

REPUBLIC OF LEBANON
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

DETAILED DESIGN OF BISRI DAM PROJECT

CONTRACT NO.17909

DAM FOOTPRINT

GEOTECHNICAL INVESTIGATION REPORT VI

FACTUAL

July 2014



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1. Introduction

Two boreholes (BHVR1 and BHVR4) were located (Appendix 1) and drilled within the right side valley of the dam in a manner to determine the subsurface soil strata (multi-layered foundation soil of the dam) and underlying bedrock stratigraphy.

BHVR1: 115m

BHVR4: 84m

Two boreholes (BHLA3 and BHLA4) were located (Appendix 1) and drilled within the left side abutment of the dam, in a manner to determine depth and distribution of the mylonitized limestone encountered in BHLA1.

BHLA3: 49.5m

BHLA4: 57m



2. Field Investigation

The field investigation was performed between May 22 and June 19, 2014. Four boreholes (BHVR1, BHLA3, BHLA4 and BHVR4) to a maximum depth of 115m were drilled at locations shown on Figure 1. Crawler and truck mounted rotary drill rigs as shown on Figure 2 and 3 were used in field investigation.

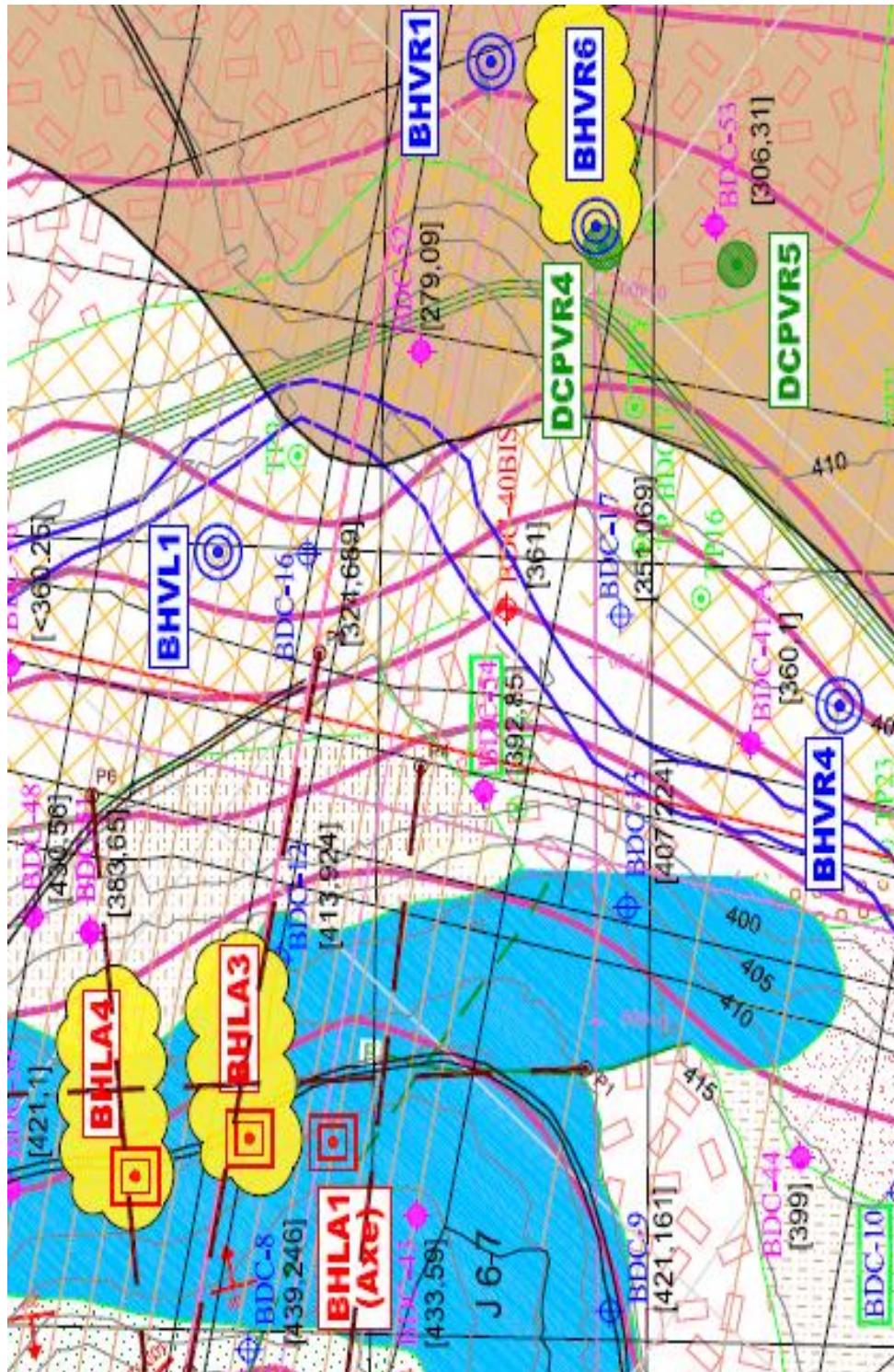


Figure 1: Borehole locations.

BHVR1 / Piezometer (+413.97 NGL): 115 meters deep.

0-73m: Flood-plain and lacustrine soil deposits.

73-84m: Old colluvial soil deposits.

84-115m: C2b.

BHLA3 / Piezometer (+425.27 NGL): 49.5 meters deep.

0-7.5m: Mylonitized LIMESTONE (J7-J6).

7.5-49.5m: LIMESTONE (J7-J6).

BHLA4 / Piezometer (+424.18 NGL): 57 meters deep.

0-3m: Colluvial (Slopewash) soil deposits.

3-9m: Mylonitized LIMESTONE (J7-J6).

9-57m: LIMESTONE (J7-J6).

BHVR4 / Piezometer (+398.14 NGL): 84 meters deep.

0-41.5m: Flood-plain and lacustrine soil deposits.

41.5-84m: LIMESTONE (J7-J6)

Groundwater table was detected in boreholes at below given depths (June 19, 2014) from the natural ground level (NGL).

BHVR1 / Piezometer (+413.97 NGL):

Groundwater table at a depth of 9.33m (+404.64)

BHLA3 / Piezometer (+425.27 NGL):

Groundwater table at a depth of 29.4m (+395.87)

BHLA4 / Piezometer (+424.18 NGL):

Groundwater table at a depth of 28.1m (+396.08)

BHVR4 / Piezometer (+398.14 NGL):

Groundwater table at a depth of 2.25m (+395.89)





Figure 2: BHLa4

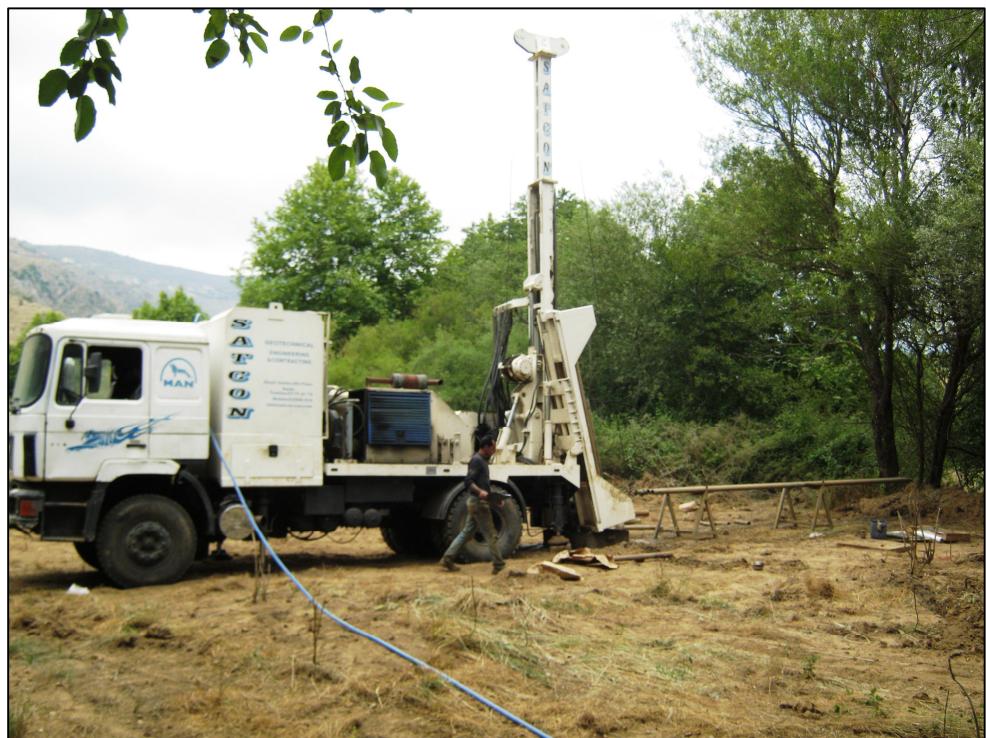


Figure 3: BHVR4

3. Scope of Works

The scope of works of this field investigation consisted of the followings:

- Continuous core drilling in soil and rock.
- Performing Standard Penetration Test in soil and obtaining disturbed (D) samples.
- Undisturbed (UD) soil sampling by using thin wall Shelby tubes.
- Performing borehole water permeability (Falling Head Test) and Lugeon tests in soil and rock strata respectively.
- Installing standpipe open piezometers into the boreholes and measuring the depth and fluctuations of the groundwater table.

86mm diameter (OD) double tube ("T" type) and 96mm diameter (OD) wireline ("H" type) core barrels equipped with tungsten carbide and surface-set diamond core bits were used in continuous core drilling with BW drill rods and HW casings (see Figure 4 and 5).

Core drilling was performed by using as minimum as possible amount of circulation water, only clean water was used during the drilling, water losses were recorded on site and indicated in logs of borings.

Cores taken from the boreholes were sealed with waterproof plastic tapes and stored in standard wooden core boxes (see Figure 6). All the necessary information related to the runs of coring and boreholes were clearly indicated on the boxes. Photos of core boxes are presented in Appendix 3 of this factual report.

In soil strata, Standard Penetration Test (SPT) was performed at 1.5m intervals by using Split-Spoon SPT sampler in 2 inches outside diameter (see Figure 7) and disturbed samples were obtained, labelled and kept in moisture-proof containers.





Figure 4: Double tube core barrel



Figure 5: Wireline core barrel



Figure 6: Standard wooden core boxes



Figure 7: SPT sampler

Standard Penetration Tests (SPT) was performed by using automatic trip SPT hammer as shown on Figure 8, to estimate the relative densities and consistencies of the subsurface soil strata.



Figure 8: Automatic trip SPT hammer.

Multistage Lugeon test was performed in rock strata as shown on Figure 9 at different depths. The test was conducted in portions (3 meters long) of the boreholes isolated by the single pneumatic packer having a diameter of 66mm. The test results are presented in Appendix 4 of this factual report.



Figure 9: Multistage Lugeon Test

In soil and mylonitized rock strata, Falling Head borehole water permeability test was performed at 3m intervals (see Figure 10). The test results are presented in Appendix 4 of this factual report.

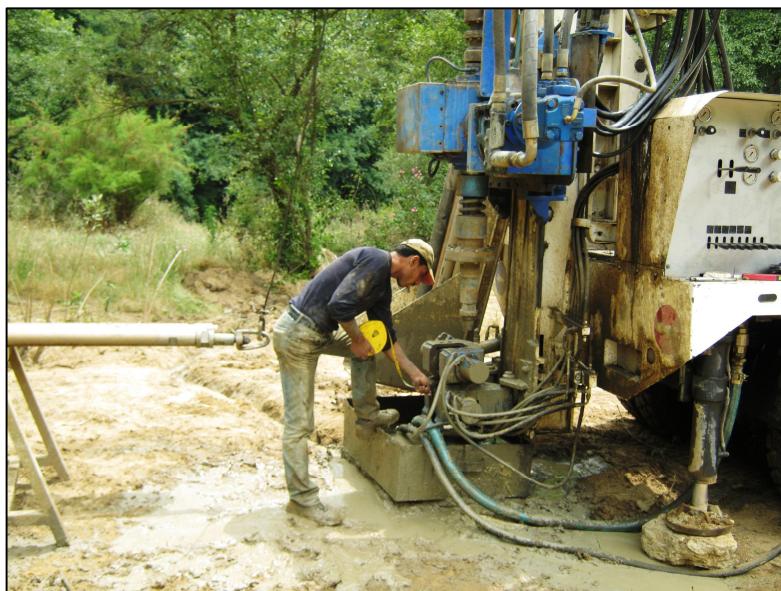


Figure 10

Perforated (one third of the standpipe) UPVC pipes, 60mm diameter (OD) and 2mm thick, wrapped with geotextile (PP, 150 gr/m²) were installed into the boreholes as open standpipe piezometers with concrete heading and steel pipe protection (see Figure 11), in a manner to measure the depth and fluctuations of the groundwater table (Appendix 5).



Figure 11

All the field works were performed according to ASTM standards (ASTM D6640: Core drilling in soil and rock, ASTM D1586: Standard Penetration Test, ASTM D4630: Standard Test Method for Constant Head Injection Test, Lambe & Whitman: Falling Head Test, ASTM D4750: Determining Subsurface Liquid Levels in a boreholes and ASTM D1587: Undisturbed soil sampling) and were supervised by an engineering geologist..

4. Subsurface Strata

According to the core boxes, the following subsurface soil and rock strata were encountered within the boreholes BHVR1, BHLA3, BHLA4 and BHVR4. The logs of borings are presented in Appendix 2 of this factual report.

BHVR1 / Piezometer (NGL: +413.97): 115 meters deep, groundwater table (GWT) at a depth of 9.33m (GWT: +404.64).

0-73m: Flood-plain and lacustrine soil deposits (loose clayey Silt, medium dense to dense silty fine Sand and soft to medium stiff silty Clay of semi-pervious to impervious, semi-pervious and impervious respectively).

73-84: Old colluvial soil deposits of pervious (sub-rounded gravels, cobbles and boulders of Limestone with Marl) *with repetitive cavities between 76.5 and 81m*

84-115m: C2b

84-99.5m: Beige slightly weathered mainly crushed sometimes fractured medium strong time to time sandy and dolomitic marly LIMESTONE of *high permeability*.

Loss of water circulation, 100% and continuously, between 73.5 and 88.5m

99.5-115m: Bluish grey to grey and olive green moderately and moderately to highly sometimes completely weathered fractured and crushed time to time fossiliferous sandy calcareous MARLSTONE and clayey MARLSTONE of *medium to high permeability*.

BHLA3 / Piezometer (NGL: +425.27): 49.5 meters deep, groundwater table (GWT) at a depth of 29.4m (GWT: +395.87).

0-7.5m: Mylonitized LIMESTONE (transition zone from saprolite to the parent rock, *loss of water circulation, 100%, at 4m*)

7.5-49.5m: J7-J6

7.5-16.5m: Beige slightly weathered blocky/seamy to fractured sometimes crushed medium strong occasionally karstified (karst voids are filled with fine sand) sometimes cherty slightly dolomitic and sandy LIMESTONE of *medium permeability*.

16.5-29.5m: Light olive brown fresh to slightly weathered mainly fractured sometimes blocky and seamy strong occasionally sandy and dolomitic highly karstified (karst voids are filled with fine sand) sometimes cherty LIMESTONE of *medium permeability*.

Repetitive cavities (19.5-25.5m), 25 to 40cm deep and occasionally filled with sand

29.5-49.5m: Light olive brown fresh to slightly weathered blocky/seamy and fractured strong sometimes sandy and slightly dolomitic occasionally karstified (karst voids are filled with fine sand and sometimes with sandy clay) cherty (rarely) LIMESTONE of *medium permeability*.

BHLA4 / Piezometer (NGL: +424.18): 57 meters deep, groundwater table (GWT) at a depth of 28.1m (GWT: +396.08).

0-3m: Colluvial (Slopewash) soil deposits.

3-9m: Mylonitized LIMESTONE (transition zone from saprolite to the parent rock)

9-57m: J7-J6

9-23.5m: Light olive brown fresh to slightly weathered blocky/seamy to fractured and crushed sometimes dolomitic slightly karstified strong LIMESTONE of *medium permeability*.

Loss of water circulation (100%) at 12.5m

23.5-46.5m: Light olive brown and beige fresh to slightly weathered blocky and seamy sometimes moderately to highly karstified (karst voids are filled with fine sand and sometimes with sandy clay) strong sandy and dolomitic LIMESTONE of *medium permeability*.

46.5-57m: Light olive brown and beige fresh to slightly weathered blocky/seamy and fractured strong sometimes sandy and slightly dolomitic occasionally karstified LIMESTONE of *medium permeability*.

BHVR4 / Piezometer (NGL: +398.14): 84 meters deep, groundwater table (GWT) at a depth of 2.25m (GWT: +395.89).

0-41.5m: Flood-plain and lacustrine soil deposits (medium dense to dense and very dense silty fine Sand, soft to medium stiff silty Clay and loose clayey Silt of semi-pervious and semi-pervious to impervious, respectively).

41.5-84m: J7-J6

Light olive brown and beige fresh to slightly weathered fractured and crushed sometimes sandy and slightly dolomitic rarely karstified LIMESTONE of *high permeability*.

Loss of water circulation, 70% and continuously, between 52 and 68m.



5. Soil Sampling & Laboratory Testing

Representative soil (disturbed SPT samples, 10 nos.) and rock (core, 10 nos.) samples from the boreholes (BHVR1, BHVR2, BHRA1, BHRA2, BHRA3 and BHRA4) at different depths were selected (see Figure 12) for laboratory testing. List of sampling and laboratory testing (second package) is presented in Appendix 6 of this factual report.

The physical tests included:

Soil

Moisture Content, Density, Sieve Analysis, Hydrometer, Atterberg Limits, Void Ratio and Organic content

Rock

Unit Weight, Point Load Strength (PLI), Uni-axial Compressive Strength, Water Absorption, Soundness and Slake Durability

The chemical tests included:

Soil and rock

Sulphate, Chloride, pH and Calcium carbonate.





Figure 12

6. Closure

The findings presented in this factual report are based on the assumption that the subsurface soil and rock strata and their conditions do not deviate appreciably from those disclosed in boreholes. There may be conditions pertaining to the site which were not disclosed by this subsurface soil/rock survey, and thus could not be taken into account. Therefore, the findings are valid under this assumption only.



APPENDICES

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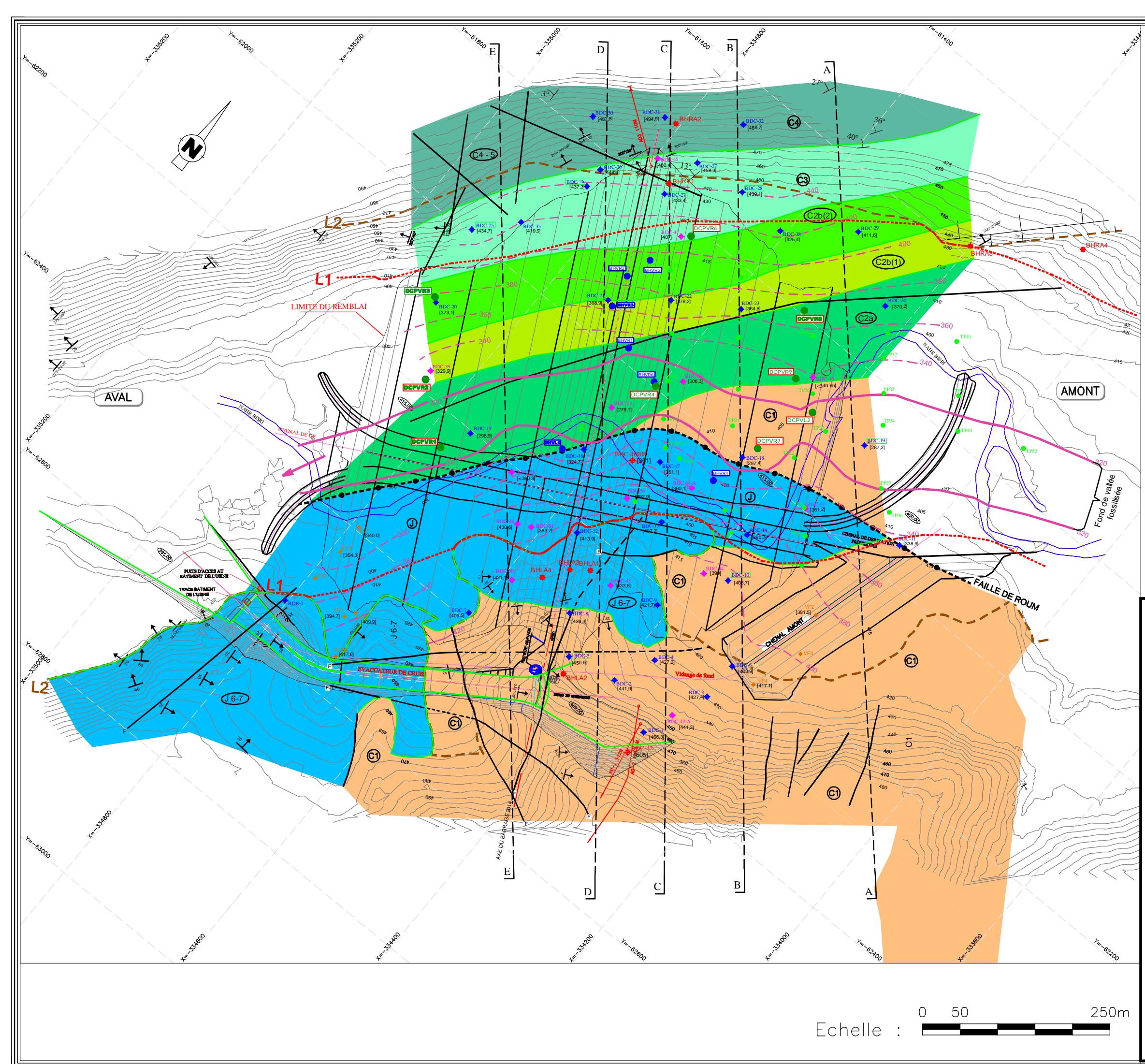


APPENDIX 1. GEOLOGIE DU SITE (PLAN G-02 / APRIL 17, 2014)



DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيح طالب وشريك

Detailed Design Of Bisri Dam: Geo. Inv. Rep.II: (Factual) / Spillway & Bottom Outlet - July 2014



No	DATE	REV	TOP	GEO	CIV	ARCH	STRUCT	MECH	ELEC
LEBANESE REPUBLIC									
COUNCIL FOR DEVELOPMENT & RECONSTRUCTION									
BARRAGE BISRI									
DRAWN									
CHECKED									
APPROVED									
SCALE	1/5 000								
DATE	16/01/2013								
FILENAME	PLAN G-02								
PROJECT			DIVISION			SHEET		REVISION	

SITE DU BARRAGE

GEOLOGIE DU SUBSTRATUM RECONSTITUE A TRAVERS LES COUPES DES SONDEURS

APPENDIX 2. LOGS OF BORINGS



CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 413.97			SHEET: 1 OF: 15						
EQUIPMENT: MAN		METHOD: Rotary			BOREHOLE DEPTH (m): 115m						
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68			DATE STARTED: 22/5/2014						
ENGINEER: K.S.		DRILLER: Nawraz			DATE FINISHED: 6/6/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
1					loose to medium dense light brown silty clayey SAND		21	0	0		
2											Shelby tube (1.5-2m)
3											Shelby tube (2-2.5m)
4							24	0	0		
5											Shelby tube(4.5-5m)
6											Shelby tube(5-5.5m)
7							66	0	0		
8					medium stiff light olive green silty CLAY						Shelby tube(7.5-8m)
9											Shelby tube(8-8.5m)
10							85	0	0		

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT:		DAR-TALEB		FILE NO.:		14-001		BOREHOLE NO.:		BHVR01						
PROJECT:		BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)														
LOCATION:		BISRI			Elevation (m):		413.97		SHEET:		2 OF: 15					
EQUIPMENT:		MAN			METHOD:		Rotary		BOREHOLE DEPTH (m):		115m					
HOLE DAM. (mm):		86 to 114			CORE DIAM. (mm):		63 to 68		DATE STARTED:		22/5/2014					
ENGINEER:		K.S.			DRILLER:		Nawraz		DATE FINISHED:		6/6/2014					
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL				% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks		
11					medium dense light brown clayey SAND				85	0	0					
12					Shelby tube(10.5-11m)											
13					Shelby tube(11-11.5m)											
14					medium stiff olive green silty CLAY				71	0	0					
15					Shelby tube(13.5-14m)											
16					Shelby tube(14-14.5m)											
17					(empty)											
18					Shelby tube(16.5-17m)											
19					Shelby tube(17-17.5m)											
20					Shelby tube(19.5-20m)											

SPT Standard Penetration Test

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SYM Symbol

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N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 3 OF: 15								
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m								
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks	
21			2,3,3 N=6		medium stiff olive green silty CLAY						Shelby tube(20-20.5m)	
22						60	0	0				
23			22,31,50/13cm refusal								Shelby tube(22.5-23m)	
24					very dense brown SAND	18					Shelby tube(23-23.5m)	
25												
26						43	0	0				
27			31,35,41 N=76			56	0	0				
28			26,36,46 N=82			13	0	0				
29			18,26,37 N=63			0	0	0				
30												

SPT Standard Penetration Test

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SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 4 OF: 15							
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m							
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014							
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014							
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
31			26-32-36 68		ditto		0	0	0		
32			18,22,36 N=58		medium stiff olive green silty CLAY		93	0	0		
33			6,3,3 N=6								
34			50/3cm Refusal				91	0	0		
35										Shelby tube(34.5-35m)	
36										Shelby tube(35-35.5m)	
37										Shelby tube(37.5-38m)	
38										Shelby tube(38-38.5m) (empty)	
39			4,3,5 N=8								
40							80	0	0		

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N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 5 OF: 15								
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m								
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks	
41					medium stiff olive green silty CLAY		80	0	0			
42							36	36	0		Shelby tube(40.5-41m)	
43											Shelby tube(41-41.5m)	
44												
45												
46												
47												
48												
49												
50												

SPT Standard Penetration Test

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LT Layer Thickness

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WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHVR01						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	413.97	SHEET:	6 OF: 15						
EQUIPMENT:	MAN	METHOD:	Rotary	BOREHOLE DEPTH (m):	115m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	22/5/2014						
ENGINEER:	K.S.	DRILLER:	Nawraz	DATE FINISHED:	6/6/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
51			1,2,2 N=4		medium stiff olive green silty CLAY						Shelby tube(47-47.5m)
52						81	0	0			
53											Shelby tube(52.5-53m)
54			3,2,2 N=4								Shelby tube(53-53.5m)
55						95	0	0			
56											Shelby tube(55.5-56m)
57			3,4,3 N=7								Shelby tube(56-56.5m)
58						87	0	0			
59											Shelby tube(58.5-59m)
60			3,3,3 N=6								Shelby tube(59-59.5m)

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 7 OF: 15								
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m								
HOLE DIA. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks	
61					medium stiff olive green silty CLAY		93	0	0			
62											Shelby tube(61.5-62m)	
63											Shelby tube(62-62.5m)	
64							97	0	0			
65											Shelby tube(64.5-65m)	
66											Shelby tube(65-65.5m)	
67							100	0	0			
68							47	0	0		Shelby tube(67.5-68m)	
69											Shelby tube(68-68.5m)	
70							87	0	0			

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 8	OF: 15							
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m								
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
71					medium stiff olive green silty CLAY		87	0	0			
72											Shelby tube(70.5-71m)	
73											Shelby tube(71-71.5m)	
74							57	26	15			
75											100% water loss	
76					Old colluvial soil deposits Gravels, cobbles and boulders of limestone with Marl		43	20	0		between 73.5-88.5m	
77												
78							34	13	0			
79											casing down to 78.0m	
80												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 9 OF: 15							
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m							
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014							
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014							
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
81					ditto		26	18	17		
82							22	10	0		
83							20	0	0		
84											
85							27	20	0		
86					Beige sandy and dolomitic marly LIMESTONE		30	24	0		
87											
88							29	13	0		
89											
90							37	25			

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 10 OF: 15								
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m								
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks	
91												
92	50/3cm Refusal											
93												
94												
95												
96												
97												
98												
99												
100					Bluish grey to grey and olive green MARLSTONE							
						34	6.7	0				

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 413.97			SHEET: 11 OF: 15						
EQUIPMENT: MAN		METHOD: Rotary			BOREHOLE DEPTH (m): 115m						
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68			DATE STARTED: 22/5/2014						
ENGINEER: K.S.		DRILLER: Nawraz			DATE FINISHED: 6/6/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
101						34	6.7	0			
102						45	7.3	0			
103						33	25	6.7			
104						37	0	0			
105						80	60	0			
106						67	67	8.7			
107						73	40	0			
108						60	60	0			
109											
110											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR01							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 413.97		SHEET: 12 OF: 12								
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 115m								
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 22/5/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 6/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
111								60	60	0		
112								60	60	0		
113								60	60	0		
114												
115								67	47	20		
116												
117												
118												
119												
120												
End of borehole at 115m												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

SOIL STUDIES

SOIL SYMBOL	ROCK SYMBOL	SAMPLERS	OTHERS	
		Dolomite		SPT (disturbed)
		Chalky Limestone		Shelby tube
		Calcarenite		Tricone
		Weak Chalky LIMESTONE		Double tube
		Sandy Limestone		
		Basalt / volcanics		
		Chert		
		CL		
		Creamy White LIMESTONE		
		Grainstone LIMESTONE		
		MARL		
		SANDSTONE		
		CLAYSTONE		
		Oolitic LIMESTONE		
		Micritic LIMESTONE		
		Mudstone		
		Gypsum		
		Siltstone		

ROCK CLASSIFICATION

% RQD	Classification
<25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

GRANULAR SOILS

N-Value	Relative Density
<4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
>50	Very Dense

COHESIVE SOIL

N-Value	Consistency
<2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very stiff
>30	Hard

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA03							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 425.27		SHEET: 1 OF: 5								
EQUIPMENT: CMV 1000		METHOD: Rotary		BOREHOLE DEPTH (m): 49.5								
HOLE DIA. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 5/31/2014								
ENGINEER: K.S.		DRILLER: A.A.		DATE FINISHED: 6/9/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks	
1					Mylonitized LIMESTONE		47	0	0			
2							40	12	0			
3							37	5.3	0			
4							63	38	0		flushing water loss at 4.0m	
5							67	23	0			
6												
7												
8					Yellowish beige slightly weathered blocky/seamy to fractured sometimes crushed medium strong time to time karstified (karst voids are filled with fine sand) and cherty slightly dolomitic sandy LIMESTONE.		97	90	19			
9												
10							67	60	8.7			

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA03							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 425.27		SHEET: 2 OF: 5								
EQUIPMENT: CMV 1000		METHOD: Rotary		BOREHOLE DEPTH (m): 49.5								
HOLE DIA. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 5/31/2014								
ENGINEER: K.S.		DRILLER: A.A.		DATE FINISHED: 6/9/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
11					ditto		67	60	8.7			
12							100	100	52			
13							93	80	30			
14							41	29	0			
15							50	50	15			
16							67	67	17			
17							98	98	29			
18							57	57	19			
19												
20												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA03							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 425.27		SHEET: 3 OF: 5								
EQUIPMENT: CMV 1000		METHOD: Rotary		BOREHOLE DEPTH (m): 49.5								
HOLE DIA. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 5/31/2014								
ENGINEER: K.S.		DRILLER: A.A.		DATE FINISHED: 6/9/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks	
21					ditto CAVITY 20.20m to 20.50m	57	57	19				
22					ditto CAVITY 21.5m to 21.75m	53	53	29				
23					ditto CAVITY 22.70m to 23.0m	27	27	0				
24					ditto	22	22	0				
25						80	80	6.7				
26						62	62	0			casing down to 27.0m	
27						96	96	55				
28					refer to next page							
29												
30												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA03							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 425.27		SHEET: 4 OF: 5								
EQUIPMENT: CMV 1000		METHOD: Rotary		BOREHOLE DEPTH (m): 49.5								
HOLE DIA. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 5/31/2014								
ENGINEER: K.S.		DRILLER: A.A.		DATE FINISHED: 6/9/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
31					Light olive brown fresh to slightly weathered blocky/seamy and fractured strong sometimes sandy and slightly dolomitic time to time moderately karstified (karst voids are filled with fine sand and sometimes with sandy clay) cherty LIMESTONE.		100	100	39			
32							90	90	22			
33							85	85	16			
34							87	87	22			
35							100	100	8			
36							100	100	29			
37							80	80	17			
38												
39												
40												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA03							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 425.27		SHEET: 5 OF: 5								
EQUIPMENT: CMV 1000		METHOD: Rotary		BOREHOLE DEPTH (m): 49.5								
HOLE DIA. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 5/31/2014								
ENGINEER: K.S.		DRILLER: A.A.		DATE FINISHED: 6/9/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
41					Light olive brown fresh to slightly weathered blocky/seamy and fractured strong sometimes sandy and slightly dolomitic time to time moderately karstified (karst voids are filled with fine sand and sometimes with sandy clay) cherty LIMESTONE.		80	80	17			
42							95	95	31			
43							99	99	66			
44							99	99	91			
45												
46							100	100	57			
47							97	97	72			
48												
49							95	95	40			
50					End of borehole at 49.5m							

