Appendices 5 Soft Component (Technical Assistance) Plan

The Preparatory Survey for The Project for Rehabilitation anad Improvement of Buluto Irrigation Scheme in the Democratic Republic of Timor-Leste

Soft Component (Technical Assistance) Plan

Contents

(1) Background of soft component plan

"The Project for Rehabilitation of Irrigation Scheme in the Democratic Republic of Timor-Buluto" aims improvement of agricultural production in target area by changing the existing traditional irrigation system of small scale to modern irrigation system with weir equipment. For the sustainable achievement of the purpose, proper maintenance of irrigation facility and fair and proper water distribution are very important activities. Ministry of Agriculture and Fisheries Irrigation Water Management Bureau will manage the key facility, and WUA will handle the issues of operation and maintenance of terminal facilities. By implementation of this project, existing small-scale irrigation schemes are to be integrated into one. Therefore, existing small-scale irrigation associations are to be united and thus makes it possible to manage more systems. By expanding scale of irrigation scale, more systematic and fair water management is needed to provide irrigation water to entire area properly.

In order to do that, capacity building of organizational management is important by supporting establishment of water users association with Department of Water Management which is maintenance governing Department of Irrigation and Water Management. The supports are to provide technical guidance for operation of new irrigation facilities and to make water management guidelines for making it possible to have proper maintenance. These technical supports will be conducted under soft component of the project.

(2) Objective of Soft Component

Considering existing facility maintenance activities and water management and on the assumption that Timor Leste side can continuously keep the activity after the completion of cooperation project, plan the soft component of the project with the objective "Concerned parties acquire the knowledge which is necessary for maintenance and water management of new and improved irrigation facility".

(3) Output of soft component

The output of the objectives as mentioned above is the "improvement of maintenance capacity of facilities" for concerned parties of Ministry of Agriculture and Fisheries Irrigation Water Management Bureau Water Management Division, Agricultural Office, and Water Users' Association (WUA) who is responsible for maintenance and water management.

(4) Confirmation of output achievement

Outcomes and achievements of soft component are to be judged by parameters 1) Checking the records of registration of water association and organization rules in the area, 2) Checking the procedure of making of water management guideline, and 3) checking the process of acquisition of operation of irrigation facilities maintenance technology based on training record such as implementation of training and guidance or questionnaire survey after the training,

(5) Activities of soft component

The table below shows more concrete activities such as supporting establishment and capacity building of water user association and guidance for water management skill. About activity items 7, after the guidance for operation of equipments and facilities in the gate by the supplier, water management guideline and the guidance for proper operation and maintenance management according to the guideline of irrigation plan are planed as soft component.

Table 0.1 Activities of soft component

Name of supporting program	Target	Activity
Support for establishment of water use association	Beneficiary farmers	**(1) Establishment of water use association(WUA)** ✓ Explanatory meeting for establishment of WUA ✓ Making list of irrigation beneficiary ✓ Explanation of responsibility of WUA leaders ✓ Consideration of membership ✓ Choosing organization leaders **(2) Formulating organization rules** ✓ Conducting study tour to Lacro irrigation area ✓ Formulation and discussion of WUA organization rules(Plan) ✓ Discussion for conduction and management method of WUA meeting place ✓ Formulation of WUA organization rules **(3) Support for government registration** ✓ Formulation of WUA organization rules ✓ Explanation of procedure of government registration ✓ Support for procedure of government registration ✓ Government registration (Accepting WUA certification)
Conduct of facility/maintenance	Government agents and beneficial farmers	**(4) Formation of water management guidance** ✓ Discussion for irrigation amount and water use fee ✓ Making of water management outline(Plan) (Supply of irrigation water, maintenance of facility, collection of water charge) **(5) Review and improvement of water management guidance** ✓ Review and improvement of water management outline as a result of technical guidance of water management(shown below) ✓ Formulation of water management outline
Guidance for water management	Government agents and beneficial farmers	**(6) Technical guidance of water management** ✓ Conducting study tour to Lacro irrigation area(main theme is water management, to leaders of WUA and operator of the gate.) ✓ Technical explanation of irrigation block ✓ Practical training of water management **(7) Operation of facility, technology transfer of maintenance management** ✓ Practical training of facility operation based on irrigation plan ✓ Technical guidance for facility maintenance

(6) Ways and Means of Resource of Soft Component

It is important to cooperate with the government's technical staffs of Timor Leste (C/P) and include them into the project's activity from the beginning of soft component so that they can subjectively work on the activity continuously even after the project. Therefore, key people of implementation organization of the soft component are Technical staff of the Ministry of Agriculture and Fisheries Irrigation Water Management Bureau Water Management Division (C/P) and Japanese engineer of consultant support them.

1) Japanese expert : 1 person

Choose a person who has experience as leader of activity or project relating to conduction maintenance of irrigation facility including water management skill and organization management as Japanese expert. He also must be able to guide manage the whole soft component work and become leader for the counterpart. The work time schedule in Timor Leste includes 2 times visit (i.e. for 1.0 month and then 0.7 month), making it 1.7 month in total. In first travel, conduct the tasks and activities mentioned as (1) to (4) and (5) to (7) in second travel.

2) Counterpart of implementation facility (C/P): 3 people

An irrigation engineer of Department of Irrigation and Water Management (1 person) and irrigation engineer from agricultural office of Manatuto and Baucau District Agriculture Offices (one person for each prefecture). The C/Ps shall be responsible for the activities of water users association and monitoring of the activities of soft component.

(7) Process of soft component

At the time when the progress in construction is achieved to some extent, then the support for the establishment of water users association should be started. When the construction of main irrigation facilities is finished, guidance on water management should be provided. Meanwhile, support of organization development shall continue. The entire period of assignment is about 12 months.

Table 0.2 Schedule of soft component

Month order	1	2	...	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Items of support	Construction Period														1st rice		
(1)Establishment of WUA																	
(2)Formulating organization																	
(3)Support for government																	
(4)Formation of water																	
(5)Review and improvement																	
(6)Technical guidance of																	
(7) Operation of facility,																	
Plan of Assignment																	
Japanese expert (1 person)																	
C/P (3 persons)																	

(8) The Deliverables of Soft Component

As deliverables of soft component, Arrange 1) final report on soft component and 2) outline of water management and submit them to the government of Timor Leste , water users association, and JICA.

(9) Outline of project cost of soft components

The cost of soft component (Personal expense of Japanese consultant) is estimated about 4.5 million yen in total as the table below shows.

Table 0.3 The cost of soft component

Items		Project expense (1,000 yen)		
		Yen	Local price	Total
A	Direct labour costs (Japanese consultant)	1,064	0	1,064
B	Direct cost (Japanese consultant)	1,475	604	2,079
C	Indirect cost (Japanese consultant)	1,362	0	1,362
Total		3,901	604	4,505

(10) Responsibility of Timor Leste side

The rehabilitation of irrigation facilities by this project is conducted under the agreement between JICA and Timor Leste side that Timor Leste side should get responsibility for the administration & maintenance management of those facilities. Based on this agreement, the following activities should be conducted by Timor Leste side for the achievement of the soft component objective mentioned above.

a) To dispatch three C/P staffs including their activity cost.
b) To prepare the office for this project
c) To conduct the continuous monitoring regarding the organizational management condition of WUA and to implement proper support & additional training for WUA based on the monitoring result.

Appendics 6 Approval of Land Acquisition

REPÚBLICA DEMOCRÁTICA DE TIMOR LESTE
MINISTÉRIO DE AGRICULTURA E PESCAS
GABINETE DO DIRETOR GERAL

No. 625/GDG/VII/2013 Dili, 24th July 2013

No.26, Farol Area, Dili, Timor-Leste

JICA Timor - Leste Office

Attention: Mr. Hirohiko TAKATA, the Chief Representative of JICA Timor - Leste Office

Subject: Submission of the report of land acquisition on the Project for Rehabilitation of Buluto Irrigation Scheme

Dear Sir,

We are honorable to inform you that we would submit you the report of land acquisition on the Project for Rehabilitation of Buluto Irrigation Scheme with signature of all land users' concerned. The land listed in the attached papers is provided voluntarly from all of land user's.

The agreement from land users' concerned which provided was implemented as the following process:

1. The lists of users' on the land for constructing and improving the facilities concerned were made by the JICA Study Team.

2. The public consultation meetings were held to explain beneficiaries the outline of the Project. All participants show their strong incentive to the Project.

3. Both of Manatuto and Baucau District Agriculture Office explain land users' concerned the outline of the Project and get their agreement to provide their land voluntary for the proposed space of weir, expansion of canals, and other facilities concerned.

It is appreciated if you would progress the Japanese Grant Aid Process on the Project for Rehabilitation of Buluto Irrigation Scheme.

With best regards,

Lourenço Borges Fontes
Director General

CC: 1. Minister for Ministry of Agriculture and Fisheries,
2. Vice Minister for Ministry of Agriculture and Fisheries
3. National Director for Irrigation and Water Management

The Preparatory Survey for the Project for Rehabilitation of Buluto Irrigation Scheme
in the Democratic Republic of Timor-Leste (JICA)

List of Land Users for Land Acquisition on Construction of Irrigation and related Facilities

June 2013

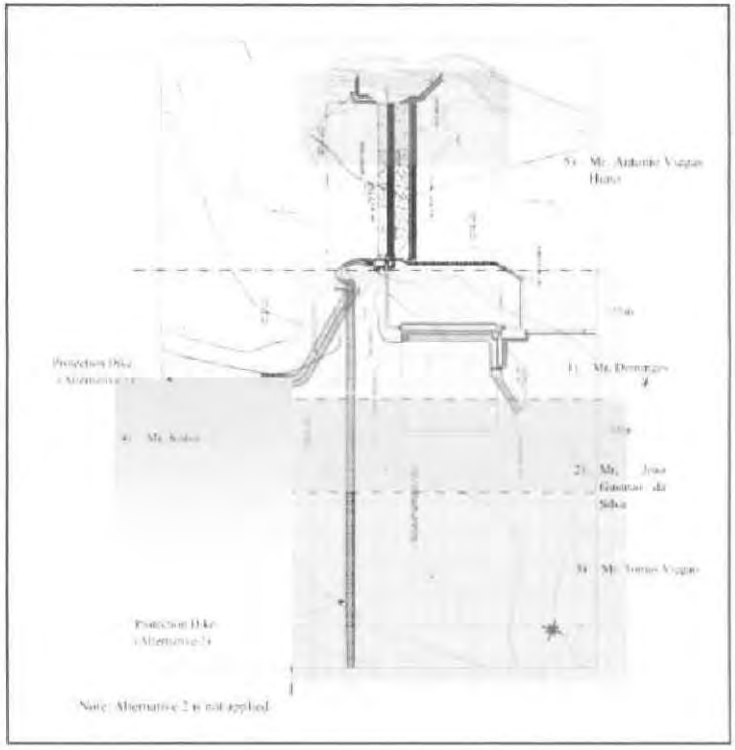
National Directorate for Irrigation and Water Management
Ministry of Agriculture and Fisheries

Contents

1. Left Bank and Right Bank of the Intake Facilities

Result of Survey for Land Acquisition

A. LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO INTAKE FACILITIES CONSTRUCTION



No	Date	Name	Land use	Signature
Left Bank Side				
1		Antonio Viegas Huno	Farm Land (0.5ha)	
Right Bank Side				
1		Domingos	Forest Area	
2		Joao Gusmão Da Silva	Forest Area	
3		Tomas Viegas	Forest Area	
4		Daughter of Kaisi	Forest Area	

