	2 to 3	3	3	3	3	18.5 L U		31	m	
32			11 %					3	3	3					Basalt, fine grained, igneous, massive, joints are planar, rough close and contains clay minerals, joint dip 30° to 50°
33						4	3	3	3	3	16.10 dic 03 Hole depth 35 00 m	33	34		
34							3	3	3	3				3	24.5 L U
35			100 %				Reddish Brown	2	1 to 2	1	1	1	30.75 dic 03 Hole depth 40 00 m		
36					Light Gray with Reddish Brown	2 to 3	2 to 3	2	2	2	38	37			36
37	19 %				Light Gray	1	2 to 3	2 to 3	2 to 3	2 to 3			38	38	
38	41 %				Light Gray	1	2 to 3	3 to 4	3 to 4	3 to 4	39	39			38
39	32 %												40	40	
40															

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GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-1 SHEET 5 OF 7

LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	70 00 m	COMMECED	2001/12/1
ELEVATION	208.84 m	DEPTH OF OVERBURDEN	2 05 m	COMPLETED	2001/12/5
COORDINATE	N 305 093 m E 569 624 m	LENGTH OF ROCK DRILLING	67 95 m	DRILLED BY	SWISSBORING
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	70 00 m	LOGGED BY	L. Perez
BEARING OF ANGLE HOLE		CORE RECOVERY	100%	SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION													
									DESCRIPTION																				
41	BASALT		0 → 100%		Light Gray	1	2 to 3	4	Same as 38 30 to 43 05m						41	m													
42									23%																				
43									40%												43 05 m		10 3 LU						
44									26%									1 to 2	2 to 3		Basalt, fine grained, igneous, massive, joints are rough, close and contains manganese, mostly dips to 30°, 40° and 60°								
45									11%									3	3				30 55 dic 04					45	163 84
46						2								46															
47									47 15 m					47															
48					Reddish Brown	2 to 3	3 to 4	4	Basalt, partially brecciateous and tuffaceous, joints are planar, rough, close, with manganese oxides.				21 8 LU	48															
49					L Reddish Brown w/ Light Gray	2		3						49															
50						2 to 3								50	158 84														

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GEOLOGIC LOG OF DRILL HOLE

PROJECT	HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER	CDB-1	SHEET 6 OF 7
LOCATION : CHAPARRAL DAM SITE	DEPTH OF HOLE ·	70 00 m	COMMECED 2001/12/1
ELEVATION : 208.84 m	DEPTH OF OVERBURDEN ·	2 05 m	COMPLETED 2001/12/5
COORDINATE N:305 093 m E 569 624 m	LENGTH OF ROCK DRILLING ·	67 95 m	DRILLED BY · SWISSBORING
ANGLE FROM HORIZONTAL · 90°	TOTAL LENGTH OF CORE	70 00 m	LOGGED BY L. Perez
BEARING OF ANGLE HOLE :	CORE RECOVERY	100%	SUPERVISION BY Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and Ron	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		DEPTH	ELEVATION
									DESCRIPTION	WATER TARI F		
			0 → 100%							WATER PRESSURE TEST LEAKAGE OF DRILLING WATER		
										0 LUGEON VALUE 40		
51			91 %		Brown to Reddish Brown	2 to 3		1 to 2	Same as 47 15 to 55 00 m		51	m
52			38 %		Light Gray w/ Brown	2	2 to 3	2 3		34 45 dic 04 Hole depth 52 40 m	52	
53			19%		Reddish Brown	3		2		13 0 LU	53	
54			67%					1 to 2			54	
55			100%					4	55 00 m	30 19 dic 04 Hole depth 55 00 m	55	153 84
56	BASALT		67 %		Light Gray	1 to 2	2 to 3	4 3 4	Basalt, Joints are planar, rough, and contain clay mineral, from 57 75 m to 58 65 m exhibit sound rock,		56	
57										6 7 LU	57	
58											58	
59			65 %						58 90 m		59	
60			55%						Agglomeratic basalt volcanic vesicular, joints are planar and rough, and contains clay minerals, dip 60° to 70°	24 80 dic 04 Hole depth 60 00 m	60	148 84

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GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER

CDB-1 SHEET 7 OF 7

LOCATION · CHAPARRAL DAM SITE	DEPTH OF HOLE 70.00 m	COMMECED 2001/12/1
ELEVATION 208.84 m	DEPTH OF OVERBURDEN 2.05 m	COMPLETED 2001/12/5
COORDINATE N 305 093 m E 569 624 m	LENGTH OF ROCK DRILLING 67.95 m	DRILLED BY SWISSBORING
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 70.00 m	LOGGED BY L. Perez
BEARING OF ANGLE HOLE	CORE RECOVERY 100%	SUPERVISION BY Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TARI F	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION			
					COLOR	WEATHERING	HARDNESS	CORE CUTTING									
61	BASALT	[Patterned]	54 %		Light Gray to Dark Gray	1 to 2	3	3 to 4	Same as 58.90 to 60.50 m	[Graph]	[Graph]	[Graph]	61	m			
62			15 %						Basalt joints are planar, rough and contain clay minerals, joints dip 50° to 60°								
63			10 %						63.80 m								
64			67 %						Basalt, igneous, massive, strong, fine grained, joints are planar, rough, contain manganese oxide films, joints dip 50° to 60°								
65			60 %						45.60 dic 05 Hole depth 65.00 m								
66			62 %						1 to 2						66.90 m		
67			55 %													Basalt, medium grained, igneous, with voids, joints are planar, rough, and contain clay minerals from 69.50 m to 69.87 joints are close and joints	
68			100 %						Reddish Brown						1 to 2	2	60 LU.
69			82 %						Light Gray						2		
70			60 %														End of Boring

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GEOLOGIC LOG OF DRILL HOLE

PROJECT · HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER

CDB-2 SHEET 1 OF 6

LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	60.00 m	COMMECED	2001/12/6
ELEVATION	183.95 m	DEPTH OF OVERBURDEN	3.00 m	COMPLETED	2001/12/9
COORDINATE	N 305 147 m E 569 702 m	LENGTH OF ROCK DRILLING	53.65 m	DRILLED BY	SWISSBORING
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	56.65 m	LOGGED BY	L. Perez
BEARING OF ANGLE HOLE		CORE RECOVERY	100%	SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER 0 LUGEON VALUE 40	DEPTH	ELEVATION
1	ALLUVIAL DEPOSIT	[Symbolic Log]	[Recovery]		Light Brown				Alluvial deposit: consists of sand and gravel, contains rock fragments up to 0.20 m in diameter, fresh to moderate weathered, silty sand matrix, low water content, low plasticity	[Graph]	[Graph]	[Graph]	1	
2														
3														
3.00								3.00 m						
4	ALLUVIAL DEPOSIT	[Symbolic Log]	[Recovery]		Light Gray				Alluvial Deposit: consists of gravel up to 0.20 m in size, rounded, hard with traces of sand	[Graph]	[Graph]	[Graph]	4	
5														
6														
7	BASALT	[Symbolic Log]	[Recovery]		Brown to Reddish Brown	2-3	3	1 to 2	Basalt, from 7.75 m to 9.40 m contains abundant voids, joints are planar, fresh to slightly weathered, contains clay minerals, joints dip 40° to 65°	[Graph]	[Graph]	[Graph]	7	178.95
8														
9														
10								3-4					10	173.95

The recovery value will only be shown if it is below 100%.

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GEOLOGIC LOG OF DRILL HOLE

PROJECT	HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-2	SHEET 2 OF 6	
LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	60.00 m	COMMECED	2001/12/6
ELEVATION	183.95 m	DEPTH OF OVERBURDEN	3.00 m	COMPLETED	2001/12/9
COORDINATE	N 305 147 m E 569 702 m	LENGTH OF ROCK DRILLING	53.65 m	DRILLED BY	SWISSBORING
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	56.65 m	LOGGED BY	L. Perez
BEARING OF ANGLE HOLE		CORE RECOVERY	100%	SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		DEPTH	ELEVATION
									DESCRIPTION	WATER TARI F		
11			25% 90%			2-3	3	3	Same as 9.40 - 10.00 m	0.97 m dic 07 Hole depth 10.6 m	11	m
12			46%		Light Gray	2	2	3	Basalt joints are planar, rough, and contains clay minerals, joints dip 50° to 70°	5.9 LU	12	
13											13	
14									14.00 m		14	
15	BASALT		67% 60% 63%					4			15	168.95
16			60%								16	
17			50% 80%		Dar k Gray	3	3	4	Fault Zone (15.25-20.00 m) Basalt, joints exhibit slickensided surfaces and contains iron oxides and clay minerals	4.9 CF	17	
18			63%							0.60m dic 08 Hole depth 18.75 m	18	
19			63%								19	
20			80% 83%							5.50 m dic 08 Hole depth 20.00 m	20	163.95

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GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-2 SHEET 3 OF 6

LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	60.00 m	COMMECED	2001/12/6
ELEVATION	183.95 m	DEPTH OF OVERBURDEN	3.00 m	COMPLETED	2001/12/9
COORDINATE	N 305 147 m E 569 702 m	LENGTH OF ROCK DRILLING	53.65 m	DRILLED BY	SWISSBORING
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	56.65 m	LOGGED BY	L. Perez
BEARING OF ANGLE HOLE		CORE RECOVERY	100%	SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
					COLOR	WEATHERING	HARDNESS	CORE CUTTING							
20	BASALT	[Log symbols]	[RQD bars: 35%, 24%, 60%, 29%, 50%, 20%, 75%, 92%]		1	3	3	4	Same as 14 00-20 60 m	[Water pressure test graph]	[Leakage graph]	[Lugeon graph]			m
21					2	4	4	2	20 60 m						
22					Dark gray to Light Gray	2	2 to 3	2 to 3	Basalt joints are planar, rough and contain clay minerals and abundant voids, joints dips 40° to 60°, moderate strength						
23							4		22 90 m						
24					Reddish Brown to Dark Brown	2	3	2	Basalt, joints are planar, rough and contains iron oxides and clay minerals, from 24.8 m to 25 25 m exhibit voids, joints dips 50° to 70°						
25							3		25 25 m						
26					Dark Gray	3	3	2	Basalt joints are planar, rough and contains iron oxides, and clay minerals, joints dip subhorizontally,						
27					Reddish Brown to Dark Brown	2 to 3	3	4	Basalt joints are planar, rough and contain clay minerals, joints dip 50°						
28					Dark Gray	2 to 3	3	4	Basalt joints are planar, rough, and contains iron oxides and clay minerals, joints dip 60°						
29					Reddish Brown	2 to 3	3	3	Basalt joints are planar, rough, and contains clay minerals, joints dip 40° to 50° and scattered voids						
30					29 30 m										