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

SOIL STUDIES

SOIL SYMBOL	ROCK SYMBOL	SAMPLERS	OTHERS	
		Dolomite		SPT (disturbed)
		Chalky Limestone		Shelby tube
		Calcarenite		Tricone
		Weak Chalky LIMESTONE		Double tube
		Sandy Limestone		
		Basalt / volcanics		
		Chert		
		CL		
		Creamy White LIMESTONE		
		Grainstone LIMESTONE		
		MARL		
		SANDSTONE		
		CLAYSTONE		
		Oolitic LIMESTONE		
		Micritic LIMESTONE		
		Mudstone		
		Gypsum		
		Siltstone		

ROCK CLASSIFICATION

% RQD	Classification
<25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

GRANULAR SOILS

N-Value	Relative Density
<4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
>50	Very Dense

COHESIVE SOIL

N-Value	Consistency
<2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very stiff
>30	Hard

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 424.18		SHEET: 1 OF: 6								
EQUIPMENT: CMV1000		METHOD: Rotary		BOREHOLE DEPTH (m): 57m								
HOLE DIA. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 10/6/2014								
ENGINEER: K.S.		DRILLER: A.A		DATE FINISHED: 17/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
1					Slopewash soil deposits		27	0	0			
2							52	52	23			
3							42	34	0			
4							57	43	7.3			
5												Casing Down to 6.0m
6					Mylonitized LIMESTONE		47	29	0			
7							39	21	0			
8												
9					Light olive brown and beige fractured sometimes kartified sandy and dolomitic LIMESTONE		60	60	6.7			
10												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 424.18		SHEET: 2 OF: 6								
EQUIPMENT: CMV1000		METHOD: Rotary		BOREHOLE DEPTH (m): 57m								
HOLE DAM. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 10/6/2014								
ENGINEER: K.S.		DRILLER: A.A		DATE FINISHED: 17/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
11							60	60	6.7			
12							100	100	13			
13							55	55	0		Flushing Water Loss at 12.5m	
14							55	55	0			
15							60	60	34			
16							100	100	73			
17							100	100	80			
18							100	100	75			
19												
20												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA04						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 424.18		SHEET: 3 OF: 6							
EQUIPMENT: CMV1000		METHOD: Rotary		BOREHOLE DEPTH (m): 57m							
HOLE DAM. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 10/6/2014							
ENGINEER: K.S.		DRILLER: A.A		DATE FINISHED: 17/6/2014							
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
21							110	100	75		
22							87	87	63		
23							100	100	91		
24							87	87	67		
25					ditto		100	100	91		
26							100	100	90		
27							100	100	95		
28											
29											
30											

SPT Standard Penetration Test

UCS Unconfined Compressive Strength

LT Layer Thickness

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

ST Sample Type

SYM Symbol

WT Water Table

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 424.18		SHEET: 4 OF: 6								
EQUIPMENT: CMV1000		METHOD: Rotary		BOREHOLE DEPTH (m): 57m								
HOLE DAM. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 10/6/2014								
ENGINEER: K.S.		DRILLER: A.A		DATE FINISHED: 17/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
31							100	100	95			
32							100	100	93			
33					ditto		100	100	73			
34							100	100	17			
35							100	100	40			
36							100	100	80			
37							100	100	87			
38												
39												
40												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHLA04						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	424.18	SHEET:	5 OF: 6						
EQUIPMENT:	CMV1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	57m						
HOLE DAM. (mm):	86-114	CORE DIAM. (mm):	63-68	DATE STARTED:	10/6/2014						
ENGINEER:	K.S.	DRILLER:	A.A	DATE FINISHED:	17/6/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
41							100	100	87		
42							100	100	83		
43							100	100	87		
44					ditto		100	100	21		
45							100	100	52		
46							95	95	87		
47							100	100	80		
48							100	100	87		
49											
50											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHLA04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 424.18		SHEET: 6 OF: 6								
EQUIPMENT: CMV1000		METHOD: Rotary		BOREHOLE DEPTH (m): 57m								
HOLE DAM. (mm): 86-114		CORE DIAM. (mm): 63-68		DATE STARTED: 10/6/2014								
ENGINEER: K.S.		DRILLER: A.A		DATE FINISHED: 17/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
51								100	100	87		
52								80	80	50		
53					ditto			100	100	20		
54								95	95	20		
55								95	95	67		
56												
57												
58												
59												
60					End of Borehole @ 57.0m							

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

SOIL STUDIES

SOIL SYMBOL	ROCK SYMBOL	SAMPLERS	OTHERS	
		Dolomite		SPT (disturbed)
		Chalky Limestone		Shelby tube
		Calcarenite		Tricone
		Weak Chalky LIMESTONE		Double tube
		Sandy Limestone		
		Basalt / volcanics		
		Chert		
		CL		
		Creamy White LIMESTONE		
		Grainstone LIMESTONE		
		MARL		
		SANDSTONE		
		CLAYSTONE		
		Oolitic LIMESTONE		
		Micritic LIMESTONE		
		Mudstone		
		Gypsum		
		Siltstone		

ROCK CLASSIFICATION

% RQD	Classification
<25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

GRANULAR SOILS

N-Value	Relative Density
<4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
>50	Very Dense

COHESIVE SOIL

N-Value	Consistency
<2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very stiff
>30	Hard

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 398.14		SHEET: 1 OF: 9							
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 84m							
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 9/6/2014							
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 19/6/2014							
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
1					medium dense light to reddish brown SAND						
2											
3											
4					medium stiff olive green silty sandy CLAY	75	0	0			Shelby tube(4.5-5m)
5											Shelby tube(5-5.5m)
6											
7											
8											Shelby tube(7.5-8m)
9											Shelby tube(8-8.5m)
10					very dense olive green SAND	6.7	0	0			

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 398.14			SHEET: 2 OF: 9						
EQUIPMENT: MAN		METHOD: Rotary			BOREHOLE DEPTH (m): 84m						
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68			DATE STARTED: 9/6/2014						
ENGINEER: K.S.		DRILLER: Nawraz			DATE FINISHED: 19/6/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
11			18,26,35 61		very dense olive green SAND	6.7	0	0			
12			20,32,41 73			0	0	0			No Sample
13											
14											
15											
16											
17					ditto, medium dense						
18					medium stiff olive green CLAY, sometimes sandy	100	0	0			
19						76	0	0			
20											Shelby tube(19.5-20m)

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 398.14			SHEET: 3 OF: 9						
EQUIPMENT: MAN		METHOD: Rotary			BOREHOLE DEPTH (m): 84m						
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68			DATE STARTED: 9/6/2014						
ENGINEER: K.S.		DRILLER: Nawraz			DATE FINISHED: 19/6/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
21			3,3,3 6		medium stiff olive green CLAY, sometimes sandy						Shelby tube(20-20.5m)
22						100	0	0			
23											Shelby tube(22.5-23m)
24			2,2,3 5								Shelby tube(23-23.5m)
25						75	0	0			
26											Shelby tube(25.5-26m)
27			3,4,3 7								Shelby tube(26-26.5m)
28						95	0	0			
29											Shelby tube(28.5-29m)
30			2,2,2 4								Shelby tube(29-29.5m)

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 398.14			SHEET: 4 OF: 9						
EQUIPMENT: MAN		METHOD: Rotary			BOREHOLE DEPTH (m): 84m						
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68			DATE STARTED: 9/6/2014						
ENGINEER: K.S.		DRILLER: Nawraz			DATE FINISHED: 19/6/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
31					medium stiff olive green CLAY, sometimes sandy		80	0	0		
32											Shelby tube(31.5-32m)
33											Shelby tube(32-32.5m)
34							75	0	0		
35											Shelby tube(34.5-35m)
36											Shelby tube(35-35.5m)
37							65	0	0		
38											Shelby tube(37.5-38m)
39											Shelby tube(38-38.5m)
40							67	0	0		

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 398.14		SHEET: 5 OF: 9								
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 84m								
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 9/6/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 19/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
41	2,2,50/3cm Refusal				medium stiff olive green CLAY, sometimes sandy		67	0	0			
42												Shelby tube(40.5-41m)
43												Shelby tube(41-41.5m)
44												
45												
46												
47												
48					Light olive brown fractured and crushed strong LIMESTONE							Casing down to 48.0m
49												
50												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 398.14		SHEET: 6 OF: 9								
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 84m								
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 9/6/2014								
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 19/6/2014								
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
51								100	100	0		
52								100	100	0		
53								53	53	0		
54				ditto				100	100	0		
55								100	100	0		
56								100	100	0		
57								100	100	0		Flushing Water Loss 52-68m
58								100	100	0		
59								100	100	0		
60								100	100	0		

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 398.14			SHEET: 7 OF: 9							
EQUIPMENT: MAN		METHOD: Rotary			BOREHOLE DEPTH (m): 84m							
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68			DATE STARTED: 9/6/2014							
ENGINEER: K.S.		DRILLER: Nawraz			DATE FINISHED: 19/6/2014							
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
61							100	100	28			
62							100	100	25			Flushing Water Loss 52-68m
63							100	100	0			
64							100	100	0			
65							100	100	0			
66							87	87	0			
67							73	73	0			
68							69	69	0			
69												
70												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04							
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)												
LOCATION: BISRI		Elevation (m): 398.14			SHEET: 8 OF: 9							
EQUIPMENT: MAN		METHOD: Rotary			BOREHOLE DEPTH (m): 84m							
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68			DATE STARTED: 9/6/2014							
ENGINEER: K.S.		DRILLER: Nawraz			DATE FINISHED: 19/6/2014							
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D. (%)	UCS N/mm ²	Remarks
71					ditto		69	69	0			
72							37	37	0			
73							43	43	0			
74							50	50	0			
75							51	51	0			
76							40	40	12			
77							30	30	0			
78							22	22	0			
79												
80												

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

CLIENT: DAR-TALEB				FILE NO.: 14-001	BOREHOLE NO.: BHVR04						
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)											
LOCATION: BISRI		Elevation (m): 398.14		SHEET: 9 OF: 9							
EQUIPMENT: MAN		METHOD: Rotary		BOREHOLE DEPTH (m): 84m							
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm): 63 to 68		DATE STARTED: 9/6/2014							
ENGINEER: K.S.		DRILLER: Nawraz		DATE FINISHED: 19/6/2014							
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
81					ditto		22	22	0		
82							33	33	0		
83							33	33	0		
84											
85											
86											
87											
88											
89											
90											
					End of Borehole@84.0m						

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

SOIL STUDIES

SOIL SYMBOL	ROCK SYMBOL	SAMPLERS	OTHERS	
		Dolomite		SPT (disturbed)
		Chalky Limestone		Shelby tube
		Calcarenite		Tricone
		Weak Chalky LIMESTONE		Double tube
		Sandy Limestone		
		Basalt / volcanics		
		Chert		
		CL		
		Creamy White LIMESTONE		
		Grainstone LIMESTONE		
		MARL		
		SANDSTONE		
		CLAYSTONE		
		Oolitic LIMESTONE		
		Micritic LIMESTONE		
		Mudstone		
		Gypsum		
		Siltstone		

ROCK CLASSIFICATION

% RQD	Classification
<25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

GRANULAR SOILS

N-Value	Relative Density
<4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
>50	Very Dense

COHESIVE SOIL

N-Value	Consistency
<2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very stiff
>30	Hard

APPENDIX 3. PHOTOS OF CORE BOXES



DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيه طالب وشريك

Detailed Design Of Bisri Dam: Geo. Inv. Rep.II: (Factual) / Spillway & Bottom Outlet - July 2014

























































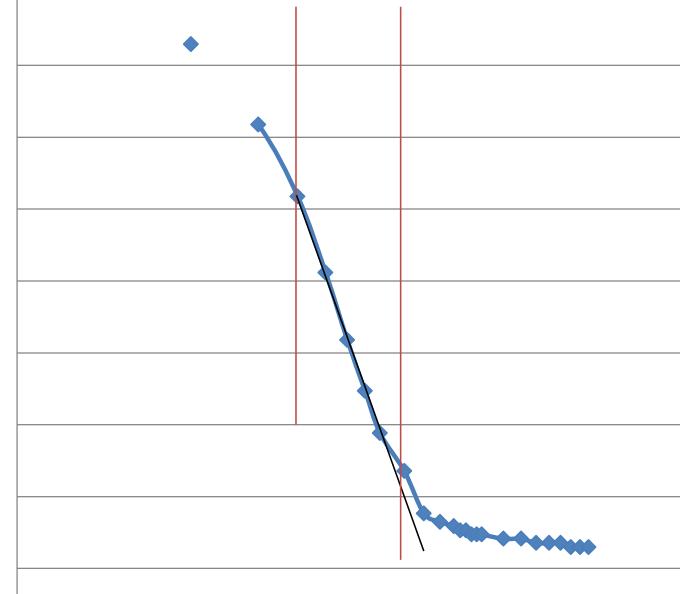




APPENDIX 4. BOREHOLE WATER PERMEABILITY & LUGEON TEST RESULTS



DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST						
				DAM FOOTPRINT								
BHVR1	Pre-T.W.D (m):	3	G.W.D (m):	9.2	Date:			22.05.2014				
Test Interval	3	to	6		K(m/sec, FHM):	1.6361E-06						
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t			
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	3	m		0	0.00	0	1.00	3.00			
Length of uncased test interval below the pre-test water level	L	3	m		1	0.13	60	0.96	2.87			
Falling Head Method (FHM)						2	0.19	120	0.94	2.81		
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.26	180	0.91	2.74		
						4	0.33	240	0.89	2.67		
						5	0.39	300	0.87	2.61		
						6	0.48	360	0.84	2.52		
H1	1.6		m		7	0.56	420	0.81	2.44			
H2	0.17		m		9	0.72	540	0.76	2.28			
t1 (as per graph)	1200		sec.		11	0.88	660	0.71	2.12			
t2	2700		sec.		13	1.04	780	0.65	1.96			
Log Time (sec)						15	1.11	900	0.63	1.89		
						16	1.16	960	0.61	1.84		
						17	1.21	1020	0.60	1.79		
						18	1.27	1080	0.58	1.73		
						19	1.34	1140	0.55	1.66		
						20	1.40	1200	0.53	1.60		
						25	1.77	1500	0.41	1.23		
						30	2.00	1800	0.33	1.00		
						35	2.31	2100	0.23	0.69		
						40	2.58	2400	0.14	0.42		
						45	2.83	2700	0.06	0.17		
Water Permeability (m/sec)			Relative Permeability			Semi-Pervious						
1.00E-03	1.00E-05		Pervious			Semi-Pervious						
1.00E-05	1.00E-08		Semi-Pervious			Semi-Pervious						
1.00E-08	1.00E-12		Impervious			Semi-Pervious						

BHVR1		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	9	to	12	K(m/sec, FHM):	2.6281E-07
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	8.5	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.29
Falling Head Method (FHM)				2	0.48
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.65
H1	7.85	m	4	0.83	
H2	7.2	m	5	0.99	
t1 (as per graph)	180	sec.	6	1.11	
t2	540	sec.	7	1.21	
Log Time (sec)				8	1.30
				9	1.40
Water Permeability (m/sec)				10	1.42
1.00E-03	1.00E-05	Pervious	11	1.43	
1.00E-05	1.00E-08	Semi-Pervious	12	1.44	
1.00E-08	1.00E-12	Impervious	13	1.44	
Relative Permeability				14	1.44
Pervious				15	1.45
Semi-Pervious				16	1.45
Impervious				17	1.46
Semi-Pervious				18	1.46

BHVR1		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST												
		DAM FOOTPRINT														
Test Interval	12	to	15	K(m/sec, FHM):	2.1803E-08											
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)											
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.2	m	0	0.00											
Length of uncased test interval below the pre-test water level	L	3	m	1	0.04											
Falling Head Method (FHM)				2	0.05											
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.07											
H1	9.13	m	4	0.09												
H2	9	m	5	0.11												
t1 (as per graph)	180	sec.	6	0.13												
t2	900	sec.	7	0.15												
Log Time (sec)				8	0.16											
				9	0.18											
<table border="1"> <tr> <td>Water Permeability (m/sec)</td> <td>Relative Permeability</td> </tr> <tr> <td>1.00E-03</td> <td>1.00E-05</td> <td>Pervious</td> </tr> <tr> <td>1.00E-05</td> <td>1.00E-08</td> <td>Semi-Pervious</td> </tr> <tr> <td>1.00E-08</td> <td>1.00E-12</td> <td>Impervious</td> </tr> </table>				Water Permeability (m/sec)	Relative Permeability	1.00E-03	1.00E-05	Pervious	1.00E-05	1.00E-08	Semi-Pervious	1.00E-08	1.00E-12	Impervious	10	0.19
Water Permeability (m/sec)	Relative Permeability															
1.00E-03	1.00E-05	Pervious														
1.00E-05	1.00E-08	Semi-Pervious														
1.00E-08	1.00E-12	Impervious														
				11	0.20											
				12	0.20											
				13	0.20											
				14	0.20											
				15	0.20											
				16	0.20											
				17	0.20											
				18	0.20											
				19	0.20											
				20	0.20											
				21	0.20											
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				89	0.20											
				90	0.20											
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				94	0.20											
				95	0.20											
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				106	0.20											
				107	0.20											
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				158	0.20											
				159	0.20											
				160	0.20											
				161	0.20											
				162	0.20											
				163	0.20											
				164	0.20											
				165	0.20											
				166	0.20											
				167	0.20											
				168	0.20											
				169	0.20											
				170	0.20											
				171	0.20											
				172	0.20											
				173	0.20											
				174	0.20											
				175	0.20											
				176	0.20											

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST				
		DAM FOOTPRINT						
BHVR1	Pre-T.W.D (m):	13	G.W.D (m):	9.2	Date:	23.05.2014		
Test Interval	15	to	18		K(m/sec, FHM):	5.3807E-09		
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00
Length of uncased test interval below the pre-test water level		L	3	m	1	0.07	60	0.99
Falling Head Method (FHM)						2	0.10	120
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.12	180
						4	0.13	240
						5	0.14	300
						6	0.15	360
H1		9.02		m	7	0.16	420	0.98
H2		8.93		m	9	0.17	540	0.98
t1 (as per graph)		660		sec.	11	0.18	660	0.98
t2		2700		sec.	13	0.19	780	0.98
Log Time (sec)						15	0.20	900
						16	0.20	960
						17	0.21	1020
						18	0.21	1080
						19	0.21	1140
						20	0.22	1200
						25	0.23	1500
						30	0.24	1800
						35	0.25	2100
						40	0.26	2400
						45	0.27	2700
						50	0.28	3000
						55	0.29	3300
						60	0.30	3600
Water Permeability (m/sec)		Relative Permeability						
1.00E-03	1.00E-05	Pervious						
1.00E-05	1.00E-08	Semi-Pervious						
1.00E-08	1.00E-12	Impervious						
						Impervious		

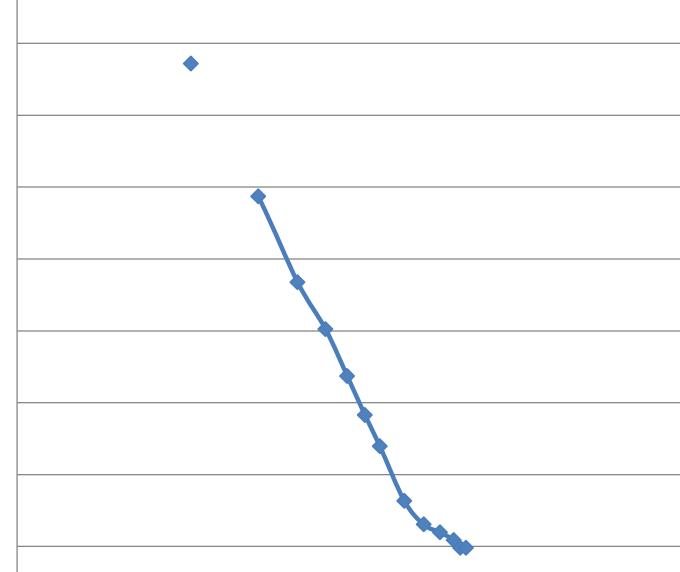
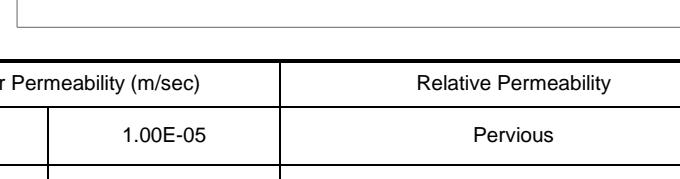
DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
				DAM FOOTPRINT							
BHVR1	Pre-T.W.D (m):	16	G.W.D (m):	9.2	Date:			23.05.2014			
Test Interval	18	to	21		K(m/sec, FHM):	9.6316E-08					
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00	9.20		
Length of uncased test interval below the pre-test water level		L	3	m	1	0.22	60	0.98	8.98		
Falling Head Method (FHM)						2	0.36	120	0.96	8.84	
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.42	180	0.95	8.78	
						4	0.46	240	0.95	8.74	
						5	0.48	300	0.95	8.72	
						6	0.49	360	0.95	8.71	
H1		8.98		m	7	0.50	420	0.95	8.70		
H2		8.7		m	9	0.50	540	0.95	8.70		
t1 (as per graph)		60		sec.							
t2		420		sec.							
Log Time (sec)											
Water Permeability (m/sec)	Relative Permeability				Impervious						
1.00E-03	1.00E-05	Pervious				Impervious					
1.00E-05	1.00E-08	Semi-Pervious				Impervious					
1.00E-08	1.00E-12	Impervious				Impervious					

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST				
				DAM FOOTPRINT						
	Pre-T.W.D (m):	9.2	G.W.D (m):	9.2	Date:			23.05.2014		
Test Interval	21	to	24		K(m/sec, FHM):	7.7246E-08				
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00	9.20	
Length of uncased test interval below the pre-test water level		L	3	m	1	0.13	60	0.99	9.07	
Falling Head Method (FHM)						2	0.21	120	0.98	
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.26	180	0.97	
						4	0.30	240	0.97	
						5	0.31	300	0.97	
						6	0.32	360	0.97	
H1		9.07	m		7	0.32	420	0.97	8.88	
H2		8.88	m							
t1 (as per graph)		60	sec.							
t2		360	sec.							
Log Time (sec)										
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious						
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Impervious					
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Impervious					
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Impervious					

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST				
				DAM FOOTPRINT						
BHVR1	Pre-T.W.D (m):	10.35	G.W.D (m):	9.2	Date:			24.05.2014		
Test Interval	24	to	27		K(m/sec, FHM):	1.5414E-07				
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00	9.20	
Length of uncased test interval below the pre-test water level		L	3	m	1	0.19	60	0.98	9.01	
Falling Head Method (FHM)						2	0.36	120	0.96	8.84
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.55	180	0.94	8.65
						4	0.66	240	0.93	8.54
						5	0.75	300	0.92	8.45
						6	0.82	360	0.91	8.38
H1		9.01		m	7	0.86	420	0.91	8.34	
H2		8.28		m	9	0.91	540	0.90	8.29	
t1 (as per graph)		60		sec.	11	0.92	660	0.90	8.28	
t2		660		sec.	13	0.92	780	0.90	8.28	
Log Time (sec)										
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious						
1.00E-03	1.00E-05	Pervious			Semi-Pervious					
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious					
1.00E-08	1.00E-12	Impervious			Semi-Pervious					

BHVR1		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	27	to	30	K(m/sec, FHM):	6.6453E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.15
Falling Head Method (FHM)				2	0.25
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.32
H1	8.85	m	4	0.39	
H2	8.41	m	5	0.46	
t1 (as per graph)	60	sec.	6	0.45	
t2	900	sec.	7	0.52	
Log Time (sec)				9	0.56
				11	0.57
				13	0.58
				15	0.59
				16	0.59
Water Permeability (m/sec)	Relative Permeability		Semi-Pervious to Impervious		
1.00E-03	1.00E-05	Pervious	Semi-Pervious to Impervious		
1.00E-05	1.00E-08	Semi-Pervious	Semi-Pervious to Impervious		
1.00E-08	1.00E-12	Impervious	Semi-Pervious to Impervious		

BHVR1		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	30	to	33	K(m/sec, FHM):	7.0775E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.2	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.12
Falling Head Method (FHM)				2	0.21
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.30
H1	9.08	m	4	0.38	
H2	8.6	m	5	0.43	
t1 (as per graph)	60	sec.	6	0.46	
t2	900	sec.	7	0.48	
Log Time (sec)				8	0.50
				9	0.52
				10	0.52
				11	0.52
				12	0.52
				13	0.52
				14	0.52
				15	0.60
				16	0.60
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Impervious	
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			

BHVR1		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	33	to	36	K(m/sec, FHM):	8.6911E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.2	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.21
Falling Head Method (FHM)				2	0.38
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.49
H1	8.99	m	4	0.55	
H2	8.37	m	5	0.61	
t1 (as per graph)	60	sec.	6	0.66	
t2	960	sec.	7	0.70	
Log Time (sec)				8	0.77
				9	0.80
				10	0.81
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Impervious	
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
				DAM FOOTPRINT					
BHVR1	Pre-T.W.D (m):	9	G.W.D (m):	9.2	Date:	26.05.2014			
Test Interval	36	to	39		K(m/sec, FHM):	2.0510E-08			
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9	m	0	0.00	0	1.00	
Length of uncased test interval below the pre-test water level		L	3	m	1	0.10	60	0.99	
Falling Head Method (FHM)						2	0.11	120	
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.11	180	
H1		8.9		m					
H2		8.89		m					
t1 (as per graph)		60		sec.					
t2		120		sec.					
Log Time (sec)									
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious					
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Impervious				
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Impervious				
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Impervious				

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST						
				DAM FOOTPRINT								
BHVR1	Pre-T.W.D (m):	13	G.W.D (m):	9.2	Date:	26.05.2014						
Test Interval	39	to	42		K(m/sec, FHM):	1.2384E-07						
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00				
Length of uncased test interval below the pre-test water level		L	3	m	1	0.18	60	0.98				
Falling Head Method (FHM)						2	0.28	120				
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.38	180				
						4	0.45	240				
						5	0.49	300				
						6	0.52	360				
H1	9.02		m		7	0.54	420	0.94				
H2	8.66		m		9	0.54	540	0.94				
t1 (as per graph)	60		sec.									
t2	420		sec.									
Log Time (sec)												
Water Permeability (m/sec)		Relative Permeability			Semi-Pervious							
1.00E-03	1.00E-05	Pervious			Semi-Pervious							
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious							
1.00E-08	1.00E-12	Impervious			Semi-Pervious							

BISRI DAM					FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
DAM FOOTPRINT										
BHVR1	Pre-T.W.D (m):	28.05	G.W.D (m):	9.2	Date:	26.05.2014				
Test Interval	42	to	45		K(m/sec, FHM):	6.3587E-08				
Diameter of test interval	D	86	mm		Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.2	m	0	0.00	0	1.00	9.20		
Length of uncased test interval below the pre-test water level	L	3	m	1	0.15	60	0.98	9.05		
Falling Head Method (FHM)					2	0.25	120	0.97		
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.33	180	0.96		
					4	0.38	240	0.96		
					5	0.41	300	0.96		
					6	0.43	360	0.95		
H1	9.05		m	7	0.44	420	0.95	8.76		
H2	8.74		m	9	0.45	540	0.95	8.75		
t1 (as per graph)	60		sec.	11	0.46	660	0.95	8.74		
t2	660		sec.	13	0.46	780	0.95	8.74		
Log Time (sec)										
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious						
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Impervious					
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Impervious					
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Impervious					

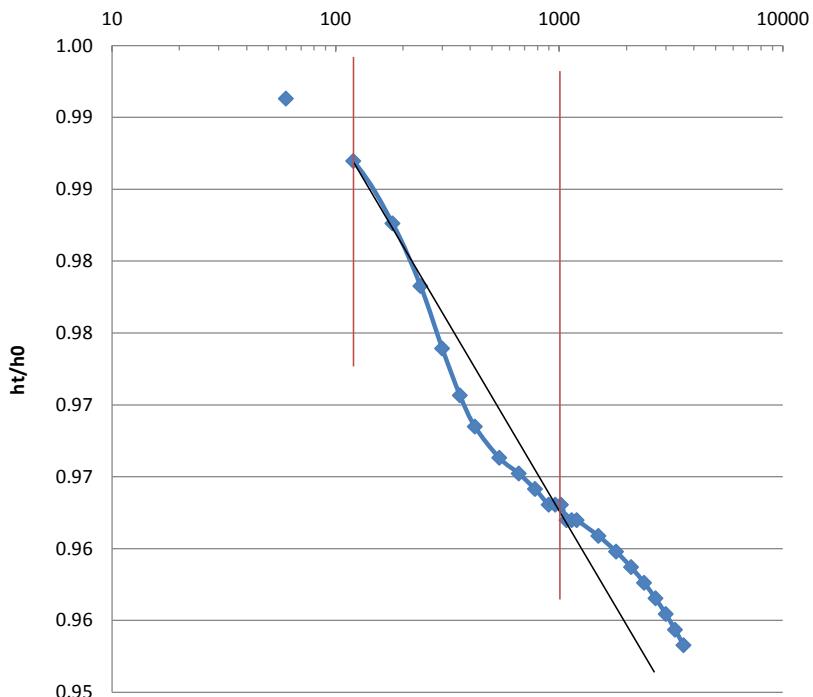
DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
				DAM FOOTPRINT							
BHVR1	Pre-T.W.D (m):	18	G.W.D (m):	9.2	Date:	26.05.2014					
Test Interval	45	to	48		K(m/sec, FHM):	3.4290E-08					
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00	9.20		
Length of uncased test interval below the pre-test water level		L	3	m	1	0.07	60	0.99	9.13		
Falling Head Method (FHM)						2	0.11	120	0.99		
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.14	180	0.98		
						4	0.16	240	0.98		
						5	0.18	300	0.98		
						6	0.20	360	0.98		
H1	9.13		m	7	0.22	420	0.98	8.98			
H2	8.96		m	9	0.23	540	0.98	8.97			
t1 (as per graph)	60		sec.	11	0.24	660	0.97	8.96			
t2	660		sec.	13	0.24	780	0.97	8.96			
Log Time (sec)											
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious							
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Impervious						
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Impervious						
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Impervious						

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دارالهندسة نازح طالب وشركاه للمهندسين والاستراتيجييين		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
		DAM FOOTPRINT				
	Pre-T.W.D (m):	26	G.W.D (m):	9.2	Date:	27.05.2014
Test Interval	48	to	51	K(m/sec, FHM):	1.5616E-07	
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.2	m	0	0.00	
Length of uncased test interval below the pre-test water level	L	3	m	1	0.27	
Falling Head Method (FHM)						
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						
H1	8.68	m	7	1.20	420 0.87 8.00	
H2	7.9	m	9	1.26	540 0.86 7.94	
t1 (as per graph)	120	sec.	11	1.28	660 0.86 7.92	
t2	780	sec.	13	1.30	780 0.86 7.90	
Log Time (sec)						
Water Permeability (m/sec)	Relative Permeability		Semi-Pervious to Impervious			
1.00E-03	1.00E-05	Pervious				
1.00E-05	1.00E-08	Semi-Pervious				
1.00E-08	1.00E-12	Impervious				

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST						
		DAM FOOTPRINT								
BHVR1	Pre-T.W.D (m):	31.5	G.W.D (m):	9.2	Date:	27.05.2014				
Test Interval	51	to	54		K(m/sec, FHM):	1.6022E-08				
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00	9.20	
Length of uncased test interval below the pre-test water level		L	3	m	1	0.06	60	0.99	9.14	
Falling Head Method (FHM)					2	0.08	120	0.99	9.12	
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.10	180	0.99	9.10	
					4	0.11	240	0.99	9.09	
					5	0.13	300	0.99	9.07	
					6	0.13	360	0.99	9.07	
H1		8.97		m	7	0.14	420	0.98	9.06	
H2		8.63		m	9	0.16	540	0.98	9.04	
t1 (as per graph)		960		sec.	11	0.18	660	0.98	9.02	
t2		3600		sec.	13	0.19	780	0.98	9.01	
Log Time (sec)					15	0.22	900	0.98	8.98	
					16	0.23	960	0.98	8.97	
					17	0.23	1020	0.98	8.97	
					18	0.25	1080	0.97	8.95	
					19	0.26	1140	0.97	8.94	
					20	0.27	1200	0.97	8.93	
					25	0.32	1500	0.97	8.88	
					30	0.36	1800	0.96	8.84	
					35	0.40	2100	0.96	8.80	
					40	0.44	2400	0.95	8.76	
					45	0.48	2700	0.95	8.72	
					50	0.52	3000	0.94	8.68	
					55	0.55	3300	0.94	8.65	
					60	0.57	3600	0.94	8.63	
Water Permeability (m/sec)		Relative Permeability			Semi-Pervious to Impervious					
1.00E-03	1.00E-05	Pervious								
1.00E-05	1.00E-08	Semi-Pervious								
1.00E-08	1.00E-12	Impervious								