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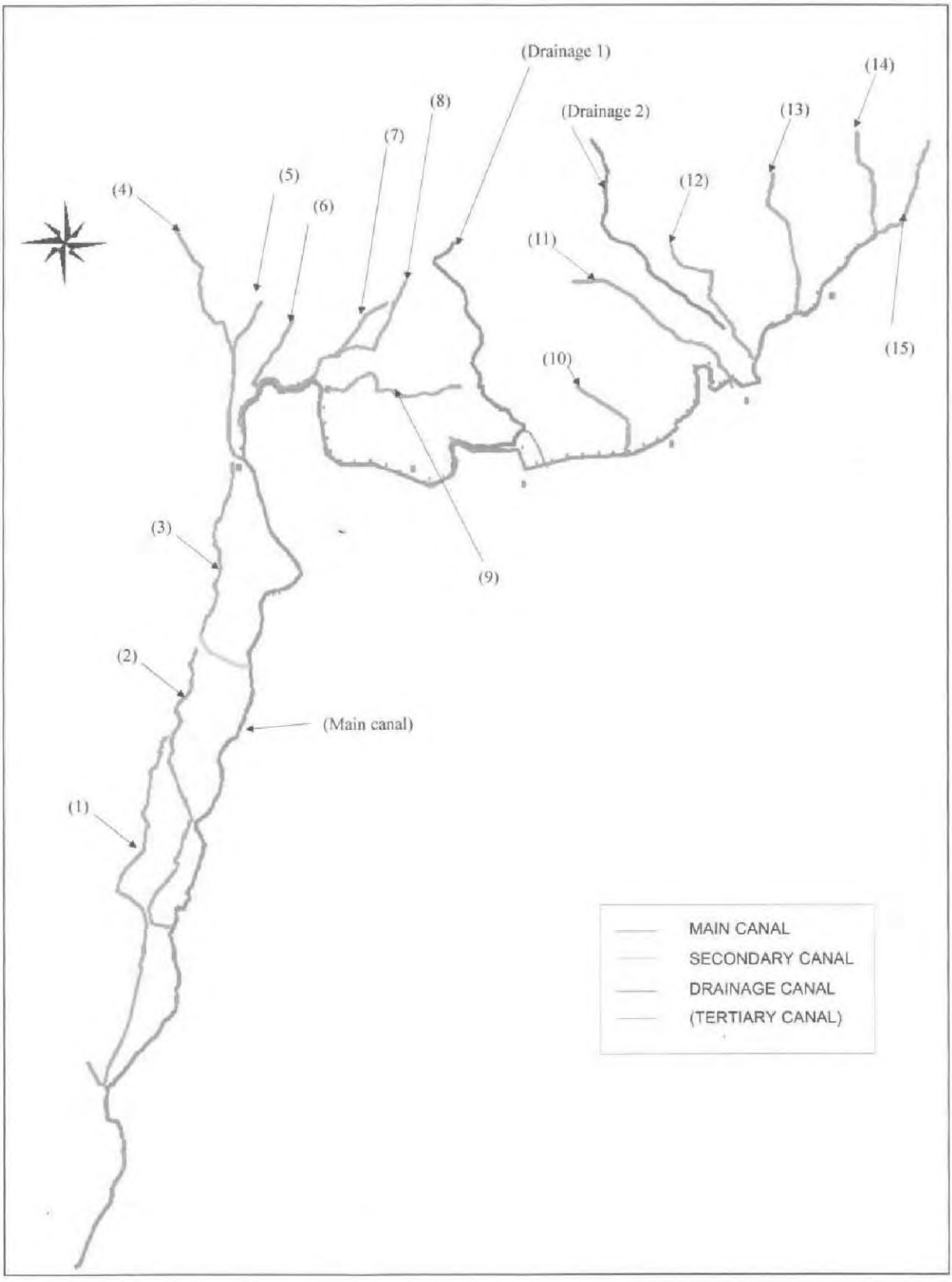

Fig.— 1 Canal Network

2. Main Irrigation Canal

Result of Survey for Land Acquisition

A. LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE MAIN CANALCONSTRUCTION

No	Date	Name	Left side Distance(m)	Right side Distance (m)	Left side survey point		Right side survey point		Land use	Signature
1		(Government)	1390	5985					Potential land for Agriculture	
2		Domingos de Araujo	228	228	0+000	0+228	0+000	0+228	Potential land for Agriculture	
3		Joao Gusumao	300	300	0+228	0+528	0+228	0+528	Potential land for Agriculture	
4		Tomas Amaral Ximenes	150	150	0+528	0+678	0+528	0+678	Potential land for Agriculture	
5		Agustinho Gusumao	220	220	0+678	0+898	0+678	0+898	Potential land for Agriculture	
6		Sebastiao Guran de Sousa	210	210	0+898	1+098	0+898	1+098	Potential land for Agriculture	
7		Tome Domingos de Sousa	132	252	1+098	1+230	1+098	1+350	Farm Land	
8		Domingos Sera Gusmao	20	0	1+230	1+250	Government L=550m		Farm Land	
9		Miguel de Sousa Naek	50	0	1+250	1+300			Farm Land	
10		Joao Alfredo	50	0	1+300	1+350			Farm Land	
11		Simao Gusmao	100	0	1+350	1+450			Farm Land	
12		Sebastiao Gura Sousa	50	0	1+450	1+500			Farm Land	
13		Domingos de Sousa	250	0	1+500	1+750			Farm Land	
14		Marcelo Caitano de Sousa	100	0	1+750	1+850			Farm Land	
15		Zito Clementino de Sousa	150	10	1+850	2+000	1+990	2+000	Farm Land	
16		Luis Alexandre de Sousa	125	0	2+000	2+125	Government L=1,050m		Farm Land	
17		Ursula de Sousa	250	0	2+125	2+375			Farm Land	
18		Luis Soares	25	0	2+375	2+400			Farm Land	
19		Julio Kere Gusmao	175	0	2+400	2+575			Farm Land	
20		Unknown/João Alfredo Soares	145	0	2+575	2+720			Farm Land	

No	Date	Name	Left side Distance(m)	Right side Distance (m)	Left side survey point		Right side survey point		Land use	Signature
21		Carlito da Costa	230	0	2+720	2+950			Farm Land	
22		Antonio Buik Gusmao	50	0	2+950	3+000			Farm Land	
23		Sebastiao Boru de Sousa	100	0	3+000	3+100			Farm Land	
24		Vicente Gusmao	50	0	3+100	3+150			Farm Land	
25		Vicente Bohak	0	100			3+050	3+150	Farm Land	
26		Jacinto Sekar Gusmao	110	0	3+150	3+260			Farm Land	
27		Estefania de Sousa	240	0	3+260	3+500			Farm Land	
28		Joao Kai	12	0	3+500	3+512			Farm Land	
29		Simao Hunu Viegas	38	0	3+512	3+550	Government L=700m		Farm Land	
30		Teozoro da Silva	50	0	3+550	3+600			Farm Land	
31		Agapito Viegas	100	0	3+600	3+800			Farm Land	
32		Miguel Viegas	150	0	3+800	3+850			Farm Land	
33		Joao Gusmao Luan	175	50	3+850	4+025	3+850	3+900	Farm Land	
34		Antonio Viegas I'ak	75	0	4+025	4+100			Farm Land	
35		Jose Gusmao To	125	0	4+100	4+225			Farm Land	
36		Julio Gusmao Meta	275	0	4+225	4+500			Farm Land	
37		Vicente dos Remedes de Sousa	70	0	4+500	4+570			Farm Land	
38		Domingos Gusmao	80	0	4+570	4+650			Farm Land	
39		Jose Horacio	50	0	4+650	4+700			Farm Land	
40		Antonio Bai	110	0	4+700	4+810			Farm Land	
41		Lucas Salvador Lindolvo de Sousa	125	0	4+810	4+900			Farm Land	
42		Jose Nero Gusmao	50	0	4+900	4+950			Farm Land	
43		Costorio de Sousa	100	0	4+950	5+050			Farm Land	
44		Casa Badak Viegas	125	0	5+050	5+175			Farm Land	
45		Tomas Marques Viegas	75	0	5+175	5+250			Farm Land	
46		Julio Mendes	75	0	5+250	5+325			Farm Land	

No	Date	Name	Left side Distance(m)	Right side Distance (m)	Left side survey point		Right side survey point		Land use	Signature
47		Duarte Gusmao	295	0	5+325	5+620			Farm Land	
48		Mario Assuncao Gusmao	150	0	5+620	5+770			Farm Land	
					Government L=1,390m		Government L=3,260m			
49		Jose Hendrique de Sousa	250	250	7+160	7+410	7+160	7+410	Farm Land	
50		Maskai da Silva	150	150	7+410	7+560	7+410	7+560	Farm Land	
51		Hermegildo Maskai	160	160	7+560	7+720	7+560	7+720	Farm Land	
52		Marcelino Soares	30	30	7+720	7+750	7+720	7+750	Farm Land	
53		Felizarda Soares	60	60	7+750	7+810	7+750	7+810	Farm Land	
54		Luis Laleia	330	330	7+810	8+140	7+810	8+140	Farm Land	
55		Nico Loi Paicheco	40	40	8+140	8+180	8+140	8+180	Farm Land	
56		Evaristo Freitas	630	630	8+180	8+810	8+180	8+810	Farm Land	
57		Nico Loi Paicheco	250	250	8+810	9+060	8+810	9+060	Farm Land	
58		Lamberto Freitas	250	0	9+060	9+310	Government L=250m		Farm Land	
59		Domingos Soares	20	20	9+310	9+330	9+310	9+330	Road	
60		Paulino Domingos Faria	80	0	9+330	9+410	Government L=80m		Road	
61		Aleixo Faria	505	505	9+410	9+915	9+410	9+915	Road	
62		Cosme da Silva	20	0	9+915	9+935	Government L=95m		Road	
63		Guilherme Soares	75	0	9+935	10+010			Road	
64		Joanico Soares	170	170	10+010	10+180	10+010	10+180	Road	
65		Joao da Costa Freitas	35	0	10+180	10+215			Road	
66		Joanico Freitas	0	5			10+180	10+185	House	
67		Eduarda da Silva	0	50			10+185	10+235	House	
68		Luis da Silva	45	0	10+215	10+260			House	
69		Mafalda	50	75	10+260	10+310	10+235	10+310	House	
70		Duarte Freitas	110	110	10+310	10+420	10+310	10+420	House	

No	Date	Name	Left side Distance(m)	Right side Distance (m)	Left side survey point		Right side survey point		Land use	Signature
71		Joao Lela da Silva	310	410	10+420	10+730	10+420	10+830	House	
72		Domingos Ramos Correia	20	0	10+730	10+750			House	
73		Joao da Costa Freitas	320	180	10+750	11+060	10+830	11+010	House	
74		Rui Manuel	2	0	11+060	11+062			House	
75		Felizarda Viegas	0	90			11+010	11+100	House	
76		Carlos Freitas	0	150			11+100	11+250	House	
77		Antonio Luis da Silva	48	160	11+062	11+110	11+640	11+680	House	
78		Leopoldo Freitas	150	0	11+110	11+260			House	
79		Mateus da Silva	0	210			11+250	11+460	Farm Land	
80		Vitor Correia	125	0	11+260	11+385			Farm Land	
81		Sebastiao Correia	215	140	11+385	11+600	11+460	11+600	Farm Land	
82		Beto Kai Correia	80	40	11+600	11+680	11+600	11+640	Farm Land	
83		Marcelino Bosi Oro Soares (Waigia)	654	654	11+680	12+334	11+680	12+334	Farm Land	
		Total Distance	12334	12334						