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GEOLOGIC LOG OF DRILL HOLE

PROJECT · HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER

CDB-2 SHEET 4 OF 6

LOCATION · CHAPARRAL DAM SITE	DEPTH OF HOLE · 60.00 m	COMMECED · 2001/12/6
ELEVATION · 183.95 m	DEPTH OF OVERBURDEN · 3.00 m	COMPLETED · 2001/12/9
COORDINATE · N 305 147 m E 569 702 m	LENGTH OF ROCK DRILLING · 53.65 m	DRILLED BY · SWISSBORING
ANGLE FROM HORIZONTAL · 90°	TOTAL LENGTH OF CORE · 56.65 m	LOGGED BY · L Perez
BEARING OF ANGLE HOLE	CORE RECOVERY · 100%	SUPERVISION BY · Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION																																					
					COLOR	WEATHERING	HARDNESS	CORE CUTTING																																												
31	BASALT	[Log pattern]	13% → 94%		1	2 to 3	3	3	Same as 29.30 to 30.00 m 30.75 m	[Water pressure test graph]				31	m																																					
32			32% → 86%	Dark Gray	2 to 3	3	2 to 3	Basalt joints are planar, rough and contains iron oxides, from 30.75 m to 31.05 m exhibit voids, joints dip 30° to 50° 32.00 m	20.3 L.U.									32																																		
33				Reddish Brown	2 to 3	3	4	Basalt, contains voids, joints are planar, rough and contains clay minerals, joints dip 60° 32.90 m												29.10 dic 09 Hole depth 35.00 m			33																													
34			100%	Dark Gray	2	3	4	Basalt joints are slickensided and contains clay stains, joints dips subhorizontally 37.35 m																	14.5 L.U.			34																								
35			69%		2	2	3																							Basalt altered, in part with tuff breccia, joints are planar, rough, and contains clay stains, joints dip 50°			35	148.95																		
36			56%	Reddish Brown	3	3	4	30.60 dic 09 Hole depth 40.00 m																													36															
37					2	3	4																																30.60 dic 09 Hole depth 40.00 m			37										
38				Reddish Brown	2	3	4																																					30.60 dic 09 Hole depth 40.00 m			38					
39			14%		2	3	4																																										30.60 dic 09 Hole depth 40.00 m			39
40			36%	2	3	2 to 3	30.60 dic 09 Hole depth 40.00 m																																													

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GEOLOGIC LOG OF DRILL HOLE

PROJECT	HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER	CDB-2	SHEET 5 OF 6
LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	60.00 m
ELEVATION	183.95 m	DEPTH OF OVERBURDEN	3.00 m
COORDINATE	N 305 147 m E 569 702 m	LENGTH OF ROCK DRILLING	53.65 m
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	56.65 m
BEARING OF ANGLE HOLE		CORE RECOVERY	100%
		SUPERVISION BY Walter Hernandez	

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
									DESCRIPTION							
41	BASALT	[Pattern]	14%		Reddish Brown	2 to 3	4	4	Same as 37.35 to 40.00 m with phenocrysts. Fractured surface, contains clay stains and some yellow altered material.		[Graph]			0	41	m
42			2	4												
43			88%				1	43.60 m							43	
44							3 to 4	Basalt, in some places is amigdaloid and contains calcite, joints dip subhorizontally and contain manganese oxides and calcite; from 44.73 m to 44.92 m the rock exhibits calcite veins and joints dip 55°							44	
45			67%				2							39.00 dic 10	45	138.95
46			63%											Hole depth 45.00 m		
47			100%		Dark Gray	2	2	1 to 2						47.10 Micro escape	47	
48			100%											0.5 L U	48	
49															49	
50			88%											31.90 dic 10	50	133.95
														Hole depth 50.00 m		

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GEOLOGIC LOG OF DRILL HOLE

PROJECT	HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-2	SHEET 6 OF 6	
LOCATION	CHAPARRAL DAM SITE	DEPTH OF HOLE	60.00 m	COMMECED	2001/12/6
ELEVATION	183.95 m	DEPTH OF OVERBURDEN	3.00 m	COMPLETED	2001/12/9
COORDINATE	N 305 147 m E 569 702 m	LENGTH OF ROCK DRILLING	53.65 m	DRILLED BY	SWISSBORING
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	56.65 m	LOGGED BY	L Perez
BEARING OF ANGLE HOLE		CORE RECOVERY	100%	SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
									DESCRIPTION							
51	BASALT		93 %		Dark Gray	1 to 2	2	1 to 2	Basalt exhibit vertical joints and contains manganese oxides and calcite						51	
52	BASALT				Dark Gray	2	2	3 to 4							52	
53	BASALT				Dark Gray	2	2	3 to 4	53.25 m						53	
54	TUFF		67 %		Dark Gray	2	3	1 to 2	Lithic Tuff, smooth, weak, joints are planar, rough and contains manganese oxides and calcite					54		
55	TUFF		75 %		Dark Gray	2	3 to 4	4	Tuff and Basalt, fine grained with some lapilli up to 0.05 m in diameter					55	128.95	
56	BASALT		67 %		Light Gray			2	Basalt intercalated with fine tuff exhibits vertical joints with some red stains					56		
57	BASALT		100 %		Light Gray	2	2	1						57		
58	BASALT				Dark greenwash w/black			1	58.50 m					58		
59	BASALT		67 %		Dark greenwash w/black				Basalt joints contains calcite, and dips 40° to 50°					59		
60	BASALT		67 %		Dark greenwash w/black				End of Boring					60	123.95	

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-3 SHEET 1 OF 5	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 50.00 m	COMMECED 2002/12/10	
ELEVATION . mosl (136 m)	DEPTH OF OVERBURDEN 4.00 m	COMPLETED 2002/12/12	
COORDINATE N 305,195-E 569,771	LENGTH OF ROCK DRILLING 46.00 m	DRILLED BY E HERRERA J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 47.00 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 94%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
									DESCRIPTION	LUGEON					
0			0 → 100%												
1		COLLUVIAL DEPOSIT	60%		BROWN				COLLUVIAL DEPOSIT; consists of high weathered rock fragments up to 5cm in size with sand and silt, low to medium consistency, no plastic						
2					LIGHT BROWN										
3															
4									4.00 m - 4.30 m Basalt, fine grained and igneous, weak rock, jointing cannot be determined						
5			10%						4.30 - 4.60 m TUFF, fine grained, water laid, poorly cemented						
6			31%						4.60 m						
7		BASALT	92%		LIGHT GRAY	2-3	2	2	4.80 m BASALT; massive-hard, fine grained and igneous, joints are open, rough, filled with manganese oxides and dip 45° and 90°						
8			35%						5.55 m BASALT; massive-hard, joints are rough and contains calcite films and manganese oxides, dip 0°, 30° and 45°						
9			16%		REDDISH BROWN	3	3-4	3	7.70 m BASALT; massive, joints are planar, rough and contains epidote and iron oxides						
10			92%			2	2-3	1	9.90 m BASALT; massive, fine to medium grained, phaneritic, joints are wide to close, rough, contains iron oxides and dip 0° (horizontal)						
															331.0
															326.0

GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-3 SHEET 2 OF 5

LOCATION **DAM SITE, RIGHT MARGIN**

DEPTH OF HOLE 50.00 m

COMMECED 2002/12/10

ELEVATION mosl (136 m)

DEPTH OF OVERBURDEN 4.00 m

COMPLETED 2002/12/12

COORDINATE **N 305,195-E 569,771**

LENGTH OF ROCK DRILLING 46.00 m

DRILLED BY **E HERRERA-J RIVERA**

ANGLE FROM HORIZONTAL **90°**

TOTAL LENGTH OF CORE 47.00 m

LOGGED BY **L PEREZ**

BEARING OF ANGLE HOLE

CORE RECOVERY 94%

SUPERVISION BY **W HERNANDEZ**

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD 0 → 100%	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
					COLOR	WEATHERING	HARDNESS	CORE CUTTING							
11		BASALT			LIGHT GRAY	2	3	3	BASALT; massive, fine grained and igneous, very close to close jointing, most of joints are open and dip horizontally, vertically, joints contains epidite and manganese oxides and disseminated pyrite crystals						
12			58%			2-3	3	2	10.80 m						
13			17% 75%		REDDISH BROWN	3	3-4	4	BASALT; AGGLOMERATIC; contains subangular to subrounded andesitic and basaltic and basaltic fragments up to 3cm in length, in a fine-grained moderate to high cemented tuffaceous matrix, very close to close jointing, rough, open, clean with voids up to 3 cm in length						
14			85%			2	2-3	2-3					5m		
15			26%										10 Dec. 02		
16									16.10 m						
17			16%		LIGHT BROWN TO LIGHT GRAY WITH SOME BEIGE CLASTS	3	4	3	TUFF, soft						
18			83%			2	2	1-2	16.70 m						
19		TUFF	79%						LAPILLI TUFF; hard rock, strong, contains angular to subangular andesitic and basaltic clasts up to 4cm in length in a well cemented tuffaceous matrix, moderate to wide close jointing, joints are close, rough, clean and dip horizontally				6.8 LU		
20			66%						19.90 m						
														321.0	
														316.0	