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST							
				DAM FOOTPRINT									
BHVR1	Pre-T.W.D (m):	33	G.W.D (m):	9.2	Date:			27.05.2014					
Test Interval	54	to	57		K(m/sec, FHM):	2.5129E-08							
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.2	m		0	0.00	0	1.00	9.20				
Length of uncased test interval below the pre-test water level	L	3	m		1	0.10	60	0.99	9.10				
Falling Head Method (FHM)						2	0.12	120	0.99				
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.13	180	0.99				
						4	0.14	240	0.98				
						5	0.15	300	0.98				
						6	0.15	360	0.98				
H1	9.1		m										
H2	9.05		m										
t1 (as per graph)	60		sec.										
t2	300		sec.										
Log Time (sec)													
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious									
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Impervious								
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Impervious								
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Impervious								

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
				DAM FOOTPRINT							
BHVR1	Pre-T.W.D (m):	35	G.W.D (m):	9.2	Date:	28.05.2014					
Test Interval	57	to	60		K(m/sec, FHM):	2.9831E-08					
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0			
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00			
Length of uncased test interval below the pre-test water level		L	3	m	1	0.08	60	0.99			
Falling Head Method (FHM)						2	0.12	120 0.99			
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.16	180 0.98			
						4	0.20	240 0.98			
						5	0.24	300 0.97			
						6	0.27	360 0.97			
H1	9.08		m	7	0.29	420	0.97	8.91			
H2	8.86		m	9	0.31	540	0.97	8.89			
t1 (as per graph)	120		sec.	11	0.32	660	0.97	8.88			
t2	1020		sec.	13	0.33	780	0.96	8.87			
Log Time (sec)						15	0.34	900 0.96			
						16	0.34	960 0.96			
						17	0.34	1020 0.96			
						18	0.35	1080 0.96			
						19	0.35	1140 0.96			
						20	0.35	1200 0.96			
						25	0.36	1500 0.96			
						30	0.37	1800 0.96			
						35	0.38	2100 0.96			
						40	0.39	2400 0.96			
						45	0.40	2700 0.96			
						50	0.41	3000 0.96			
						55	0.42	3300 0.95			
						60	0.43	3600 0.95			
Water Permeability (m/sec)			Relative Permeability			Semi-Pervious to Impervious					
1.00E-03	1.00E-05		Pervious								
1.00E-05	1.00E-08		Semi-Pervious								
1.00E-08	1.00E-12		Impervious								



DAR AL HANDASAH NAZIH TALEB & PARTNERS	consulting engineers	BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST							
BHVR1	Diameter of test interval	Time (min)	Drawdown from R.L (m)	Test Interval	60	to	Time (sec)	Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	h _t /h ₀	h _t
Length of uncased test interval below the pre-test water level	L	3	m	Falling Head Method (FHM)							

BHVR1		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	63	to	66	K(m/sec, FHM):	6.7469E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.2	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.08
Falling Head Method (FHM)				2	0.12
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.16
H1	9	m	4	0.20	120 0.99 9.08
H2	8.77	m	5	0.24	180 0.98 9.04
t1 (as per graph)	240	sec.	6	0.28	240 0.98 9.00
t2	660	sec.	7	0.32	300 0.97 8.96
			8	0.36	360 0.97 8.92
			9	0.40	420 0.97 8.88
			10	0.44	540 0.96 8.81
			11	0.43	660 0.95 8.77
			12	0.44	780 0.95 8.76
			13	0.45	900 0.95 8.75
			14	0.45	960 0.95 8.75
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		Semi-Pervious to Impervious		
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			

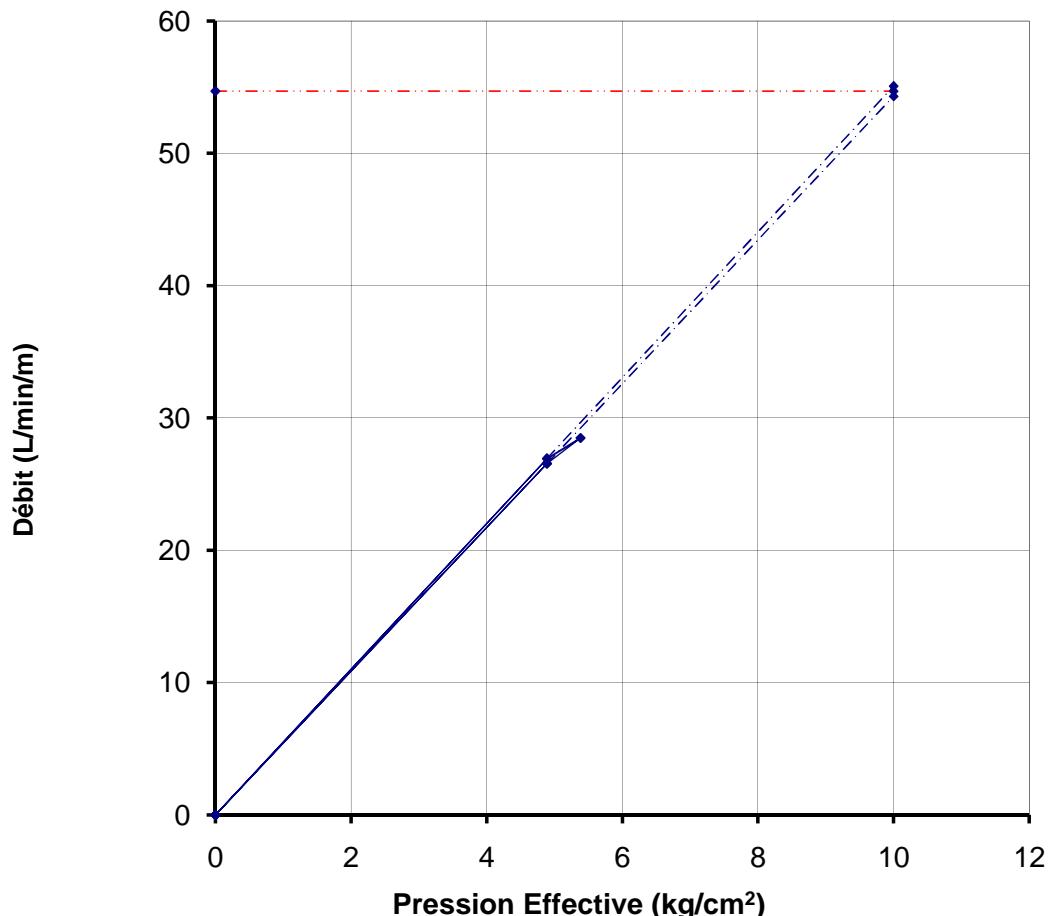
DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST				
		DAM FOOTPRINT						
BHVR1	Pre-T.W.D (m):	31.5	G.W.D (m):	9.2	Date:	29.05.2014		
Test Interval	66	to	69		K(m/sec, FHM):	1.9634E-08		
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00
Length of uncased test interval below the pre-test water level		L	3	m	1	0.06	60	0.99
Falling Head Method (FHM)						2	0.10	120
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.12	180
						4	0.14	240
						5	0.16	300
						6	0.18	360
H1		9.02		m	7	0.21	420	0.98
H2		8.79		m	9	0.24	540	0.97
t1 (as per graph)		360		sec.	11	0.28	660	0.97
t2		1800		sec.	13	0.30	780	0.97
Log Time (sec)						15	0.34	900
						16	0.35	960
						17	0.36	1020
						18	0.37	1080
						19	0.37	1140
						20	0.38	1200
						25	0.40	1500
						30	0.41	1800
						35	0.41	2100
						40	0.42	2400
						45	0.42	2700
						50	0.42	3000
						55	0.43	3300
						60	0.43	3600
Water Permeability (m/sec)		Relative Permeability						
1.00E-03	1.00E-05	Pervious						
1.00E-05	1.00E-08	Semi-Pervious						
1.00E-08	1.00E-12	Impervious						
						Semi-Pervious to Impervious		

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دَارُ الْهَنْدَاسَةِ نَازِحٌ طَالِبٌ وَشَرِكَةٌ لِلصَّوْبَرِ وَالْمُهَندِسِينَ الْفَيْدِيَةَ		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST								
		DAM FOOTPRINT											
	Pre-T.W.D (m):	31.5	G.W.D (m):	9.2	Date:		30.05.2014						
Test Interval	69	to	72		K(m/sec, FHM):		4.0543E-08						
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.2	m	0	0.00	0	1.00	9.20				
Length of uncased test interval below the pre-test water level		L	3	m	1	0.10	60	0.99	9.10				
Falling Head Method (FHM)						2	0.13	120	0.99	9.07			
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.17	180	0.98	9.03			
						4	0.19	240	0.98	9.01			
						5	0.21	300	0.98	8.99			
						6	0.23	360	0.98	8.97			
H1		9.1		m	7	0.25	420	0.97	8.95				
H2		8.9		m	9	0.29	540	0.97	8.92				
t1 (as per graph)		60		sec.	11	0.30	660	0.97	8.90				
t2		660		sec.	13	0.30	780	0.97	8.90				
Log Time (sec)													
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious									
1.00E-03	1.00E-05	Pervious											
1.00E-05	1.00E-08	Semi-Pervious											
1.00E-08	1.00E-12	Impervious											

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE SONDAGE No.: BHVR 01 TRANCHE ESSAYEE 90.00 m à 93.00 m						Date: 6/3/2014
							Manomètre 0.50 m
							depth to water: 9.20 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	797	10	3	79.7	26.57	0.97	7.89E-02	4.891
4.5	855	10	3	85.5	28.50	0.97	8.46E-02	5.385
4	808	10	3	80.8	26.93	0.97	8.00E-02	4.890



Lugeon = 54.70 L/min/m

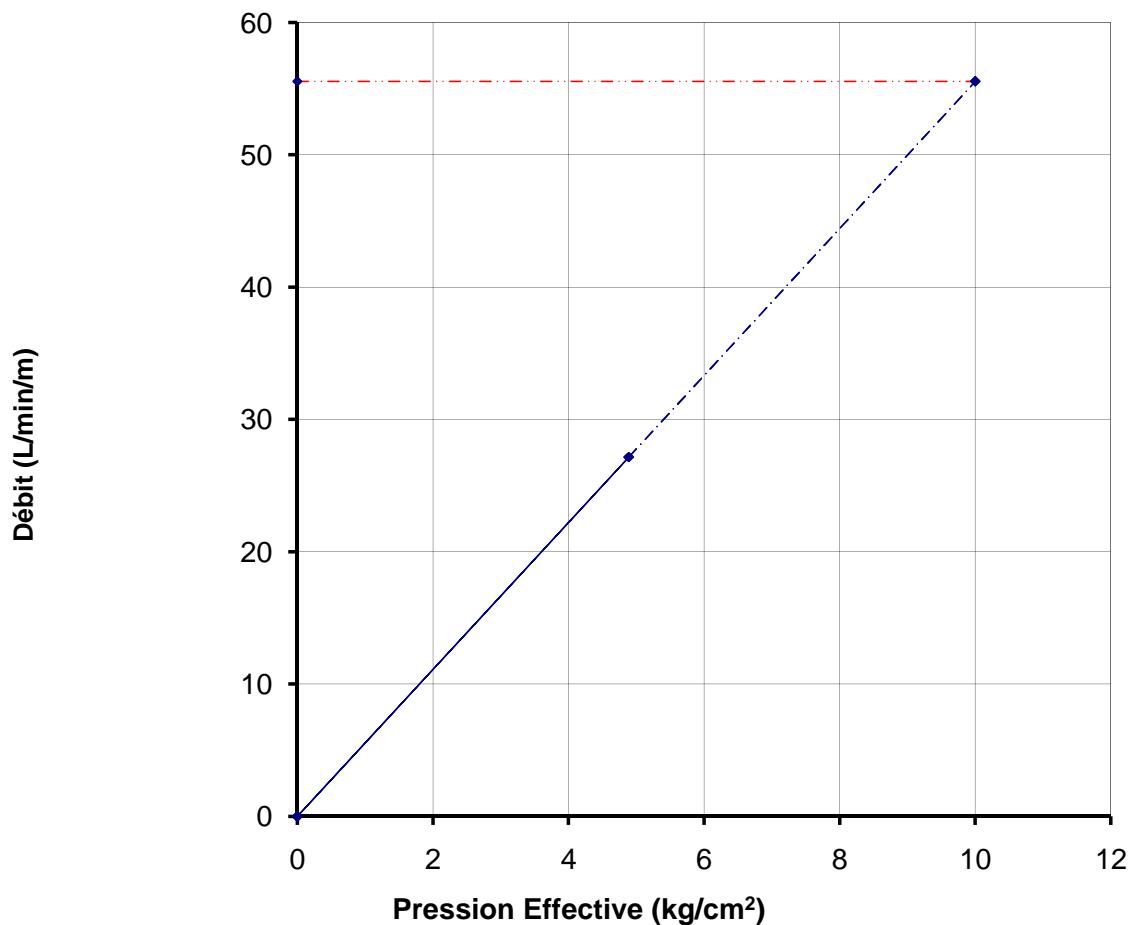


PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/3/2014
SONDAGE No.: BHVR 01	
TRANCHE ESSAYEE 93.00 m à 96.00 m	Manomètre 0.50 m

depth to water: 9.20 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	815	10	3	81.5	27.17	0.97	8.07E-02	4.889



Lugeon = 55.56 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 01**
TRANCHE ESSAYEE **96.00 m à 99.00 m**

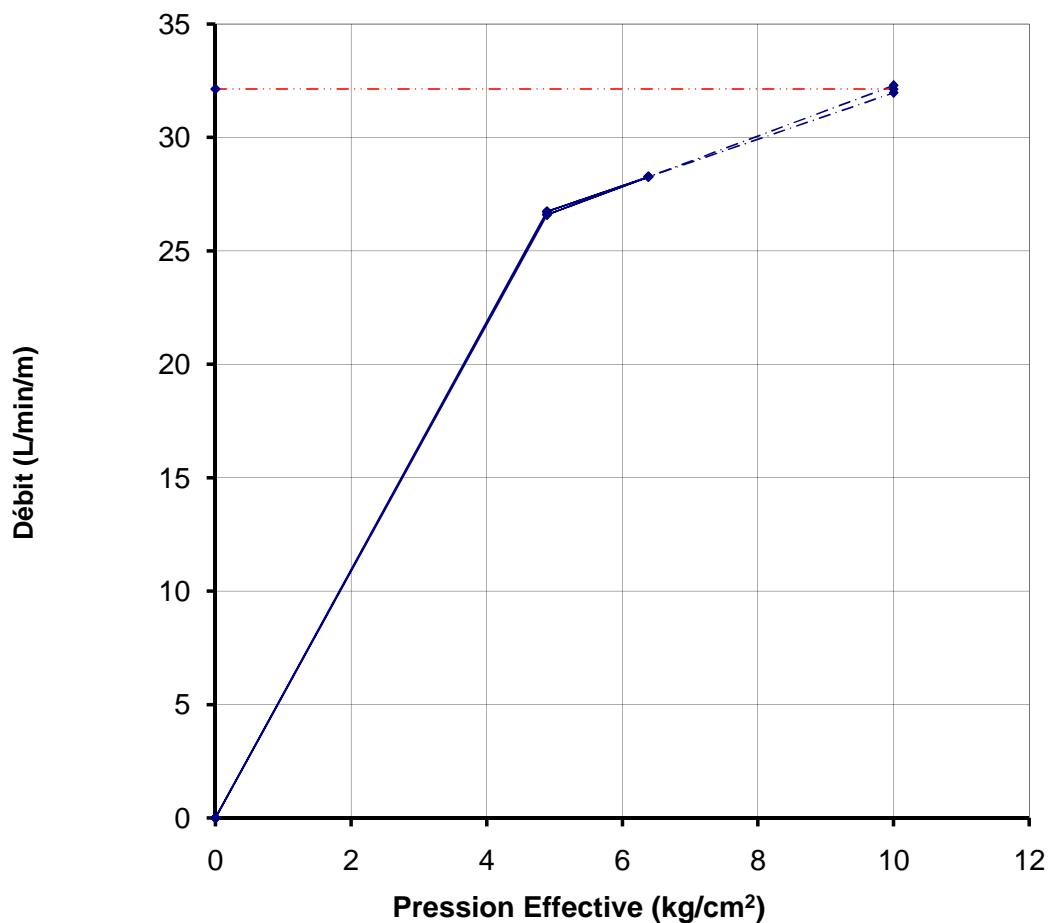
Date: **6/3/2014**

Manomètre **0.50 m**

depth to water: **9.20 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	802	10	3	80.2	26.73	0.97	7.94E-02	4.891
5.5	848	10	3	84.8	28.27	0.97	8.40E-02	6.386
4	798	10	3	79.8	26.60	0.97	7.90E-02	4.891

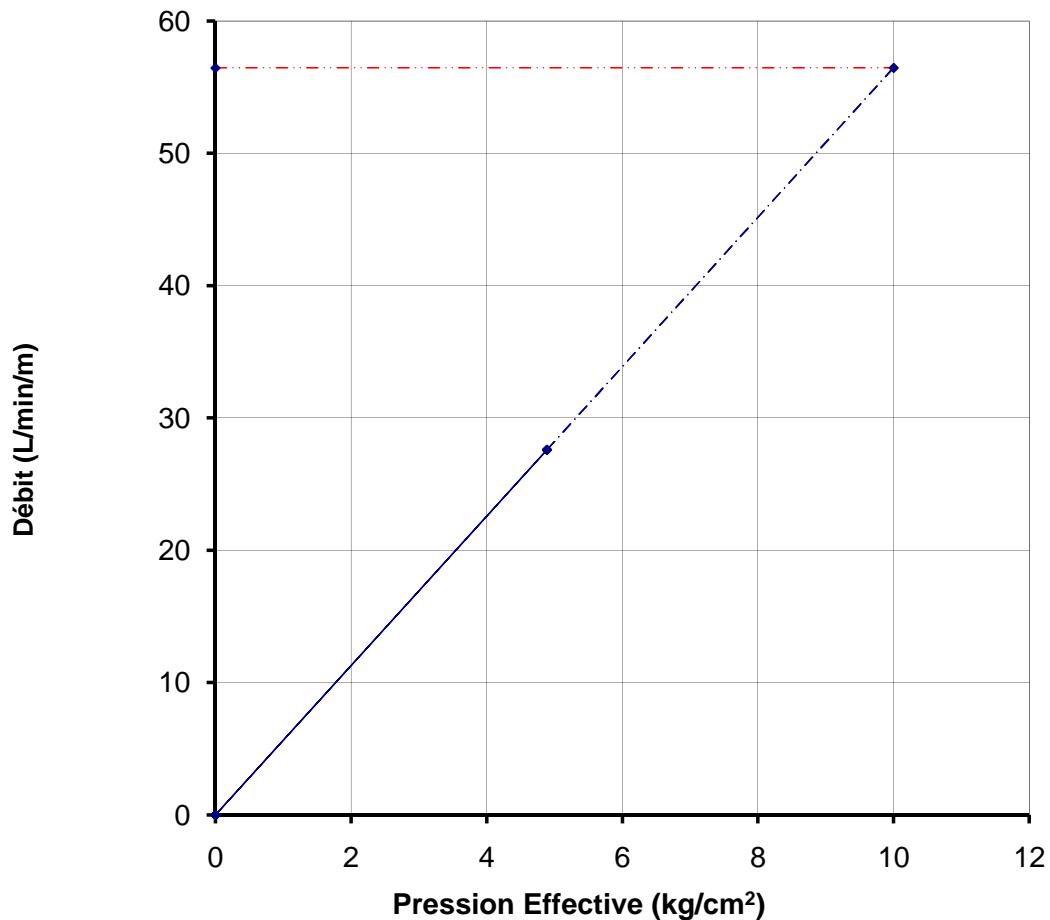


Lugeon = 32.13 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/4/2014
SONDAGE No.: BHVR 01	TRANCHE ESSAYEE 99.00 m à 102.00 m	Manomètre 0.50 m
		depth to water: 9.20 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	828	10	3	82.8	27.60	0.97	8.20E-02	4.888



Lugeon = 56.46 L/min/m



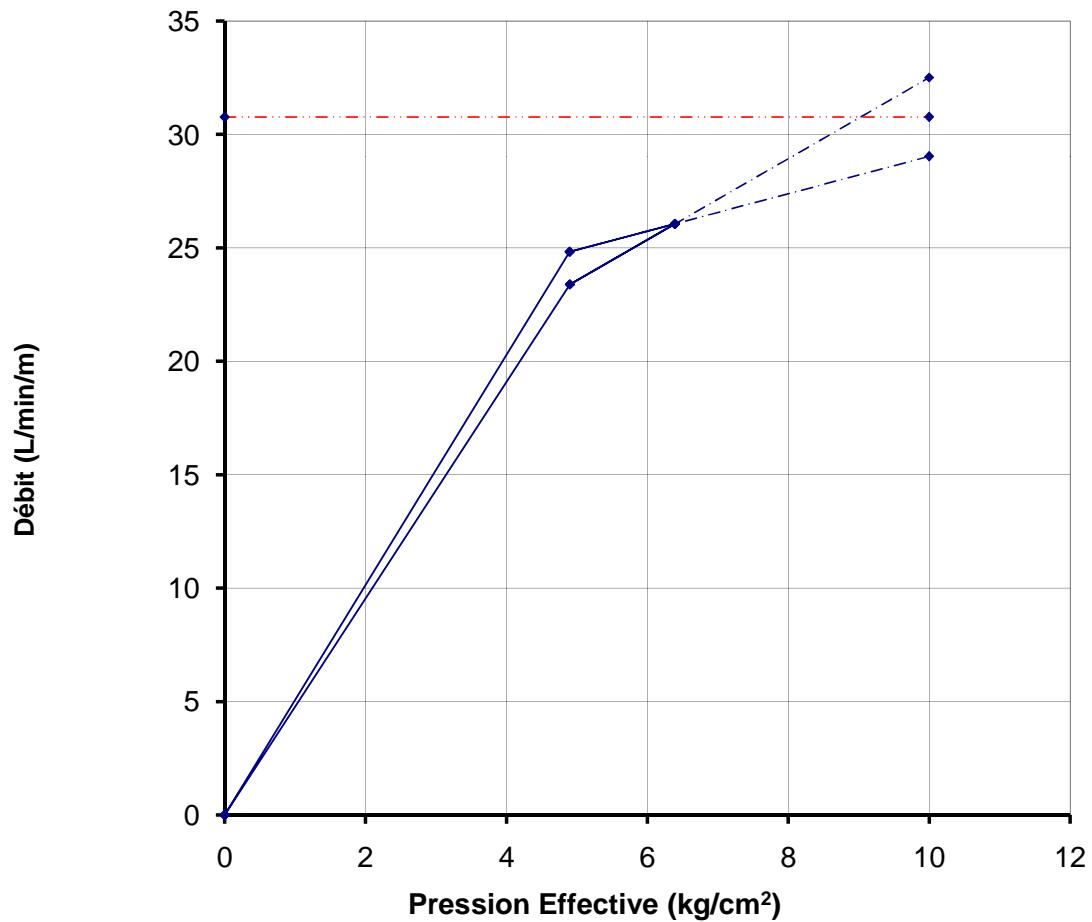
PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 01**
TRANCHE ESSAYEE **102.00 m** à **105.00 m**

Date: **6/4/2014**
Manomètre **0.50 m**

depth to water: **9.20 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	702	10	3	70.2	23.40	0.97	6.95E-02	4.901
5.5	782	10	3	78.2	26.07	0.97	7.74E-02	6.393
4	745	10	3	74.5	24.83	0.97	7.38E-02	4.896



Lugeon = 30.78 L/min/m



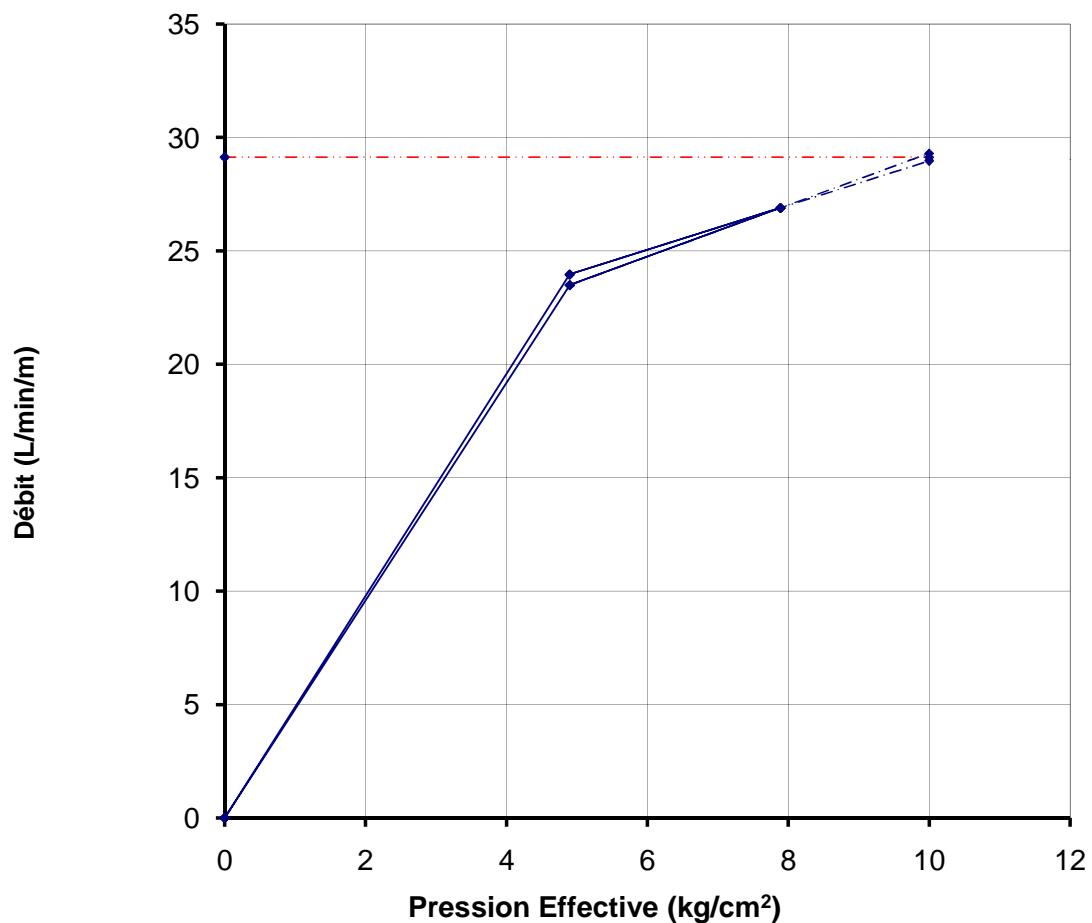
PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 01**
TRANCHE ESSAYEE **105.00 m** à **108.00 m**

Date: **6/5/2014**
Manomètre **0.50 m**

depth to water: **9.20 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	705	10	3	70.5	23.50	0.97	6.98E-02	4.900
7	807	10	3	80.7	26.90	0.97	7.99E-02	7.890
4	719	10	3	71.9	23.97	0.97	7.12E-02	4.899



Lugeon = 29.13 L/min/m



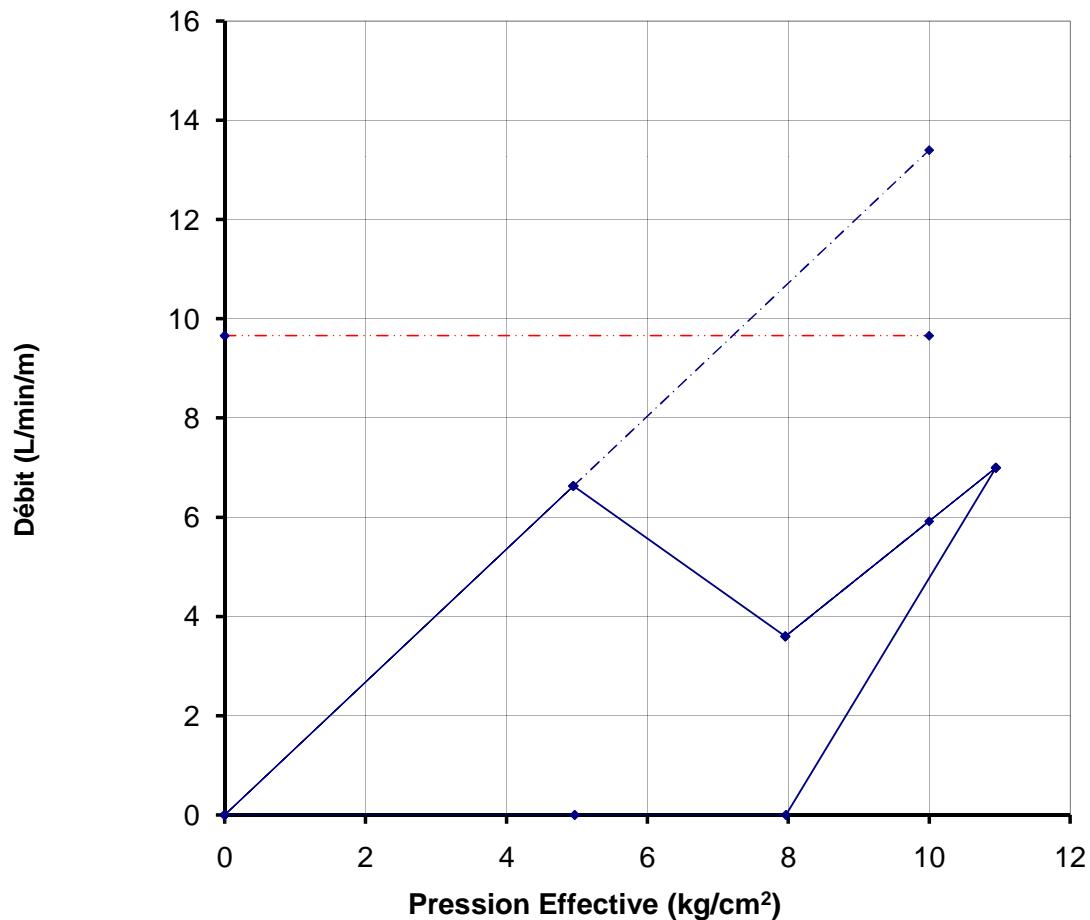
PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 01**
TRANCHE ESSAYEE **108.00 m** à **111.00 m**

Date: **6/5/2014**
Manomètre **0.50 m**

depth to water: **9.20 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	199	10	3	19.9	6.63	0.97	1.97E-02	4.950
7	108	10	3	10.8	3.60	0.97	1.07E-02	7.959
10	210	10	3	21	7.00	0.97	2.08E-02	10.949
7	0	10	3	0	0.00	0.97	0.00E+00	7.970
4	0	10	3	0	0.00	0.97	0.00E+00	4.970



Lugeon = 9.66 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 01**
TRANCHE ESSAYEE **111.00 m** à **114.00 m**

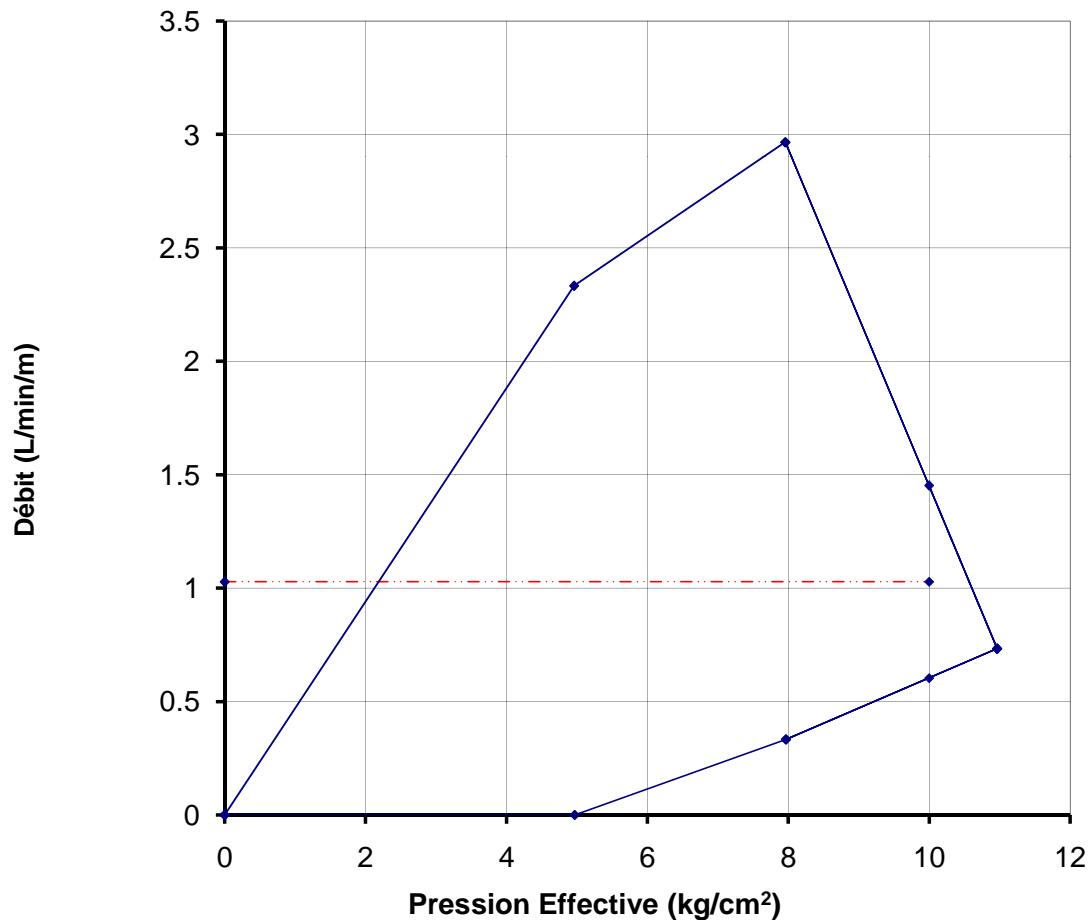
Date: **6/5/2014**

Manomètre **0.50 m**

depth to water: **9.20 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	70	10	3	7	2.33	0.97	6.93E-03	4.963
7	89	10	3	8.9	2.97	0.97	8.81E-03	7.961
10	22	10	3	2.2	0.73	0.97	2.18E-03	10.968
7	10	10	3	1	0.33	0.97	9.90E-04	7.969
4	0	10	3	0	0.00	0.97	0.00E+00	4.970