B. Secondary Canals

LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.1 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point				Left side survey point				Signature
1		Miguel Sousa Nack	200	200	HM	1+00	HM	3+00	HM	1+00	HM	3+00	
			0	100					HM	4+50	HM	5+50	
2		Domingos Hera	100	0	HM	3+00	HM	4+00					
3		Joao Alfredo de Sousa	50	100	HM	4+00	HM	4+50	HM	3+00	HM	4+00	
4		Simao Ximenes	0	50					HM	4+00	HM	4+50	
5		Rosa Lau de Sousa	100	0	HM	4+50	HM	5+50					
6		Tome Domingos de Sousa	0	200					HM	5+50	HM	7+50	
7		Gregorio Hendrique de Sousa	200	0	HM	5+50	HM	7+50	HM		HM		
8		Zito Clementino de Sousa	0	50					HM	7+50	HM	8+00	
9		Joao Viegas Malela	50	0	HM	7+50	HM	8+00					
10		Antonio de Sousa Correia	100	100	HM	8+00	HM	9+00	HM	8+00	HM	9+00	
11		Raul Ximenes	150	0	HM	9+00	HM	10+50					
12		Antonio Dara de Sousa	0	125					HM	9+00	HM	10+25	
13		Ursula de Sousa	400	225	HM	10+50	HM	14+50	HM	10+25	HM	12+50	
14		Joao Soares	0	150					HM	12+50	HM	14+00	
15		Antao de Sousa	0	47					HM	14+00	HM	14+47	
16		Salvador Gusmao	175	0	HM	14+50	HM	16+25					
17		Marcelo Gusmao	0	163					HM	14+47	HM	16+10	
18		Tomas Ximenes	150	0	HM	19+10	HM	20+50					
19		Guilhermina Viegas	0	290					HM	16+10	HM	19+00	
20		Unknown Mario Gusmão	195	0	HM	16+25	HM	18+20					
21		Tomas Viegas	80	0	HM	18+20	HM	19+10					
22		Mario Gusumao	60	0	HM	20+50	HM	21+10					

22		Simao Ximenes	0	110			HM	19+00	HM	20+10	
23		Vitor Viegas	0	190			HM	20+10	HM	22+00	
24		Joao Kai Gusmao	0	170			HM	22+00	HM	23+70	
25		Pedro Gusmao	150	0	HM	22+00	HM	23+50			
26		Parish (Church)	60	0	HM	23+50	HM	24+10			
27		Filomena Diaz Ximenes	65	90	HM	24+10	HM	24+75	HM	23+70	HM 24+60
28			90	0	HM	21+10	HM	22+00			
		Sebastiao Gusmao	25	0	HM	24+75	HM	25+00			
29		Joao Viegas Malela	0	40					HM	24+60	HM 25+00
		Total Distance	2400	2400							

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.2 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Ursula de Sousa	150	50	HM 0+00	HM 1+50	HM 1+50	HM 2+00	
2		Luis Soares	0	150	HM	HM	HM 0+00	HM 1+50	
3		Joao Alfredo de Sousa	150	0	HM 1+50	HM 3+00	HM	HM	
4		Antao de Sousa	180	0	HM 3+00	HM 3+80	HM	HM	
6		Alexandre de Sousa	0	100	HM	HM	HM 2+00	HM 3+00	
7		Maria Antonio de Sousa	0	150	HM	HM	HM 3+00	HM 4+50	
8		Francisco Alexandre de Sousa	0	175	HM	HM	HM 4+50	HM 6+25	
9		Rita Ximenes Gusmao	145	0	HM 4+80	HM 6+25			
10		Miguel Gusmao	0	125	HM	HM	HM 6+25	HM 7+50	
11		Joao Gusmao	100	0	HM 6+25	HM 7+25	HM	HM	
12		Francisco Alexandre Viegas	35	0	HM 7+25	HM 7+60	HM	HM	
13		Carlito da Costa	0	30	HM	HM	HM 7+50	HM 7+80	
14		Leki Mauk	90	0	HM 7+60	HM 8+50	HM	HM	
15		Vicente Gusmao Larus	0	70	HM	HM	HM 7+80	HM 8+50	
		Total Distance	850	850					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.3 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
14		Leki Mauk	90	0	HM 7+60	HM 9+60	HM	HM	
15		Vicente Gusmao Larus	0	90	HM	HM	HM 7+80	HM 9+60	
17		Joao Gusmao Chama	230		HM 9+60	HM 11+90	HM	HM	
18		Arsenio Viegas	0	230	HM	HM	HM 9+60	HM 11+90	
19		Simao Viegas	140	0	HM 11+90	HM 13+30			
20		Domingos Batista de Sousa	0	110	HM	HM	HM 11+90	HM 13+00	
21		Vicente Boak	0	30	HM	HM	HM 13+00	HM 13+30	
22		Manuel Viegas	0	20	HM	HM	HM 13+30	HM 13+50	
23		Simao Viegas Mahunu	20	0	HM 13+30	HM 13+50	HM	HM	
24		Joao Viegas	0	30	HM	HM	HM 13+50	HM 13+80	
25		Francisco Gusmao Metan	40 0 105	0 120 0	HM 13+50 HM HM 13+90	HM 13+90 HM HM 14+95	HM HM 13+80 HM	HM HM 15+00 HM	
26		Joao Gusmao Bohak	0	60	HM	HM	HM 15+00	HM 15+60	
27		Joao Gusmao Luan	25	0	HM 14+95	HM 15+20	HM	HM	
28		Jose Neru Gusmao	180	140	HM 15+20	HM 17+00	HM 15+60	HM 17+00	
29		Santana Ximenes	100	100	HM 17+00	HM 18+00	HM 17+00	HM 18+00	
30		Domingos Bento Viegas	125	125	HM 18+00	HM 19+25	HM 18+00	HM 19+25	
31		Antonio Gusmao Nauh	25	25	HM 19+25	HM 19+50	HM 19+25	HM 19+50	
32		Agapito Viegas	20	20	HM 19+50	HM 19+70	HM 19+50	HM 19+70	
33		Cristina Viegas	130	130	HM 19+70	HM 21+00	HM 19+70	HM 21+00	
34		Bernado Bere Ximenes	160	150	HM 21+00	HM 22+50	HM 21+00	HM 22+50	
		Total Distance	1390	1380					

* The number of the list of Land users' along Secondary No.3 is continuous of the list of Secondary No.2. It means this list includes all land users along Secondary No 3

LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.4 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Vicente dos Remedes de Sousa	0	30			HM 0+00	HM 0+30	
			170	110	HM 0+00	HM 1+80	HM 1+50	HM 2+60	
2		Basildo Ximenes	0	120			HM 0+30	HM 1+50	
			90	0	HM 5+00	HM 5+90			
3		Manuel Ximenes	80	0	HM 1+80	HM 2+60			
			10	0	HM 10+80	HM 11+10			
4		Luis Viegas	140	140	HM 2+60	HM 4+00	HM 2+60	HM 4+00	
5		Leki Esak	25	25	HM 4+00	HM 4+25	HM 4+00	HM 4+25	
6		Na'uk Bambang da Costa	75	75	HM 4+25	HM 5+00	HM 4+25	HM 5+00	
7		Tome Ximenes	0	80			HM 5+00	HM 5+80	
8		Gaspar da Costa	100	70	HM 5+90	HM 6+90	HM 5+80	HM 6+50	
9		Jacinta da Costa	0	160			HM 6+50	HM 8+10	
10		Tomas Ximenes	115	0	HM 6+90	HM 8+05	HM		
11		Jose Manuel da Costa	25	0	HM 8+05	HM 8+30			
12		Alexandre Lopes da Costa	0	30			HM 8+10	HM 8+40	
13		Antonio Ximenes	80	0	HM 8+30	HM 9+10			
14		Frederico Sanak	0	90			HM 8+40	HM 9+30	
15		Cosme Ximenes	40	0	HM 9+10	HM 9+50			
16		Seriaco da Costa	0	40			HM 9+30	HM 9+70	
17		Vicente Viegas	5	0	HM 9+50	HM 9+55			
18		Alberto Osak	0	110			HM 9+70	HM 10+80	
19		Joao Bosco Gusmao	155	0	HM 9+55	HM 11+10			

20		Luis Modo	0	40			HM	10+80	HM 11+20	
21		Paulo do rosario da Costa	40	0	HM	11+10	HM	11+50		
22		Francisco Loi	0	105			HM	11+20	HM 12+25	
23		Joao Bosco Gusmao	300	0	HM	11+50	HM	14+50	HM	HM
24		Vicente da Costa	0	200			HM	12+25	HM 14+25	
25		Mario Assuncao Gusmao	0	75			HM	14+25	HM 15+00	
26		Ina Eve	100	0	HM	14+50	HM	15+50		
27		Jose Hendrique de Sousa	0	58			HM	15+00	HM 15+58	
28		Tome Domingos de Sousa	8	0	HM	15+50	HM	15+58		
		Total Distance	1558	1558						

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.5 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Jose Hendrique de Sousa	170	0	HM 0+00	HM 1+70	HM	HM	
2		Tome Domingos de Sousa	0	130	HM	HM	HM 0+00	HM 1+30	
3		Manuel Ximenes Ta'an	90	0	HM 1+70	HM 2+60	HM	HM	
4		Francisco da Costa Metan	0	130	HM	HM	HM 1+30	HM 2+60	
5		Costorio de Sousa	210	0	HM 2+60	HM 4+70	HM	HM	
6		Joao Luca Soares	0	160	HM	HM	HM 2+60	HM 4+20	
7		Cosme Ximenes	0	60	HM	HM	HM 4+20	HM 4+80	
8		Maladis	90	0	HM 4+70	HM 5+60	HM	HM	
			23	0	HM 10+60	HM 10+83	HM	HM	
9		Ambesi Luruk	0	110	HM	HM	HM 4+80	HM 5+90	
10		Vital Liban	310	0	HM 5+60	HM 8+70	HM	HM	
11		Jose Capitao	0	80	HM	HM	HM 5+90	HM 6+70	
12		Jose Hendriques	0	30	HM	HM	HM 6+70	HM 7+00	
13		Jacinto Coli	0	300	HM	HM	HM 7+00	HM 10+00	
14		Sebastiao da Costa	190	0	HM 8+70	HM 10+60	HM	HM	
15		Joao Coli	0	60	HM	HM	HM 10+00	HM 10+60	
16		Vicente Pereira	0	23	HM	HM	HM 10+60	HM 10+83	
		Total Distance	1083	1083					

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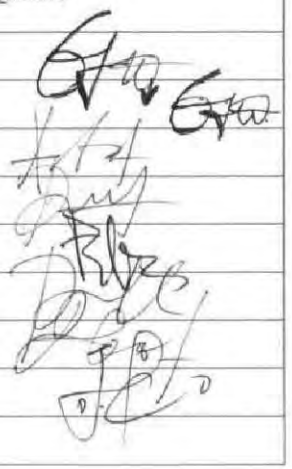
LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.6 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Jose Correia	0	140	HM	HM	HM 0+00	HM 1+40	
2		Policia Mano	240	110	HM 0+00	HM 2+40	HM 1+40	HM 2+50	
3		Domingos Soares	40	0	HM 2+40	HM 2+80	HM	HM	
4		Domingos Freitas	0	138	HM	HM	HM 2+50	HM 3+88	
5		Joao Sinu	108	0	HM 2+80	HM 3+88	HM	HM	
		Total Distance	388	388					

LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.7 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Hermegildo Maukai	65	370	HM 0+00	HM 0+65	HM 0+00	HM 3+70	
			80	0	HM 0+65	HM 1+45			
2		Alexandre Freitas	225	0	HM 1+45	HM 1+65	HM	HM	
3		Domingos Capitao	25	0	HM 3+70	HM 3+95	HM	HM	
4		Egidio Correia	0	70	HM	HM	HM 3+70	HM 4+40	
5		Elias Freitas	127	0	HM 3+95	HM 5+22	HM	HM	
6		Rui Carlos	0	30	HM	HM	HM 4+40	HM 4+70	
7		Jose Correia	0	52	HM	HM	HM 4+70	HM 5+22	
		Total Distance	522	522					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.8 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Vitor da Silva	80	0	HM 15+50	HM 16+30	HM	HM	
2		Feliciano Dehak		80	HM	HM	HM 15+50	HM 16+30	
3		Antonio Karlele	180	180	HM 16+30	HM 18+10	HM 16+30	HM 18+10	
4		Vitor Freitas	140	140	HM 18+10	HM 19+50	HM 18+10	HM 19+50	
5		Julio Correia	45	50	HM 19+50	HM 19+95	HM 19+50	HM 19+95	
6		Jacinto Coli	5	0	HM 19+95	HM 20+00	HM	HM	
7		Leonardo Metan	100	100	HM 20+00	HM 21+00	HM 19+95	HM 21+00	
		Total Distance	550	550					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.9 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Hermegildo Maukai	80	100	HM 0	HM 0+80	HM 0+00	HM 1+00	
2		Maria do Ceo	170	0	HM 0+80	HM 2+50	HM	HM	
3		Lamberto Freitas	0	110	HM	HM	HM 1+00	HM 2+10	
4		Egidio Correia	150	170	HM 2+50	HM 4+00	HM 2+10	HM 3+80	
5		Teotonio Freitas	40	135	HM 4+00	HM 4+40	HM 3+80	HM 5+15	
6		Domingos Ikun	210	135	HM 4+40	HM 6+50	HM 5+15	HM 6+50	
7		Maskai	248	70	HM 6+50	HM 8+25	HM 6+50	HM 7+20	
8		Martinho Freitas	0	155	HM	HM	HM 7+20	HM 8+75	
9		Joao Maduan	0	23	HM	HM	HM 8+75	HM 8+98	
10		Cosme Freitas	0	141	HM	HM	HM 8+98	HM 10+39	
11		Inakita Ximenes	82	0	HM 8+98	HM 9+80	HM	HM	
12		Julio Correia	59	0	HM 9+80	HM 10+39	HM	HM	
		Total Distance	1039	1039					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.10 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Government	453	453					—
2		Comes da sousa	110	60	HM 0+60	HM 1+70	HM 0+00	HM 0+60	
3		Afonso Soares	60	0	HM 0+00	HM 0+60	HM	HM	
4		Finomena Viegas	0	110	HM	HM	HM 0+60	HM 1+70	
		Total Distance	623	623					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.12 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Domingos Ramos Correia	175	0	HM 0+00	HM 1+75	HM	HM	
2		Rui Manuel Freitas	0	70	HM	HM	HM 0+00	HM 0+70	
3		Francisco Freitas	0	55	HM	HM	HM 0+70	HM 1+25	
4		Jose Fernando Correia	0	125	HM	HM	HM 1+25	HM 2+50	
5		Joao da Costa Freitas	200	145	HM 1+75	HM 3+75	HM 2+50	HM 3+95	
6		Siliberio Freitas	45	5	HM 3+75	HM 4+20	HM 3+95	HM 4+00	
7		Domingos Ramos Correia	0	20	HM	HM	HM 4+00	HM 4+20	
8		Inicencio	0	80	HM	HM	HM 4+20	HM 5+00	
9		Jose Freitas	280	0	HM 4+20	HM 7+00	HM	HM	
10		Domingos Guterres	0	80	HM	HM	HM 5+00	HM 5+80	
11		Marcal Faria	0	30	HM	HM	HM 5+80	HM 6+10	
12		Marcelino Bosi Oro	0	70	HM	HM	HM 6+10	HM 6+80	
13		Jose Fernando Correia	0	20	HM	HM	HM 6+80	HM 7+00	
14		Joao Gusmao	0	120	HM	HM	HM 7+00	HM 8+20	
15		Francisco Alexandre Viegas	100	0	HM 7+00	HM 8+00	HM	HM	
16		Carlito da Costa	220	0	HM 8+00	HM 10+20	HM	HM	
17		Carlito da Costa	0	230	HM	HM	HM 8+20	HM 10+50	
18		Rui Manuel Freitas	100	0	HM 10+20	HM 11+20	HM	HM	
19		Inicencio	60	0	HM 11+20	HM 11+80	HM	HM	
20		Siliberio Freitas	20	0	HM 11+80	HM 12+00	HM	HM	

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21		Vitor Viegas	50	0	HM 12+00	HM 12+50	HM	HM	
22		Joao Kai Gusmao	10	0	HM 12+50	HM 12+60	HM	HM	
23		Pedro Gusmao	40	0	HM 12+60	HM 13+00	HM	HM	
24		Andre Gusmao	0	40	HM	HM	HM 10+50	HM 10+90	
25		Jastin da Costa	30	0	HM 13+00	HM 13+30	HM	HM	
26		Filomena Diaz Ximenes	0	10	HM	HM	HM 10+90	HM 11+00	
27		Sebastiao Gusmao	0	100	HM	HM	HM 11+00	HM 12+00	
28		Francisco Freitas	0	120	HM	HM	HM 12+00	HM 13+20	
29		Tomas Masai	0	10	HM	HM	HM 13+20	HM 13+10	
		Total Distance	1330	1330					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.13 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Leopoldo Freitas	0	260			HM 0+00	HM 2+60	
2		Felisarda Viegas	200	0	HM 0+00	HM 2+00			
3		Joao da Costa Freitas	50	0	HM 2+00	HM 2+50			
4		Jose Fernando Correia	70	0	HM 2+50	HM 3+20			
5		Gastao Soares	0	120			HM 2+60	HM 3+80	
6		Maudara Correia	996	936	HM 3+20	HM 13+16	HM 3+80	HM 13+16	
		Total Distance	1316	1316					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.14 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Beto Kai	160	125	HM 0+50	HM 1+20	HM 0+00	HM 0+125	
2		Vitor da Silva	50	0	HM 0+00	HM 0+50			
3		Marcelino Bosi Oro	0	225			HM 1+25	HM 3+50	
4		Jose Uma Kalen	140	0	HM 2+10	HM 3+50			
5		Inicencio	95	0	HM 3+50	HM 4+45			
6		Justino	0	95			HM 3+50	HM 4+45	
7		Andre Gusmao	35	0	HM 4+45	HM 4+80			
8		Constancio Freitas	0	75			HM 4+45	HM 5+20	
9		Agusto (Infermeiro)	295	0	HM 4+80	HM 7+75			
10		Sancho	0	10			HM 5+20	HM 5+30	
11		Inacio	0	90			HM 5+30	HM 6+20	
12		Jose Freitas	0	110			HM 6+20	HM 7+30	
13		Joao de Fatima Seran	0	70			HM 7+30	HM 8+00	
14		Guilherme Soares	85	0	HM 7+75	HM 8+60			
15		Domingos Guterres	0	188			HM 8+00	HM 9+88	
16		Daniel Soares	128	0	HM 8+60	HM 9+88			
		Total Distance	988	988					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.15 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Leopoldo Freitas	325	90	HM 0+00	HM 3+25	HM 0+00	HM 0+90	
2		Manuel Diogo	0	315			HM 0+90	HM 4+05	
3		Tomas Masai	231	0	HM 3+25	HM 5+56			
4		Tolomeu	0	135			HM 4+05	HM 5+40	
5		Jose da Silva	0	60			HM 5+40	HM 6+00	
6		Constancio Freitas	94	0	HM 5+56	HM 6+50			
7		Fernando da Silva	0	50			HM 6+00	HM 6+50	
		Total Distance	650	650					

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LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.16 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Domingos Leki Freitas	0	200			HM 0+00	HM 2+00	
2		Alberto da Silva	200	50	HM 0+00	HM 2+00	HM 2+00	HM 2+50	
3		Domingos Leki Freitas	50	160	HM 2+00	HM 2+50	HM 2+50	HM 4+10	
4		Ricardo da Silva	45	0	HM 2+50	HM 9+95			
5		Filomeno Freitas	160	0	HM 9+95	HM 4+55			
6		Estevo Freitas	95	140	HM 4+55	HM 5+50	HM 4+10	HM 5+50	
7		Alberto da Silva	25	0	HM 5+50	HM 5+75			
8		Joana Freitas	25	0	HM 5+75	HM 6+00			
9		Tomas Freitas	55	50	HM 6+00	HM 6+55	HM 5+50	HM 6+00	
10		Filomeno Freitas	0	55			HM 6+00	HM 6+55	
11		Bartolomeu da Silva	10	10	HM 6+55	HM 6+65	HM 6+55	HM 6+65	
		Total Distance	665	665					

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3. Drainage Canals

Result of Survey for Land Acquisition

A. LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE DRAIN CANAL NO.1 CONSTRUCTION

No	Date	Name	Left side Distance(m)	Right side Distance (m)	Left side survey point		Right side survey point		Land use	Signature
1		Joanico Paicheco	200	320	0+00	2+00	0+00	3+20	Farm Land	
2		Agusto Freitas	120	0	2+00	3+20			Farm Land	
3		Constancio Freitas	50	0	3+20	3+70			Farm Land	
4		Lamberto Freitas	0	150			3+20	4+70	Farm Land	
5		Martinho Freitas	90	0	3+70	4+60			Farm Land	
6		Simao Soares	0	170			4+70	6+40	Farm Land	
7		Church Parish	180	0	4+60	6+40			Farm Land	
8		Amino Soares	0	70			6+40	7+10	Farm Land	
9		Antonio Baha Batu	170	0	6+40	8+10			Farm Land	
10		Feliciano Dehak	230	0	8+10	10+40			Farm Land	
11		Antonio Karlele	0	500			7+10	12+10	Farm Land	
12		Vitor	220	0	10+40	12+60			Farm Land	
13		Julio Correia	40	0	12+60	13+00			Farm Land	
14		Jacinto Coli	130	0	13+00	14+30			Farm Land	
15		Leonardo Metan	20	240	14+30	14+50	12+10	14+50	Farm Land	
16		Gaspar Makasa	662	662	14+50	21+12	14+50	21+12	Potential land for agriculture	
17		Carlos Fraitas (Suco Leader)	239	239	21+12	23+51	21+12	23+51	Swamp area (Natural)	
		Total Distance	2,351	2,351						

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Result of Survey for Land Acquisition

B. LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE DRAIN CANAL NO.2 CONSTRUCTION

No	Date	Name	Left side Distance(m)	Right side Distance (m)	Left side survey point		Right side survey point		Land use	Signature
1		Maudara Correia		30			0+00	0+30	Farm Land	
2		Elias Soares	882	852	0+00	8+82	0+30	8+82	Farm Land	
3		Carlos Fraitas (Suco Leader)	763	763	8+82	16+45	8+82	16+45	Swamp area (Natural)	
		Total Distance	1645	1645						

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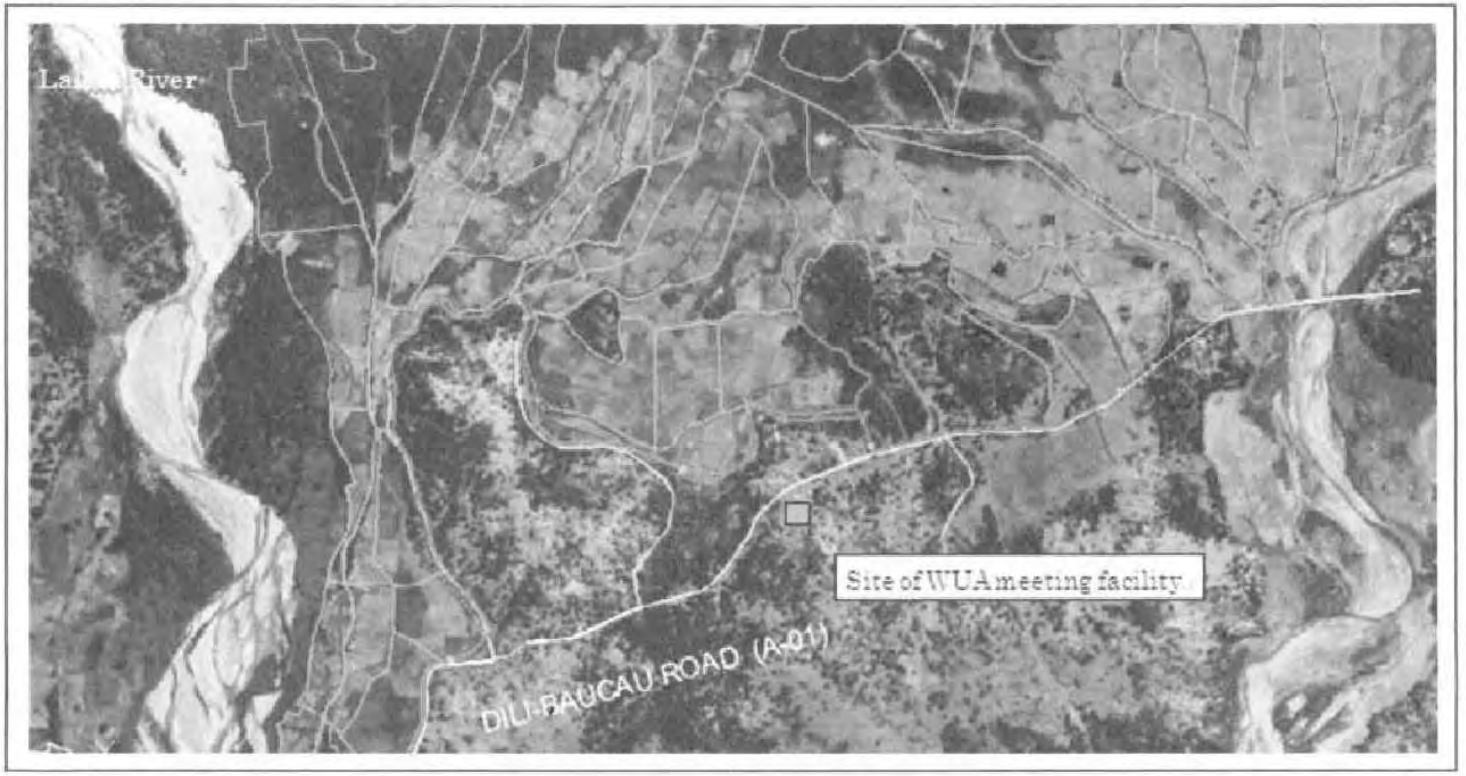
4. WUA Meeting Facilities