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-3 SHEET 3 OF 5	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 50 00 m	COMMECED 2002/12/10	
ELEVATION mosl (136 m)	DEPTH OF OVERBURDEN 4 00 m	COMPLETED 2002/12/12	
COORDINATE N 305,195-E 569,771	LENGTH OF ROCK DRILLING 46 00 m	DRILLED BY E HERRERA-J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 47 00 m	LOGGED BY L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 94%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TABLE WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
					COLOR	WEATHERING	HARDNESS	CORE CUTTING				
21		TUFF	44%		LIGHT BROWN-LIGHT GRAY	3	3-4	3	From 20.8 m to 21.1 m fine tuff band	6.8 LU	21	m
22			60%		LIGHT BROWN-LIGHT GRAY	3	3-4	4	21.60 m TUFF; fine grained, slightly cemented, soft, water laid, tuffaceous volcanic debris, contains agglomeratic material, under 1 cm diameter, close to moderate close jointing, smooth, clean, most fractures are due to drilling operations.	5m 10 Dic. 02 Hole Depth 23 m	22	
23			100%		LIGHT GREEN	2-3	4-5	3			23	
24		TUFF	86%		BLACK	2-3	4-5	3			24	
25			85%		DARK BROWN	2	3-4	2	24.4 m TUFF, black to dark grey, soft, poorly cemented		25	311 0
26			55%		DARK BROWN	2	3-4	2			26	
27		BASALT	54%		DARK GRAY AND DARK BROWN	2-3	3	2-3	27.15 m BASALT; fine to medium grained and igneous, contains voids up to 2cm in size, close jointing, joints are open, rough, bluish grey coat, dip 0°, 20°, 45° and 90°	4.4 L.U.	27	
28			70%		DARK GRAY AND DARK BROWN	2-3	3	2-3			28	
29			73%		DARK GRAY AND DARK BROWN	2-3	3	2-3			29	
30			54%		DARK GRAY AND DARK BROWN	2-3	3	2-3	29.50 m		30	306 0

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-3 SHEET 4 OF 5	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 50 00 m	COMMECED :	2002/12/10
ELEVATION mosl (136 m)	DEPTH OF OVERBURDEN 4 00 m	COMPLETED	2002/12/12
COORDINATE N 305,195-E 569,771	LENGTH OF ROCK DRILLING 46 00 m	DRILLED BY	E HERRERA-J RIVERA
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 47 00 m	LOGGED BY	L. PEREZ
BEARING OF ANGLE HOLE	CORE RECOVERY 94%	SUPERVISION BY	W HERNANDEZ

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD 0 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TABLE	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
									DESCRIPTION	LUGEON				
31		BASALT	23		DARK GRAY			3	30 45 m			5m		m
32			82		DARK GRAY WITH RED AND GRAY CLASTS	2	2-3	1	BASALT; AGLOMERATIC; hard rock, strong, coarse grained, subangular, andesitic clasts up to 3 cm in length, with many voids under 1cm diameter in a medium to coarse grained andesitic matrix, close to wide close jointing, rough, clean dip 0°, 30° and 90°			11 Dic. 02 Hole Depth 31 m		
33			100%									1.7L.U.		
34			77%											
35			80%									5m		301 0
36			83%						35 60 m			11 Dic. 02 Hole Depth 36 m		
37			77%		DARK GRAY		1-2	1-2	BASALT; fine to medium grained, hard, strong, moderate jointing, fractures are open, rough, clean, dip 0° and 45°					
38			65%						37 50 m					
39			77%						BASALT; AGGLOMERATIC; hard, strong, coarse grained, subangular, andesitic clasts up to 4 cm in length, exhibit many voids under 2 cm diameter, in a dense andesitic matrix, close to moderate jointing, joints are open, rough, clean, and dip 0°, 30° and 45°					
40			65%					3						296 0

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-3 SHEET 5 OF 5	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 50.00 m	COMMECED 2002/12/10	
ELEVATION mosl (136 m)	DEPTH OF OVERBURDEN 4.00 m	COMPLETED 2002/12/12	
COORDINATE N 305,195-E 569,771	LENGTH OF ROCK DRILLING 46.00 m	DRILLED BY E HERRERA - J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 47.00 m	LOGGED BY L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 94%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	OBSERVATION OF CORE				DESCRIPTION	WATER TABLE	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
				KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS					
41			35%			2	2	3	40.05m Contact at 40.05 m is gradual			m
42					DARK GRAY		2-3	4	BASALT ; hard, strong, fine grained and igneous, close jointing, open, rough, dip 20°, 30° and 45°	10.0 L.U.		
43									40.08 m			
44			20%		DARK BROWN				from 40.80 m to 43.00 m; very close jointing, joints are open, rough, contains iron oxides and manganese	5m		
45		BASALT	20%						43.00 m	11 Dic. 02		291.0
46			45%			2	2	2-3	BASALT	Hole Depth 45 m		
47			38%		DARK GRAY				from 43.00 m to 48.00 m; close jointing, joints are open, smooth, rough, contains iron oxides and manganese, and dip 30°-45° and 60°	4.8 L.U.		
48										45 m		
49			84%						From 48.00 m to 50.00 m; moderate to wide close jointing, joints are close, rough and dip 0°, 30°, and 80°	5m		
50			62%						50.00 m END OF BORING	11 Dic. 02		286.0
										Hole Depth 50 m		

GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-4 SHEET 1 OF 8

LOCATION DAM SITE AXIS, RIGHT MARGIN	DEPTH OF HOLE 80.00 m	COMMECED 2002/11/20
ELEVATION mosl (211.99 m)	DEPTH OF OVERBURDEN 1.25 m	COMPLETED 2002/11/30
COORDINATE N 305,252- E 569,852	LENGTH OF ROCK DRILLING 78,75 m	DRILLED BY E HERRERA - J RIVERA
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 59,20 m	LOGGED BY L. PEREZ
BEARING OF ANGLE HOLE	CORE RECOVERY 74%	SUPERVISION BY W HERNANDEZ

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD 0 → 100%	OBSERVATION OF CORE					DESCRIPTION	WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
				KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING							
0 - 1		COLLUVIAL DEPOSIT			LIGHT BROWN TO LIGHT GRAY										
1 - 1.25					LIGHT BROWN TO LIGHT GRAY				CLAYEY SILT; low water content, non plastic, high dry resistance, with high weathered rock fragments up to 3 cm in length						
1.25 - 2					LIGHT BROWN				1.25 m BASALT; HIGHLY WEATHERED; low water content, non plastic, high dry resistance, with high weathered rock fragments up to 3 cm in length						
2 - 3					LIGHT BROWN										
3 - 4			50%		LIGHT BROWN										
4 - 5			70%		LIGHT BROWN			5							
5 - 6			75%		LIGHT BROWN			5							
6 - 7		BASALT			LIGHT GRAY				7.00 m - 8.00 m ROCK FRAGMENTS; weathered, up to 4 cm in size, contains silt, low to medium water content, low plasticity						
7 - 8					LIGHT GRAY				8.00 m - 9.3 m Medium water content, low plasticity, consist of a residual, saprolitic clayey silt with scattered rock fragments						
8 - 9					LIGHT GRAY										
9 - 10			75%		LIGHT GRAY			4	9.30 m BASALT; highly weathered, weak rock, fine grained and igneous, jointing cannot be determined, contains clay and oxides						

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-4 SHEET 3 OF 8	
LOCATION DAM SITE AXIS, RIGHT MARGIN	DEPTH OF HOLE 80.00 m	COMMECED 2002/11/20	
ELEVATION mosl (211.99 m)	DEPTH OF OVERBURDEN 1.25 m	COMPLETED 2002/11/30	
COORDINATE N 305,252- E 569,852	LENGTH OF ROCK DRILLING : 78,75 m	DRILLED BY E HERRERA - J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 59,20 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 74%	SUPERVISION BY W HERNANDEZ	

DEPTH LOG	ROCK NAME	CORE RECOVERY RON 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TABLE WATER PRESSURE TEST LEAKAGE OF DRILLING WATER LUGEON	DEPTH	ELEVATION
21		50%		DARK GRAY	2	3-4	4-5	20.50 m Contact zone between volcanic flows, close jointing, joints are open, rough, clean and dip 0° - 45°, porous in upper portion	7m	21	m
22		45%		REDDISH PURPLE	3	2-3	2-3	21.00 m BASALT ; fine grained and igneous, massive, hard, with voids under 1 cm diameter, very close to close jointing, joints are open, rough, and dip 0°, 20°, 30° and 45°	22 Nov. 02 Hole Depth 22 m	22	
23		50%						21.90 m	15.6 L.U.	23	
24		35%								24	
25	BASALT	35%		DARK REDDISH GRAY	2-3	2-3	4-5			25	197.5
26		60%			2-3		4		5m	26	
27		10%						27.00 m	23 Nov 02 Hole Depth 27 m	27	
28								From 27.00 m to 28.30 m; close jointing, joints are close, open, rough, with oxides and chlorite, and dip 0°, 30° and 45° A pore 10 cm across at 28.1 m	20 L.U.	28	
29		35%								29	
30					1	2	2-3	29.60 m		30	192.5