Lugeon = 1.03 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 03**
TRANCHE ESSAYEE **9.00 m à 12.00 m**

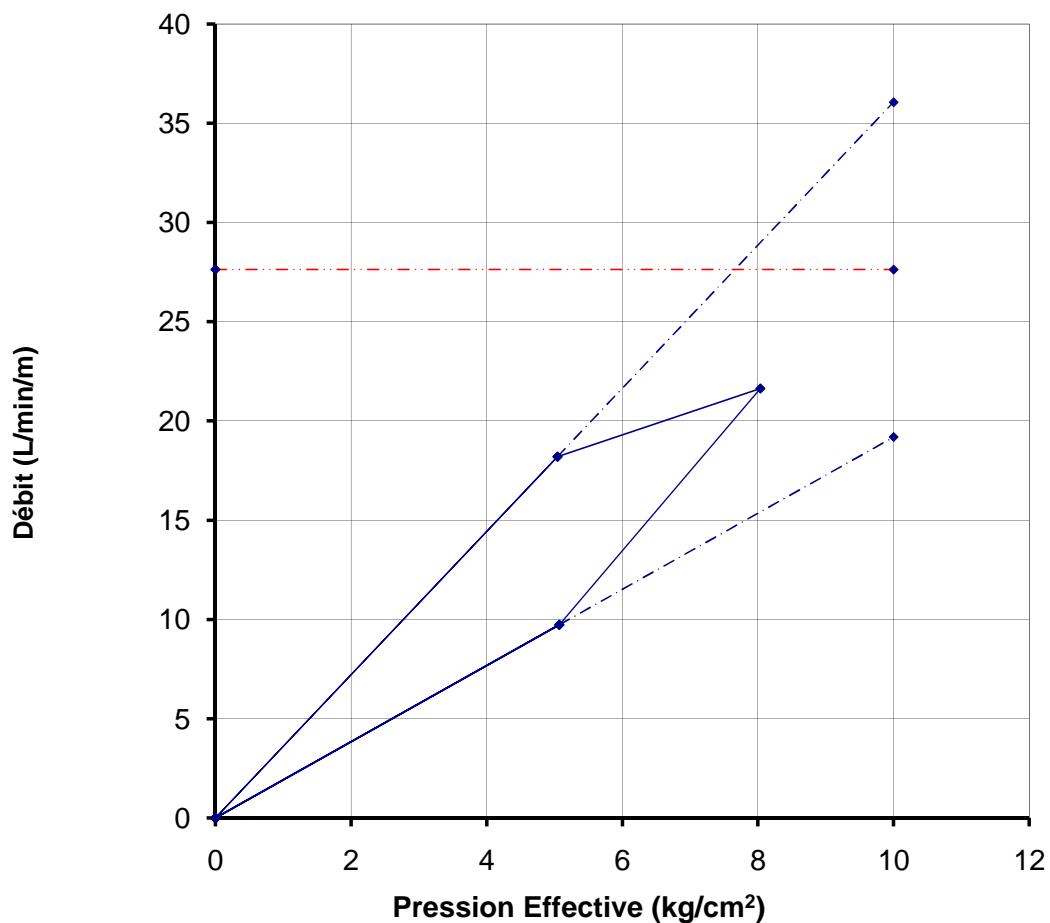
Date: **6/2/2014**

Manomètre **0.50 m**

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	546	10	3	54.6	18.20	1.1	5.41E-02	5.046
7	649	10	3	64.9	21.63	1.1	6.43E-02	8.036
4	292	10	3	29.2	9.73	1.1	2.89E-02	5.071

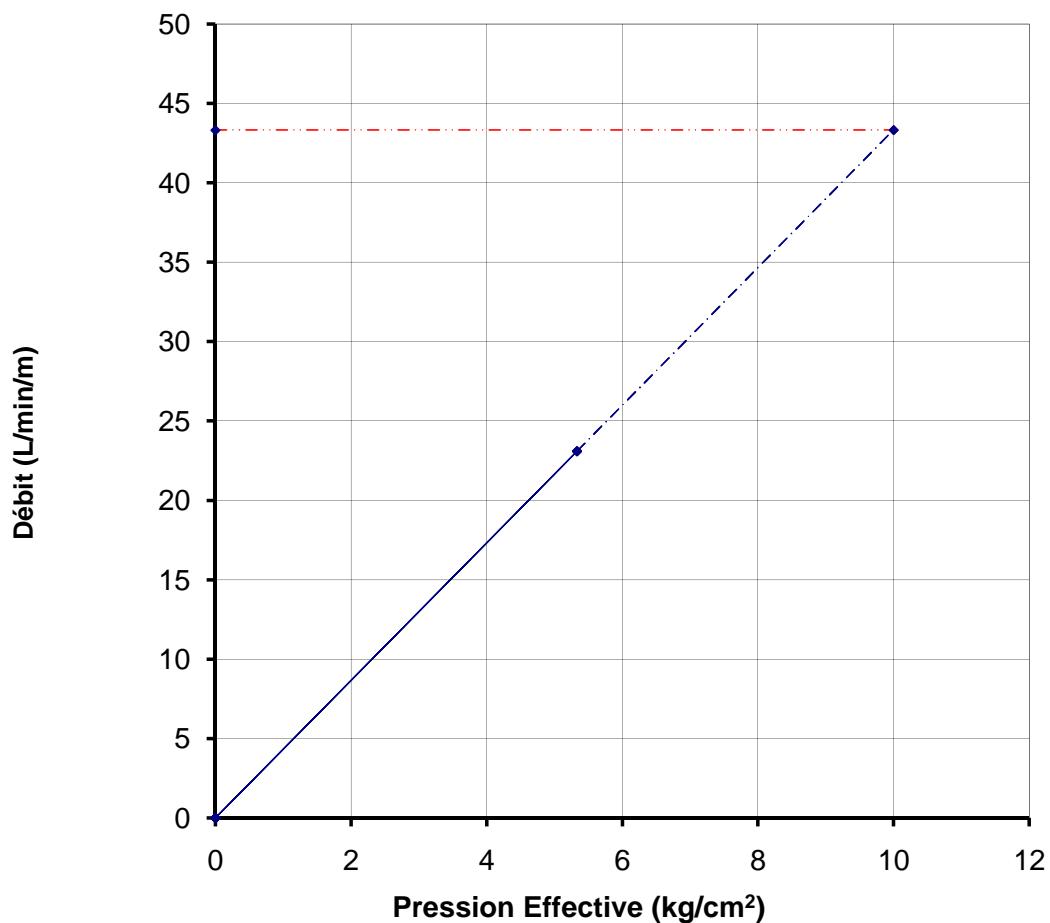


Lugeon = **27.63 L/min/m**

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/2/2014
SONDAGE No.: BHLA 03	TRANCHE ESSAYEE 12.00 m à 15.00 m	Manomètre 0.50 m
		depth to water: 29.40 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	693	10	3	69.3	23.10	1.4	6.86E-02	5.331



Lugeon = 43.33 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 03**
TRANCHE ESSAYEE **15.00 m à 18.00 m**

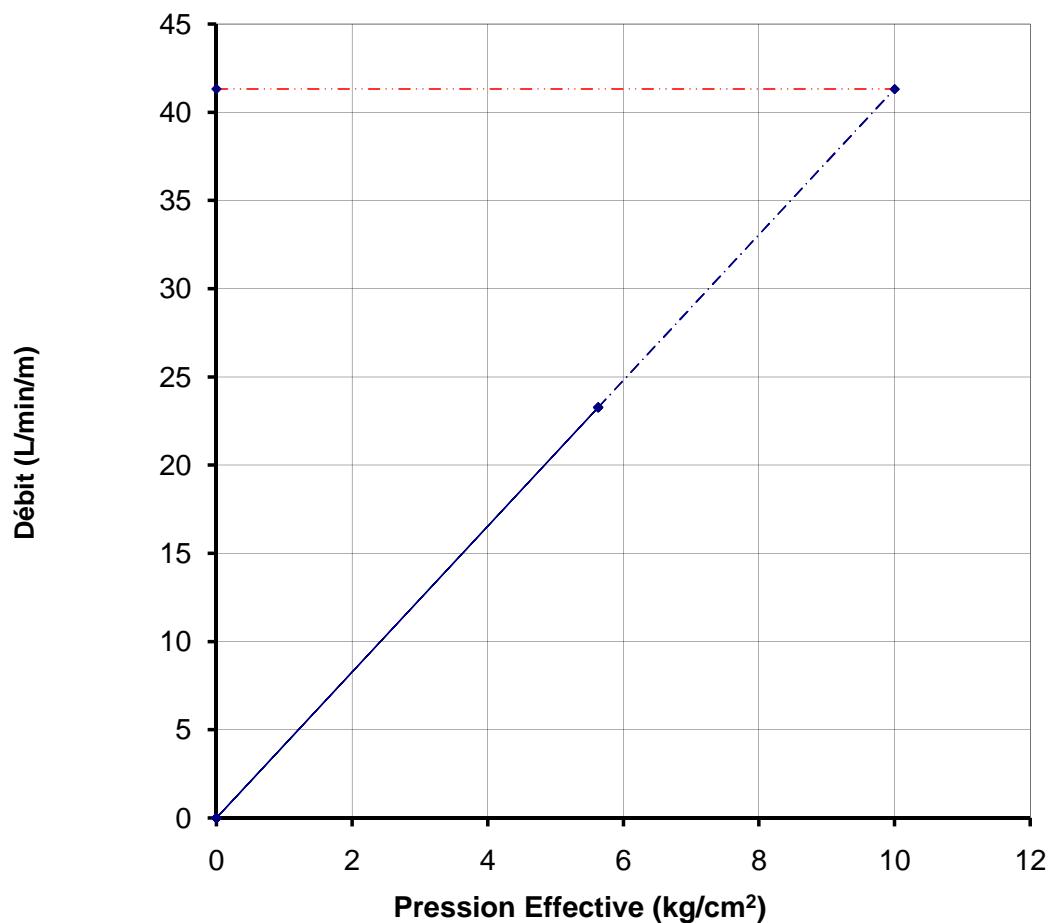
Date: **6/2/2014**

Manomètre **0.50 m**

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	698	10	3	69.8	23.27	1.7	6.91E-02	5.631



Lugeon = **41.32 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 03**
TRANCHE ESSAYEE **18.00 m à 21.00 m**

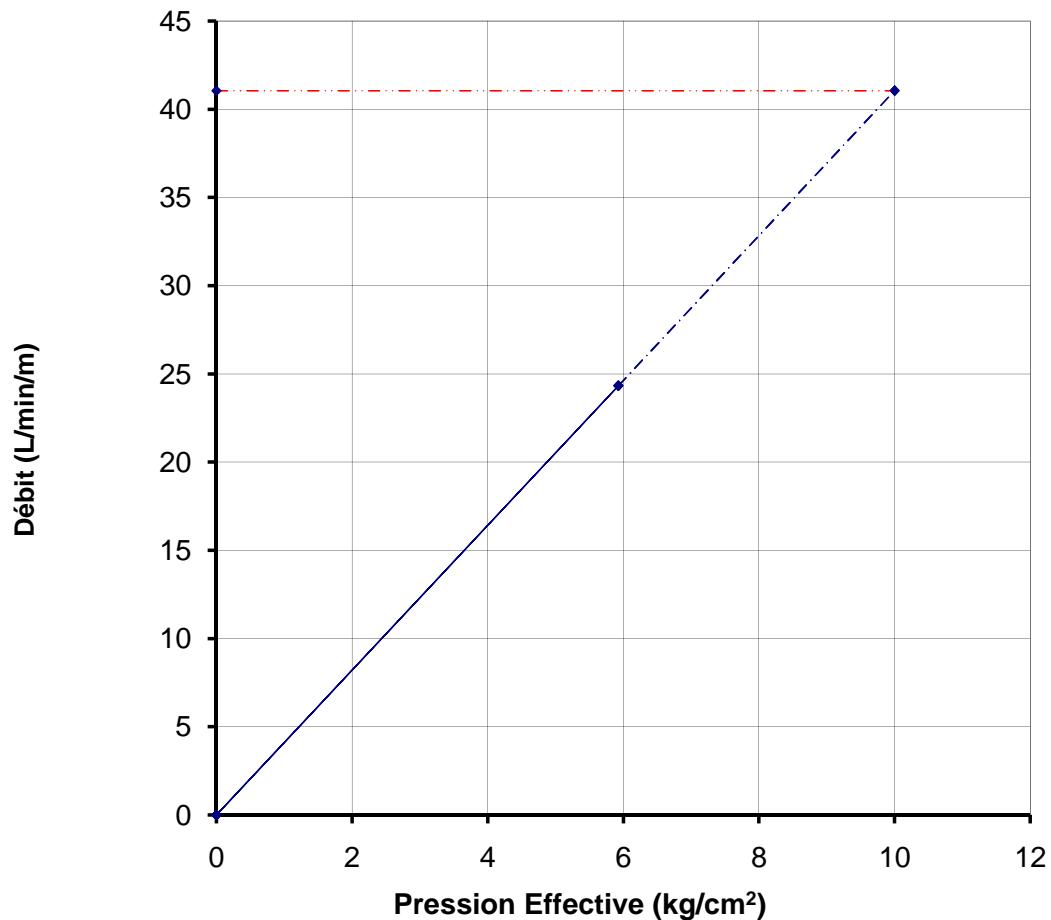
Date: **6/4/2014**

Manomètre **0.50 m**

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	730	10	3	73	24.33	2	7.23E-02	5.928



Lugeon = 41.05 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 03**
TRANCHE ESSAYEE **21.00 m à 24.00 m**

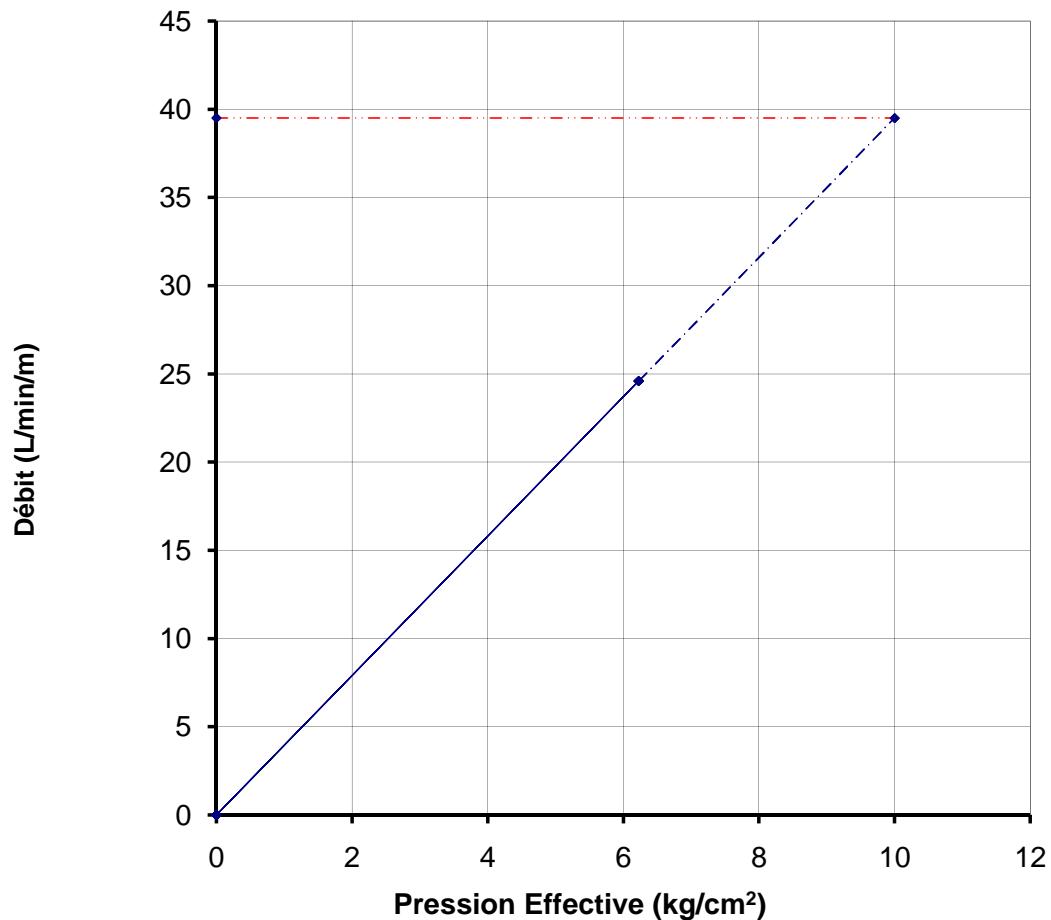
Date: **6/4/2014**

Manomètre **0.50 m**

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	738	10	3	73.8	24.60	2.3	7.31E-02	6.227

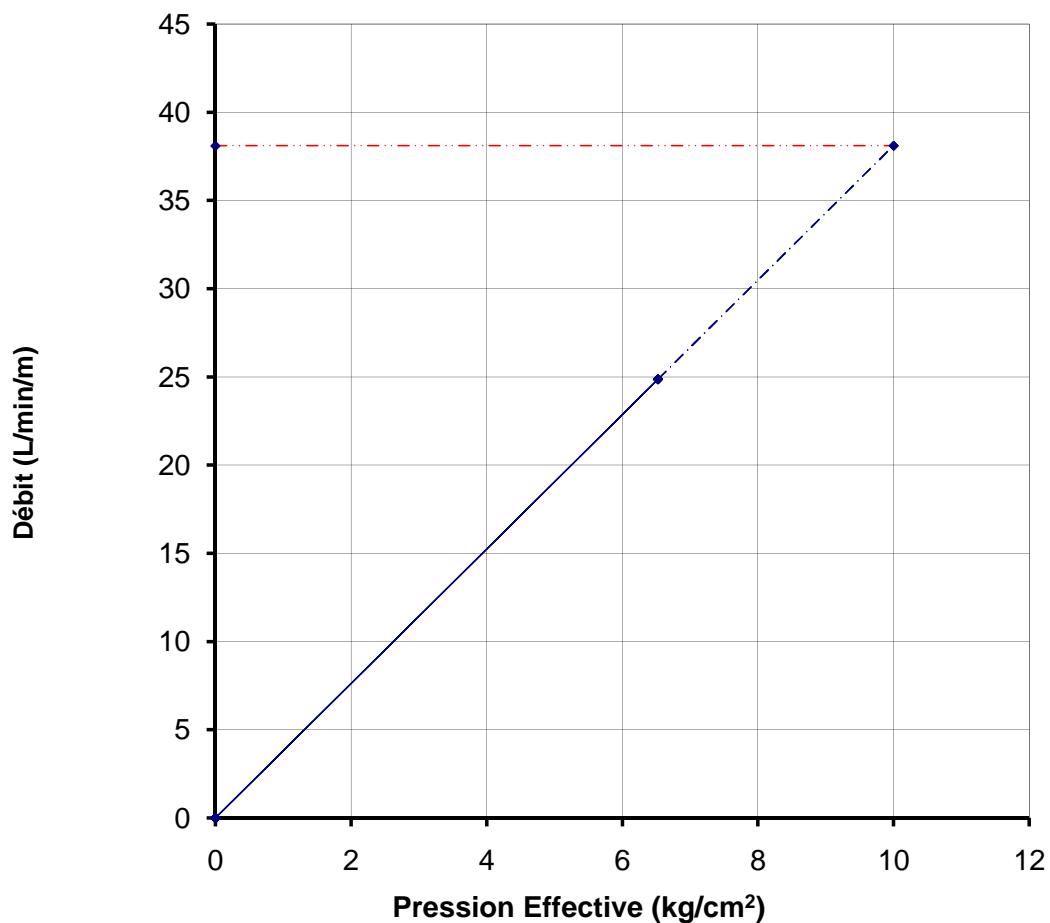


Lugeon = 39.51 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/4/2014
SONDAGE No.: BHLA 03	TRANCHE ESSAYEE 24.00 m à 27.00 m	Manomètre 0.50 m
		depth to water: 29.40 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	746	10	3	74.6	24.87	2.6	7.39E-02	6.526



Lugeon = 38.10 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 03**
TRANCHE ESSAYEE **27.00 m à 30.00 m**

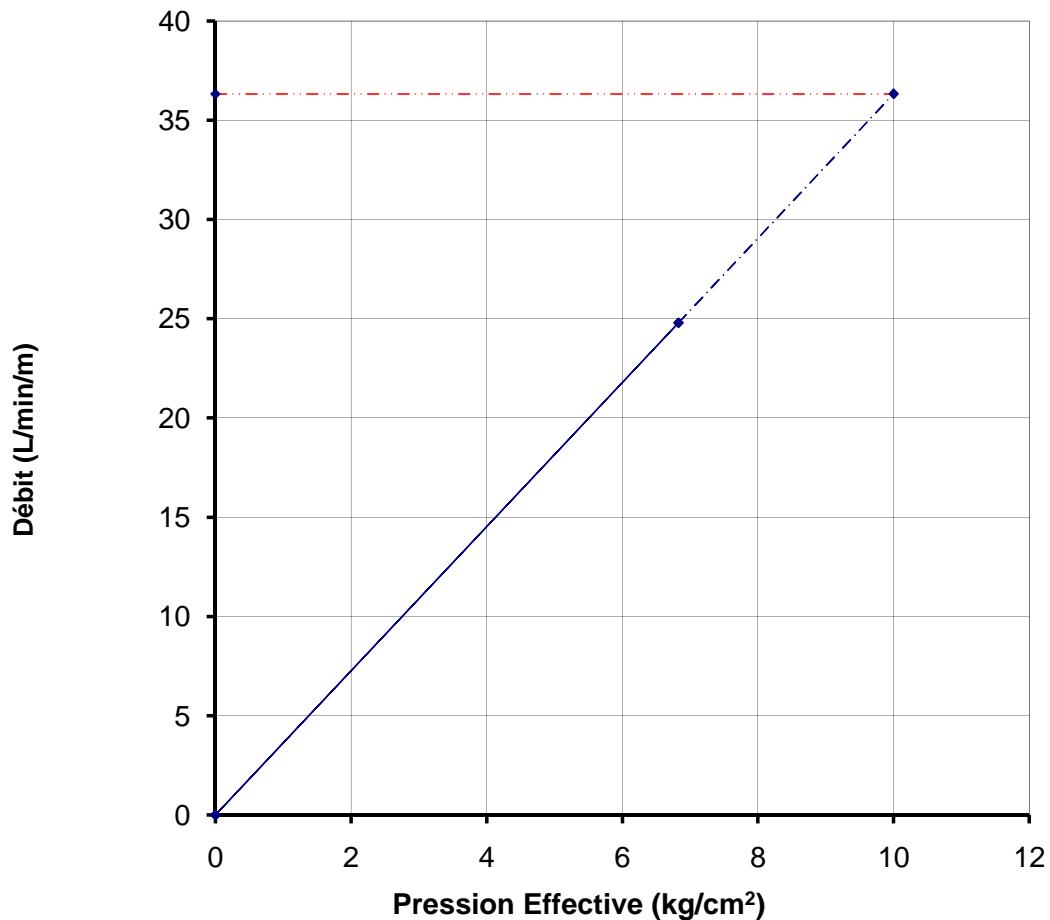
Date: **6/6/2014**

Manomètre **0.50 m**

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	744	10	3	74.4	24.80	2.9	7.37E-02	6.826

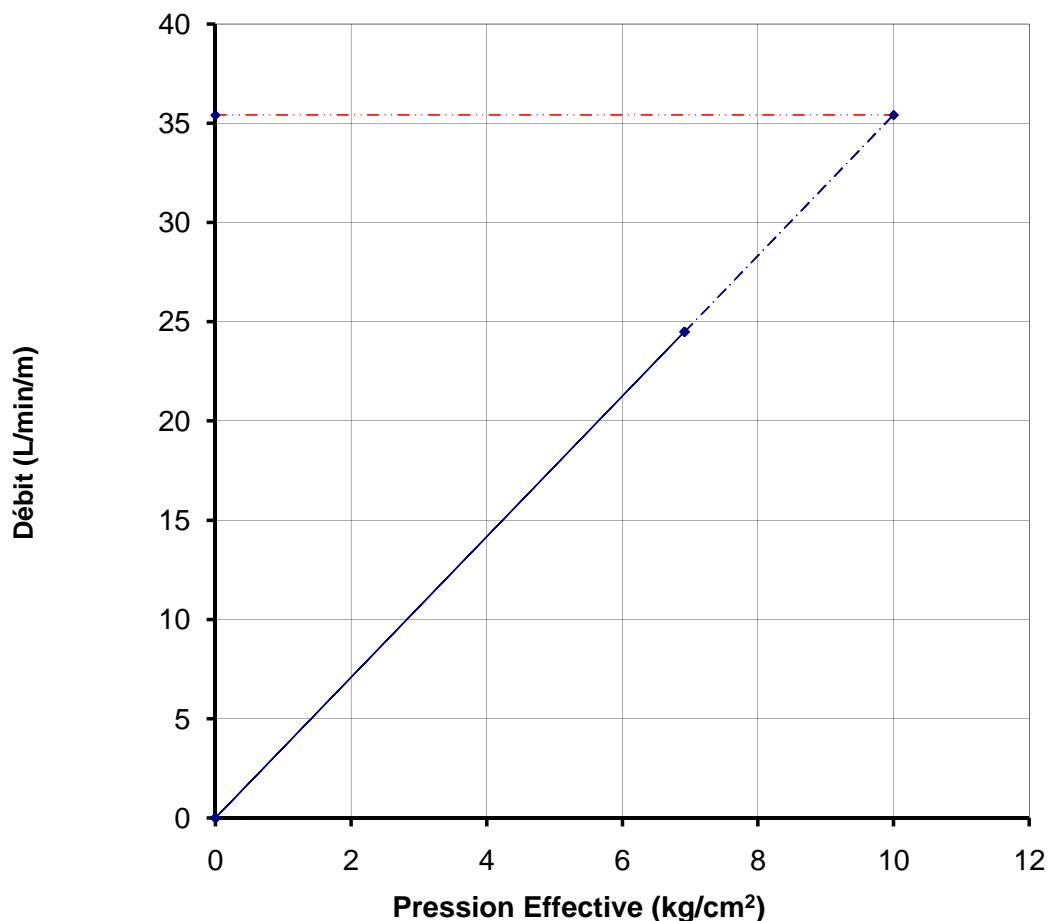


Lugeon = 36.33 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/7/2014
SONDAGE No.: BHLA 03	TRANCHE ESSAYEE 30.00 m à 33.00 m	Manomètre 0.50 m
		depth to water: 29.40 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	735	10	3	73.5	24.50	2.99	7.28E-02	6.917

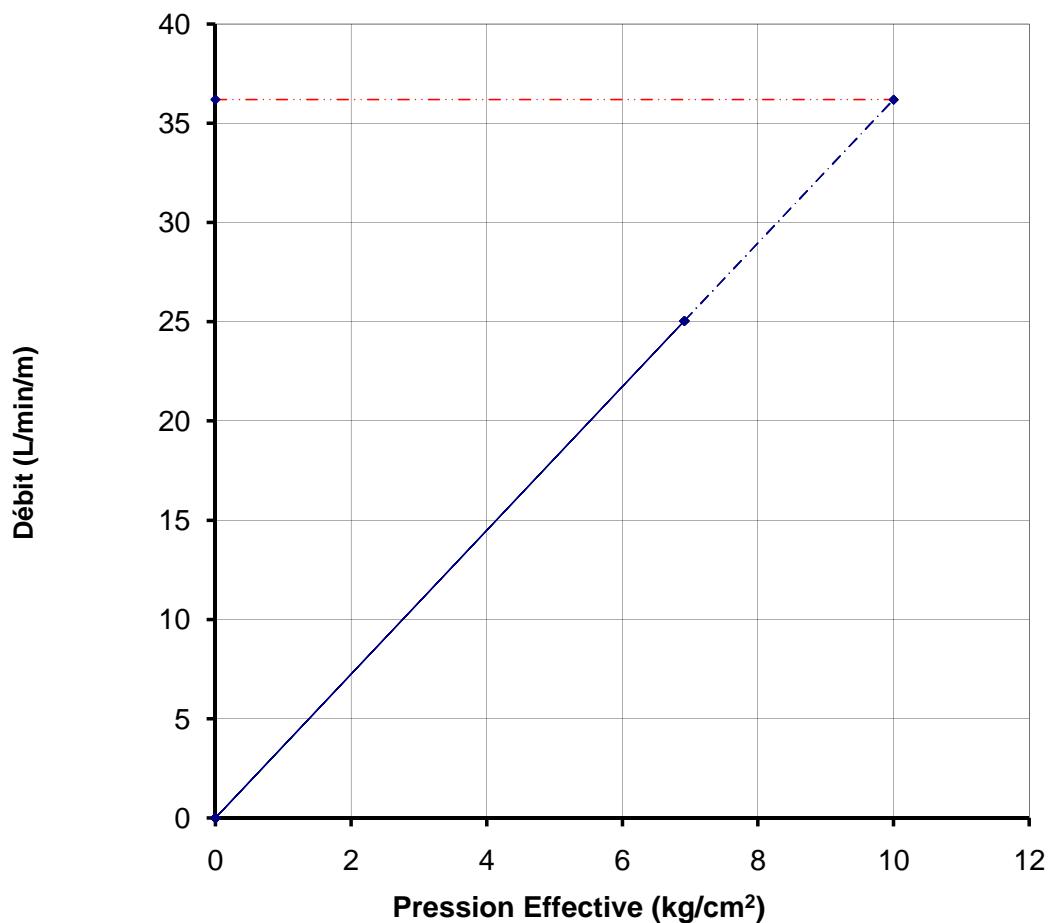


Lugeon = 35.42 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/7/2014
SONDAGE No.: BHLA 03	TRANCHE ESSAYEE 33.00 m à 36.00 m	Manomètre 0.50 m
		depth to water: 29.40 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	751	10	3	75.1	25.03	2.99	7.43E-02	6.916



Lugeon = 36.20 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 03**
TRANCHE ESSAYEE **36.00 m à 39.00 m**