No	Date	Name	Land use	Signature
1		Carlos Freitas (Suco Leader)	Waste Land (0.5ha)	

5. Felling Trees

Survey Result of kind and number of tree for Felling Trees

1. Left Side of Proposed Weir

(Unit: Number of tree)

Date	Area(m2)	Name of Land User	Kind and number of tree				Signature
			Ai kakeu	Ai haneki	Kulu	Herotak	
	15,000	Antonio Viegas Huno	30	60	15	30	

2. Right Side of Proposed Weir

(Unit: Number of tree)

Date	Area (m2)	Name of Land User	Kind and number of tree				Signature
			Ai kakeu	Ai haneki	Kulu	Herotak)	
	34,500	Domingos de Araujo	690	1380	345	690	

3. Proposed River Protection Dike on the Right Bank

(Unit: Number of tree)

Date	Area (m2)	Name of Land User	Kind and number of tree				Signature
			Ai kakeu	Ai haneki	Kulu	Herotak	
	3,75	Domingos de Araujo	76	152	38	76	
	11,00	Kaisai	161	323	80	161	
Total	11,875		237	475	118	237	

4. Proposed River Protection Dike on the Left Bank

(Unit: Number of tree)

Date	Area (m2)	Name of Land User	Kind and number of tree				Signature
			Ai kakeu	Ai haneki	Kulu	Herotak	
	2,315	Miguel do Rosario Soares	46	92	23	46	

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5. Period from Beginning Point (BP) to "1+090"

(Unit: Number of tree)

Date	Area(m2)	Name of Land User	Kind and number of tree				Signature
			Ai kakeu	Ai haneki	Kulu	Herotak	
	3,420	Domingos de Araujo	68	136	34	68	
	4,500	Joao Gusumao	90	180	45	90	
	2,250	Tomas Amaral Ximenes	44	88	22	44	
	3,300	Agustinho Gusumao	66	132	33	66	
	Total		268	536	134	268	

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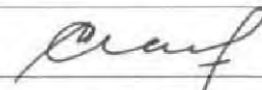
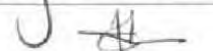
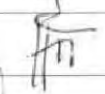
LIST OF LANDUSERS NEEDING LAND ACQUISITION DUE TO THE SECONDARY CANAL NO.11 CONSTRUCTION

No	Date	Name	Left side Distance (m)	Right side Distance (m)	Left side survey point		Left side survey point		Signature
1		Cosme Freitas	20	10	HM 0.00	HM 0.20	HM 0.00	HM 0.10	
2		Januario Freitas		15			HM 0.10	HM 0.25	
3		João Agustinho Freitas		10			HM 0.25	HM 0.35	
4		João Freitas		15			HM 0.35	HM 0.50	
5		Felisarda Viegas Freitas	30		HM 0.20	HM 0.50			
6		Agusto Freitas	25		HM 0.50	HM 0.75			
7		Paulino Soares		25			HM 0.50	HM 0.75	
8		Ana Rosalia Soares		25			HM 0.75	HM 100	
9		Pedro Freitas	25		HM 0.75	HM 100			
		Total distance	100	100					

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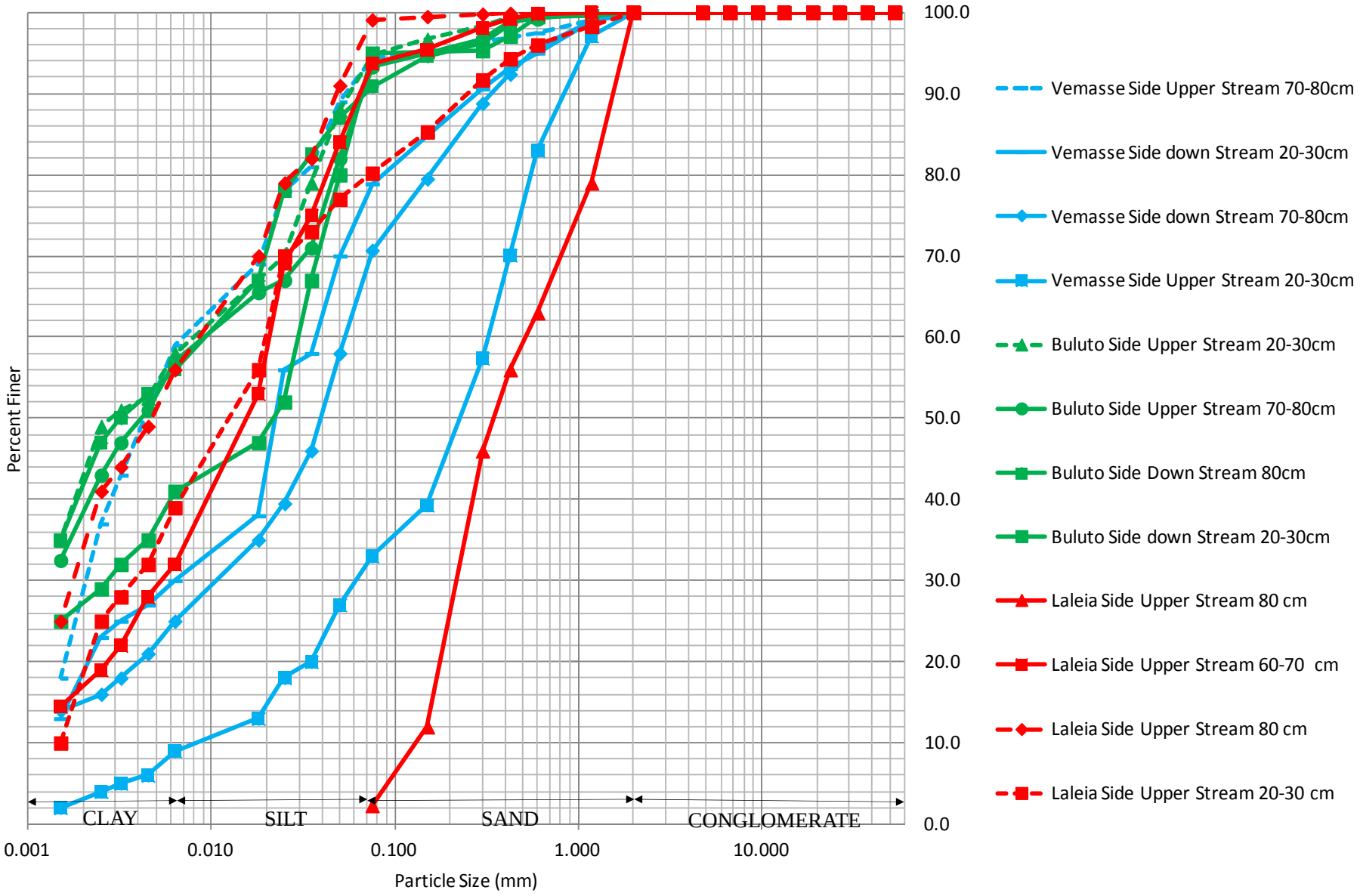
Appendices 7　Geotechnical Investigation

(1)　Test Pit among the Proposed Irrigable Area

	礫	砂							シルト					粘土			
	>4.75	2.00	1.18	0.600	0.425	0.300	0.150	0.075	0.050	0.035	0.0250	0.0180	0.0063	0.0045	0.0032	0.0025	0.0015
1	100.0	100.0	98.9	95.6	92.4	88.8	79.5	70.7	58.0	46.0	39.5	35.0	25.0	21.0	18.0	16.0	14.0
2	100.0	100.0	99.6	99.5	97.1	95.3	95.2	95.0	80.0	67.0	52.0	47.0	41.0	35.0	32.0	29.0	25.0
3	100.0	100.0	99.9	99.7	99.4	98.3	96.7	94.7	88.0	79.0	70.0	67.0	58.0	52.5	51.0	49.0	35.0
4	100.0	100.0	100.0	99.8	99.2	98.1	95.4	93.7	84.0	75.0	69.0	53.0	32.0	28.0	22.0	19.0	14.5
5	100.0	100.0	97.1	83.0	70.1	57.4	39.3	33.0	27.0	20.0	18.0	13.0	9.0	6.0	5.0	4.0	2.0
6	100.0	100.0	99.9	99.2	98.8	96.7	95.0	93.3	82.0	71.0	67.0	65.5	57.0	51.0	47.0	43.0	32.5
7	100.0	100.0	99.9	99.7	98.6	96.2	94.6	90.9	87.0	82.5	78.0	67.0	56.0	53.0	50.0	47.0	35.0
8	100.0	100.0	99.0	97.5	96.9	96.3	95.2	94.4	89.0	81.0	78.0	69.0	59.0	51.0	43.0	37.0	18.0
9	100.0	100.0	98.8	95.0	93.1	90.6	84.8	78.9	70.0	58.0	56.0	38.0	30.0	27.0	25.0	23.0	13.0
10	100.0	100.0	99.9	99.9	99.9	99.8	99.5	99.1	91.0	82.0	79.0	70.0	56.0	49.0	44.0	41.0	25.0
11	100.0	100.0	98.3	96.0	94.3	91.7	85.3	80.2	77.0	73.0	70.0	56.0	39.0	32.0	28.0	25.0	10.0
12	100.0	100.0	79.0	63.0	56.0	46.0	12.0	2.3									


Percent Finer
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
CLAY
SILT
SAND
CONGLOMERATE
0.001
0.010
0.100
1.000
10.000
Particle Size (mm)
Vemasse Side Upper Stream 70-80cm
Vemasse Side down Stream 20-30cm
Vemasse Side down Stream 70-80cm
Vemasse Side Upper Stream 20-30cm
Buluto Side Upper Stream 20-30cm
Buluto Side Upper Stream 70-80cm
Buluto Side Down Stream 80cm
Buluto Side down Stream 20-30cm
Laleia Side Upper Stream 80 cm
Laleia Side Upper Stream 60-70 cm
Laleia Side Upper Stream 80 cm
Laleia Side Upper Stream 20-30 cm

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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT: VEMASSE RIVER	LOCATION: Vemassi		DATE: 11-Dec-12
COORDINATES: Soil (20-30cm) East down No.1	SAMPLE SPECIMEN NUMBER: down No.1 Soil (20-30cm) East		CLASSIFICATION: -
DISH NUMBER: D1	CYLINDER ID.: D1		HYDROMETER TYPE (151H/152H): 152H
DISPERSING AGENT USED: sodium hexametaphosphate			QUANTITY: 125mL at 40g/L solution
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000		SP. GR. OF SOLIDS, Gs = 2.73