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-4 SHEET 4 OF 8	
LOCATION DAM SITE AXIS, RIGHT MARGIN	DEPTH OF HOLE 80.00 m	COMMECED 2002/11/20	
ELEVATION mosl (211.99 m)	DEPTH OF OVERBURDEN 1.25 m	COMPLETED 2002/11/30	
COORDINATE N 305,252- E 569,852	LENGTH OF ROCK DRILLING 78,75 m	DRILLED BY E HERRERA-J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 59,20 m	LOGGED BY L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 74%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
31		BASALT	35%				2	3	BASALT ; hard rock, strong, fine grained and igneous, with several voids filled with quartz, close to moderate jointing, joints are close, planar, rough and contains caly minerals and oxides, and dip 0° and 45°				5 m	187.5
32			24%				1-2	31.40 m						23 Nov 2002
33			67%										16.3 LU	
34			73%											
35			13%				2	2-3	BASALT ; hard rock, strong, fine grained and igneous, with several voids filled with quartz, close to moderate jointing, joints are close, planar, rough, contains clay minerals, oxides, and dip 0° and 45°				5 m	187.5
36			30%			2-3	36.30 m						24 Nov 2002	
37			64%				2	2-1					37 m	
38			34%										15.1 L.U.	
39			28%				2-3	2-3						
40			56%						Note microscopic analysis					

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-4 SHEET 5 OF 8	
LOCATION DAM SITE AXIS, RIGHT	DEPTH OF HOLE 80.00 m	COMMECED 2002/11/20	
ELEVATION mostl (211.99 m)	DEPTH OF OVERBURDEN 1.25 m	COMPLETED 2002/11/30	
COORDINATE N 305,252- E 569,852	LENGTH OF ROCK DRILLING 78,75 m	DRILLED BY E HERRERA-J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 59,20 m	LOGGED BY L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 74%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE	WATER TARIFF	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
41		BASALT			TO D. GRAY	2	2-3	3-4	40.90 m					41	
42		TUFF	10%		REDDISH BROWN	2	5	5	TUFF; soft, fine grained, water laid, poorly cemented, most core was not recovered due to drilling operations					42	
43					REDDISH GRAY				BASALT; medium hard to hard rock, fine to medium, grained and igneous, with small voids up to 0.5cm in diameter, very close to close jointing, joints are open, rough, with oxide, mostly dip 0°, 30°, 45° and 90°				120 L.U.	43	
44					REDDISH GRAY	2-3	2-3	3-4						44	
45									44.50 m					45	177.5
46		BASALT	24%		DARK GRAY			3-4						46	
47			29%						47.00 m					47	
48			80%		LIGHT GRAY	2-3	3	4-5	BASALT; medium hard to hard rock, moderate strength, coarse grained, with voids filled by white clay minerals up to 0.5cm in diameter					48	
49			45%											49	
50			40%		L. REDDISH BROWN									50	172.5

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-4 SHEET 6 OF 8	
LOCATION DAM SITE AXIS, RIGHT MARGIN	DEPTH OF HOLE 80.00 m	COMMECED 2002/11/20	
ELEVATION mosl (211.99 m)	DEPTH OF OVERBURDEN 1.25 m	COMPLETED 2002/11/30	
COORDINATE N 305,252- E 569,852	LENGTH OF ROCK DRILLING 78.75 m	DRILLED BY E HERRERA-J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 59.20 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 74%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION						
									DESCRIPTION													
51		BASALT	40%		LIGHT REDDISH GRAY	2-3	3	4-5	BASALT ; medium hard to hard rock, moderate strength, coarse grained, with voids filled by clay minerals up to 0.5 cm in diameter													
52			40%																			
53			30%																			
54			65%						BASALT ; hard rock, strong, fine grained and igneous, close jointing, joints are close, planar, rough and contains clay minerals, oxides and dip 0°, 45° in some parts the material was not recovered due to drilling operations													
55			40%		DARK GRAY	2	2-3	3-4										167.5				
56			40%						From 57.30 to 62.50; BASALT with voids, several are filled by clay minerals.													
57			11%																			
58			52%																			
59			18%		DARK REDDISH GRAY	2		4-5														
60			60%													162.5						
60			40%																			

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-4 SHEET 8 OF 8	
LOCATION DAM SITE AXIS, RIGHT MARGIN	DEPTH OF HOLE 80.00 m	COMMECED 2002/11/20	
ELEVATION mosl (211.99 m)	DEPTH OF OVERBURDEN 1.25 m	COMPLETED 2002/11/30	
COORDINATE : N 305,252- E 569,852	LENGTH OF ROCK DRILLING 78,75 m	DRILLED BY E HERRERA-J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 59,20 m	LOGGED BY L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 74%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE	WATER TABLE		DEPTH	ELEVATION
										WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER		
			0 → 100%							0	LUGEON	40	
71			32%		DARK GRAY		2-3	3	71 30 m			12.4 L.U.	m
72			43%						BASALT; AGGLOMERATIC; medium hard to hard rock, moderate strength, consists of subangular andesitic and basaltic clasts up to 3 cm in length, in a medium grained andesitic matrix, close jointing, open, rough, clean, and dip 0°, 30° and 45°				
73			14%				2-3						
74			40%		REDDISH GRAY	2		4				5m	
75		BASALT	65%									28 Nov 2002	
75												Hole Depth	
75									75 30 m			75.0 m	147.5
76			45%						BASALT; medium hard, weak to moderate strength, massive, fine grained, very close to close jointing, joints are open, rough, some parts cannot be determined jointing			9.8 L.U.	
77			63%		DARK GRAY	2		4-5					
78			45%				2-3						
79			75%									7m	
80			45%						80 00 m END OF BORING			30 Nov 02	
80												Hole Depth	
80												80 m	142.5

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-5A SHEET 1 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/2/6	
ELEVATION mosl (225.45 m)	DEPTH OF OVERBURDEN 7.5 m	COMPLETED 2003/2/10	
COORDINATE . N 305,355- E 569,995	LENGTH OF ROCK DRILLING 62.5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 69.37 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 99.10%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TABLE 	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
1					DARK BROWN- DARK GRAY				CLAYEY SILT; medium water content, medium to high plasticity, high dry strength, with organic contents and weathered rock fragments up to 10 cm in length						
2															
3					DARK GRAY										
4					DARK GRAY										
5									4.80 m						
6					DARK GRAY				ROCK BLOCKS; fairly fresh to strongly weathered, weak to moderate strength, contains abundant basaltic and andesitic rock fragments from 1 cm to 30 cm in length and clayey silt, moderate water contents, high plasticity, high dry strength						
7															
8									7.50 m						
9					DARK GRAY AND BROWN				TOP OF WEATHERED ROCK , CLAYEY SILT WITH ROCK FRAGMENTS; consists of a clayey silt, low to medium water content, low to medium plasticity, contains abundant highly weathered rock fragments up to 15 cm in length						
10															

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-5A SHEET 2 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/2/6	
ELEVATION mosl (225.45 m)	DEPTH OF OVERBURDEN 7.5 m	COMPLETED 2003/2/10	
COORDINATE N 305,355- E 569,995	LENGTH OF ROCK DRILLING 62.5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 69.37 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 99.10%	SUPERVISION BY W HERNANDEZ	

DEPTH LOG	ROCK NAME	CORE RECOVERY RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
11	BASALT			DARK GRAY AND BROWN	4-5	4-5	5	IDEM MATERIAL; TOP OF WEATHERED ROCK , CLAYEY SILT WITH ROCK FRAGMENTS; consists of a clayey silt, low to medium water content, low to medium plasticity, contains abundant highly weathered rock fragments up to 15 cm in length					11	
12								12.00 m					12	
13	BASALT			DARK GRAY	3-4	3-4	4	BASALT; brittle, fine grained and igneous, no apparent jointing, highly fractured					13	
14								14.80 m					14	
15		7%			2-3	3	3	TOP OF SOUND ROCK; BASALT; dense, moderate to high weathered, fine grained and igneous, close jointing, joints are open, rough, with clay minerals and manganese					15	210.45
16								16.00 m					16	
17		52%		GREENISH, REDDISH AND LIGHT GRAY			4	BASALT, AGGLOMERATIC; brittle, very close to close jointing, contains basaltic fragments up to 15 cm in diameter, in a fine grained tuffaceous and andesitic matrix Porous		42.6 LU			17	
18	BASALT	25%			3	3-4	2	17.5-19.2 with white clay fill					18	
19							4	18.70 m		5m			19	
20				DARK GRAY			4	BASALT; very brittle to brittle, fairly fresh, very close jointing, joints are open, rough and contains iron oxides and manganese		7 Feb.			20	205.45
								19.80 m		Hole				
										Depth				
										20.00 m				

GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-5A SHEET 3 OF 7

LOCATION **DAM SITE, RIGHT MARGIN**

DEPTH OF HOLE **70 00 m**

COMMECED **2003/2/6**

ELEVATION **mosl (225.45 m)**

DEPTH OF OVERBURDEN **7 5 m**

COMPLETED **2003/2/10**

COORDINATE **N 305,355- E 569,995**

LENGTH OF ROCK DRILLING **62 5 m**

DRILLED BY **JOSE VALLECILLOS**

ANGLE FROM HORIZONTAL **90°**

TOTAL LENGTH OF CORE **69 37 m**

LOGGED BY **L. PEREZ**

BEARING OF ANGLE HOLE

CORE RECOVERY **99 10%**

SUPERVISION BY **W HERNANDEZ**

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TARI F WATER PRESSURE TEST LEAKAGE OF DRILLING WATER 0 LUGEON 40	DEPTH	ELEVATION
21		BASALT	26%		REDDISH				<p>IDEM MATERIAL; BASALT; hard to brittle, fairly fresh, close jointing, joints are open, rough and contains iron oxides and manganese</p>	42 3 LU	21	m
22							2	3			22	
23										5m 8 Feb 2003 Hole Depth 25 00 m	23	
24					DARK GRAY	2-3			24 00 m		24	
25									24 7-27 0 Porous partly filled with clay minerals		25	200 45
26							3	3-4		36 6 L.U.	26	
27									27 20 m		27	
28		TUFF	17%		REDDISH-BROWN	3-4	3	4	<p>TUFF; fine grained, water laid, tuffaceous matrix, strongly cemented, joints are open, rough, with clay and iron oxides</p> <p>Rich in amocdals</p>	5m 8 Feb 02 2003 Hole Depth 30 00 m	28	
29			65%						29 00 m		29	
30		BASALT	10%		DARK GRAY	2-3	2-3	2-3	<p>BASALT; dense, fine to medium grained and igneous, massive, close jointing, open, rough with manganese, mostly dip 0, 70° and 90°</p>		30	195 45