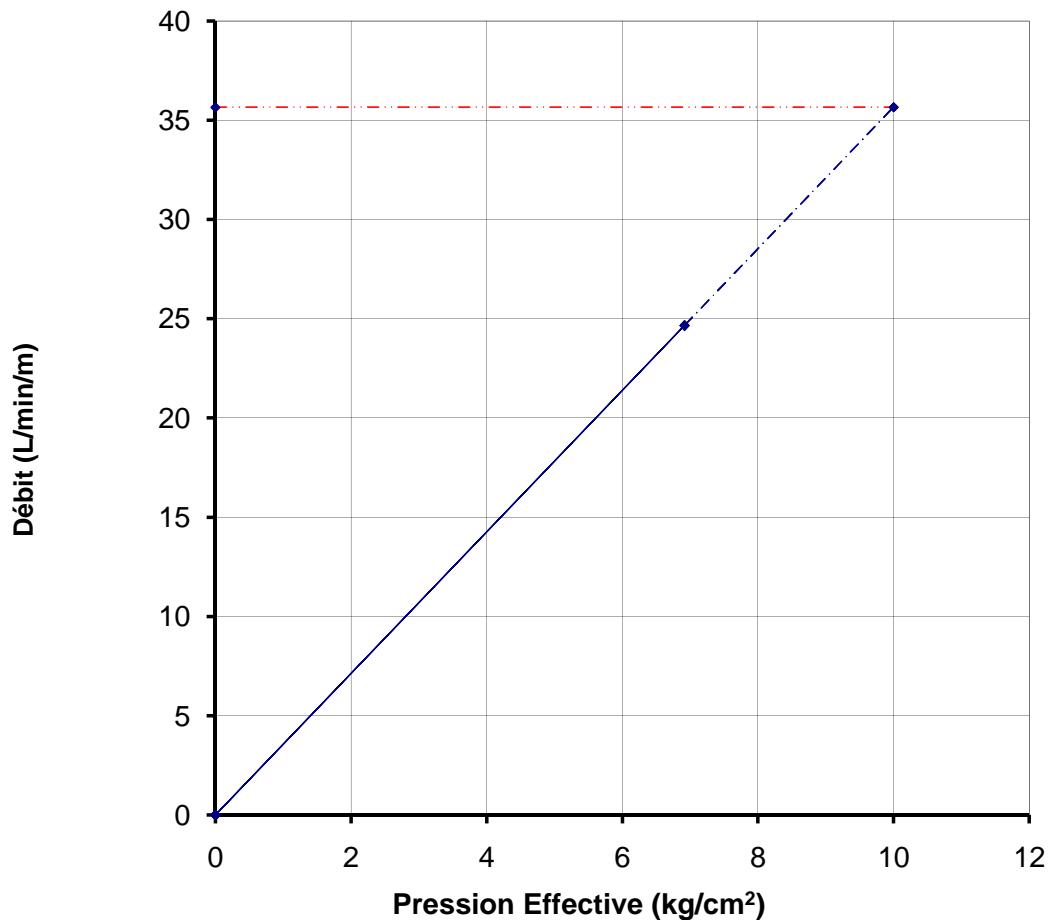
Date: **6/7/2014**

Manomètre **0.50 m**

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	740	10	3	74	24.67	2.99	7.33E-02	6.917



Lugeon = 35.66 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 03**
TRANCHE ESSAYEE **39.00 m à 42.00 m**

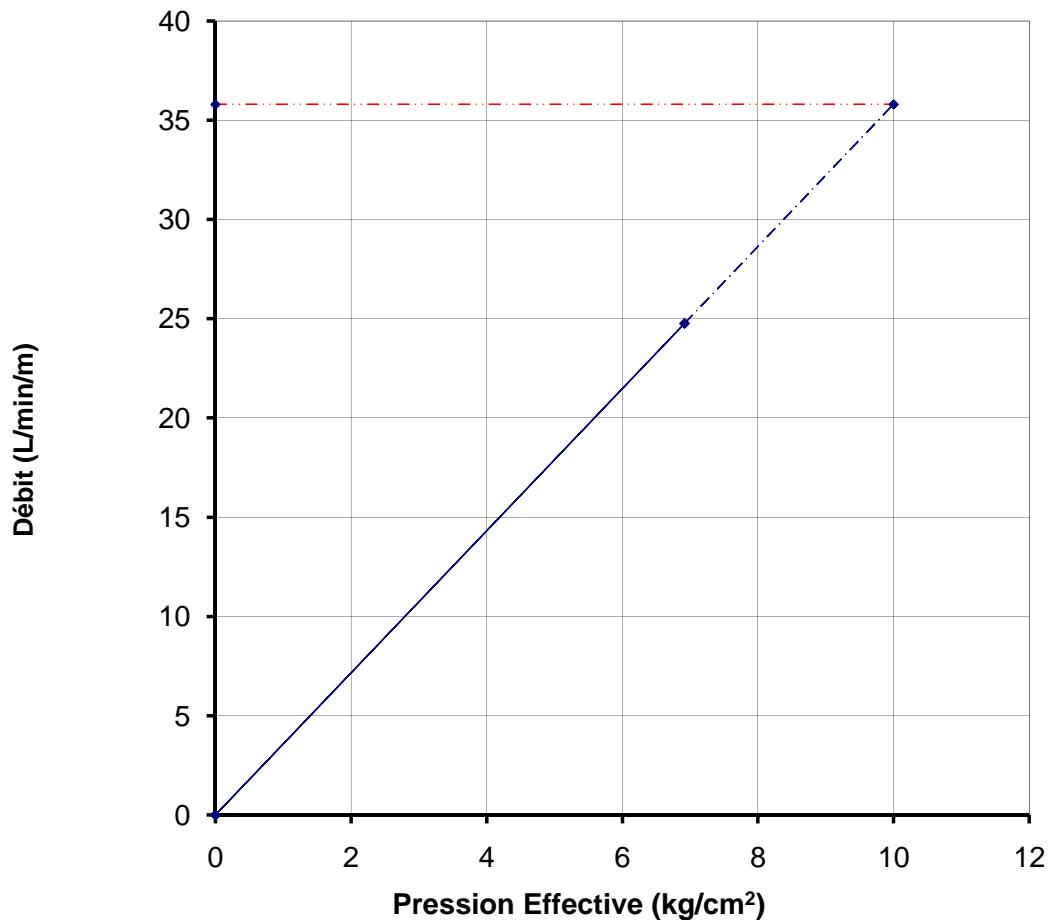
Date: **6/7/2014**

Manomètre **0.50 m**

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	743	10	3	74.3	24.77	2.99	7.36E-02	6.916

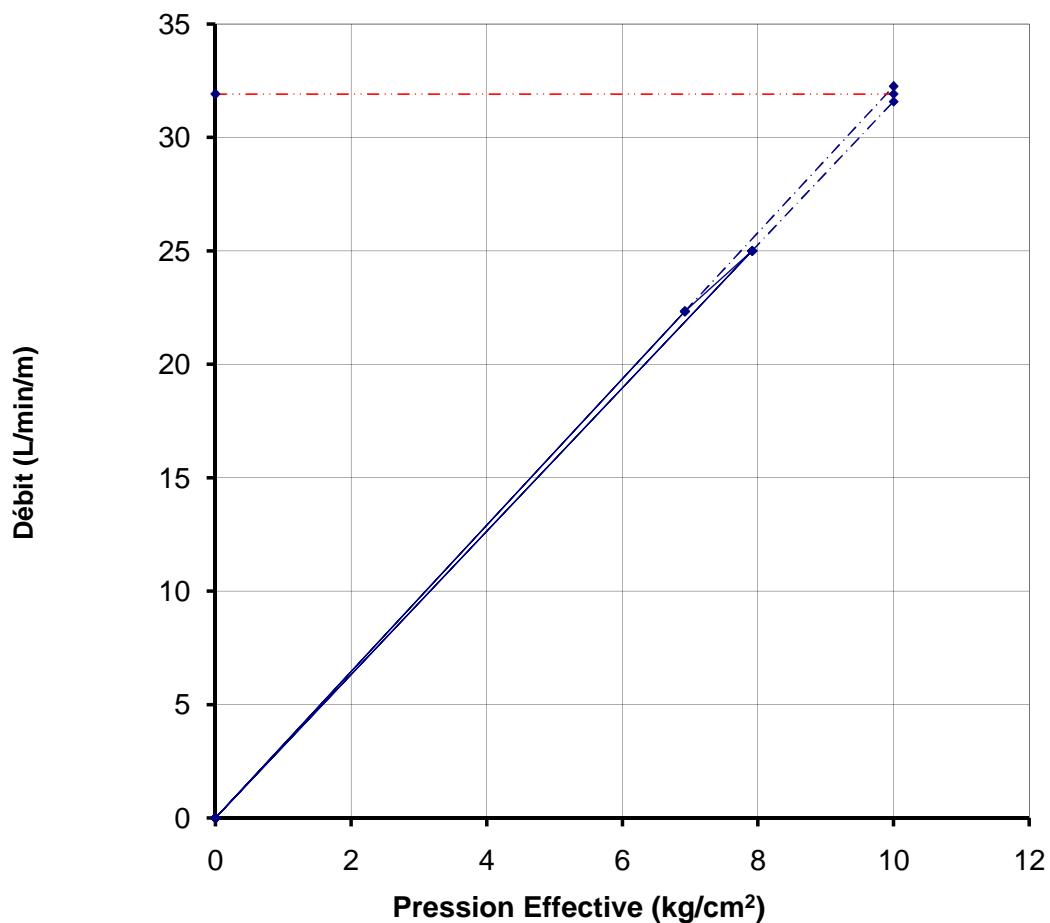


Lugeon = 35.81 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/7/2014
SONDAGE No.: BHLA 03	TRANCHE ESSAYEE 42.00 m à 45.00 m	Manomètre 0.50 m
		depth to water: 29.40 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	670	10	3	67	22.33	2.99	6.63E-02	6.924
5	750	10	3	75	25.00	2.99	7.43E-02	7.916



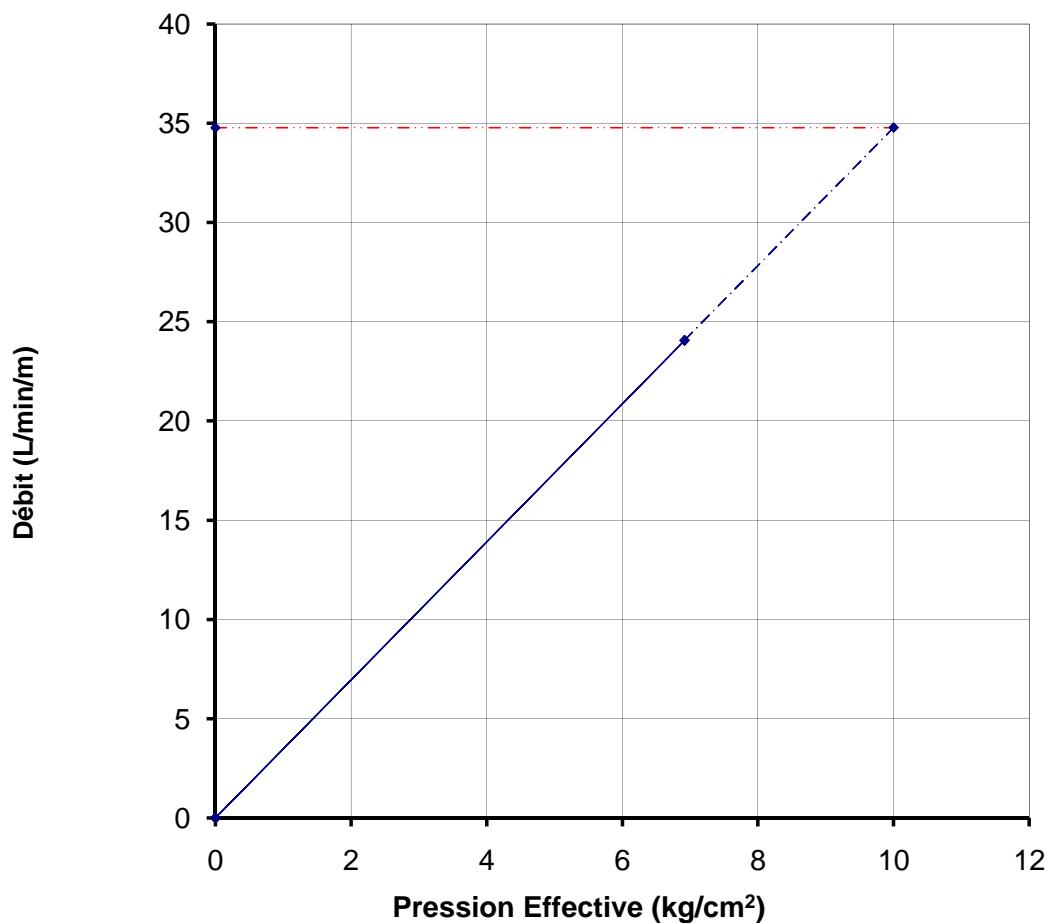
Lugeon = 31.92 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/9/2014
SONDAGE No.: BHLA 03		
TRANCHE ESSAYEE 45.00 m	à 48.00 m	Manomètre 0.50 m

depth to water: **29.40 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	722	10	3	72.2	24.07	2.99	7.15E-02	6.919



Lugeon = **34.79 L/min/m**

BISRI DAM					FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
DAM FOOTPRINT								
BHLA3	Pre-T.W.D (m):	1.9	G.W.D (m):	29.4	Date:			31.05.2014
Test Interval	0	to	3		K(m/sec, FHM):	5.2175E-06		
Diameter of test interval	D	86	mm		Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	1.9	m	0	0.00	0	1.00	1.90
Length of uncased test interval below the pre-test water level	L	1.1	m	1	0.46	60	0.76	1.44
Falling Head Method (FHM)					2	0.54	120	0.72
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.58	180	0.69
					4	0.59	240	0.69
					5	0.64	300	0.66
					6	0.67	360	0.65
					7	0.67	420	0.65
					9	0.76	540	0.60
					11	0.92	660	0.52
					13	1.18	780	0.38
Log Time (sec)					15	1.30	900	0.32
					16	1.34	960	0.29
					17	1.46	1020	0.23
					18	1.49	1080	0.22
					19	1.52	1140	0.20
					20	1.56	1200	0.18
					25	1.79	1500	0.06
					30	1.86	1800	0.02
Water Permeability (m/sec)		Relative Permeability			Semi-Pervious to Pervious			
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Pervious			
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Pervious			
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Pervious			

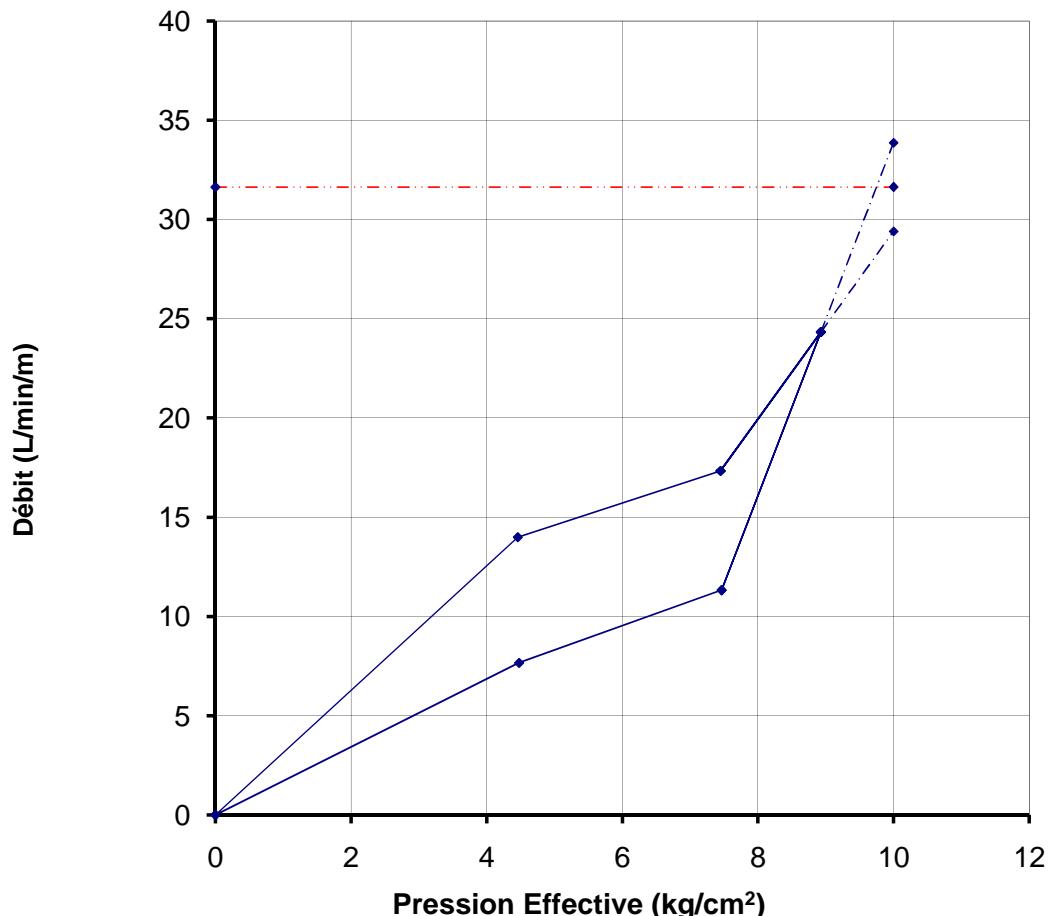


PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/11/2014
SONDAGE No.: BHLA 04	
TRANCHE ESSAYEE 3.00 m à 6.00 m	Manomètre 0.50 m

depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	230	10	3	23	7.67	0.5	2.28E-02	4.477
7	340	10	3	34	11.33	0.5	3.37E-02	7.466
8.5	730	10	3	73	24.33	0.5	7.23E-02	8.928
7	520	10	3	52	17.33	0.5	5.15E-02	7.449
4	420	10	3	42	14.00	0.5	4.16E-02	4.458



Lugeon = 31.64 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 04**
TRANCHE ESSAYEE **9.00 m à 12.00 m**

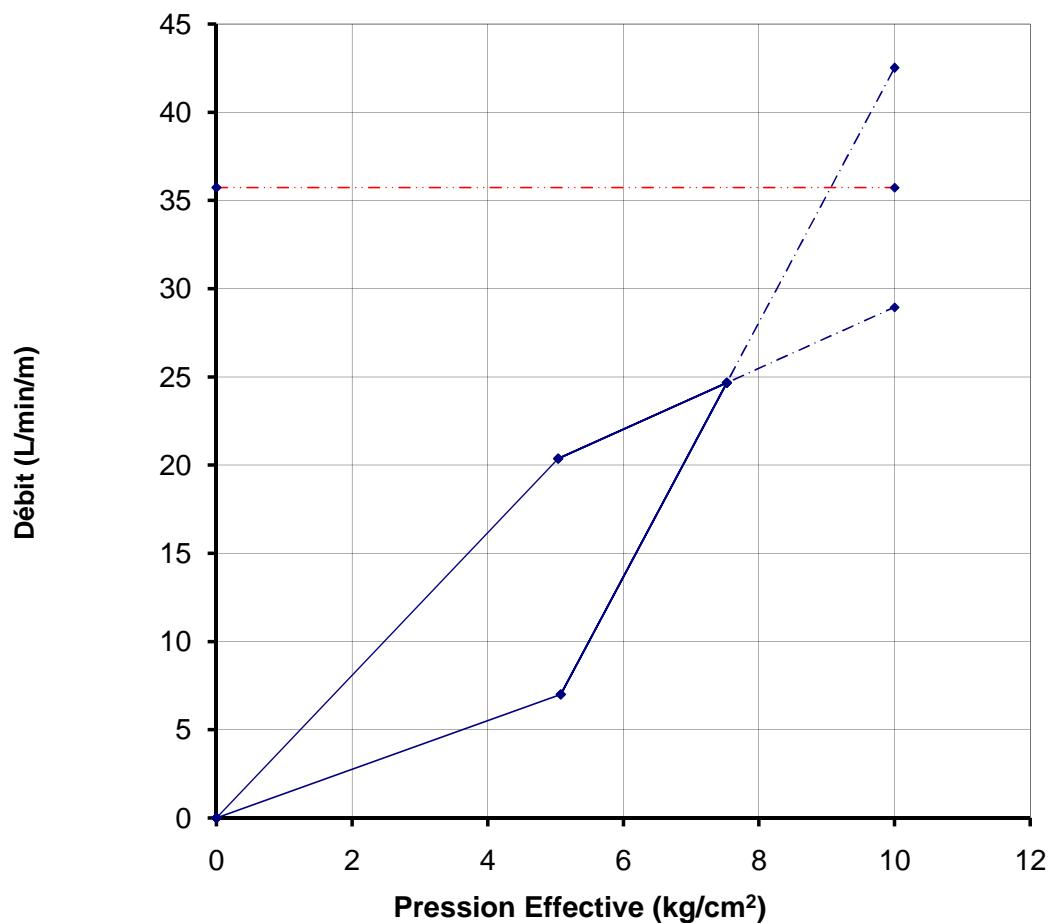
Date: **6/12/2014**

Manomètre **0.50 m**

depth to water: **28.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	210	10	3	21	7.00	1.1	2.08E-02	5.079
6.5	740	10	3	74	24.67	1.1	7.33E-02	7.527
4	611	10	3	61.1	20.37	1.1	6.05E-02	5.040

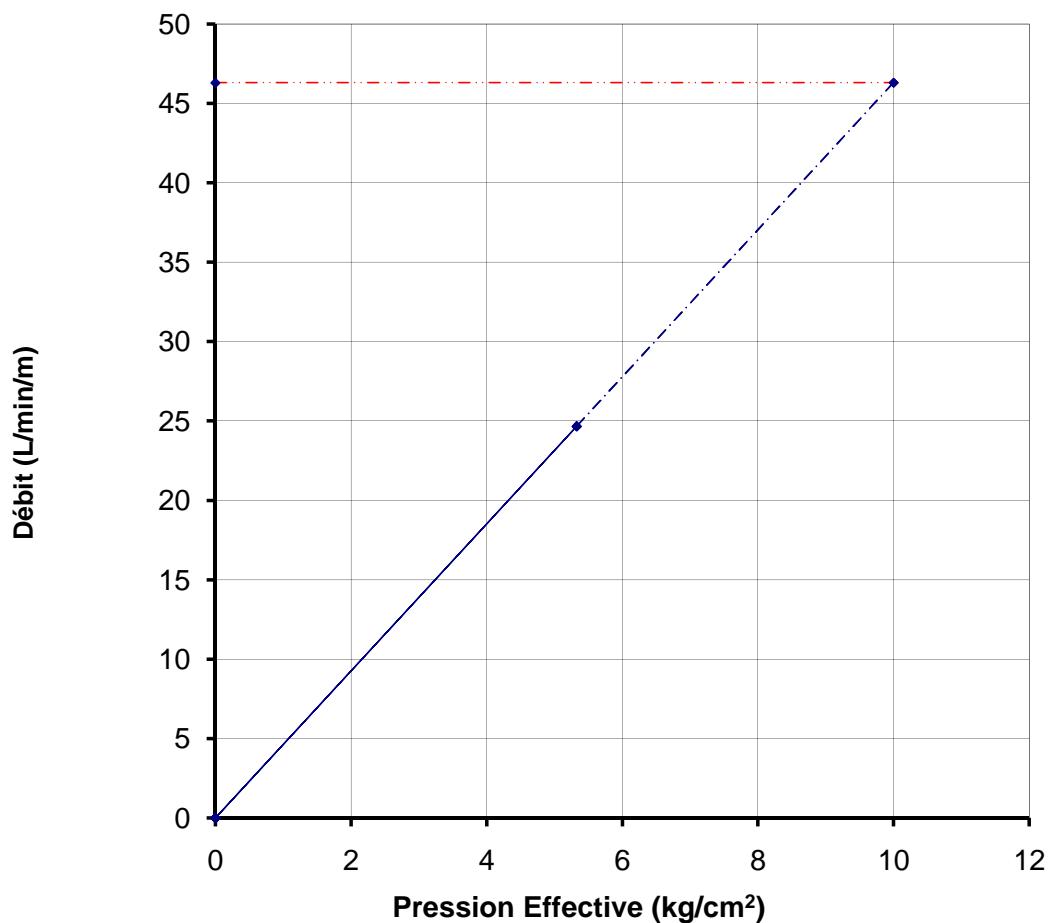


Lugeon = 35.73 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/13/2014
SONDAGE No.: BH LA 04	TRANCHE ESSAYEE 12.00 m à 15.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	740	10	3	74	24.67	1.4	7.33E-02	5.327

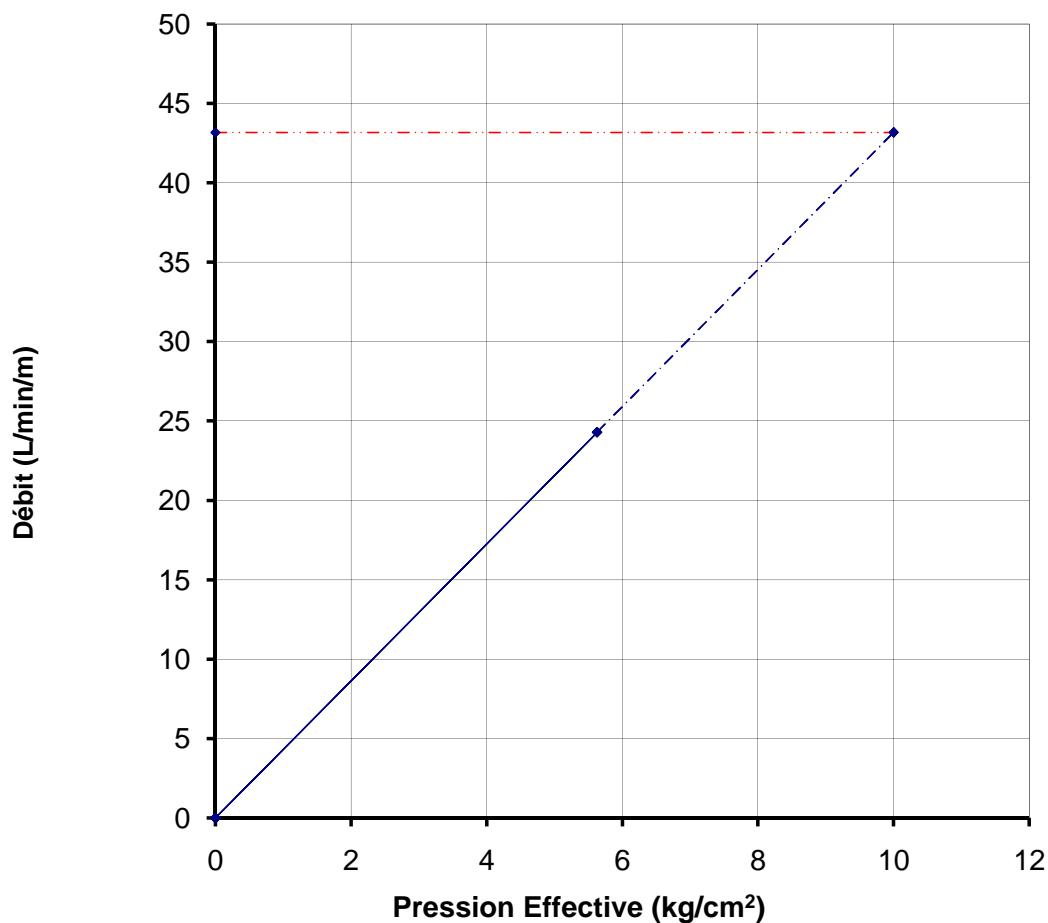


Lugeon = 46.31 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/13/2014
SONDAGE No.: BHLA 04	TRANCHE ESSAYEE 15.00 m à 18.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	729	10	3	72.9	24.30	1.7	7.22E-02	5.628



Lugeon = 43.18 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 04**
TRANCHE ESSAYEE **18.00 m à 21.00 m**

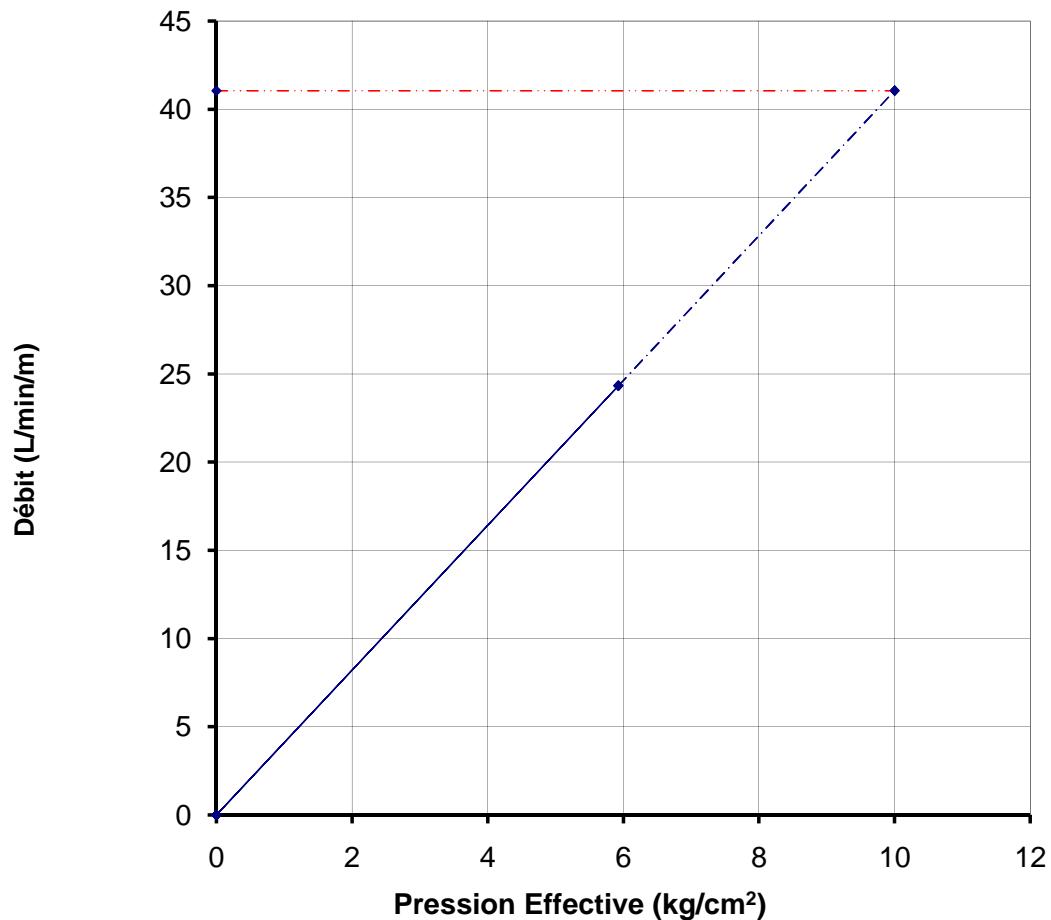
Date: **6/14/2014**

Manomètre **0.50 m**

depth to water: **28.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	730	10	3	73	24.33	2	7.23E-02	5.928



Lugeon = **41.05 L/min/m**

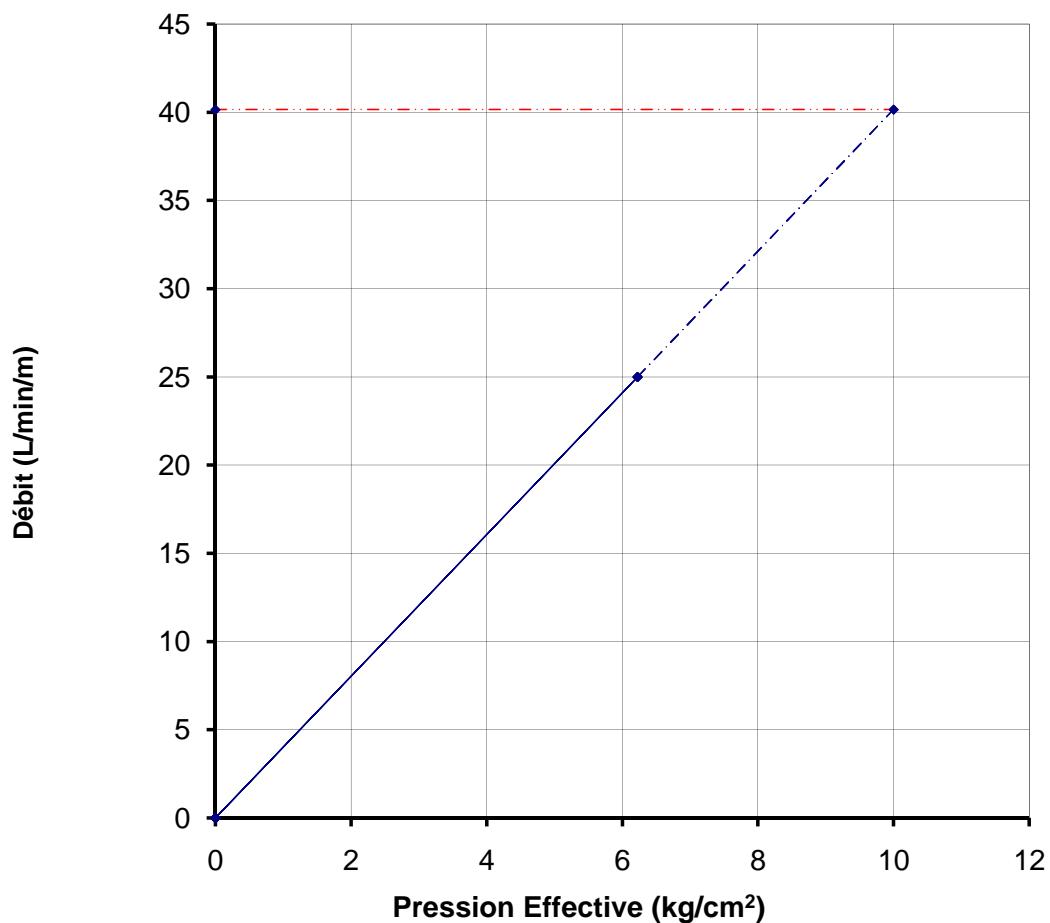


PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/14/2014
SONDAGE No.: BHLA 04	
TRANCHE ESSAYEE 21.00 m à 24.00 m	Manomètre 0.50 m

depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	750	10	3	75	25.00	2.3	7.43E-02	6.226