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R'm)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	13:55	-	-	-	-	-	-	-	-
1	13:56	32	24	20	0.01344	12.4	0.047	47.92	47.5
2	13:57	28	20	20	0.01344	13.0	0.0343	39.6	39.6
5	14:00	26	18	20	0.01344	13.3	0.0220	35.64	35.6
15	14:10	24	16	20	0.01344	13.7	0.0128	31.68	31.7
30	14:25	22	14	20	0.01344	14.0	0.0092	27.72	27.7
60	14:55	20	12	20	0.01344	14.3	0.0066	23.76	23.8
90	15:15	18	11	20	0.01344	14.5	0.0057	21.78	21.8
240	18:08	16	9	20	0.01344	15.0	0.0033	15.84	15.8
1440	13:55	13	6	20	0.01344	15.0	0.0014	9.9	9.9

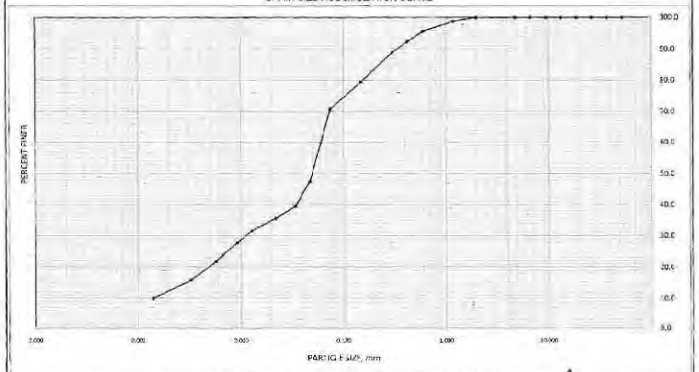
GRADATION:

SIEVE SIZE ASTM	SIEVE SIZE MM	Percent Passing
2"	50.00	100.0
1-1/2"	37.50	100.0
1"	25.00	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	98.9
#30	0.600	95.6
#40	0.425	92.4
#50	0.300	88.8
#100	0.150	79.5
#200	0.075	70.7

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	35
0.002mm	12.5
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	7.6
Fine Sand	425-75µm	21.6
Silt	75-2µm	68.2
Clay	<2µm	12.5
Total Percent Silt & Clay (% Passing 75micron sieve)		70.7
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT: VEMASSE RIVER	LOCATION: Vemasse		DATE: 09-Dec-12
COORDINATES: (20-30cm) Middle Down No.04	SAMPLE SPECIMEN NUMBER: Middle Down No.04 Soil (20-30cm)		CLASSIFICATION: -
DISH NUMBER: D2	CYLINDER ID.: C11		HYDROMETER TYPE (151H/152H): 152H
DISPERSING AGENT USED: sodium hexametaphosphate			QUANTITY: 125mL at 40g/L solution
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000		SP. GR. OF SOLIDS, Gs = 2.67

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R'm)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	9:57	-	-	-	-	-	-	-	
1	9:58	35	27	20	0.01431	11.9	0.049	65.16	58.2
2	9:59	33	25	20	0.01431	12.2	0.0353	62	52.0
5	10:02	31	23	20	0.01431	12.5	0.0225	47.84	47.8
15	10:12	30	22	20	0.01431	12.7	0.0132	45.76	45.8
30	10:27	29	21	20	0.01431	12.8	0.0094	43.68	43.7
60	10:57	27	19	20	0.01431	13.0	0.0067	39.52	39.6
90	11:17	26	17	20	0.01431	13.5	0.0055	35.36	35.4
250	14:14	22	14	20	0.01431	14.0	0.0034	29.12	29.1
1440	9:57	20	12	20	0.01431	14.3	0.0014	24.96	25.0

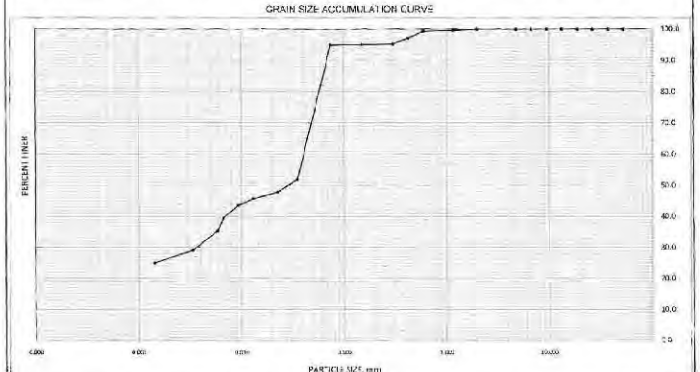
GRADATION:

SIEVE SIZE ASTM	SIEVE SIZE MM	Percent Passing
2"	50.00	100.0
1-1/2"	37.50	100.0
1"	25.00	100.0
3/4"	19.00	100.0
1/2"	12.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	99.6
#30	0.600	99.3
#40	0.425	97.1
#50	0.300	95.3
#100	0.150	95.2
#200	0.075	95.0

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	47
0.002mm	26.5
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	2.9
Fine Sand	425-75um	2.1
Silt	75-2µm	68.6
Clay	<2um	26.5
Total Percent Silt & Clay (% Passing 75micron sieve)		95.0
Colloids	<1um	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT : Vemassa River	LOCATION: Vemassa		DATE: 11-Dec-12
COORDINATES : (20-30cm) Middle Upper No.03	SAMPLE/ SPECIMEN NUMBER : Middle Upper No.03	CLASSIFICATION :	
DISH NUMBER : 03	CYLINDER ID. : C9	HYDROMETER TYPE (151H/152H):	152H
DISPERSING AGENT USED : sodium hexametaphosphate		QUANTITY: 125mL at 40g/L solution	
COMPOSITE CORRECTION: see calibration	DECIMAL FINES: 1.000	SP.GR. OF SOLIDS, Gs =	2.62

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R1)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	9:36	-	-	-	-	-	-	-	-
1	9:37	42	34	20	0.01385	10.7	0.045	68.66	68.7
2	9:40	39	31	20	0.01385	11.2	0.0328	62.62	62.6
5	9:43	38	30	20	0.01385	11.4	0.0219	60.6	60.6
15	9:53	37	29	20	0.01385	11.5	0.0122	58.56	58.6
30	10:08	36	28	20	0.01385	11.7	0.0087	56.56	56.6
60	10:38	34	26	20	0.01385	12.0	0.0062	52.52	52.5
90	10:58	32	24	20	0.01385	12.4	0.0054	48.48	48.5
250	13:55	29	21	20	0.01385	12.8	0.0033	42.42	42.4
1440	9:38	25	17	20	0.01385	13.5	0.0013	34.34	34.3

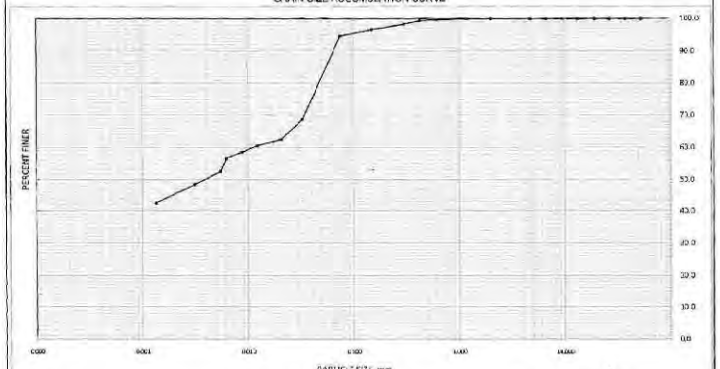
GRADATION:

SIEVE SIZE ASTM	MM	Percent Passing
2"	63.00	100.0
1-1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	99.9
#30	0.600	99.7
#50	0.425	99.4
#60	0.300	98.3
#100	0.150	96.7
#200	0.075	94.7

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	66
0.002mm	35
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	0.6
Fine Sand	425-75µm	4.7
Silt	75-2µm	56.7
Clay	<2µm	38.0
Total Percent Silt & Clay (% Passing 75micron sieve)		94.7
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT : Vemassa River	LOCATION: Vemassa		DATE: 10-Dec-12
COORDINATES : West Upper (60-70cm)	SAMPLE/SPECIMEN NUMBER : West Upper (60-70cm)	CLASSIFICATION :	
DISH NUMBER : 04	CYLINDER ID. : C13	HYDROMETER TYPE (151H/152H):	152H
DISPERSING AGENT USED : sodium hexametaphosphate		QUANTITY: 125ml at 40g/L solution	
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs =	2.70

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R1)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	13:10	-	-	-	-	-	-	-	-
1	13:11	45	37	20	0.01385	10.2	0.044	73.26	73.3
2	13:12	42	34	20	0.01385	10.7	0.0316	67.32	67.3
5	13:15	39	31	20	0.01385	11.2	0.0204	61.38	61.4
15	13:25	33	22	20	0.01385	12.1	0.0126	43.56	43.6
30	13:40	25	18	20	0.01385	13.3	0.0091	35.64	35.6
60	14:10	23	16	20	0.01385	13.6	0.0066	29.7	29.7
90	14:40	22	14	20	0.01385	14.0	0.0057	27.72	27.7
250	14:37	17	9	20	0.01385	14.8	0.0033	17.82	17.8
1440	10:30	16	7	20	0.01385	15.1	0.0014	13.86	13.9

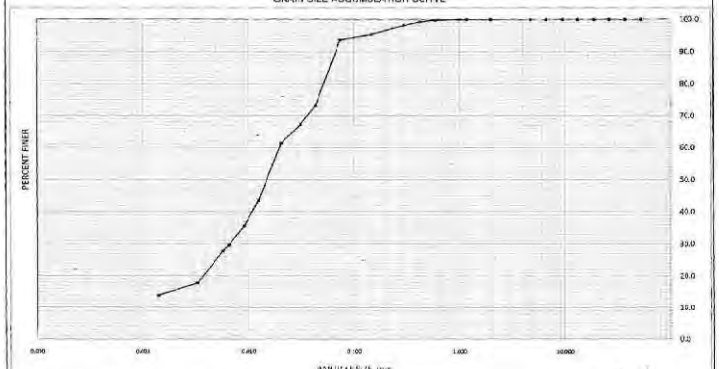
GRADATION:

SIEVE SIZE ASTM	MM	Percent Passing
2"	63.00	100.0
1-1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	100.0
#30	0.600	99.8
#40	0.425	99.2
#60	0.300	98.1
#100	0.150	95.4
#200	0.075	93.7

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	54.3
0.002mm	15.3
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425um	0.8
Fine Sand	425-75um	5.6
Silt	75-2um	78.4
Clay	<2um	15.3
Total Percent Silt & Clay (% Passing 75micron sieve)		93.7
Colloids	<1um	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT : Vemasse River	LOCATION: Vemasse		DATE: 18-Dec-12
COORDINATES : (70-80cm) East down No. 1	SAMPLE/ SPECIMEN NUMBER : East down No. 1	CLASSIFICATION :	
DISH NUMBER : D5	CYLINDER ID. : C10	HYDROMETER TYPE (151H/152H):	152H
DISPERSING AGENT USED : sodium hexametaphosphate		QUANTITY: 125ml, at 40g/L solution	
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs =	2.54

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (Rt)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	9:40	-	-	-	-	-	-	-	-
1	9:41	12	11	20	0.01386	14.5	0.0558	22.22	22.2
2	9:42	11	5	20	0.01386	14.8	0.0377	18.18	18.2
5	9:45	15	7	20	0.01386	15.1	0.0241	14.14	14.1
15	9:55	14	6	20	0.01386	15.3	0.0140	12.12	12.1
30	10:10	13	5	20	0.01386	15.6	0.0100	10.1	10.1
60	10:40	12	4	20	0.01386	15.8	0.0071	8.08	8.1
80	11:20	11	3	20	0.01386	15.8	0.0062	6.06	6.1
250	15:50	10	2	20	0.01386	16.0	0.0035	4.04	4.0
1440	9:40	9	1	20	0.01386	16.1	0.0015	2.02	2.0