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-5A SHEET 4 OF 7	
LOCATION . DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70 00 m	COMMECED 2003/2/6	
ELEVATION mosl (225.45 m)	DEPTH OF OVERBURDEN . 7 5 m	COMPLETED 2003/2/10	
COORDINATE . N 305,355- E 569,995	LENGTH OF ROCK DRILLING 62 5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 69 37 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 99 10%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE	DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
31			29%			2-3	2-3	2-3		ITEM MATERIAL; BASALT; dense, fine to medium grained and igneous, massive, close jointing, open, rough with manganese, mostly dip 0, 70° and 90°. Some parts the block sides is up to 35 cm in length						
32			22%						31 5 m							
33			14%			3	3	3				5m				
34			23%						33 40 m			8 Feb. 2003				
35		BASALT	49%			2-3	2-3	2-3				Hole Depth				190 45
36			39%						36 30 m			25 0 LU				
37					DARK GRAY					From 3630 m to 42.50 m; some block size are from 10 to 25 cm						
38			25%			3	3	3		38 9-39 5m reddish in part		5m				
39										A red band 2cm wide at 80° at 39.3m.		8 Feb. 2003				
40												Hole Depth				185 45
												40 00 m				

GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-5A SHEET 5 OF 7

LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/2/6
ELEVATION <i>most</i> (225.45 m)	DEPTH OF OVERBURDEN 7.5 m	COMPLETED 2003/2/10
COORDINATE N 305,355- E 569,995	LENGTH OF ROCK DRILLING 62.5 m	DRILLED BY JOSE VALLECILLOS
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 69.37 m	LOGGED BY L PEREZ
BEARING OF ANGLE HOLE	CORE RECOVERY 99.10%	SUPERVISION BY W HERNANDEZ

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	OBSERVATION OF CORE					WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
				KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING					
			0 → 100%							0 LUGEON 40			
41			10%										
42			13%										
43										27.90 L.U.			
44				DARK GRAY	2	2	2-3			5 m 10 Dic 02 Hole Depth 45 m			
45		BASALT	25%									180.45	
46													
47										12.40 L.U.			
48				LIGHT GRAY TO DARK GRAY	3	3-4	4						
49			10%							5 m 1 Feb. 2003 Hole Depth 50 m			
50												175.45	

GEOLOGIC LOG OF DRILL HOLE

PROJECT: HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-5A SHEET 6 OF 7	
LOCATION: DAM SITE, RIGHT MARGIN	DEPTH OF HOLE: 70.00 m	COMMENCED: 2003/2/6	
ELEVATION: mosl (225.45 m)	DEPTH OF OVERBURDEN: 7.5 m	COMPLETED: 2003/2/10	
COORDINATE: N 305,355- E 569,995	LENGTH OF ROCK DRILLING: 62.5 m	DRILLED BY: JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL: 90°	TOTAL LENGTH OF CORE: 69.37 m	LOGGED BY: L. PEREZ	
BEARING OF ANGLE HOLE:	CORE RECOVERY: 99.10%	SUPERVISION BY: W. HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TABLE WATER PRESSURE TEST LEAKAGE OF DRILLING WATER LUGEON	DEPTH	ELEVATION
51		BASALT			LIGHT GRAY	2-3	2-3	3	IDEM MATERIAL; BASALT; dense, fine to medium grained and igneous, massive, close jointing, open, rough with manganese, mostly dip 0, 70° and 90°. Some parts the block sides is up to 35 cm in length 51.00 m	23.20 L.U.	51	m
52					REDDISH BROWN	3	3-4	4-5	TUFF; fine grained, moderately cemented, with basalt clast up to 10 cm in size 51.0-51.6m sandy and stratified 51.6-52.2m silty 52.20 m		52	
53		TUFF			DARK GRAY	2-3	3	2-3	LAPPILI TUFF	5 m 1 Feb. 2003 Hole Depth 55 m	53	
54											54	
55											55	170.45
56									BASALT; hard rock, massive, strong, joints are closed, rough, contains calcite and iron oxides and manganese, mostly dip 30°, 45° and 90°	20.7 L.U.	56	
57											57	
58		BASALT	13% 10% 65%			2-3	3-4	3-4	57.60 m		58	
59			20% 10%			2	2-3	2-3		5 m 2 Feb. 2003 Hole Depth 60 m	59	
60											60	165.45

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-5A SHEET 7 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/2/6	
ELEVATION mosl (225.45 m)	DEPTH OF OVERBURDEN 7.5 m	COMPLETED 2003/2/10	
COORDINATE N 305,355- E 569,995	LENGTH OF ROCK DRILLING 62.5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 69.37 m	LOGGED BY: L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 99.10%	SUPERVISION BY W HERNANDEZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		DEPTH	ELEVATION
									DESCRIPTION	WATER TARI F		
			0 → 100%									
61		BASALT	44%		DARK GRAY	2	2	2-3	<p>IDEM MATERIAL BASALT; hard rock, massive, strong, joints are closed, rough, contains calcite and iron oxides and manganese, mostly dip 30°, 45° and 90°</p>	20.5L U.	61	m
62			24%						61.75 m		62	
63		AGGLOMERATIC BASALT	63%		DARK GRAY AND REDDISH GRAY	2	2-3	1-2		5 m	63	
64			72%							3 Feb. 2003	64	
65			58%							Hole Depth 65 m	65	160.45
66			32%			3	4	4		25.2 U	66	
67			74%						66.90 m		67	
68		BASALT	38%		DARK GRAY	2	2	2-3	<p>BASALT; hard rock, strong to very strong, close to wide close jointing, joints are close, contains iron oxides and manganese, dip 0°, 45° and 90°</p>	5 m	68	
69			24%							3 Feb 2003	69	
70										Hole Depth 70 m	70	155.45


GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-6A SHEET 1 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/1/22	
ELEVATION mosl (219 m)	DEPTH OF OVERBURDEN 13.5 m	COMPLETED 2003/2/3	
COORDINATE N 305,320- E 570,159	LENGTH OF ROCK DRILLING 56.5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 68.60 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 98.00%	SUPERVISION BY W Hernandez	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		DEPTH	ELEVATION
									DESCRIPTION			
1										CLAYEY SILT (OVERBURDEN); moderate to high water content, medium plasticity, high dry strength, contains few and scattered weathered rock fragments and organic material	1	
2					DARK BROWN - BLACK						2	
3											3	
4											4	
5									5.00 m		5	215.48
6					REDDISH BROWN						6	
7											7	
8											8	
9					LIGHT BROWN						9	
10											10	210.48

GEOLOGIC LOG OF DRILL HOLE

PROJECT: HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER				CDB-6A SHEET 2 OF 7	
LOCATION	DAM SITE, RIGHT MARGIN	DEPTH OF HOLE	70.00 m	COMMECED	2003/1/22
ELEVATION	mosl (219 m)	DEPTH OF OVERBURDEN	13.5 m	COMPLETED	2003/2/3
COORDINATE	N 305,320- E 570,159	LENGTH OF ROCK DRILLING	56.5 m	DRILLED BY	JOSE VALLECILLOS
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	68.60 m	LOGGED BY	L. PÉREZ
BEARING OF ANGLE HOLE		CORE RECOVERY	98.00%	SUPERVISION BY	W. Hernandez

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F 	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
									DESCRIPTION							
11		COLLUVIAL DEPOSIT OR RESIDUAL SOIL			LIGHT BROWN	5	5		IDEM MATERIAL; CLAYEY SILT (OVERBURDEN); moderate to high water content, medium plasticity, high dry strength, contains few and scattered weathered rock fragments and organic material A few hard fragments are contained 12-12.4m, 10cm long basalt core							
13.5								5	13.50 m Weathered rocks Tuff or lapilli tuff							
15		TUFF			BROWN - LIGHT GRAY	4-5	4-5									205.48
18.8					REDDISH BROWN				18.8 m From 18.80-24.9m reddish. Contains lapilli tuff fragments (~10cm across)							
20																200.48

GEOLOGIC LOG OF DRILL HOLE

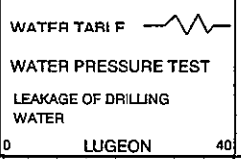
PROJECT · HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-6A SHEET 3 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70 00 m	COMMECED 2003/1/22	
ELEVATION mosl (219 m)	DEPTH OF OVERBURDEN 13 5 m	COMPLETED 2003/2/3	
COORDINATE N 305,320- E 570,159	LENGTH OF ROCK DRILLING 56 5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 68 60 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 98 00%	SUPERVISION BY W Hernandez	

DEPTH LOG	ROCK NAME	CORE RECOVERY RQD 0 → 100%	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON 0 40	DEPTH	ELEVATION
				COLOR	WEATHERING	HARDNESS	CORE CUTTING							
21	TUFF			BROWN - LIGHT GRAY				<p>IDEM MATERIAL; TUFF; very weak, consist of andesitic and basaltic highly weathered clasts up to 2 cm in size in a tuffaceous matrix, poorly cemented, jointing cannot be determinated</p>				21	195 48	
22					4-5	4-5			22					
23				REDDISH BROWN					23					
24									24					
25									25					
26				DARK GRAY-BROWN	5	4-5	5		26					
27									27					
28									28					
29					4-5	4-5	4-5		29					
30				D. G.					28.2 m	30	190 48			
							TUFF.							
							24.9-30.2m greenish grey tuff inside the core.							