Lugeon = 40.16 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 04**
TRANCHE ESSAYEE **24.00 m à 27.00 m**

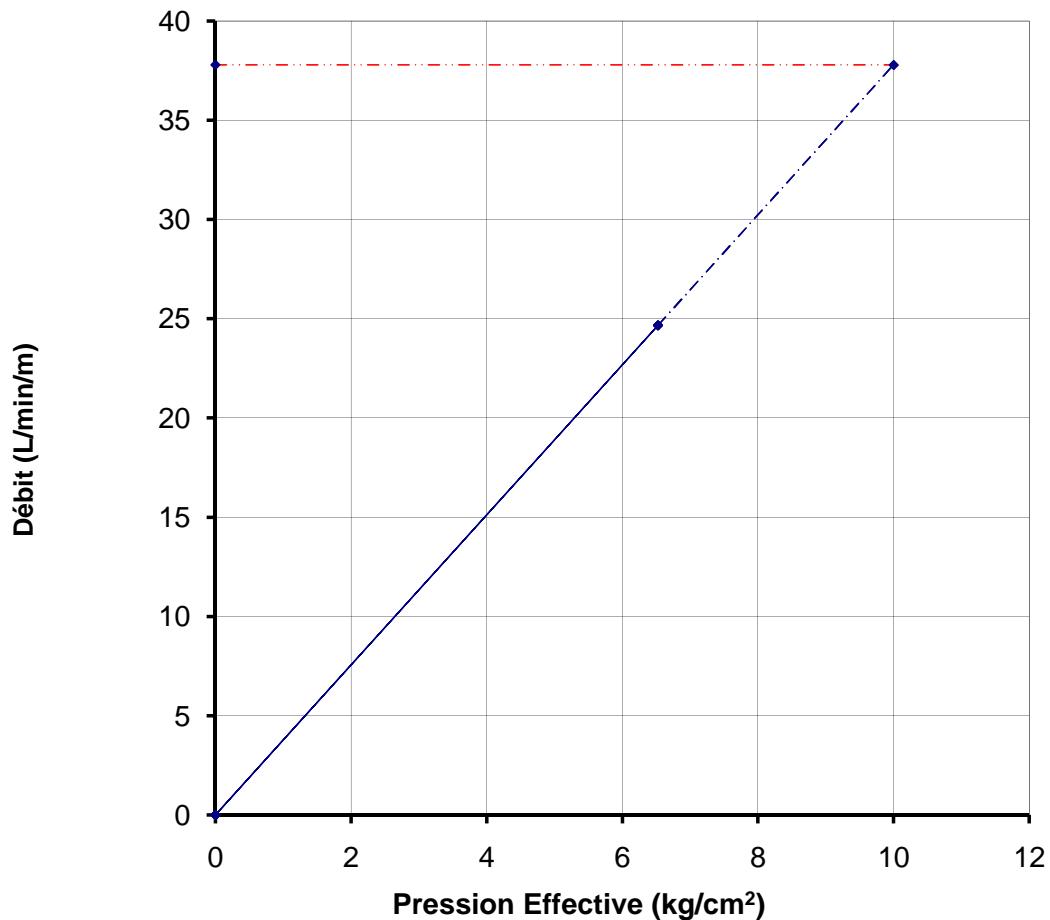
Date: **6/14/2014**

Manomètre **0.50 m**

depth to water: **28.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	740	10	3	74	24.67	2.6	7.33E-02	6.527

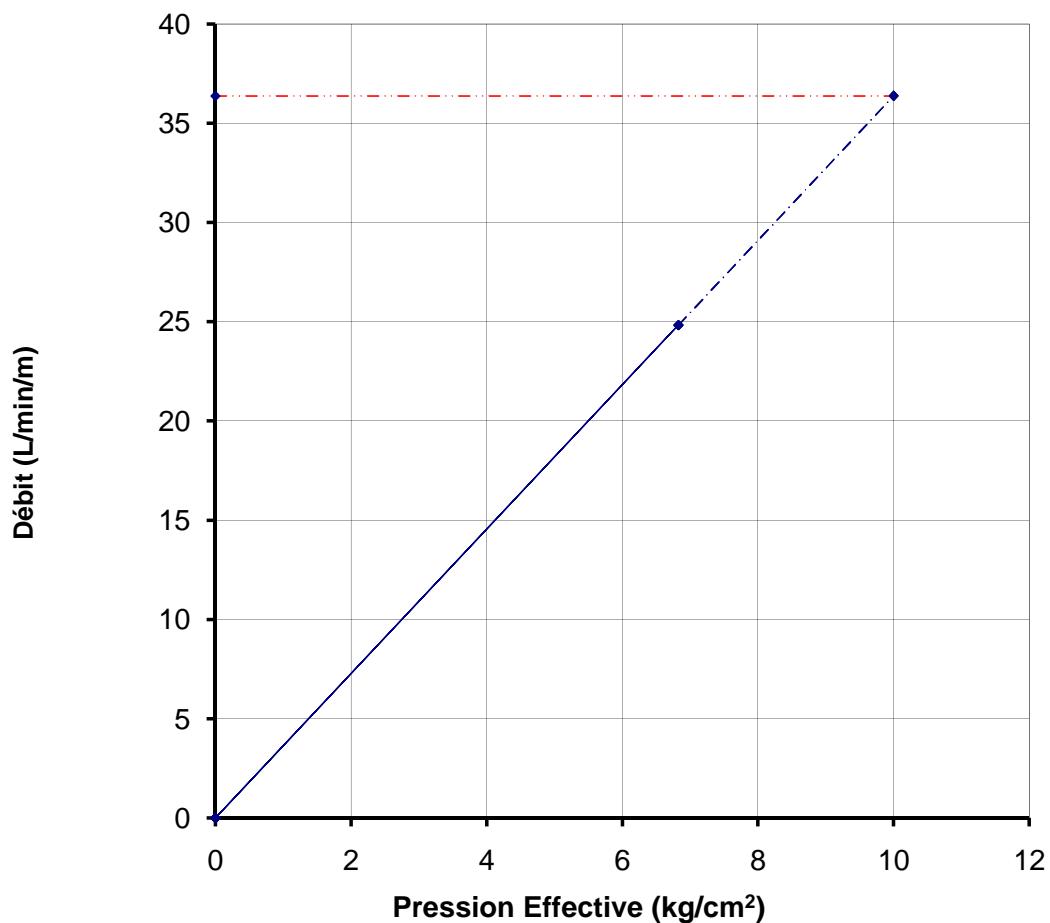


Lugeon = 37.79 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/14/2014
SONDAGE No.: BHLA 04	TRANCHE ESSAYEE 27.00 m à 30.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	745	10	3	74.5	24.83	2.9	7.38E-02	6.826

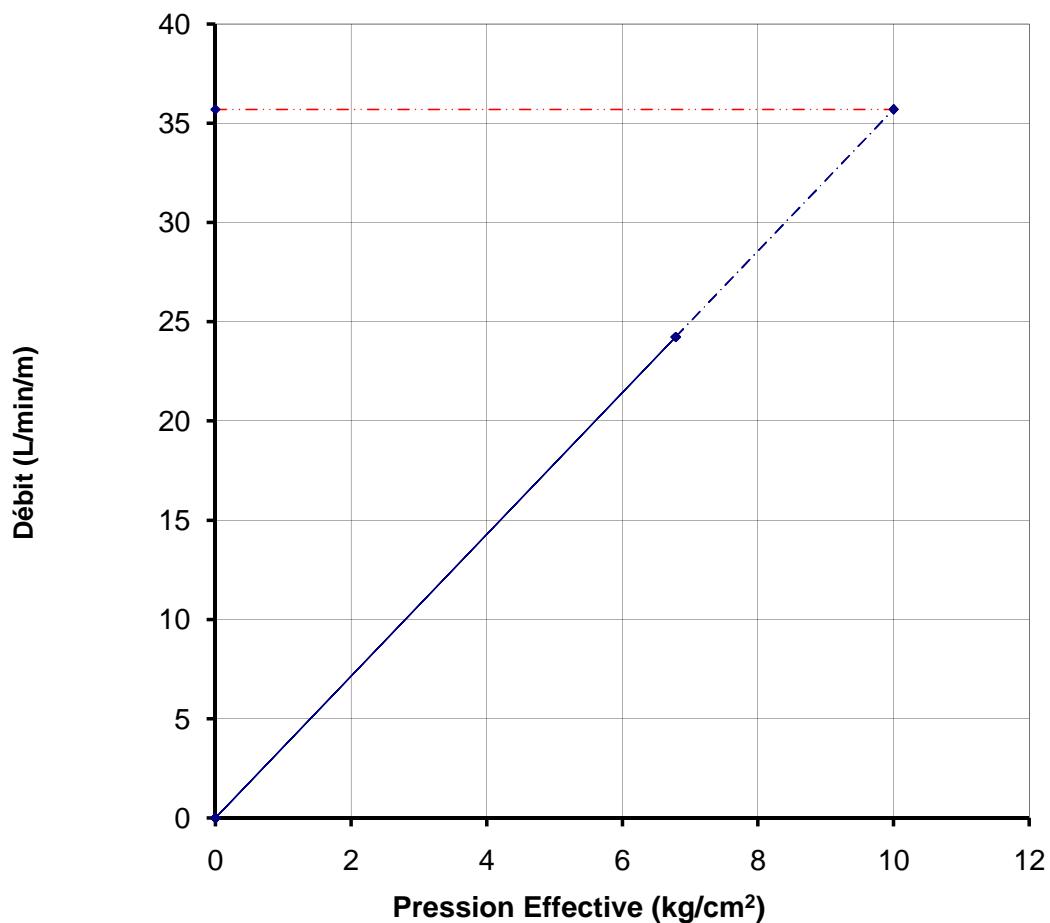


Lugeon = 36.38 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/14/2014
SONDAGE No.: BHLA 04	TRANCHE ESSAYEE 30.00 m à 33.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	727	10	3	72.7	24.23	2.86	7.20E-02	6.788



Lugeon = 35.70 L/min/m

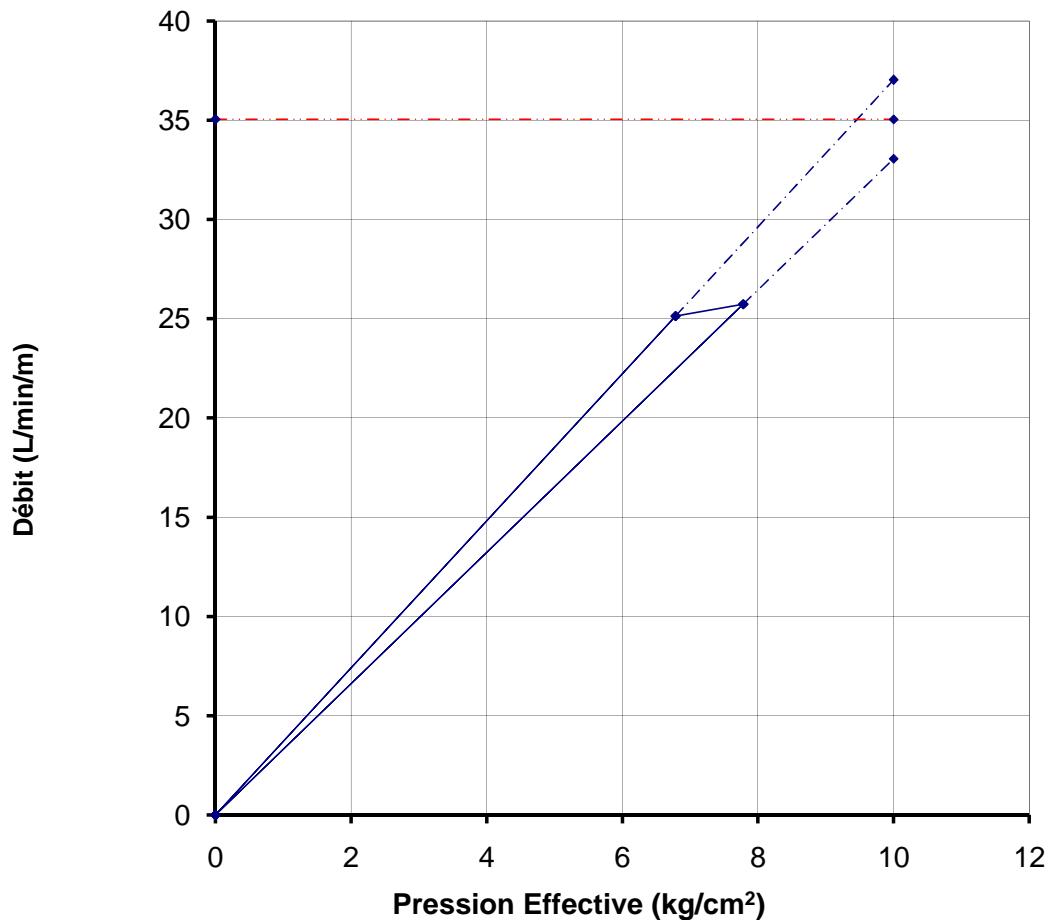
SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/14/2014
SONDAGE No.: BHLA 04		
TRANCHE ESSAYEE 33.00 m	à	36.00 m

Manomètre **0.50 m**

depth to water: **28.10 m**

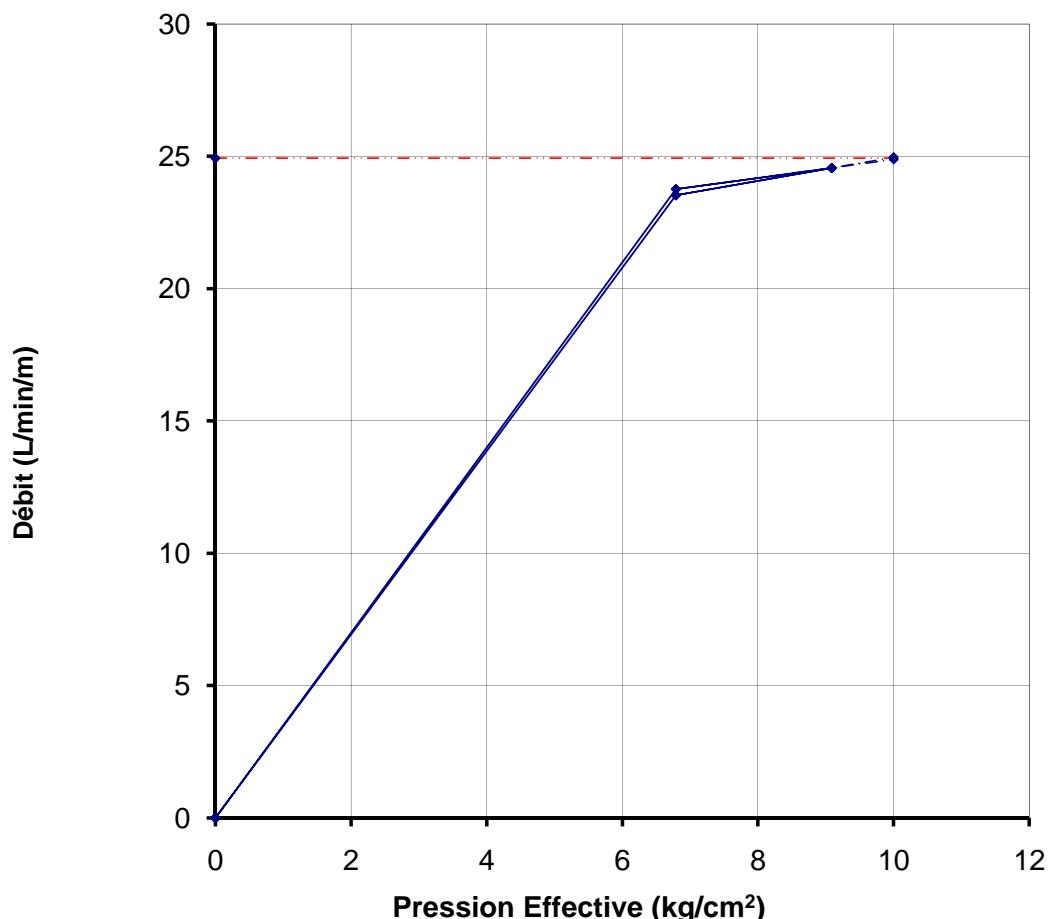
ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	754	10	3	75.4	25.13	2.86	7.46E-02	6.785
5	772	10	3	77.2	25.73	2.86	7.64E-02	7.784



Lugeon = **35.05 L/min/m**

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE SONDAGE No.: BHLA 04 TRANCHE ESSAYEE 36.00 m à 39.00 m						Date: 6/16/2014	
							Manomètre 0.50 m	
							depth to water: 28.10 m	
<u>ESSAI DE PERMEABILITE LUGEON</u>								
Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	713	10	3	71.3	23.77	2.86	7.06E-02	6.789
6.3	737	10	3	73.7	24.57	2.86	7.30E-02	9.087
4	706	10	3	70.6	23.53	2.86	6.99E-02	6.790

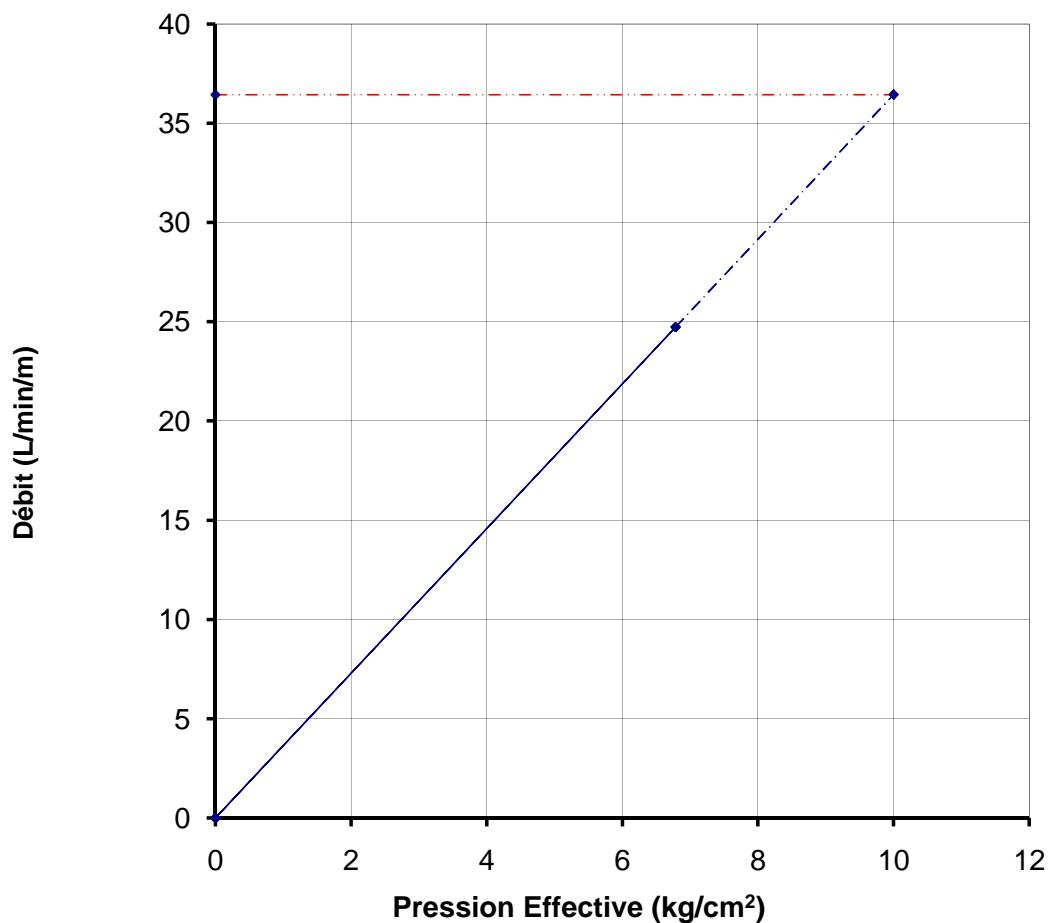


Lugeon = 24.93 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/16/2014
SONDAGE No.: BHLA 04	TRANCHE ESSAYEE 39.00 m à 42.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	742	10	3	74.2	24.73	2.86	7.35E-02	6.787

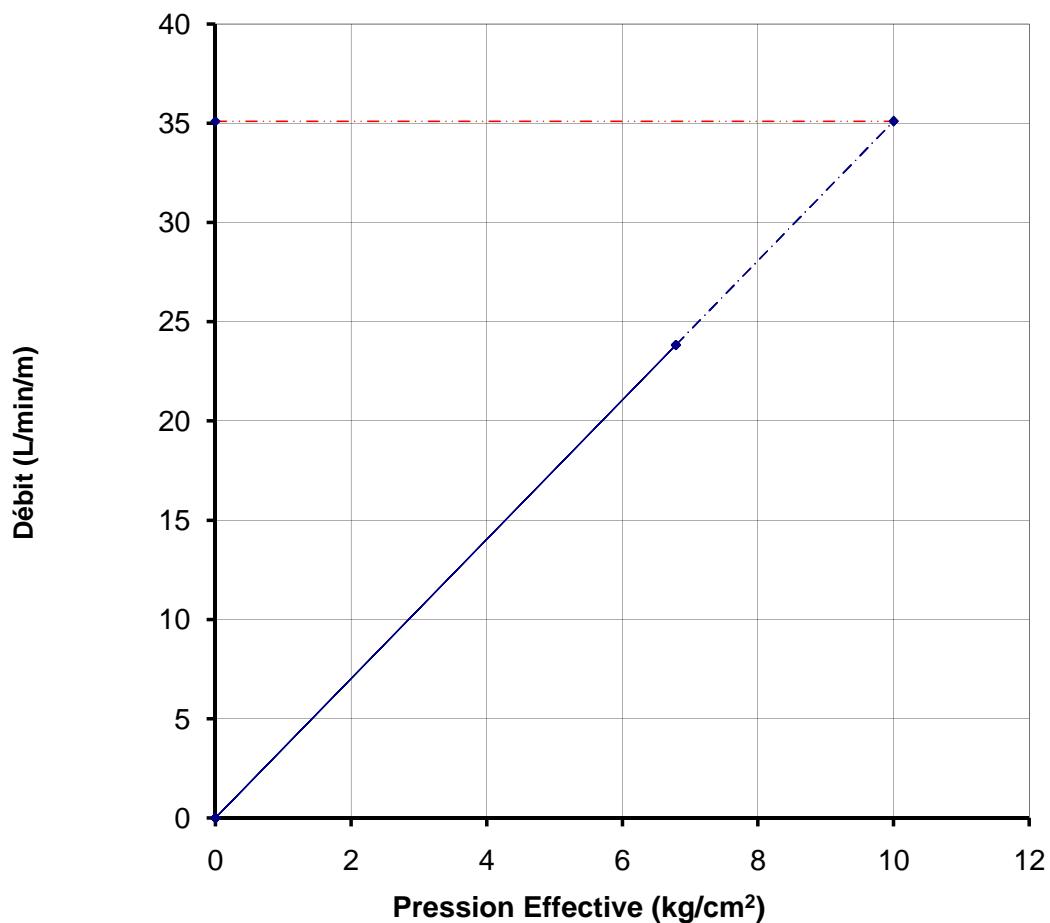


Lugeon = 36.44 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/16/2014
SONDAGE No.: BHLA 04	TRANCHE ESSAYEE 42.00 m à 45.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	715	10	3	71.5	23.83	2.86	7.08E-02	6.789

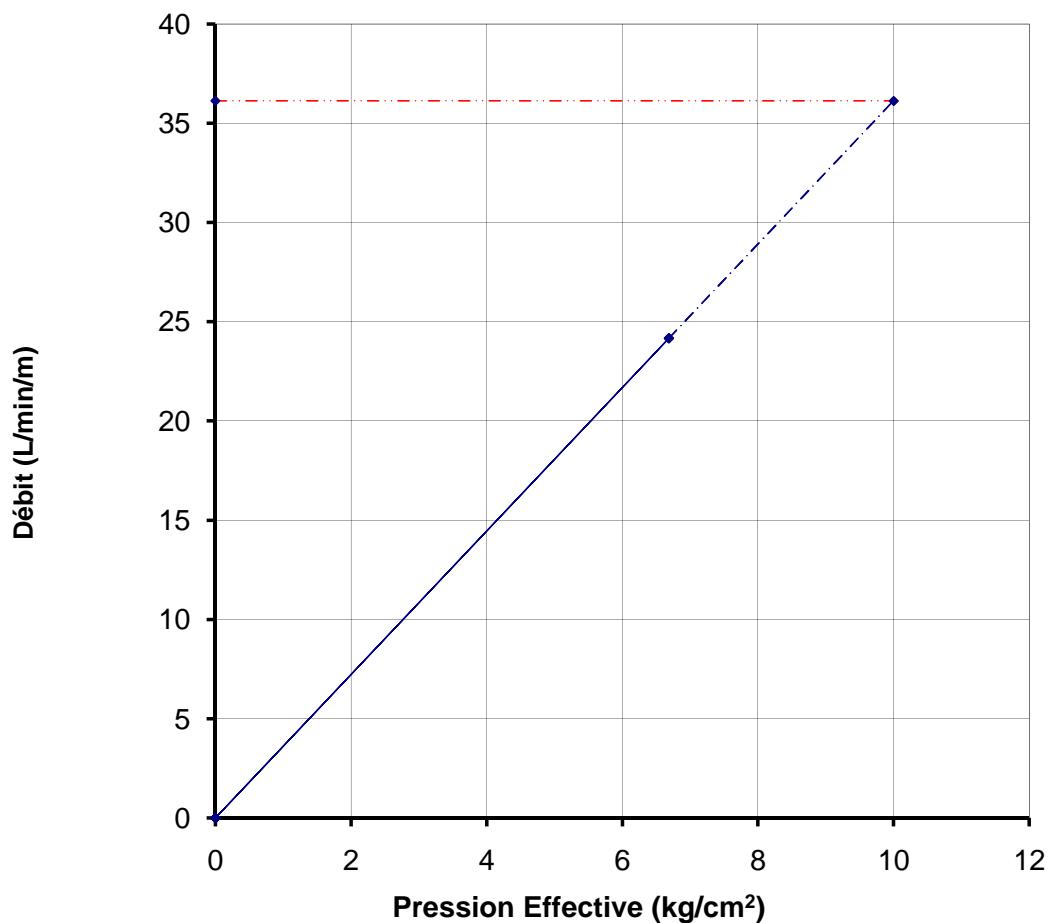


Lugeon = 35.10 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/16/2014
SONDAGE No.: BHLA 04	TRANCHE ESSAYEE 45.00 m à 48.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
3.9	725	10	3	72.5	24.17	2.86	7.18E-02	6.688



Lugeon = 36.13 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHLA 04**
TRANCHE ESSAYEE **48.00 m** à **51.00 m**

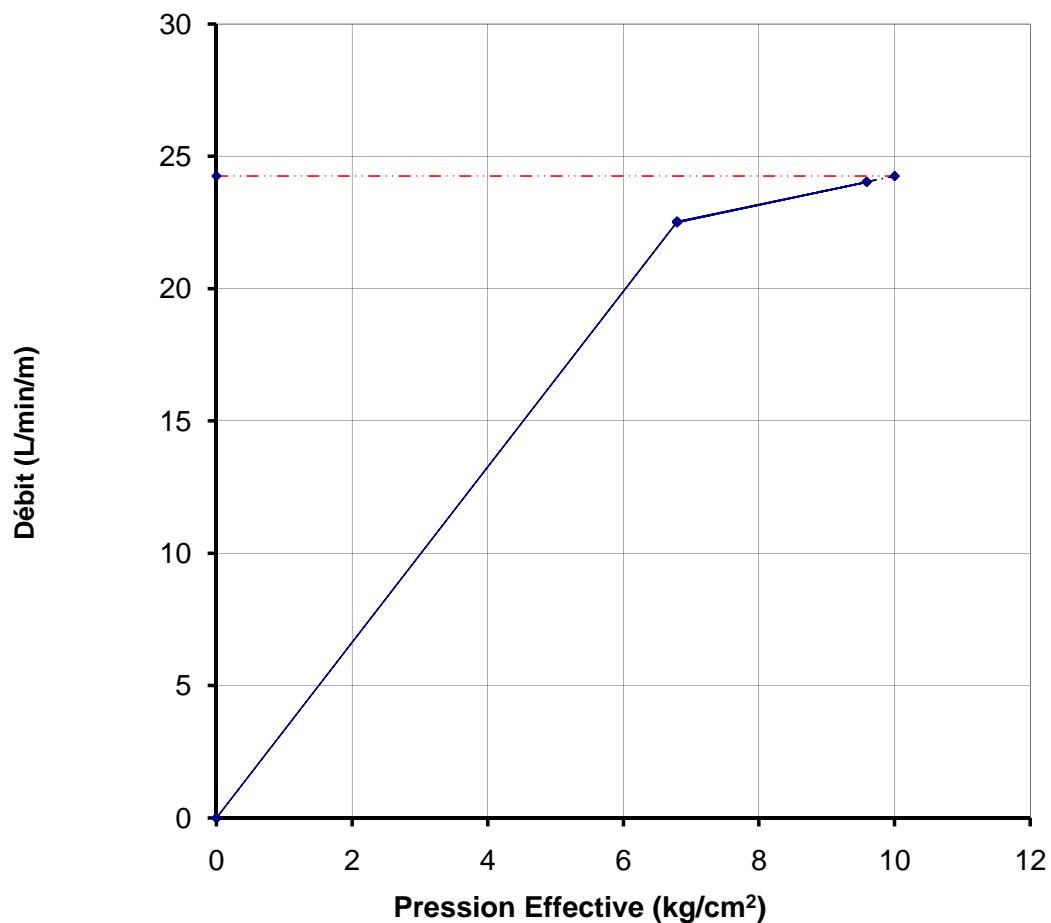
Date: **6/17/2014**

Manomètre **0.50 m**

depth to water: **28.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	675	10	3	67.5	22.50	2.86	6.68E-02	6.793
6.8	721	10	3	72.1	24.03	2.86	7.14E-02	9.589
4	676	10	3	67.6	22.53	2.86	6.69E-02	6.793

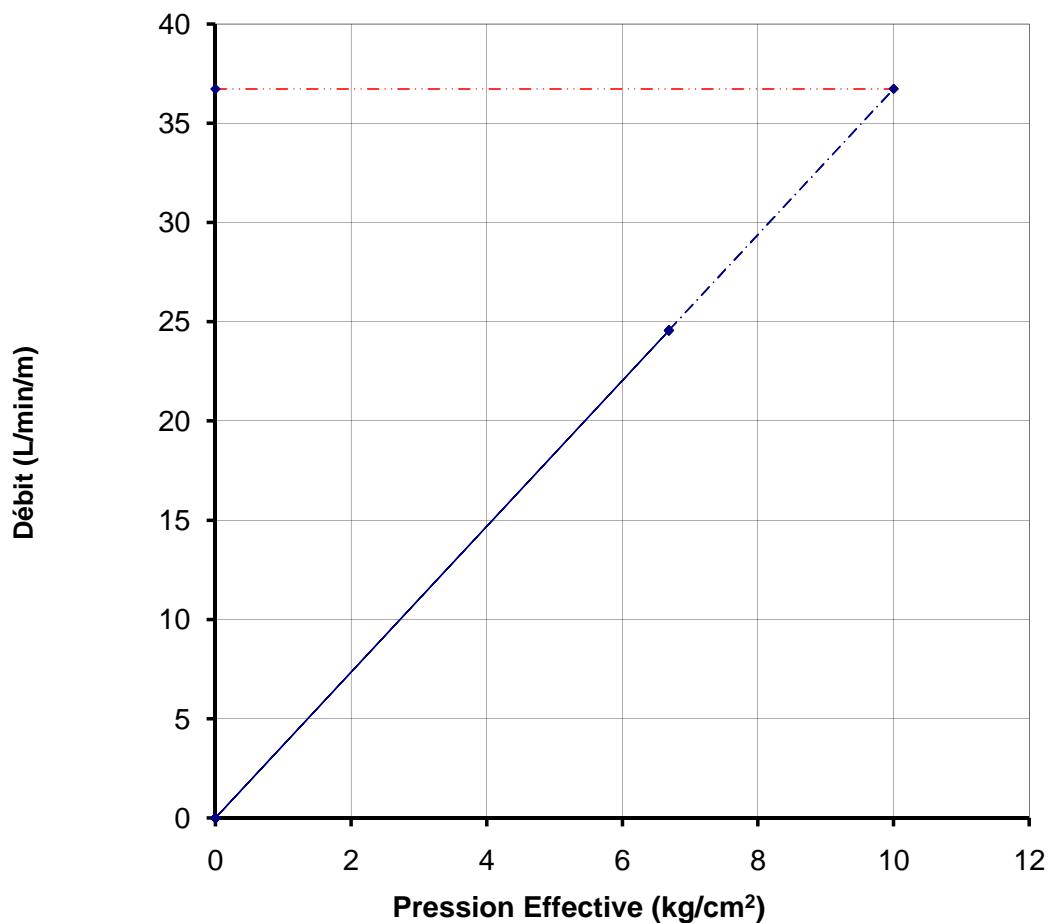


Lugeon = 24.26 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/17/2014
SONDAGE No.: BHLA 04	TRANCHE ESSAYEE 51.00 m à 54.00 m	Manomètre 0.50 m
		depth to water: 28.10 m