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-6A SHEET 5 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/1/22	
ELEVATION mostl (219 m)	DEPTH OF OVERBURDEN 13.5 m	COMPLETED 2003/2/3	
COORDINATE N 305,320- E 570,159	LENGTH OF ROCK DRILLING 56.5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 68.60 m	LOGGED BY L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 98.00%	SUPERVISION BY .W Hernandez	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		DEPTH	ELEVATION
									DESCRIPTION	WATER TARI F		
			0 → 100%									
41		BASALT, AGGLOMERATIC	46%		DARK GRAY WITH SOME REDDISH BROWN PARTS	2	2-3	2-3	IDEM MATERIAL; AGGLOMERATIC; slightly weathered to fresh, massive, moderate strength to strong, joints are open, rough, with calcite veins, mostly dip 0°, 45° and 90°			m
42			62%									
43			32%									
44			48%									
45			73%									
46			28%									
47		51%										
48		23%										
49		28%										
50		25%			D. G.	2-3	3	3-4	BASALT; fine grained and igneous, massive, moderate strength, very close to close jointing, joints are open, rough, contains calcite, chlorite and clay minerals.			170.48



GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-6A SHEET 6 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/1/22	
ELEVATION mosl (219 m)	DEPTH OF OVERBURDEN 13.5 m	COMPLETED 2003/2/3	
COORDINATE N 305,320- E 570,159	LENGTH OF ROCK DRILLING 56.5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 68.60 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 98.00%	SUPERVISION BY W Hernandez	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER 0 LUGEON 40	DEPTH	ELEVATION
									DESCRIPTION					
51									IDEM MATERIAL; BASALT; fine grained and igneous, massive, moderate strength, very close to close jointing, joints are open, rough, contains calcite, chrolite and clay minerals		8.6 L U at Pe=6.4 Pc=6.4			
52														
53									55 4-56 4m clinker like, brittle		5 m 1 Feb. 2003 Hole Depth 55 m			
54														
55		BASALT			DARK GRAY	2-3	3	3-4						165.48
56							4		58 7-59 1m, purplish, clinker like		6.0 L U. at Pe= 2.3 Pc=6.25			
57														
58			65%				3				5 m 2 Feb. 2003 Hole Depth 60 m			
59														
60			10%					3						160.48

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-6A SHEET 7 OF 7	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 70.00 m	COMMECED 2003/1/22	
ELEVATION mostl (219 m)	DEPTH OF OVERBURDEN 13.5 m	COMPLETED 2003/2/3	
COORDINATE N 305,320- E 570,159	LENGTH OF ROCK DRILLING 56.5 m	DRILLED BY JOSE VALLECILLOS	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 68.60 m	LOGGED BY L. PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 98.00%	SUPERVISION BY . W. Hernandez	

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TEST	DEPTH	ELEVATION
					COLOR	WEATHERING	HARDNESS	CORE CUTTING				
61		BASALT	24%		DARK GRAY	2-3	3	3	IDEM MATERIAL; BASALT; fine grained and igneous, massive, moderate strength, very close to close jointing, joints are open, rough, contains calcite, chlorite and clay minerals 61.00 m	8.1 L.U. at Pe=6.16 Pc=6.16	61	m
62		TUFF			REDDISH BROWN	2-3	3-4	4-5	TUFF; fine grained, weak, moderate cemented, very close jointing, joints content abundant manganese and calcite stains Banded at 25° upper portion is finer and reddish 63.0 m	15 m 3 Feb 2003 Hole Depth 65 m	62	
63											63	
64											64	
65		BASALT, AGGLOMERATIC	54%		DARK GRAY - REDDISH BROWN	2-3	2-3	2-3	BASALT; AGGLOMERATIC; moderate strength to strong, massive, consists of andesitic and basaltic clasts up to 10 cm in length, joints are open, rough and dip 0°, 30° and 90° 68.30 m	4.1 L.U. at Pe=2.46 Pc=6.43	65	155.48
66			38%								66	
67			10%								67	
68			52%								68	
69		BASALT	31%		DARK GRAY	2-3	2-3	2-3	BASALT; massive, medium grained and igneous, close jointing, joints are open, rough, and contains chlorite, calcite, iron oxides and manganese, dip 0°, 45° and 90° 70.00 m END OF BORING	5 m 3 Feb 2003 Hole Depth 70 m	69	
70			43%								70	150.48

EPDC

swissboring

CEL

GEOLOGIC LOG OF DRILL HOLE

PROJECT: HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-7 SHEET 1 OF 5	
LOCATION: POWER HOUSE SITE	DEPTH OF HOLE: 50.00 m	COMMECED: 2001/12/11	
ELEVATION: 184.06 m	DEPTH OF OVERBURDEN: 7.87 m	COMPLETED: 2001/12/13	
COORDINATE: N 305 221 m E 569 651 m	LENGTH OF ROCK DRILLING: 42.13 m	DRILLED BY: SWISSBORING	
ANGLE FROM HORIZONTAL: 90°	TOTAL LENGTH OF CORE:	LOGGED BY: L Perez	
BEARING OF ANGLE HOLE:	CORE RECOVERY:	SUPERVISION BY: Walter Hernandez	

DEPTH	ROCK NAME	LOG	Core Recovery and RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
									DESCRIPTION							
1	HIGHLY WEATHERED ROCK				Dark Brown	5	5	5	Residual soil, highly weathered rock, low water content, moderate plasticity, moderate dry strenght, consists of silty clay, contains weathered rock fragments up to 10.00 cm in size							
2																
3																
4																
5																
6																
7																
8	BASALT		18 %		Light Gray	3 to 4	3 to 4	3, 4 and 5	Basalt, fresh to moderate weathered, with voids joints are planar, rough and contains clay minerals and iron oxides, joints dips 40° to 60° some joints are subhorizontal							
9																
10																

The recovery value will only be shown if it is below 100%

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GEOLOGIC LOG OF DRILL HOLE

CEL

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-7 SHEET 2 OF 5

LOCATION POWER HOUSE SITE	DEPTH OF HOLE : 50.00 m	COMMECED 2001/12/11
ELEVATION 184.06 m	DEPTH OF OVERBURDEN 7.87 m	COMPLETED 2001/12/13
COORDINATE N 305 221 m E 569 651 m	LENGTH OF ROCK DRILLING 42.13 m	DRILLED BY SWISSBORING
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE	LOGGED BY L Perez
BEARING OF ANGLE HOLE	CORE RECOVERY	SUPERVISION BY Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION								
									DESCRIPTION															
11	BASALT	[Patterned]	34%	Light Gray	Light Gray	2	2 to 3	2 to 3	2 to 3	Same as 7.95 to 11.00 m	[Wavy Line]	[Blank]	[Blank]	0	40	m								
12			37%							1 to 2							2 to 3	11.00 m						
13			25%							3							1 to 2	3 to 4	2 to 3	2 to 3	2 to 3	2 to 3	Basalt joints are planar, rough and contain clay minerals and iron oxides, slightly to highly water content joints dip 40° to 60°, some joints are subhorizontal	24.3 LU
14			46%																					
15			28%							3							1 to 2	3 to 4	1 to 2	1 to 2	1 to 2	1 to 2	10.25 d/c 12 Hole depth 15.00 m	[Wavy Line]
16			55%																					
17			64%							3							1 to 2	3 to 4	1 to 2	1 to 2	1 to 2	1 to 2	13.2 LU	
18			100%																					1 to 2
19										3							1 to 2	3 to 4	1 to 2	1 to 2	1 to 2	1 to 2	9.75 d/c 12 Hole depth 20.00 m	[Wavy Line]
20																								

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GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-7 SHEET 3 OF 5	
LOCATION POWER HOUSE SITE	DEPTH OF HOLE 50.00 m	COMMECED	2001/12/11
ELEVATION 184.06 m	DEPTH OF OVERBURDEN 7.87 m	COMPLETED	2001/12/13
COORDINATE N 305 221 m E 569 651 m	LENGTH OF ROCK DRILLING 42.13 m	DRILLED BY	SWISSBORING
ANGLE FROM HORIZONTAL: 90°	TOTAL LENGTH OF CORE	LOGGED BY	L Perez
BEARING OF ANGLE HOLE	CORE RECOVERY	SUPERVISION BY	Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
21	BASALT	[Pattern]	75%		Light Gray	1 to 2	3 to 4	2 to 3	Same as 11.00 to 28.20 m	[Graph]	[Graph]	[Graph]	19 L U	21	m
22			44%											22	
23			24%										23		
24			20%										24		
25													25	159.06	
26						2 to 3	2 to 3	4 to 5					26		
27													27		
28									28.20 m				28		
29					Reddish Brown	1 to 2	1	1	Basalt, solid joints are planar, rough and contains clay minerals, joints dip 90°				29		
30									29.65				30	154.06	

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GEOLOGIC LOG OF DRILL HOLE

PROJECT · **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-7 SHEET 4 OF 5

LOCATION · POWER HOUSE SITE	DEPTH OF HOLE 50.00 m	COMMECED : 2001/12/11
ELEVATION 184.06 m	DEPTH OF OVERBURDEN 7.87 m	COMPLETED 2001/12/13
COORDINATE · N 305 221 m E 569 651 m	LENGTH OF ROCK DRILLING 42.13 m	DRILLED BY SWISSBORING
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE ·	LOGGED BY L. Perez
BEARING OF ANGLE HOLE	CORE RECOVERY ·	SUPERVISION BY Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
31	BASALT	[Pattern]	39%		Dark Reddish Brown	2	2	3	Same from 29.65 to 36.10 m	[Graph]			16.8 LU	31	M
32			3	Basalt, massive, hard with voids, up to 0.03m in size, fractures are close, rough, with iron oxide, and some contains clay minerals				3	31						
33			16%					4					33		
34								3						34	
35			75%					4 to 5						35	149.06
36			20%					3	36.10 m					36	
37			31%		Medium Gray	1 to 2	3	3		[Graph]			15.9 LU	37	
38			88%											1	Basalt; massive, hard, joints are planar, rough and contains manganese oxides and clay minerals joints dip 0°, 20° and 30°
39														39	
40			100%											40	144.06

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GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-7 SHEET 5 OF 5