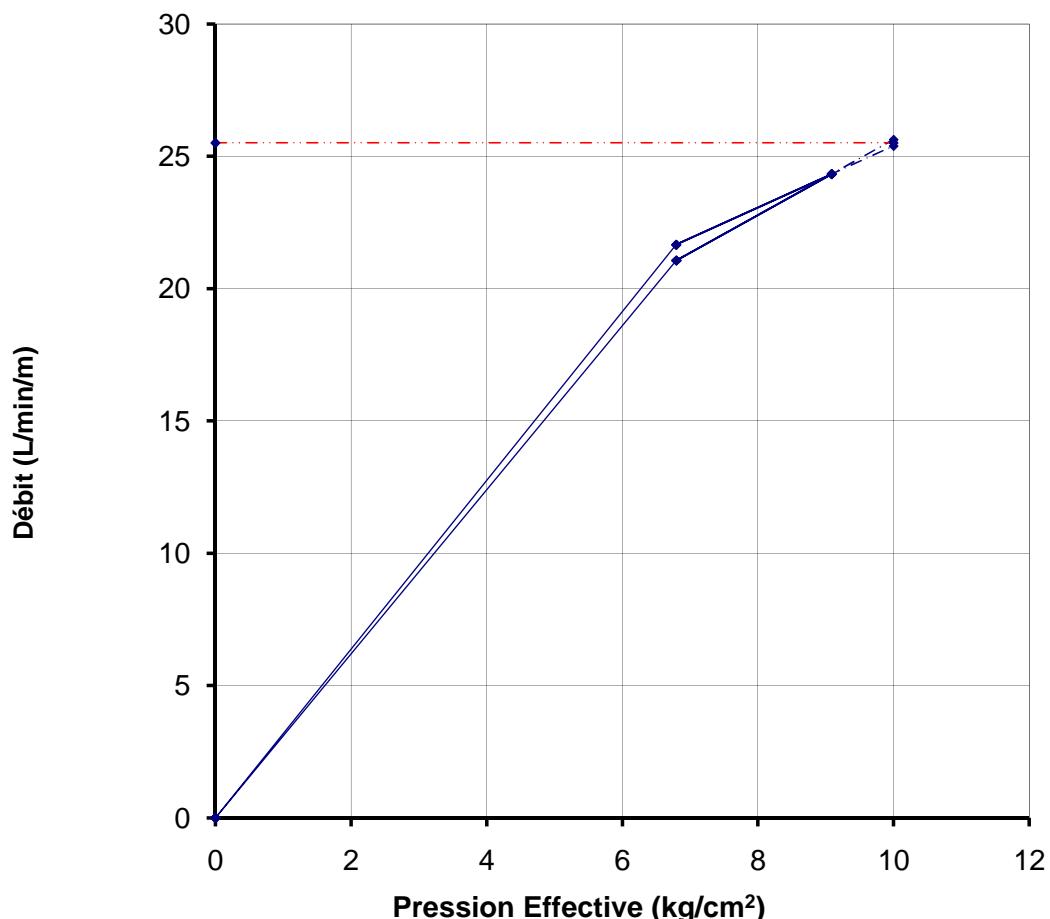
ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
3.9	737	10	3	73.7	24.57	2.86	7.30E-02	6.687



Lugeon = 36.74 L/min/m

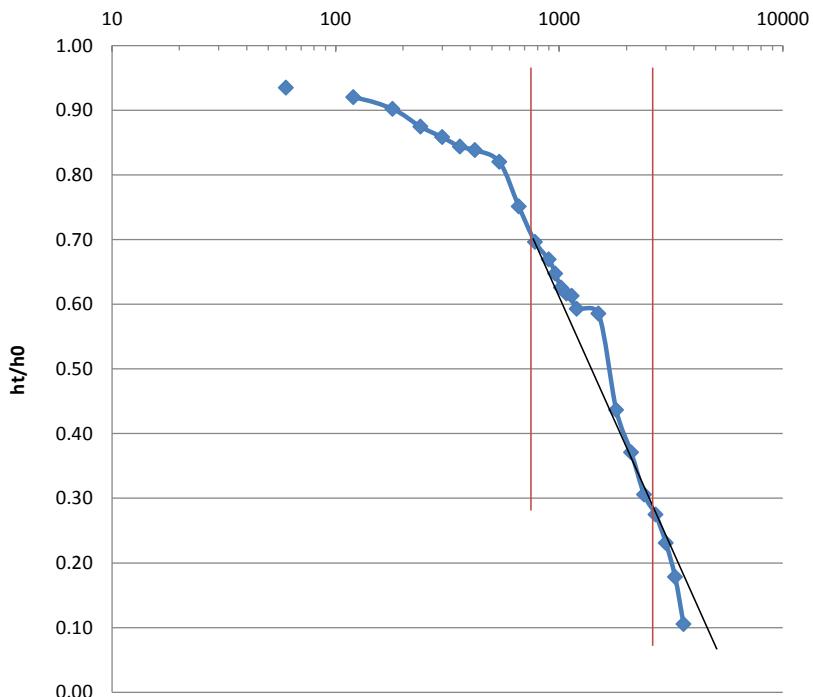
SATCON	PROJECT: BISRI DAM / SECOND PACKAGE SONDAGE No.: BHLA 04 TRANCHE ESSAYEE 54.00 m à 57.00 m						Date: 6/17/2014	
							Manomètre 0.50 m	
							depth to water: 28.10 m	
<u>ESSAI DE PERMEABILITE LUGEON</u>								
Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	650	10	3	65	21.67	2.86	6.44E-02	6.796
6.3	730	10	3	73	24.33	2.86	7.23E-02	9.088
4	632	10	3	63.2	21.07	2.86	6.26E-02	6.797



Lugeon = 25.51 L/min/m

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
		DAM FOOTPRINT							
BHLA4	Pre-T.W.D (m):	2.2	G.W.D (m):	28.1	Date:	10.06.2014			
Test Interval	0	to	3		K(m/sec, FHM):	4.2099E-05			
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.2	m		0	0.00	0	1.00	2.20
Length of uncased test interval below the pre-test water level	L	0.8	m		1	0.75	60	0.66	1.45
Falling Head Method (FHM)					2	1.20	120	0.45	1.00
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	1.49	180	0.32	0.71
					4	1.72	240	0.22	0.48
					5	2.10	300	0.05	0.10
H1		0.71	m						
H2		0.1	m						
t1 (as per graph)		180	sec.						
t2		300	sec.						
Log Time (sec)									
Water Permeability (m/sec)	Relative Permeability			Pervious					
1.00E-03	1.00E-05	Pervious			Pervious				
1.00E-05	1.00E-08	Semi-Pervious			Pervious				
1.00E-08	1.00E-12	Impervious			Pervious				

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دَارُ الْهَنْدَاسَةِ نَازِحٌ طَالِبٌ وَشَرِكَةٌ لِلصَّوْبَرِ وَالْمُتَنَاهِيَاتِ الْفَقِيهِ		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST							
		DAM FOOTPRINT										
BHLA4	Pre-T.W.D (m):	5.5	G.W.D (m):	28.1	Date:	11.06.2014						
Test Interval	6	to	9		K(m/sec, FHM):	5.3063E-07						
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	5.5	m	0	0.00	0	1.00	5.50				
Length of uncased test interval below the pre-test water level	L	3	m	1	0.36	60	0.93	5.14				
Falling Head Method (FHM)					2	0.44	120	0.92	5.06			
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.54	180	0.90	4.96			
					4	0.69	240	0.87	4.81			
					5	0.78	300	0.86	4.72			
					6	0.86	360	0.84	4.64			
H1	3.83		m	7	0.89	420	0.84	4.61				
H2	1.51		m	9	0.99	540	0.82	4.51				
t1 (as per graph)	780		sec.	11	1.37	660	0.75	4.13				
t2	2700		sec.	13	1.67	780	0.70	3.83				
Log Time (sec)					15	1.82	900	0.67	3.68			
					16	1.94	960	0.65	3.56			
					17	2.06	1020	0.63	3.44			
					18	2.11	1080	0.62	3.39			
					19	2.13	1140	0.61	3.37			
					20	2.24	1200	0.59	3.26			
					25	2.28	1500	0.59	3.22			
					30	3.10	1800	0.44	2.40			
					35	3.46	2100	0.37	2.04			
					40	3.82	2400	0.31	1.68			
					45	3.99	2700	0.27	1.51			
					50	4.23	3000	0.23	1.27			
					55	4.52	3300	0.18	0.98			
					60	4.92	3600	0.11	0.58			
Water Permeability (m/sec)		Relative Permeability			Semi-Pervious							
1.00E-03	1.00E-05	Pervious										
1.00E-05	1.00E-08	Semi-Pervious										
1.00E-08	1.00E-12	Impervious										



BHVR4		Pre-T.W.D (m):	0	G.W.D (m):	2.25	Date:		09.06.2014			
Test Interval		0	to	3		K(m/sec, FHM):		2.9634E-07			
Diameter of test interval			D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)			h_0	2.25	m	0	0.00	0	1.00	2.25	
Length of uncased test interval below the pre-test water level			L	0.75	m	1	0.06	60	0.97	2.19	
Falling Head Method (FHM)							2	0.11	120	0.95	2.15
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$							3	0.13	180	0.94	2.12
$H_1 = 2.12 \text{ m}$							4	0.15	240	0.93	2.10
$H_2 = 2.01 \text{ m}$							5	0.17	300	0.92	2.08
$t_1 \text{ (as per graph)} = 180 \text{ sec.}$							6	0.19	360	0.92	2.06
$t_2 = 660 \text{ sec.}$							7	0.21	420	0.91	2.04
$Log Time (sec)$							9	0.23	540	0.90	2.02
11							11	0.24	660	0.89	2.01
13							13	0.25	780	0.89	2.00
15							15	0.25	900	0.89	2.00
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DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دار الهندسة نازح طالب وشركاه للمهندسين والمتخصصين		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST								
		DAM FOOTPRINT											
BHVR4	Pre-T.W.D (m):	5	G.W.D (m):	2.25	Date:	08.06.2014							
Test Interval	3	to	6		K(m/sec, FHM):	1.4293E-07							
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	2.25	m	0	0.00	0	1.00	2.25				
Length of uncased test interval below the pre-test water level		L	3	m	1	0.05	60	0.98	2.20				
Falling Head Method (FHM)						2	0.07	120	0.97	2.18			
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.10	180	0.95	2.15			
						4	0.13	240	0.94	2.12			
						5	0.15	300	0.93	2.10			
						6	0.18	360	0.92	2.07			
H1		2.18		m	7	0.21	420	0.91	2.04				
H2		2		m	9	0.23	540	0.90	2.02				
t1 (as per graph)		120		sec.	11	0.25	660	0.89	2.00				
t2		780		sec.	13	0.25	780	0.89	2.00				
Log Time (sec)													
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious									
1.00E-03	1.00E-05	Pervious											
1.00E-05	1.00E-08	Semi-Pervious											
1.00E-08	1.00E-12	Impervious											

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST							
		DAM FOOTPRINT									
BHVR4	Pre-T.W.D (m):	5	G.W.D (m):	2.25	Date:	09.06.2014					
Test Interval	6	to	9		K(m/sec, FHM):	1.2704E-07					
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t			
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.25	m	0	0.00	0	1.00	2.25			
Length of uncased test interval below the pre-test water level	L	3	m	1	0.07	60	0.97	2.18			
Falling Head Method (FHM)					2	0.11	120	0.95	2.14		
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.13	180	0.94	2.12		
					4	0.15	240	0.93	2.10		
					5	0.18	300	0.92	2.07		
					6	0.20	360	0.91	2.05		
H1	2.14		m	7	0.21	420	0.91	2.04			
H2	2.01		m	9	0.23	540	0.90	2.02			
t1 (as per graph)	120		sec.	11	0.24	660	0.89	2.01			
t2	660		sec.	13	0.24	780	0.89	2.01			
Log Time (sec)											
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious							
1.00E-03	1.00E-05	Pervious			Semi-Pervious						
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious						
1.00E-08	1.00E-12	Impervious			Semi-Pervious						

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دار الهندسة نازح طالب وشركاه للمهندسين والمتخصصين		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
		DAM FOOTPRINT								
BHVR4	Pre-T.W.D (m):	9	G.W.D (m):	2.25	Date:		10.06.2014			
Test Interval	9	to	12		K(m/sec, FHM):	4.1182E-08				
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	2.25	m	0	0.00	0	1.00	2.25	
Length of uncased test interval below the pre-test water level		L	3	m	1	0.03	60	0.99	2.22	
Falling Head Method (FHM)					2	0.03	120	0.98	2.22	
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.04	180	0.98	2.21	
					4	0.04	240	0.98	2.21	
H1		2.22		m						
H2		2.21		m						
t1 (as per graph)		60		sec.						
t2		180		sec.						
Log Time (sec)										
Water Permeability (m/sec)		Relative Permeability			Semi-Pervious to Impervious					
1.00E-03	1.00E-05	Pervious								
1.00E-05	1.00E-08	Semi-Pervious								
1.00E-08	1.00E-12	Impervious								

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دار الهندسة نازح طالب وشركاه للمهندسين والاستشاريين		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST								
		DAM FOOTPRINT											
BHVR4	Pre-T.W.D (m):	7	G.W.D (m):	2.25	Date:	10.06.2014							
Test Interval	12	to	15		K(m/sec, FHM):	8.2364E-08							
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	2.25	m	0	0.00	0	1.00	2.25				
Length of uncased test interval below the pre-test water level		L	3	m	1	0.03	60	0.99	2.22				
Falling Head Method (FHM)					2	0.04	120	0.98	2.21				
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.04	180	0.98	2.21				
H1		2.22		m									
H2		2.21		m									
t1 (as per graph)		60		sec.									
t2		120		sec.									
Log Time (sec)													
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious									
1.00E-03	1.00E-05	Pervious											
1.00E-05	1.00E-08	Semi-Pervious											
1.00E-08	1.00E-12	Impervious											

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST						
		DAM FOOTPRINT								
BHVR4	Pre-T.W.D (m):	10	G.W.D (m):	2.25	Date:	10.06.2014				
Test Interval	15	to	18		K(m/sec, FHM):	2.7393E-08				
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	2.25	m	0	0.00	0	1.00	2.25	
Length of uncased test interval below the pre-test water level		L	3	m	1	0.01	60	1.00	2.24	
Falling Head Method (FHM)						2	0.01	120	1.00	2.24
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.02	180	0.99	2.23
						4	0.02	240	0.99	2.23
						5	0.02	300	0.99	2.23
						6	0.03	360	0.99	2.22
H1		2.23		m	7	0.04	420	0.98	2.21	
H2		2.21		m	9	0.04	540	0.98	2.21	
t1 (as per graph)		180		sec.						
t2		540		sec.						
Log Time (sec)										
Water Permeability (m/sec)		Relative Permeability				Semi-Pervious to Impervious				
1.00E-03	1.00E-05	Pervious								
1.00E-05	1.00E-08	Semi-Pervious								
1.00E-08	1.00E-12	Impervious								

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
		DAM FOOTPRINT							
BHVR4	Pre-T.W.D (m):	11	G.W.D (m):	2.25	Date:	10.06.2014			
Test Interval	18	to	21		K(m/sec, FHM):	4.0997E-08			
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	2.25	m	0	0.00	0	1.00	2.25
Length of uncased test interval below the pre-test water level		L	3	m	1	0.02	60	0.99	2.23
Falling Head Method (FHM)					2	0.03	120	0.99	2.23
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.03	180	0.99	2.22
H1		2.23		m					
H2		2.22		m					
t1 (as per graph)		60		sec.					
t2		180		sec.					
Log Time (sec)									
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious					
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Impervious				
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Impervious				
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Impervious				

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST							
				DAM FOOTPRINT									
	Pre-T.W.D (m):	17	G.W.D (m):	2.25	Date:			10.06.2014					
Test Interval	24	to	27		K(m/sec, FHM):	1.0437E-07							
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.25	m		0	0.00	0	1.00	2.25				
Length of uncased test interval below the pre-test water level	L	3	m		1	0.04	60	0.98	2.21				
Falling Head Method (FHM)						2	0.07	120	0.97				
$K(m/sec) = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.08	180	0.96				
						4	0.09	240	0.96				
						5	0.10	300	0.96				
						6	0.10	360	0.96				
H1	2.21		m										
H2	2.16		m										
t1 (as per graph)	60		sec.										
t2	300		sec.										
Log Time (sec)													
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious									
1.00E-03	1.00E-05	Pervious			Semi-Pervious								
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious								
1.00E-08	1.00E-12	Impervious			Semi-Pervious								

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دارالهندسة نزيح طالب وشركاه للمهندسين والاستراتيجييين		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
		DAM FOOTPRINT				
	Pre-T.W.D (m):	15	G.W.D (m):	2.25	Date:	11.06.2014
Test Interval	27	to	30	K(m/sec, FHM):	1.5985E-07	
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.25	m	0	0.00	
Length of uncased test interval below the pre-test water level	L	3	m	1	0.09	
Falling Head Method (FHM)						
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						
H1	2.11	m	7	0.27	420 0.88 1.98	
H2	1.95	m	9	0.29	540 0.87 1.96	
t1 (as per graph)	120	sec.	11	0.30	660 0.86 1.95	
t2	660	sec.	13	0.31	780 0.86 1.94	
Log Time (sec)						
Water Permeability (m/sec)	Relative Permeability		Semi-Pervious			
1.00E-03	1.00E-05	Pervious				
1.00E-05	1.00E-08	Semi-Pervious				
1.00E-08	1.00E-12	Impervious				

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دار الهندسة نازح طالب وشركاه للمهندسين والاستشاريين		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST				
		DAM FOOTPRINT							
Pre-T.W.D (m):	12	G.W.D (m):	2.25	Date:		11.06.2014			
Test Interval	30	to	33	K(m/sec, FHM):		8.2551E-08			
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t	
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.25	m	0	0.00	0	1.00	2.25	
Length of uncased test interval below the pre-test water level	L	3	m	1	0.03	60	0.99	2.22	
Falling Head Method (FHM)					2	0.04	120	0.98	2.21
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.05	180	0.98	2.20
					4	0.05	240	0.98	2.20
H1	2.22	m							
H2	2.2	m							
t1 (as per graph)	60	sec.							
t2	180	sec.							
Log Time (sec)									
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious					
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Impervious				
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Impervious				
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Impervious				

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers				BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST							
				DAM FOOTPRINT									
BHVR4	Pre-T.W.D (m):	22.5	G.W.D (m):	2.25	Date:			11.06.2014					
Test Interval	33	to	36		K(m/sec, FHM):	1.2411E-07							
Diameter of test interval	D		86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.25	m		0	0.00	0	1.00	2.25				
Length of uncased test interval below the pre-test water level	L	3	m		1	0.03	60	0.99	2.22				
Falling Head Method (FHM)						2	0.05	120	0.98				
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.06	180	0.98				
						4	0.06	240	0.97				
									2.19				
H1	2.22		m										
H2	2.19		m										
t1 (as per graph)	60		sec.										
t2	180		sec.										
Log Time (sec)													
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious									
1.00E-03	1.00E-05	Pervious			Semi-Pervious								
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious								
1.00E-08	1.00E-12	Impervious			Semi-Pervious								

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دارالهندسة نزيح طالب وشركاه للمهندسين والاستشاريين		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST						
		DAM FOOTPRINT									
Pre-T.W.D (m):	31.3	G.W.D (m):	2.25	Date:		12.06.2014					
Test Interval	39	to	42	K(m/sec, FHM):		2.7088E-08					
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t			
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.25	m	0	0.00	0	1.00	2.25			
Length of uncased test interval below the pre-test water level	L	3	m	1	0.01	60	1.00	2.25			
Falling Head Method (FHM)					2	0.01	120	1.00	2.24		
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	0.01	180	1.00	2.24		
H1	2.25	m									
H2	2.24	m									
t1 (as per graph)	0	sec.									
t2	180	sec.									
Log Time (sec)											
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Impervious							
1.00E-03	1.00E-05	Pervious									
1.00E-05	1.00E-08	Semi-Pervious									
1.00E-08	1.00E-12	Impervious									

DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST					
		DAM FOOTPRINT								
BHVR4	Pre-T.W.D (m):	2.25	G.W.D (m):	2.25	Date:	13.06.2014				
Test Interval	45	to	48		K(m/sec, FHM):	3.2936E-05				
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	2.25	m	0	0.00	0	1.00	2.25		
Length of uncased test interval below the pre-test water level	L	3	m	1	1.20	60	0.47	1.05		
Falling Head Method (FHM)					2	2.20	120	0.02	0.05	
$K(m/sec) = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	2.24	180	0.00	0.01	
H1	2.25		m							
H2	0.01		m							
t1 (as per graph)	0		sec.							
t2	180		sec.							
Log Time (sec)										
Water Permeability (m/sec)	Relative Permeability			Pervious						
1.00E-03	1.00E-05	Pervious			Pervious					
1.00E-05	1.00E-08	Semi-Pervious			Pervious					
1.00E-08	1.00E-12	Impervious			Pervious					



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 04**
TRANCHE ESSAYEE **48.00 m à 51.00 m**

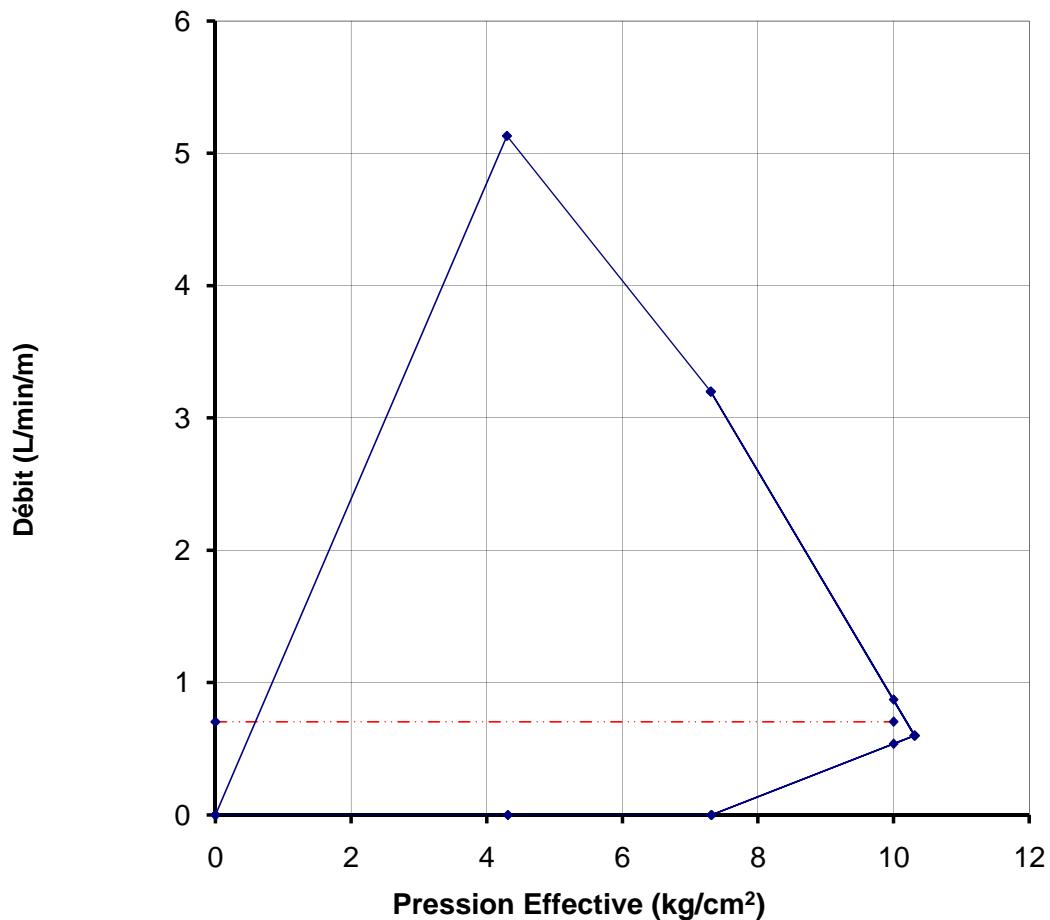
Date: **6/13/2014**

Manomètre **0.50 m**

depth to water: **2.65 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	154	10	3	15.4	5.13	0.315	1.52E-02	4.300
7	96	10	3	9.6	3.20	0.315	9.50E-03	7.305
10	18	10	3	1.8	0.60	0.315	1.78E-03	10.313
7	0	10	3	0	0.00	0.315	0.00E+00	7.315
4	0	10	3	0	0.00	0.315	0.00E+00	4.315

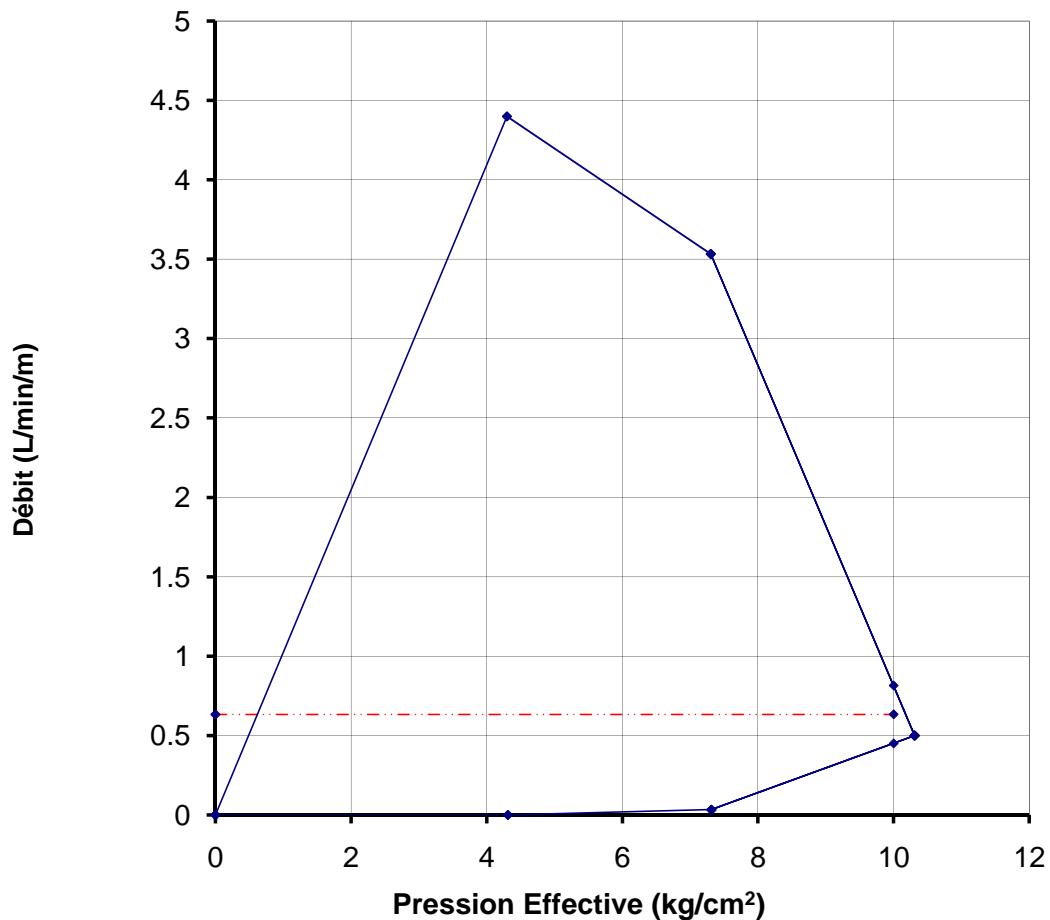


Lugeon = 0.70 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/13/2014
SONDAGE No.: BHVR 04	TRANCHE ESSAYEE 51.00 m à 54.00 m	Manomètre 0.50 m
		depth to water: 2.65 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	132	10	3	13.2	4.40	0.315	1.31E-02	4.302
7	106	10	3	10.6	3.53	0.315	1.05E-02	7.305
10	15	10	3	1.5	0.50	0.315	1.49E-03	10.314
7	1	10	3	0.1	0.03	0.315	9.90E-05	7.315
4	0	10	3	0	0.00	0.315	0.00E+00	4.315



Lugeon = 0.63 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 04**
TRANCHE ESSAYEE **57.00 m à 60.00 m**

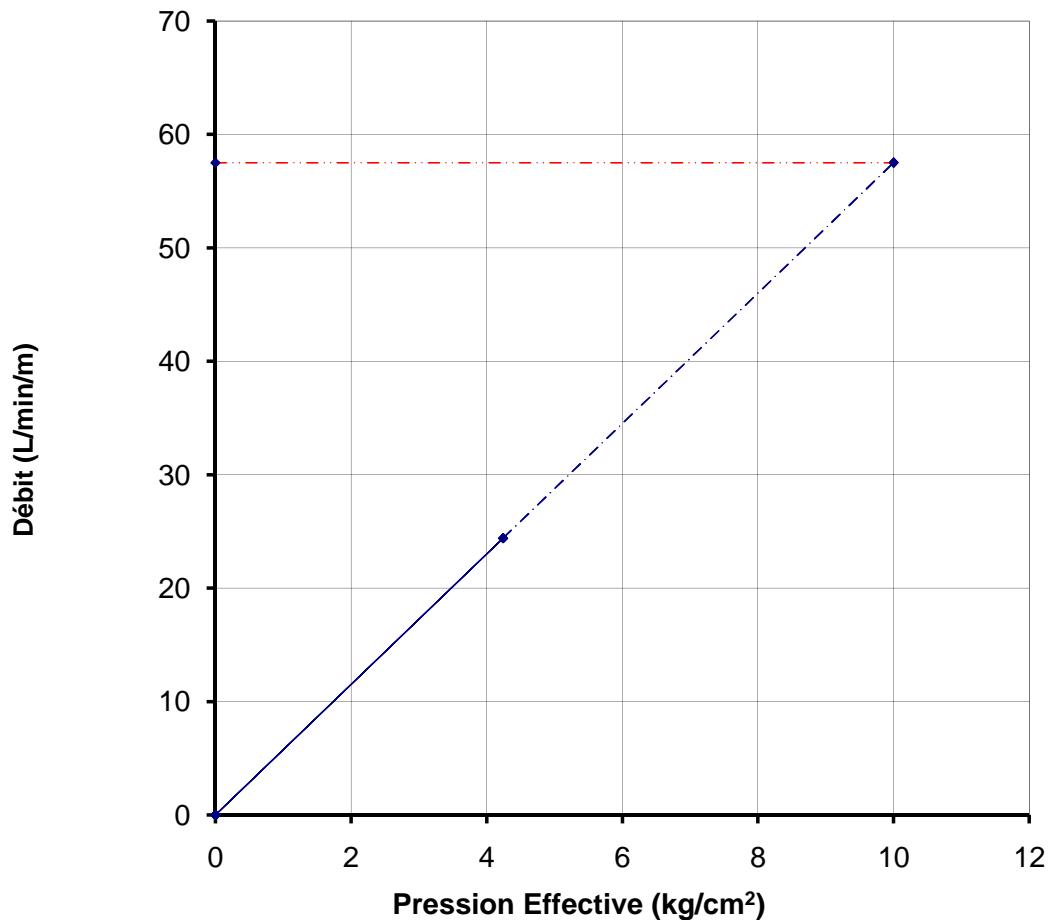
Date: **6/14/2014**

Manomètre **0.50 m**

depth to water: **2.65 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	732	10	3	73.2	24.40	0.315	7.25E-02	4.243



Lugeon = 57.51 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 04**
TRANCHE ESSAYEE **60.00 m à 63.00 m**