LOCATION . POWER HOUSE SITE	DEPTH OF HOLE 50.00 m	COMMECED 2001/12/11
ELEVATION . 184.06 m	DEPTH OF OVERBURDEN . 7.87 m	COMPLETED . 2001/12/13
COORDINATE . N 305.221 m E 569.651 m	LENGTH OF ROCK DRILLING 42.13 m	DRILLED BY . SWISSBORING
ANGLE FROM HORIZONTAL . 90°	TOTAL LENGTH OF CORE .	LOGGED BY . L. Perez
BEARING OF ANGLE HOLE .	CORE RECOVERY .	SUPERVISION BY Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TARI F	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
									DESCRIPTION	LUGEON VALUE				
41	BASALT	[Patterned]	23% → 100%		Medium Gray	1 to 2	1 to 2	1	Same rock from 36.10 to 45.80 m	0	[Graph]	0	41	m
42			81%	0.8 L.U.										
43			66%											
44			59%											
45			92%											
46	82%	From 45.40 m to 46.10 m basalts are vesicular	3 2 L U											
47	53%	Basalt, massive, moderately strength, joints are open, rough, contains oxides, joints dip 0° to 30°												
48	34%	Basalt joints are planar, rough and contain clay minerals, joints dip 40°, 50° and subhorizontally, from 49.00 m to 50.00 m basalt is vesicular												
49		Dark Gray		2	2 to 3	3	4							
50							1	End of Boring	26.35 13 dic Hole depth 50.00 m	50	134.06			

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-8 SHEET 1 OF 5	
LOCATION DAM SITE, RIGHT MARGIN	DEPTH OF HOLE 50.00 m	COMMECED 2002/12/2	
ELEVATION mosl (204.33 m)	DEPTH OF OVERBURDEN 1.00 m	COMPLETED 2002/12/12	
COORDINATE N 305,324- E 569,802	LENGTH OF ROCK DRILLING 49.00 m	DRILLED BY E HERRERA J RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 37.00 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 74.00%	SUPERVISION BY W PEREZ	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD 0 → 100%	KIND OF BIT CASING	OBSERVATION OF CORE				WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
					COLOR	WEATHERING	HARDNESS	CORE CUTTING					
1		COLLUVIAL D			DARK BROWN								m
2		BASALT			REDDISH BROWN	5	5	5					
3													
4													
5													199.33
6						LIGHT GRAY TO DARK GRAY	3-4	3-4	4-5				
7													
8													
9							2-3	2-3	3-4				
10							2	2	2				

CLAYEY SILT (COLLUVIAL DEPOSIT); moderate water content, low plasticity, high dry strength, contains few and scattered weathered rock fragments up to 3cm in length
1.00 m

BASALT; highly weathered, core is like soil with rock fragments

3.70 m
BASALT; massive, weathered, weak, fine grained and igneous, jointings cannot be determined. Several weathered materials was not recovered

7.70 m
From 7.70 m to 9.20 m; very close jointing, joints are open, rough, contains clay minerals and iron oxides

9.20 m
From 9.20 m to 11.00 m; close jointing, joints are open, rough, contains clay minerals and iron oxides and dip 0°, 60° and 90°

GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-8 SHEET 2 OF 5

LOCATION · DAM SITE, RIGHT MARGIN	DEPTH OF HOLE · 50.00 m	COMMECED 2002/12/2
ELEVATION mosl (204.33 m)	DEPTH OF OVERBURDEN : 1.00 m	COMPLETED 2002/12/12
COORDINATE N 305,324- E 569,802	LENGTH OF ROCK DRILLING 49.00 m	DRILLED BY HERRERARIVERA
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 37.00 m	LOGGED BY L. PEREZ
BEARING OF ANGLE HOLE	CORE RECOVERY 74.00%	SUPERVISION BY

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TABLE WATER PRESSURE TEST LEAKAGE OF DRILLING WATER LUGEON	DEPTH	ELEVATION
11		BASALT	14				2	2-3	<p>IDEM MATERIAL; BASALT; weak to moderate strength, massive, fine grained and igneous, very close to close jointing, fractures are open, rough and exhibit clay minerals and iron oxides</p>			
12						2-3		3-4				
13												
14									<p>13.60 m</p> <p>BASALT; strong, massive, fresh,</p>			
15			36				1-2	1-2	<p>From 13.60 m to 15.70 m; close to moderate close jointing, joints are close, rough with iron oxides and dip 0°, 30°, and 45°</p>			189.33
16			60				2	2-3	<p>15.70 m</p> <p>From 15.70 m to 17.50 m; very close to close jointing, fractures are open, rough, exhibit iron oxides and dip 20°, 45°, and 60°.</p>	17.2 L.U.		
17			10				2	3				
18			29						<p>17.50 m</p> <p>From 17.50 m to 21.40 m; close to moderate jointing, joints are open, rough, contains clay minerals and dip 0° and 30°</p>			
19			79				1-2	2				
20			40							6 m 5 Nov. 02		184.33

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-8 SHEET 3 OF 5	
LOCATION · DAM SITE, RIGHT MARGIN	DEPTH OF HOLE · 50.00 m	COMMECED	2002/12/2
ELEVATION · mosl (204.33 m)	DEPTH OF OVERBURDEN 1.00 m	COMPLETED	2002/12/12
COORDINATE N 305,324- E 569,802	LENGTH OF ROCK DRILLING · 49.00 m	DRILLED BY HERRERA/RIVERA	
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 37.00 m	LOGGED BY L PEREZ	
BEARING OF ANGLE HOLE	CORE RECOVERY 74.00%	SUPERVISION BY	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE DESCRIPTION	WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON	DEPTH	ELEVATION
21		BASALT	76		LIGHT GRAY TO DARK GRAY	2	1-2	1-2	IDEM MATERIAL; BASALT; massive, fresh, moderate strength to strong, very close to close jointing, fractures are open, rough, contains clay minerals					Hole Depth 21.0 m	m
22		BASALT	32		LIGHT GRAY TO DARK GRAY	2	2	3						25.6 L U	
23		BASALT	60		LIGHT GRAY TO DARK GRAY	2	2	3							
24		BASALT			REDDISH GRAY	2	2-3	3-4	BASALT, with voids, fine to medium grained and igneous, weak to moderate strength, very close jointing, joints are open, rough, contains clay minerals and iron oxides and dip 30°, 45° and 90°					5m	
25		BASALT			REDDISH GRAY	2	2-3	3-4						5 Dic. 2002	Hole Depth 25.00 m
26		TUFF	5%		DARK GRAY	5	4	5	TUFF; fine grained, weak, weathered poorly cemented, with few and scattered andesite fragments						
27		TUFF	0%		DARK GRAY	5	4	5	Most parts was not recovered						
28		TUFF	20%		DARK GRAY	5	4	5							
29		TUFF	7%		DARK GRAY	5	4	5							
30		BASALT	37		DARK GRAY	2-3	3-4	4-5	BASALT; fine grained and igneous, weak to moderate strength, with voids up to 1cm in size						174.33

GEOLOGIC LOG OF DRILL HOLE

PROJECT **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CDB-8 SHEET 4 OF 5

LOCATION **DAM SITE, RIGHT MARGIN**

DEPTH OF HOLE **50.00 m**

COMMECED **2002/12/2**

ELEVATION **mosl (204.33 m)**

DEPTH OF OVERBURDEN **1.00 m**

COMPLETED **2002/12/12**

COORDINATE **N 305,324- E 569,802**

LENGTH OF ROCK DRILLING **49.00 m**

DRILLED BY **HERRERA/RIVERA**

ANGLE FROM HORIZONTAL **90°**

TOTAL LENGTH OF CORE **37.00 m**

LOGGED BY **L. PEREZ**

BEARING OF ANGLE HOLE

CORE RECOVERY **74.00%**

SUPERVISION BY

DEPTH	LOG	ROCK NAME	CORE RECOVERY RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		WATER TABLE	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION		
									DESCRIPTION	LUGEON							
31			50			3	3-4	4-5	<p>BASALT; massive, moderate strength, fine grained and igneous, with voids up to 1cm in size, some voids are filled with weathered plagioclase, very close to close jointing, joints are open, rough, clean and dip 0° and 30° some parts was not recovered</p>								
32			18														
33			26														
34			34														
35		BASALT			DARK GRAY AND REDDISH GRAY			3	34.00 m								
36			90					5	35.00 m						169.33		
37						2-3	3	3-4	35.40 m								
38			10														
39			15		REDDISH BROWN			4	38.40 m	Contact between lava flows, andesite is burning (metamorphic contact)							
40			60			2-3	3	3-4	38.75 m								
									39.60 m								
									40.00 m								

GEOLOGIC LOG OF DRILL HOLE

PROJECT: HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		CDB-8 SHEET 5 OF 5	
LOCATION: DAM SITE, RIGHT MARGIN	DEPTH OF HOLE: 50.00 m	COMMECED: 2002/12/2	
ELEVATION: mosl (204.33 m)	DEPTH OF OVERBURDEN: 1.00 m	COMPLETED: 2002/12/12	
COORDINATE: N 305,324- E 569,802	LENGTH OF ROCK DRILLING: 49.00 m	DRILLED BY: HERRERA/RIVERA	
ANGLE FROM HORIZONTAL: 90°	TOTAL LENGTH OF CORE: 37.00 m	LOGGED BY: L PEREZ	
BEARING OF ANGLE HOLE:	CORE RECOVERY: 74.00%	SUPERVISION BY:	