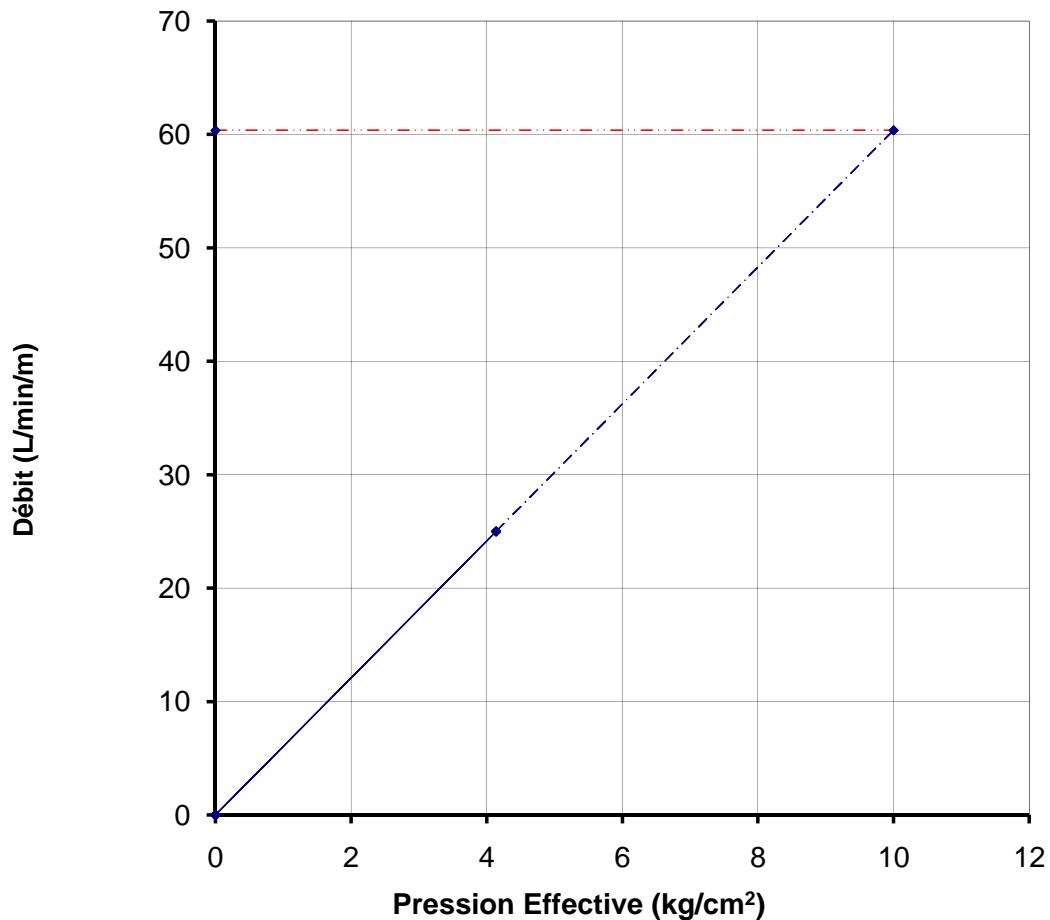
Date: **6/14/2014**

Manomètre **0.50 m**

depth to water: **2.65 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
3.9	750	10	3	75	25.00	0.315	7.43E-02	4.141



Lugeon = 60.38 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 04**
TRANCHE ESSAYEE **63.00 m à 66.00 m**

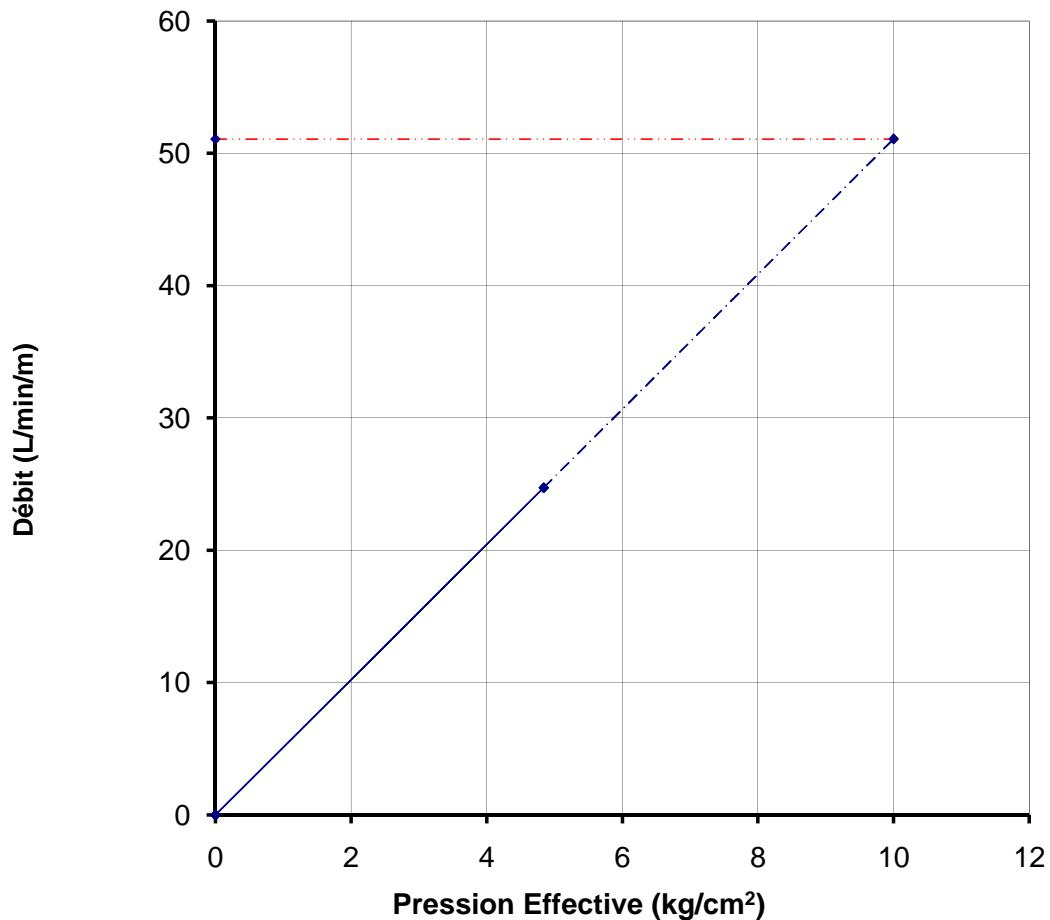
Date: **6/16/2014**

Manomètre **0.50 m**

depth to water: **2.65 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4.6	742	10	3	74.2	24.73	0.315	7.35E-02	4.842

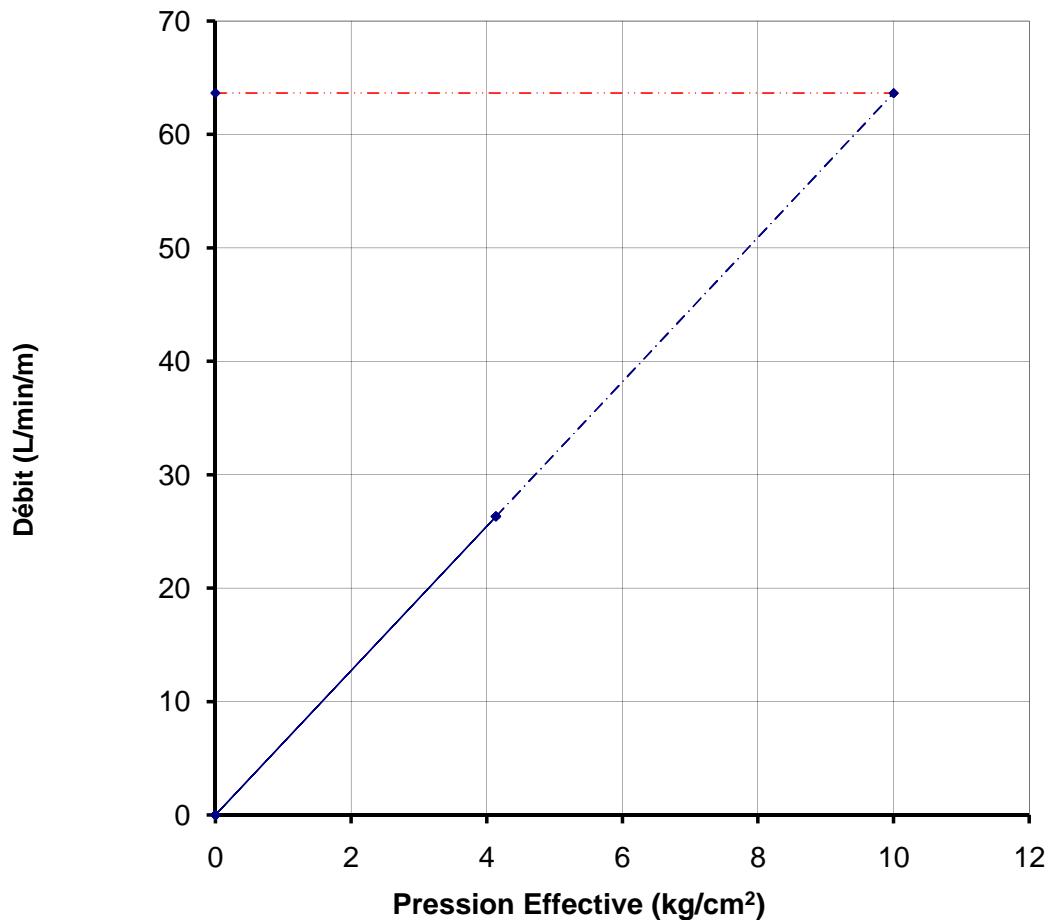


Lugeon = 51.09 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/16/2014
SONDAGE No.: BHVR 04	TRANCHE ESSAYEE 69.00 m à 72.00 m	Manomètre 0.50 m
		depth to water: 2.65 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
3.9	790	10	3	79	26.33	0.315	7.82E-02	4.137

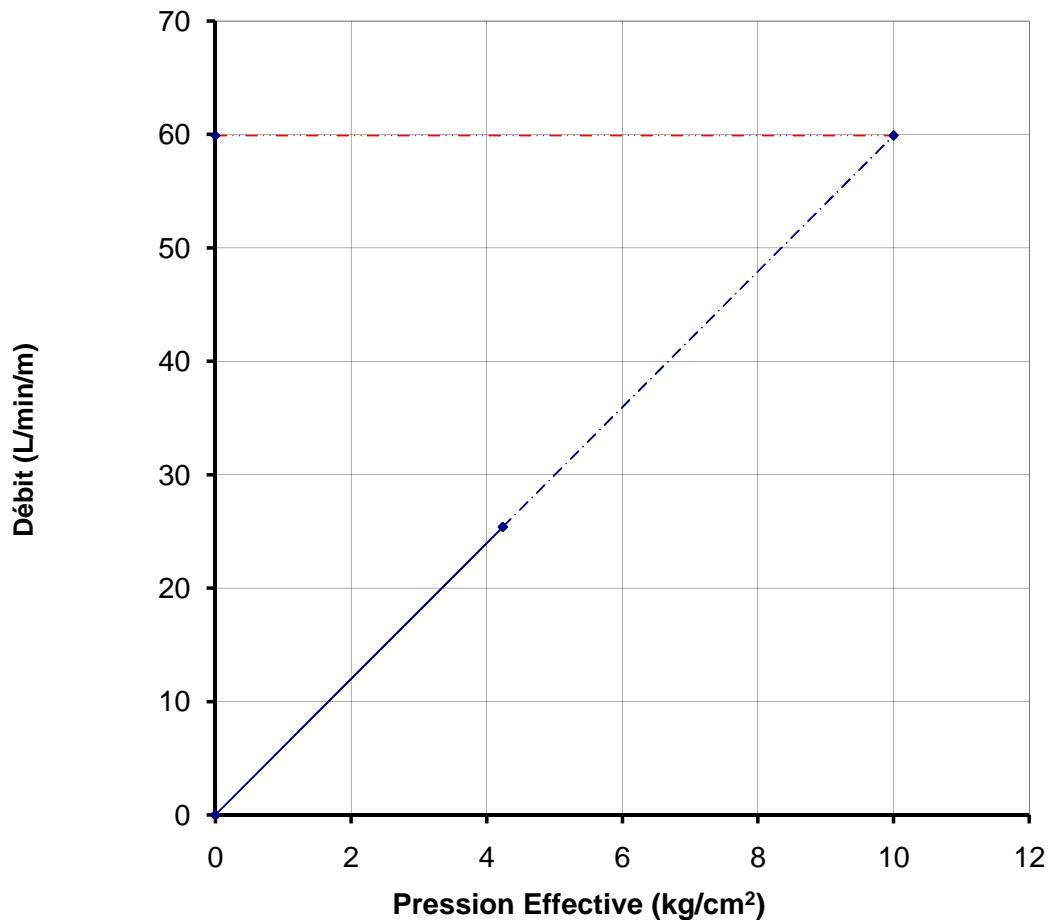


Lugeon = 63.66 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/16/2014
SONDAGE No.: BHVR 04	TRANCHE ESSAYEE 72.00 m à 75.00 m	Manomètre 0.50 m
		depth to water: 2.65 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	762	10	3	76.2	25.40	0.315	7.54E-02	4.240

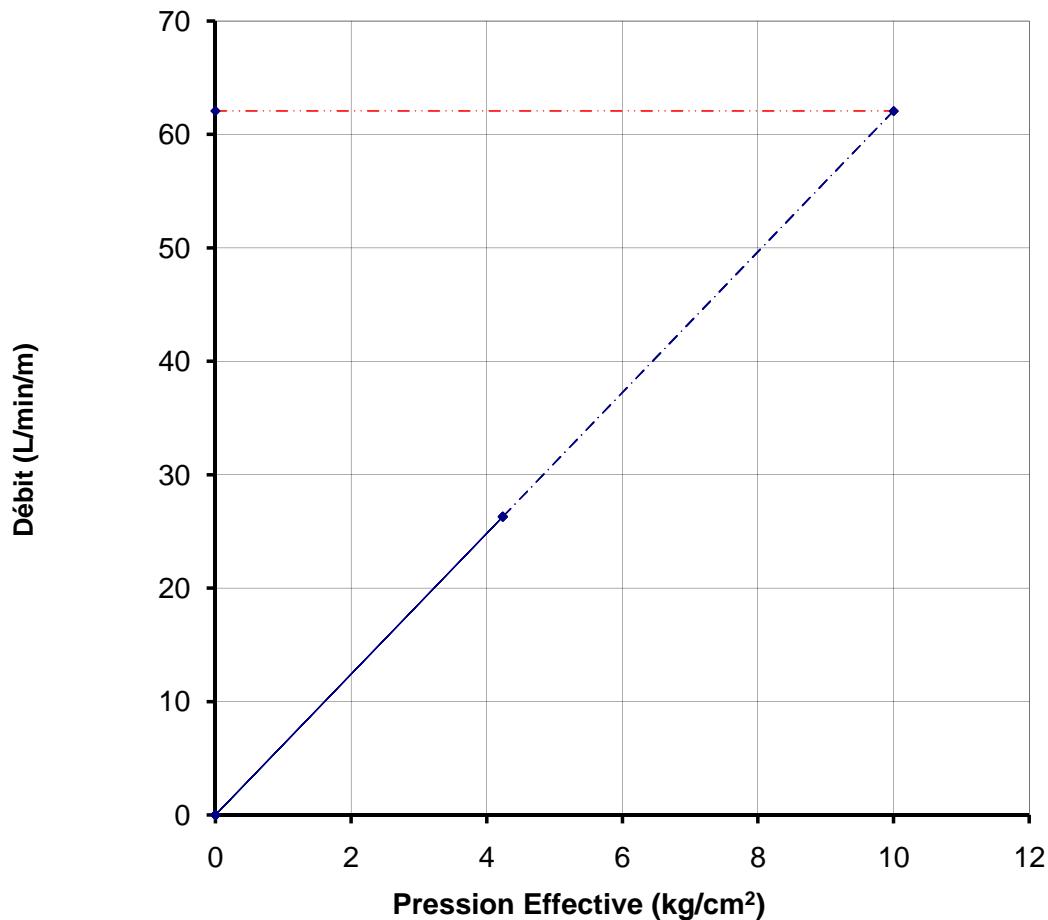


Lugeon = 59.91 L/min/m

SATCON	PROJECT: BISRI DAM / SECOND PACKAGE	Date: 6/16/2014
SONDAGE No.: BHVR 04	TRANCHE ESSAYEE 75.00 m à 78.00 m	Manomètre 0.50 m
		depth to water: 2.65 m

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	789	10	3	78.9	26.30	0.315	7.81E-02	4.237



Lugeon = 62.07 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 04**
TRANCHE ESSAYEE **78.00 m à 81.00 m**

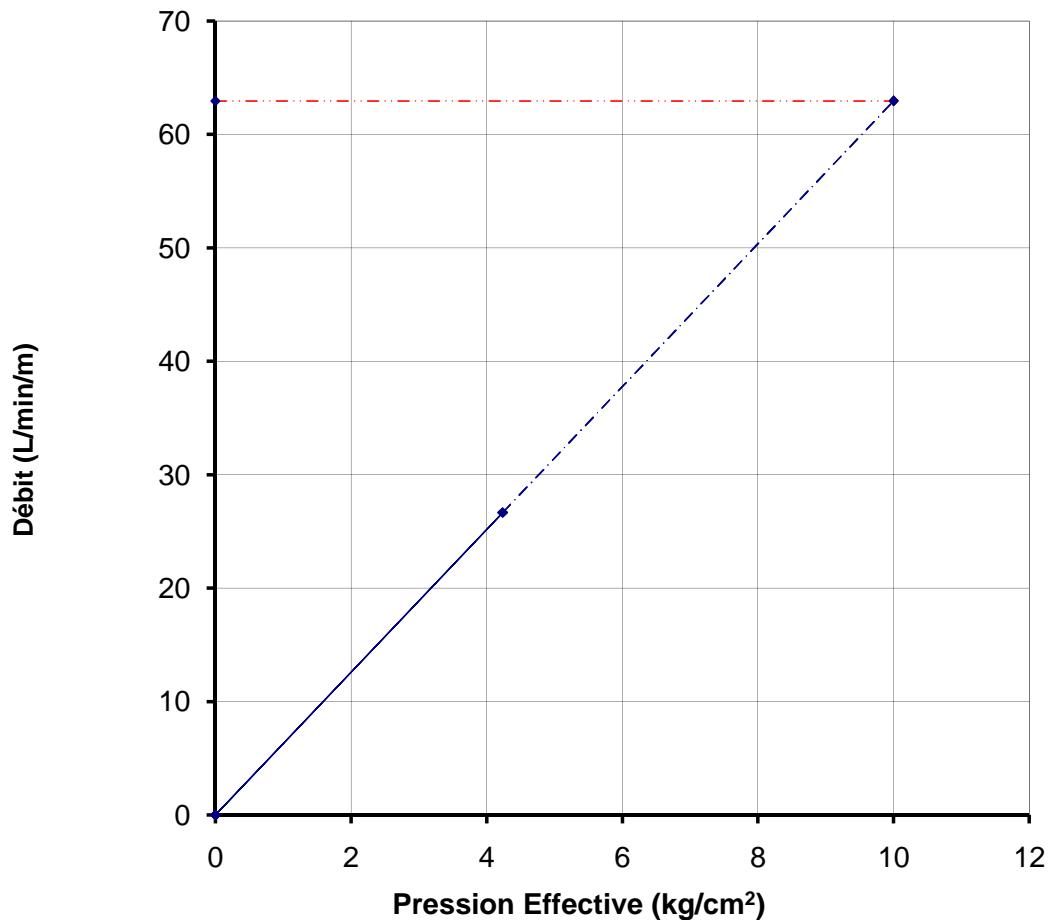
Date: **6/18/2014**

Manomètre **0.50 m**

depth to water: **2.65 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	800	10	3	80	26.67	0.315	7.92E-02	4.236



Lugeon = **62.96 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 04**
TRANCHE ESSAYEE **81.00 m à 84.00 m**

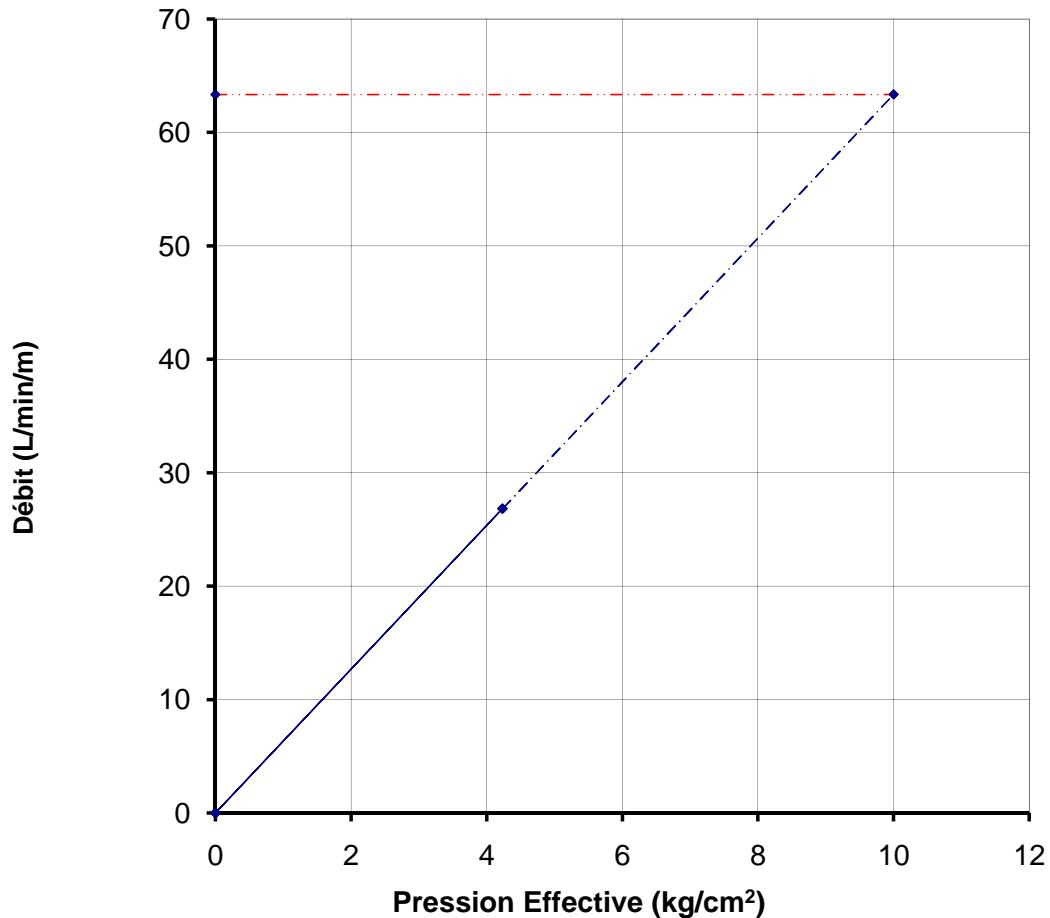
Date: **6/18/2014**

Manomètre **0.50 m**

depth to water: **2.65 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	805	10	3	80.5	26.83	0.315	7.97E-02	4.235



Lugeon = 63.36 L/min/m

APPENDIX 5. GROUNDWATER MEASUREMENTS INCLUDING DAILY MEASUREMENTS



BISRI DAM PIEZOMETRIC SURVEY DATED JUNE 09, 2014

Piezometer	Depth of groundwater table (m) from the NGL (June 09, 2014)	NGL (Updated on December 2013)	Depth of groundwater table as project level (June 09, 2014)
BDC-2	26.71	443.16	416.5
BDC-3	12.19	428.353	416.2
BDC-4	16.6	428.585	412.0
BDC-5	45.33	454.435	409.1
BDC-6	21.58	417.86	396.3
BDC-7	7.11	416.33	409.2
BDC-8	41.23	440.584	399.4
BCD-9	26.61	422.417	395.8
BCD-12	18.04	413.74	395.7
BDC-13	15.23	410.7	395.5
BDC-18	2.8	398.35	395.6
BDC-26	73.38	437.8	364.4
BDC-27	50.9	433.202	382.3
BDC-28	36.42	439.6	403.2
BDC-32	59.51	490.22	430.7
EV2	4.55	401.7	397.15
EV3	0.25	398.29	398.04
EV7	Artesian flow	396	Artesian flow
EV10	20.3	420.2	399.9
VF2	5.88	414.92	409.04
VF3	5.57	414.45	408.88
VF4	6.08	419.19	413.11
BHVL1	0.71	396.57	395.86
BHLA1	35.9	431.5	395.6
BHLA2	55.05	459.4	404.35
BHVR3	9.15	413.8	404.65
BHVR5	10.29	414.37	404.08
BHRA3	25.48	430.25	404.77
BHRA1	39	441.98	402.98
BHVR2	9.51	414.09	404.58
BHRA2	100.5	490.25	389.75
BHRA4	36.7	449.85	413.15
BHVR1	9.35	413.97	404.62
BHLA3	29.1	425.27	396.17
BHLA4	27.75	424.18	396.43
BHVR4	2.12	398.14	396.02

BISRI DAM PIEZOMETRIC SURVEY DATED JUNE 19, 2014

Piezometer	Depth of groundwater table (m) from the NGL (June 19, 2014)	NGL (Updated on December 2013)	Depth of groundwater table as project level (June 19, 2014)
BDC-2	26.63	443.16	416.5
BDC-3	12.14	428.353	416.2
BDC-4	16.4	428.585	412.2
BDC-5	45.5	454.435	408.9
BDC-6	21.71	417.86	396.2
BDC-7	7.15	416.33	409.2
BDC-8	41.6	440.584	399.0
BCD-9	26.45	422.417	396.0
BCD-12	17.95	413.74	395.8
BCD-13	15.25	410.7	395.5
BCD-18	2.6	398.35	395.8
BDC-26	73.5	437.8	364.3
BDC-27	50.75	433.202	382.5
BDC-28	36.4	439.6	403.2
BDC-32	59.3	490.22	430.9
EV2	3.9	401.7	397.8
EV3	0.26	398.29	398.03
EV7	Artesian flow	396	Artesian flow
EV10	20.4	420.2	399.8
VF2	6	414.92	408.92
VF3	5.99	414.45	408.46
VF4	5.99	419.19	413.2
BHVL1	0.5	396.57	396.07
BHLA1	35.65	431.5	395.85
BHLA2	55	459.4	404.4
BHVR3	9.3	413.8	404.5
BHVR5	9.5	414.37	404.87
BHRA3	25.68	430.25	404.57
BHRA1	39.15	441.98	402.83
BHVR2	9.68	414.09	404.41
BHRA2	100.8	490.25	389.45
BHRA4	36.73	449.85	413.12
BHVR1	9.33	413.97	404.64
BHLA3	29.4	425.27	395.87
BHLA4	28.1	424.18	396.08
BHVR4	2.25	398.14	395.89

BISRI DAM PIEZOMETRIC SURVEY DATED JUNE 30, 2014

Piezometer	Depth of groundwater table (m) from the NGL (June 30, 2014)	NGL (Updated on December 2013)	Depth of groundwater table as project level (June 30, 2014)
BDC-2	26.52	443.16	416.6
BDC-3	12.26	428.353	416.1
BDC-4	16.32	428.585	412.3
BDC-5	45.56	454.435	408.9
BDC-6	21.69	417.86	396.2
BDC-7	7.08	416.33	409.3
BDC-8	41.59	440.584	399.0
BCD-9	26.47	422.417	395.9
BCD-12	17.91	413.74	395.8
BCD-13	15.38	410.7	395.3
BCD-18	2.48	398.35	395.9
BDC-26	73.72	437.8	364.1
BDC-27	50.69	433.202	382.5
BDC-28	36.21	439.6	403.4
BDC-32	59.45	490.22	430.8
EV2	3.79	401.7	397.91
EV3	0.18	398.29	398.11
EV7	Artesian flow	396	Artesian flow
EV10	20.31	420.2	399.89
VF2	6.1	414.92	408.82
VF3	6.13	414.45	408.32
VF4	6.17	419.19	413.02
BHVL1	0.61	396.57	395.96
BHLA1	35.78	431.5	395.72
BHLA2	55.13	459.4	404.27
BHVR3	9.1	413.8	404.7
BHVR5	9.4	414.37	404.97
BHRA3	25.79	430.25	404.46
BHRA1	39.33	441.98	402.65
BHVR2	9.72	414.09	404.37
BHRA2	101.2	490.25	389.05
BHRA4	36.88	449.85	412.97
BHVR1	9.23	413.97	404.74
BHLA3	29.32	425.27	395.95
BHLA4	28.11	424.18	396.07
BHVR4	2.2	398.14	395.94

BHVR1	DATE	Morning	Evening
	5/23/2014	9	13
	5/24/2014	9.1	12
	5/26/2014	9.15	22
	5/27/2014	9.15	6
	5/28/2014	9.1	17
	5/29/2014	9.19	31
	5/30/2014	9.22	18.13
	5/31/2014	9.15	9.5
	6/2/2014	9.3	9.2
	6/3/2014	9.15	9.3
	6/4/2014	9.13	9.18
	6/5/2014	9.26	
	6/6/2014	9.18	

BHLA3	DATE	Morning	Evening
	5/31/2014		dry
	6/2/2014	dry	dry
	6/3/2014	dry	dry
	6/4/2014	dry	dry
	6/6/2014	dry	28.1
	6/7/2014	28.4	29.13
	6/9/2014	28.73	29.13
	6/10/2014	28.47	

BHLA4	DATE	Morning	Evening
	6/10/2014		1.9
	6/11/2014	dry	12.6
	6/12/2014	dry	dry
	6/13/2014	dry	19.9
	6/14/2014	24.6	27.15
	6/16/2014	28.1	28.6
	6/17/2014	28.3	

BHVR4	DATE	Morning	Evening
	6/9/2014		1
	6/10/2014	2	0.8
	6/11/2014	1.5	0.8
	6/12/2014	1	2
	6/13/2014	1.8	2.3
	6/14/2014	2.34	2.4
	6/16/2014	2.41	2.35
	6/17/2014	2.55	2.58
	6/18/2014	2.55	2.25
	6/19/2014	2.55	2.52

APPENDIX 6. LIST OF SAMPLING & LABORATORY TESTING (SECOND PACKAGE)



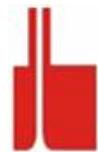
Bisri Dam Laboratory Testing Program - Second Package



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No. of BH	Depth of Sampling (m)	Type of Sample	Sample Description	Date of Sampling	Unit (U)	Testing									
						Soil					Rock				
BHVR1	5.5	SPT	Light yellowish brown clayey SILT	22.05.2014		1	1	1	1	1	Moisture Content	7			
	23.5		Olive silty fine SAND	23.05.2014		1	1	1			Void Ratio	7			
	30		Olive silty fine SAND	24.05.2014		1	1	1			Sieve	7			
	33		Olive brown clayey SILT	24.05.2014		1	1	1	1		Hydrometer	5			
	41.5		Olive brown silty CLAY	26.05.2014		1	1	1	1		UCS	0			
	56.5		Olive brown silty CLAY	28.05.2014		1	1	1	1		Triaxial (CU+U)	0			
	65.5		Olive brown silty CLAY	28.05.2014		1	1	1	1		Triaxial (CD)	0			
											Consolidation	0			
											Atterberg	5			
											Organic Content	5			
											Bulk and Saturated Density	7			
											Uni-axial CS (Saturated)	0			
											PLI (Saturated)	0			
											Water Absorption	0			
											Unit weight (Saturated)	0			
											Soundness ($MgSO_4$)	0			
											Slake Durability	0			
											Calcium Carbonate	0			
											Sulfate, Chloride, PH	4			
											General Total	47			

Bisri Dam Laboratory Testing Program - Second Package



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Sampling

Bisri Dam Laboratory Testing Program - Second Package

Sampling				Unit (U)	Testing												General Total					
					Soil						Rock											
No. of BH	Depth of Sampling (m)	Type of Sample	Sample Description	Date of Sampling	Moisture Content	Void Ratio	Sieve	Hydrometer	UCS	Triaxial (CU+U)	Triaxial (CD)	Consolidation	Atterberg	Organic Content	Bulk and Saturated Density	Uni-axial CS (Saturated)	PLI (Saturated)	Water Absorption Unit weight (Saturated)	Soundness ($MgSO_4$)	Slake Durability	Calcium Carbonate	Sulfate, Chloride, PH
BHRA1	99.4-99.7	Core	Chocolate brown MARLSTONE.	March 15 - April 08, 2014	0	0	0	0	0	0	0	0	0	0	0	6	1	1	1	1	1	1
	136-136.2		Bluish grey MARLSTONE.													6	1	1	1	1	1	1
	142.5-142.7		Bluish grey fossiliferous sandy LIMESTONE.													9	1	1	1	1	1	1
BHRA3	22.5-22.65	Core	Beige very sandy marly LIMESTONE	March 17 - 28, 2014												10	1	1	1	1	1	1
	52.5-52.7		Bluish grey calcareous MARLSTONE													3	1	1	1	1	1	1
	76.5-76.85		Bluish grey fossiliferous calcareous MARLSTONE													6	1	1	1	1	1	1
BHRA4	72-72.1	Core	Bluish grey very sandy MARLSTONE	26.05.2014												10	1	1	1	1	1	1
BHRA2	36.5-36.8	Core	Light cream to white sandy LIMESTONE	April 04 - May 10, 2014												1	1	1	1	1	1	1
	89.8-90.05		Beige sandy marly LIMESTONE													1	1	1	1	1	1	1
	136.8-137.1		Bluish grey sandy calcareous MARLSTONE													1	1	1	1	1	1	1
Total of 10 rock and 10 soil samples.																						