DEPTH	LOG	ROCK NAME	CORE RECOVERY ROD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE	DESCRIPTION	WATER TEST		DEPTH	ELEVATION
											WATER TABLE	LEAKAGE OF DRILLING WATER		
41		BASALT	45		R GRAY	2-3	3-4	4-5		BASALT; AGGLOMERATIC; weak, massive, fine grained and igneous, with voids under 1cm diameter, jointing cannot be determined			41	
42		BASALT	25, 65				2-3	3-4		BASALT; close jointing, joints are open, rough, contains iron oxides and manganese and dip 0°, 30°, 45° and 90°			42	
43		BASALT	35		DARK GRAY				35%				43	
44		BASALT	15										44	
45		BASALT	42				2	3		The contact at 45.70 m is gradual			45	159.33
46		TUFF	33		R BROWN	2	4	2-3		TUFF; fine grained, moderate strength, strongly cemented Sandy in upper portion and silty in lower portion			46	
47		BASALT	33				1	1-2		BASALT; AGGLOMERATIC; massive, strong, fine grained and igneous, contains some layers of fine aggregates with andesitic clasts up to 2cm in length, close to moderate close jointing, joints are open, rough, contains clay minerals and dip 0°, 30°, 45° and 90°, No iron oxides			47	
48		BASALT	55				2						48	
49		BASALT	32		DARK GRAY		1-2	2-3					49	
50										50.00 m END OF BORING			50	154.33

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GEOLOGIC LOG OF DRILL HOLE

CEL

PROJECT: **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CGB-1 SHEET 1 OF 1

LOCATION BORROW AREA	DEPTH OF HOLE 10.00 m	COMMECED 2001/12/16
ELEVATION 148.3 m	DEPTH OF SAND WITH GRAVEL 2.20 m	COMPLETED 2001/12/16
COORDINATE N:304 419 m E 570 590	LENGTH OF ROCK DRILLING 7.80 m	DRILLED BY SWISSBORING
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 10.0 m	LOGGED BY L. Perez
BEARING OF ANGLE HOLE	CORE RECOVERY	SUPERVISION BY Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD 0 → 100%	OBSERVATION OF CORE					DESCRIPTION	WATER TARI F 	WATER PRESSURE TEST LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
				KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING						
0 - 1	SAND				Light brown with white									m
1 - 6	BOULDERS GRAVEL WITH SAND				Brown									
6 - 6.00					Light Gray									
6.00 - 6.60					Light gray and Brown									143.30
6.60 - 7.00			17%											
7.00 - 8.00	TUFF		74%		Dark Brown to Dark Gray	2	4 to 5	4						
8.00 - 9.00			32%											
9.00 - 10.00														138.30
End of Boring.														

The recovery value will only be shown if it is below 100%.

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GEOLOGIC LOG OF DRILL HOLE

PROJECT · HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER

CGB-2 SHEET 1 OF 1

LOCATION · BORROW AREA	DEPTH OF HOLE · 10.00 m	COMMECED · 2001/12/17
ELEVATION 148.95 m	DEPTH OF OVERBURDEN 0.60 m	COMPLETED · 2001/12/17
COORDINATE N. 304.415 m E. 570.718 m	LENGTH OF ROCK DRILLING 10.0 m	DRILLED BY · SWISSBORING
ANGLE FROM HORIZONTAL : 90°	TOTAL LENGTH OF CORE · 10.0 m	LOGGED BY · L. Perez
BEARING OF ANGLE HOLE	CORE RECOVERY ·	SUPERVISION BY · Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	OBSERVATION OF CORE				DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER	LUGEON VALUE	DEPTH	ELEVATION
					COLOR	WEATHERING	HARDNESS	CORE CUTTING							
0			0 → 100%												
0.60	Sand with Gravel			CASING NW	Light Brown				Sand and gravel; up to 0.03m in size, sand is medium coarse grained						148.95
1.00	Boulders, Gravel with Sand				Medium Gray				Gravel and sand, consists of volcanic blocks, subrounded to rounded, ranging in size from 0.05m to 0.50m in length, sand is medium grained, loose						
2.70															
3.00						3	4	2 to 3	Tuffaceous Agglomerate; dark gray, fresh to slightly weathered, weak to moderate strength, massive, water laid, joints are planar, close, some with calcite stain and clay fills						
4.00			38%												
5.00															
6.00	Tuffaceous Agglomerate		87%		Dark Gray	2	3	2 to 3							
7.00			24%												
8.00															
9.00															
9.50			82%												
10.00									End of Boring						138.95

The recovery value will only be shown if it is below 100%.

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GEOLOGIC LOG OF DRILL HOLE

PROJECT: **HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER**

CGB-3 SHEET 1 OF 1

LOCATION: BORROW AREA	DEPTH OF HOLE: 10.00 m	COMMECED: 2001/12/17
ELEVATION: 146.86	DEPTH OF OVERBURDEN: 1.70 m	COMPLETED: 2001/12/17
COORDINATE: N 304.378 m E: 570.846 m	LENGTH OF ROCK DRILLING: 0.00 m	DRILLED BY: SWISSBORING
ANGLE FROM HORIZONTAL: 90°	TOTAL LENGTH OF CORE: 1.70 m	LOGGED BY: L. Perez
BEARING OF ANGLE HOLE:	CORE RECOVERY: 90%	SUPERVISION BY: Walter Hernandez

DEPTH	ROCK NAME	LOG	Core Recovery and RQD	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE				DEPTH	ELEVATION
									DESCRIPTION	WATER TARI F	WATER PRESSURE TEST	LEAKAGE OF DRILLING WATER		
0			0 → 100%									0		
1	ALLUVIAL DEPOSIT				Light Brown				Sand, fine to medium grained, contains gravel, subrounded, up to 0.02 m diameter					
1					Light Gray				Rock Block, fresh to slightly weathered up to 0.20 m in size					
2					Light Gray				Sand and gravel block up to 0.05 m in length, at 1.70 m the material consist of Agglomeratic Tuff					
2									END OF BORING					
3														
4														
5														
6														
7														
8														
9														
10														m

The recovery value will only be shown if it is below 100%.

GEOLOGIC LOG OF DRILL HOLE

PROJECT · HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		HOLE No CGB-4 SHEET 1 OF 1	
LOCATION BORROW AREA, RIGHT SIDE	DEPTH OF HOLE 10 m	COMMECED .	2003/12/18
ELEVATION :	DEPTH OF OVERBURDEN 6.50 m	COMPLETED	2003/12/18
COORDINATE : N:304 317 m E:571.067 m	LENGTH OF ROCK DRILLING 3.50 m	DRILLED BY	J RIVERA
ANGLE FROM HORIZONTAL 90°	TOTAL LENGTH OF CORE 4.70 m	LOGGED BY	R ALVARADO
BEARING OF ANGLE HOLE :	CORE RECOVERY . 47 %	SUPERVISION BY	W. HERNANDEZ

DEPTH	LOG	ROCK NAME	CORE RECOVERY 0 → 100%	KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	OBSERVATION OF CORE		DEPTH	ELEVATION
									DESCRIPTION	WATER TARI F		
0												
1		ALLUVIAL DEPOSIT	70%	Drilled with NQ wire line system double tube core barrel with diamond bit and water	GRAY	4 - 5	4		GRAVEL AND SAND; consists of subangular basaltic and andesitic fragments up to 40 cm in length, fine material was not recovered	WATER TARI F	0	40
2	50%											
3	55%											
4	14%											
5	10%											
6	75%											
7		TUFF	10%	Drilled with NQ wire line system double tube core barrel with diamond bit and water	GREENISH GRAY	4 - 5	4 - 5	5	LITHIC TUFF; consists of fine grained tuff, water laid, indeterminate bedding, tuffaceous debris, highly weathered to clay minerals	WATER TARI F	0	40
8	50%											
9	80%											
10	30%											
10.00			0%									

10.00 m END OF BORING

GEOLOGIC LOG OF DRILL HOLE

PROJECT HYDROELECTRIC COMPLEX OVER THE TOROLA RIVER		HOLE No CGB-5 SHEET 1 OF 1
LOCATION: BORROW AREA, RIGHT SIDE	DEPTH OF HOLE 10.00 m	COMMECED: 2003/12/16
ELEVATION:	DEPTH OF OVERBURDEN 1.00 m	COMPLETED: 2003/12/16
COORDINATE: N: 304.183 m E: 571.200 m	LENGTH OF ROCK DRILLING: 9.00 m	DRILLED BY: J RIVERA
ANGLE FROM HORIZONTAL: 90°	TOTAL LENGTH OF CORE: 6.5 m	LOGGED BY: R ALVARADO
BEARING OF ANGLE HOLE:	CORE RECOVERY: 65 %	SUPERVISION BY: W HERNANDEZ

DEPTH	LOG	ROCK NAME	CORE RECOVERY	OBSERVATION OF CORE				DESCRIPTION	WATER TABLE WATER PRESSURE TEST LEAKAGE OF DRILLING WATER LUGEON	DEPTH	ELEVATION
				KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS				
0		ALLUVIAL DEP.	0 → 100%								
1			40%		GRAY	4-5	4				m
1.00								GRAVEL AND SAND; consists of subangular basaltic and andesitic fragments up to 15 cm in length, fine material was not recovered			
2			45%		GREENISH GRAY	4-5	4-5				
2.00								LITHIC TUFF, consists of fine grained tuff, water laid, indeterminate bedding, tuffaceous debris, highly weathered to clay minerals. The core fractures are due to drilling operations			
3			30%		GREENISH GRAY	4-5	4-5				
3.00											
4		TUFF	20%		GREENISH GRAY	4	3-4				
4.00											
5			60%		GREENISH GRAY	4	3-4				
5.00											
6			30%		GREENISH GRAY	4	3-4				
6.00											
7			70%		GREENISH GRAY	4	3-4				
7.00											
8			30%		GREENISH GRAY	4	3-4				
8.00											
9			55%		GREENISH GRAY	4	3-4				
9.00											
10			65%		GREENISH GRAY	4	3-4				
10.00											
10			40%		BROWN	3-4	3				
10.00								TUFF, fine to medium grained, water laid, contains agglomeratic material under 0.5 cm, poorly cemented			
10.00			70%		BROWN	3-4	3				
10.00								10.00 m END OF BORING			