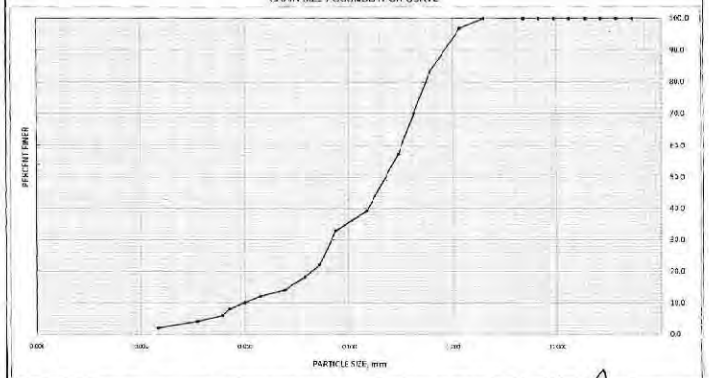
GRADATION:

SIEVE SIZE ASTM	SIEVE SIZE MM	Percent Passing
2"	53.03	100.0
1 1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	97.1
#30	0.600	83.0
#40	0.425	70.1
#50	0.300	57.4
#100	0.150	39.3
#200	0.075	33.0

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	0
0.002mm	0
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	29.9
Fine Sand	425-75µm	37.2
Silt	75-2µm	33.0
Clay	<2µm	0.0
Total Percent Silt & Clay (% Passing 75micron sieve)		33.0
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT : Vemasse River	LOCATION: Vemasse		DATE: 11-Dec-12
COORDINATES : (70-80cm) Middle Upper No. 03	SAMPLE/ SPECIMEN NUMBER : Soil (70-80cm) Middle Upper No.	CLASSIFICATION :	
DISH NUMBER : D6	CYLINDER ID. : C6	HYDROMETER TYPE (151H/152H):	152H
DISPERSING AGENT USED : sodium hexametaphosphate		QUANTITY: 125mL, at 40g/L solution	
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs =	2.57

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (Rt)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	14:20	-	-	-	-	-	-	-	-
1	14:21	43	38	20	0.01386	10.6	0.045	70.70	70.7
2	14:22	41	33	20	0.01386	10.9	0.0325	66.66	66.7
5	14:25	39	31	20	0.01386	11.2	0.020E	62.62	62.6
15	14:35	38	30	20	0.01386	11.4	0.0121	60.60	60.6
30	14:50	37	29	20	0.01386	11.5	0.0086	58.58	58.6
60	15:20	35	27	20	0.01386	11.8	0.0062	54.54	54.5
80	15:40	33	25	20	0.01386	12.0	0.0054	50.50	50.5
250	18:37	29	20	20	0.01386	13.0	0.0032	40.40	40.4
1440	14:20	24	16	20	0.01386	13.7	0.0014	32.32	32.3

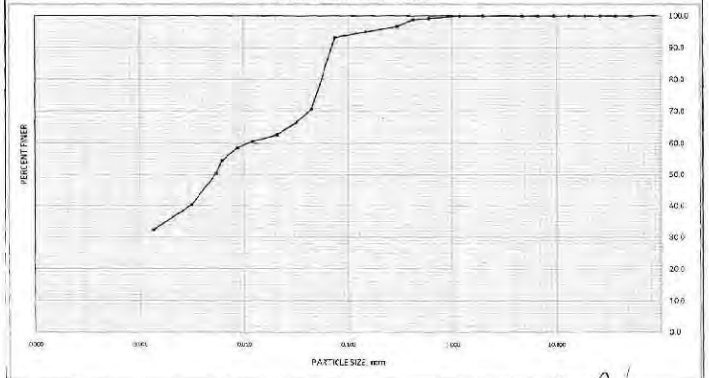
GRADATION:

SIEVE SIZE ASTM	SIEVE SIZE MM	Percent Passing
2"	53.03	100.0
1 1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	99.9
#30	0.600	99.2
#40	0.425	98.8
#50	0.300	96.7
#100	0.150	95.0
#200	0.075	93.3

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	0.1
0.002mm	0.1
0.001mm	0.1

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	1.2
Fine Sand	425-75µm	5.6
Silt	75-2µm	93.1
Clay	<2µm	0.1
Total Percent Silt & Clay (% Passing 75micron sieve)		93.3
Colloids	<1µm	0.1

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT : Vemasse River	LOCATION: Vemasse		DATE: 11-Dec-11
COORDINATES : (80 cm) Middle Down No.4	SAMPLE/ SPECIMEN NUMBER : Soil (80 cm) Middle Down No.4	CLASSIFICATION :	
DISH NUMBER : D7	CYLINDER ID. : C9	HYDROMETER TYPE (151H/152H):	152H
DISPERSING AGENT USED : sodium hexametaphosphate		QUANTITY:	125mL of 40g/L solution
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs =	2.51

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R1)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	14:28	-	-	-	-	-	-	-	-
1	14:29	48	40	20	0.01431	9.7	0.045	82.4	82.4
2	14:30	40	37	20	0.01431	10.2	0.0324	76.22	76.2
5	14:33	41	33	20	0.01431	10.9	0.0211	67.98	68.0
15	14:43	38	31	20	0.01431	11.2	0.0124	63.86	63.9
30	14:58	39	28	20	0.01431	11.7	0.0089	57.68	57.7
60	15:28	35	27	20	0.01431	11.9	0.0064	55.62	55.6
80	15:48	34	26	20	0.01431	12.0	0.0055	53.56	53.6
250	18:45	30	22	20	0.01431	12.7	0.0032	45.32	45.3
1440	14:28	25	17	20	0.01431	13.5	0.0014	35.02	35.0

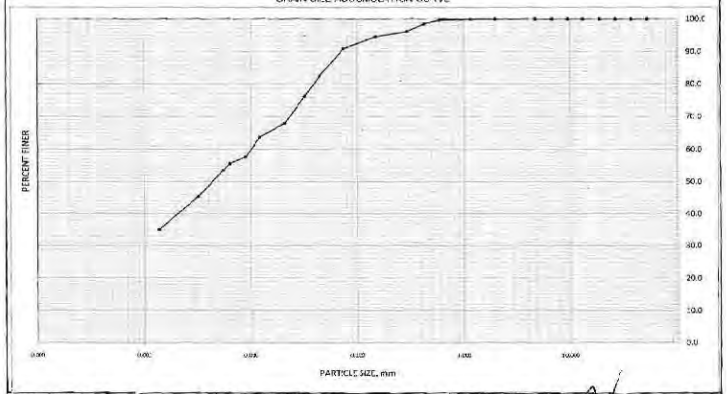
GRADATION:

SIEVE SIZE ASTM	SIEVE SIZE MM	Percent Passing
2"	53.00	100.0
1-1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	99.9
#30	0.600	99.7
#40	0.425	98.5
#50	0.300	96.2
#100	0.150	94.6
#200	0.075	90.9

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	67
0.002mm	39.5
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	1.4
Fine Sand	425-75µm	7.7
Silt	75-2µm	51.4
Clay	<2µm	39.5
Total Percent Silt & Clay (% Passing 75micron sieve)		90.9
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT : Vemasse River	LOCATION: Vemassi		DATE: 18-Dec-12
COORDINATES : (V.E.UP 30cm)No.01	SAMPLE/ SPECIMEN NUMBER : Soil(V.E UP 30cm)No.01	CLASSIFICATION :	
DISH NUMBER : D8	CYLINDER ID. : C15	HYDROMETER TYPE (151H/152H):	152H
DISPERSING AGENT USED : sodium hexametaphosphate		QUANTITY:	125mL of 40g/L solution
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs =	2.54

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R1)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	9:04	-	-	-	-	-	-	-	-
1	9:05	48	40	20	0.01386	9.7	0.043	80.80	80.8
2	9:06	46	39	20	0.01386	10.1	0.0311	78.78	78.8
5	9:09	43	35	20	0.01386	10.6	0.0201	70.70	70.7
15	9:19	43	32	20	0.01386	11.0	0.0118	64.64	64.6
30	9:34	39	31	20	0.01386	11.2	0.0085	62.62	62.6
60	10:04	38	29	20	0.01386	11.7	0.0061	56.56	56.6
80	10:24	33	25	20	0.01386	12.2	0.0054	50.50	50.5
250	14:14	26	17	20	0.01386	13.5	0.0032	34.34	34.3
1440	9:04	17	9	20	0.01386	14.8	0.0014	18.18	18.2

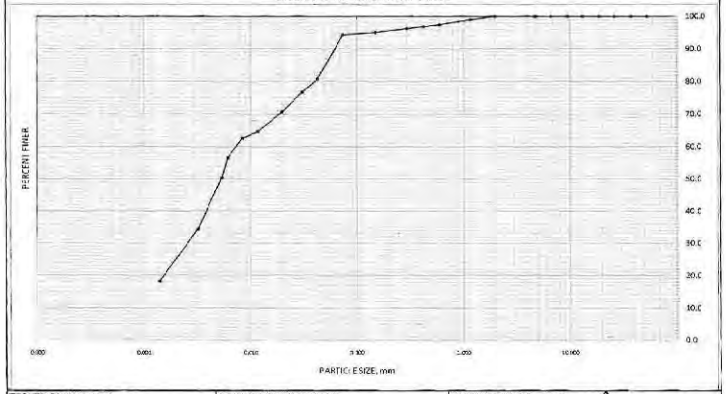
GRADATION:

SIEVE SIZE ASTM	SIEVE SIZE MM	Percent Passing
2"	53.00	100.0
1-1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	99.8
#30	0.600	97.5
#40	0.425	96.9
#50	0.300	96.1
#100	0.150	95.2
#200	0.075	94.4

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	70.6
0.002mm	35
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	3.1
Fine Sand	425-75µm	2.5
Silt	75-2µm	69.4
Clay	<2µm	25.0
Total Percent Silt & Clay (% Passing 75micron sieve)		94.4
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT: Vemasse River	LOCATION: Vemasse		DATE: 19-Dec-12
COORDINATES: (30cm) V.E.UP No.02	SAMPLE/ SPECIMEN NUMBER: Soil (30cm) V.E.UP No.02	CLASSIFICATION:	
DISH NUMBER: D9	CYLINDER ID.: C22	HYDROMETER TYPE (151H/152H): 152H	
DISPERSING AGENT USED: sodium hexametaphosphate		QUANTITY: 125mL at 40g/L solution	
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs = 2.64	

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R1)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	9:50	-	-	-	-	-			
1	9:51	39	30	20	0.01307	11.4	0.044	58.2	58.2
2	9:52	36	28	20	0.01307	11.7	0.0316	54.32	54.3
5	9:55	29	21	20	0.01307	12.8	0.0216	40.74	40.7
15	10:05	25	17	20	0.01307	13.6	0.0124	32.98	33.0
30	10:20	24	16	20	0.01307	13.7	0.0088	31.04	31.0
60	10:50	23	15	20	0.01307	13.8	0.0063	29.1	29.1
80	11:10	22	14	20	0.01307	14.0	0.0055	27.16	27.2
250	14:00	19	11	20	0.01307	14.5	0.0031	21.34	21.3
1440	9:50	14	6	20	0.01307	15.3	0.0013	11.64	11.6

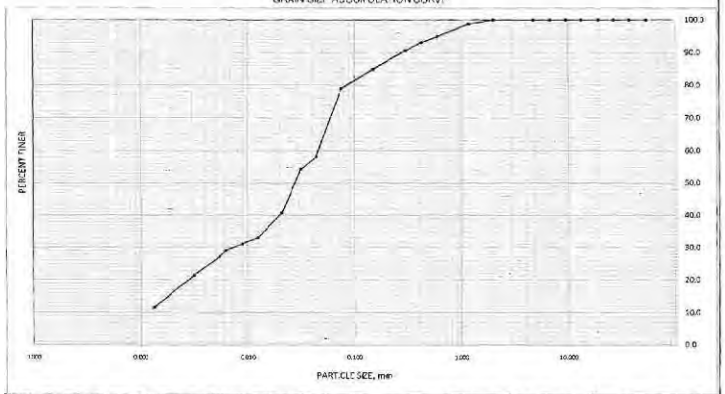
GRADATION:

SIEVE SIZE ASTM	MM	Percent Passing
2"	53.00	100.0
1-1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	98.8
#30	0.600	95.6
#40	0.425	93.1
#50	0.300	90.6
#100	0.150	84.8
#200	0.075	78.9

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	40
0.002mm	16
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	5.9
Fine Sand	425-75µm	14.2
Silt	75-2µm	62.9
Clay	<2µm	16.0
Total Percent Silt & Clay (% Passing 75micron sieve)		78.9
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT: Vemasse River	LOCATION: Vemasse		DATE: 19-Dec-12
COORDINATES: (West or Down Stream) No. 01	SAMPLE/ SPECIMEN NUMBER: Soil (West or Down Stream) No. 01	CLASSIFICATION:	
DISH NUMBER: D10	CYLINDER ID.: C18	HYDROMETER TYPE (151H/152H): 152H	
DISPERSING AGENT USED: sodium hexametaphosphate		QUANTITY: 125mL at 40g/L solution	
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs = 2.49	

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R1)	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	8:30	-	-	-	-	-			
1	8:31	48	40	20	0.01431	9.7	0.045	82.4	82.4
3	8:33	46	38	20	0.01431	10.0	0.0321	78.28	78.3
9	8:39	43	35	20	0.01431	10.5	0.0208	72.1	72.1
15	8:45	39	31	20	0.01431	11.2	0.0124	63.86	63.9
30	9:00	37	29	20	0.01431	11.5	0.0089	59.74	59.7
60	9:30	34	26	20	0.01431	12.0	0.0064	53.58	53.6
80	9:50	32	24	20	0.01431	12.4	0.0058	49.44	49.4
230	12:42	31	19	20	0.01431	13.2	0.0033	39.14	39.1
1440	8:30	20	12	20	0.01431	14.3	0.0014	24.72	24.7

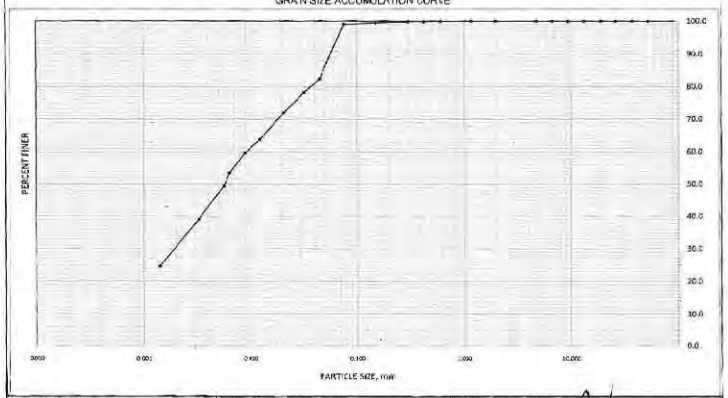
GRADATION:

SIEVE SIZE ASTM	MM	Percent Passing
2"	53.00	100.0
1-1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.73	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	99.9
#30	0.600	99.9
#40	0.475	99.9
#50	0.300	99.8
#100	0.150	99.5
#200	0.075	99.2

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	71.2
0.002mm	31
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	0.1
Fine Sand	425-75µm	0.8
Silt	75-2µm	68.1
Clay	<2µm	31.0
Total Percent Silt & Clay (% Passing 75micron sieve)		99.1
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIALS TESTING CENTRE

GRAIN - SIZE ANALYSIS (HYDROMETER METHOD) REPORT

PROJECT: Vemasse River	LOCATION: Vemasse		DATE: 19-Dec-12
COORDINATES: West or Down Stream (02)	SAMPLE/ SPECIMEN NUMBER : Soil/ West or Down Stream (02)	CLASSIFICATION :	-
DISH NUMBER : D11	CYLINDER ID. : C2	HYDROMETER TYPE (151H/152H):	152H
DISPERSING AGENT USED : sodium hexametaphosphate		QUANTITY: 125mL at 40g/L solution	
COMPOSITE CORRECTION: See calibration	DECIMAL FINES: 1.000	SP. GR. OF SOLIDS, Gs =	2.65

Time (Minutes)	ELAPSED TIME (Minutes)	ACTUAL HYDROMETER READING (R')	CORRECTED READING (R)	TEMP (°C)	TEMPERATURE AND SPECIFIC GRAVITY CONSTANT (K)	EFFECTIVE DEPTH (L)	PARTICLE DIAMETER (D),mm	PERCENT FINER (A) Partial	PERCENT FINER (B) Total
Start	9:30							-	-
1	9:31	44	36	20	0.01386	10.4	0.045	72.72	72.7
2	9:32	42	34	20	0.01386	10.7	0.0321	68.68	68.7
5	9:35	37	29	20	0.01386	11.5	0.0211	58.58	58.6
15	9:45	33	25	20	0.01386	12.2	0.0125	50.5	50.5
30	10:00	30	22	20	0.01386	12.7	0.0090	44.44	44.4
60	10:30	26	18	20	0.01386	13.3	0.0065	36.36	36.4
90	10:50	24	16	20	0.01386	13.7	0.0057	32.32	32.3
250	1:40	20	12	20	0.01386	14.3	0.0033	24.24	24.2
1440	9:30	13	5	20	0.01386	15.5	0.0014	10.1	10.1

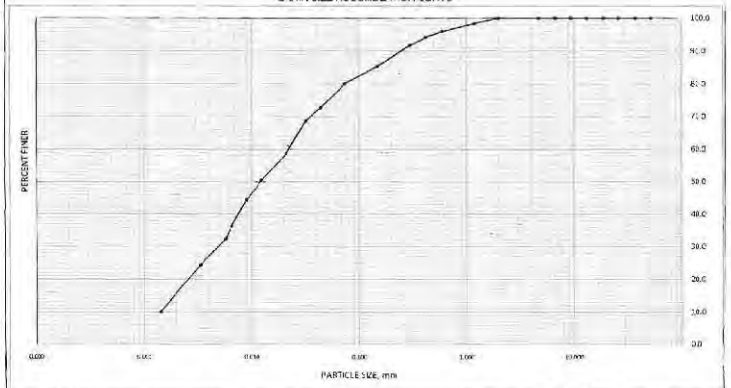
GRADATION:

SIEVE SIZE ASTM	MM	Percent Passing
2"	53.00	100.0
1-1/2"	37.50	100.0
1"	26.50	100.0
3/4"	19.00	100.0
1/2"	13.20	100.0
3/8"	9.50	100.0
1/4"	6.70	100.0
#4	4.75	100.0
#10	2.00	100.0
#16	1.18	98.3
#30	0.600	96.0
#40	0.425	94.3
#50	0.300	91.7
#100	0.150	85.3
#200	0.075	80.2

HYDROMETER ANALYSIS Smaller than	Passing
0.02mm	49.9
0.002mm	15.2
0.001mm	0

MATERIAL CLASSIFICATION Type	Size (metric)	Percent
Gravel	>2mm	0.0
Coarse Sand	2mm-425µm	5.7
Fine Sand	425-75µm	14.1
Silt	75-2µm	65.0
Clay	<2µm	15.2
Total Percent Silt & Clay (% Passing 75micron sieve)		80.2
Colloids	<1µm	0.0

GRAIN SIZE ACCUMULATION CURVE



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MATERIAL TESTING CENTRE

REPORT ON SOIL CLASSIFICATION

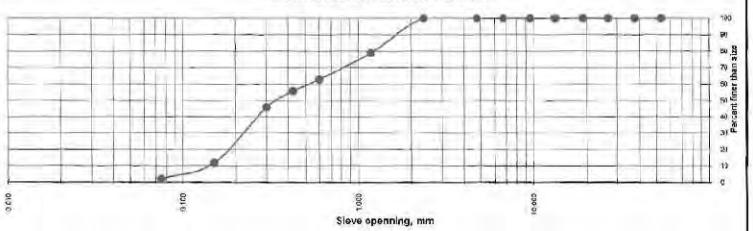
CLIENT:	NTCI			TEST REPORT NO:	RMS-QC-LAB-2012-482I
PROJECT:	Vemasse River			DATE OF REPORT:	8-Jan-13
PROJECT REF. NO:	-			DATE RECEIVED	5-Dec-12
LOCATION:	vemasse			DATE TEST STARTED	20-Dec-12
SOURCE / MATERIAL TYPE:	V.E.UP	Soil (80cm)		DATE TEST FINISHED	21-Dec-12
DATE SAMPLED:	5-Dec-12			TEST PERFORMED BY:	Graci,Adu & Andy
SAMPLED BY:	Client	TEST METHOD:	Please see remarks.		

SIEVE ANALYSIS

Sive Size,mm	Percent Passing	Specification limits Lower Limit	Specification limits Upper Limit
53.00	100		
37.50	100	-	
26.50	100	-	
19.00	100	-	
13.20	100	-	
9.50	100	-	
6.70	100	-	
4.75	100	-	
2.36	100	-	
1.18	79	-	
0.600	63	-	
0.425	56	-	
0.300	46	-	
0.150	12	-	
0.075	2.3	-	

PROPERTIES 1	Result	PROPERTIES 2	Result
Natural Moistur Content, %	6		
Liquid Limit, %	0		
Plastic Limit, %	-		
Plasticity Index, %	-		
Shrinkage, %	-		
Specific Gravity,	2.7		

GRAPHICAL DISTRIBUTION OF SIZE,mm



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Authorized Signatory

Delete as appropriate (Manager / Engineer / Supervisor)
On Behalf of RMS - East Timor

FORM NO: SO 004-2011

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MATERIAL TESTING CENTRE

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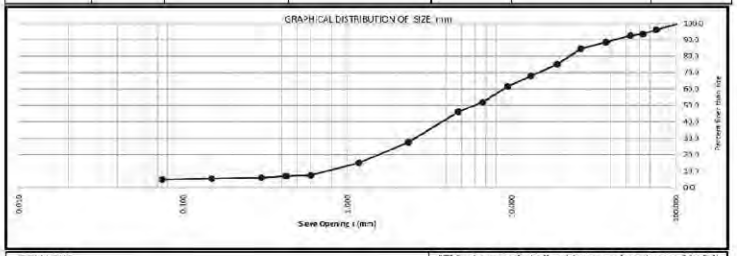
REPORT ON SOIL CLASSIFICATION

CLIENT :	NTCI		TEST REPORT NO :	RMS-QC-LAB-2012-482
PROJECT :	Vemasse River		DATE OF REPORT :	17-Dec-12
PROJECT REF. NO:	Not Applicable		DATE RECEIVED :	4-Dec-12
LOCATION :	Vemasse		DATE TEST STARTED :	6-Dec-12
SOURCE / MATERIAL TYPE :	Headrace Canal	Rover Material	DATE TEST FINISHED :	8-Dec-12
DATE SAMPLED :	4-Dec-12		TEST PERFORMED BY :	Graciao
SAMPLED BY :	Lope, Graci & Andy	Test Method :	Please see remarks.	

SIEVE ANALYSIS

Sive Size, mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
106.00	100	-		Natural Moistur Cortene, %	-		
75.70	96	-		Liquid Limit, %	-		
53.00	93.5	-		Plastic Limit, %	-		
53.00	92.5	-		Plasticity Limit, %	-		
37.50	88.5	-		Emerson Class No.	-		
26.50	84.5	-		Specfic Gravity,	-		
19.00	75	-					
13.20	68	-					
9.50	61.5	-					
6.70	52	-					
4.75	46	-					
2.36	27.5	-					
1.18	15	-					
0.600	7.5	-					
0.425	7	-					
0.300	6	-					
0.150	5.5	-					
0.075	5.0	-					



REMARKS

WELL GRADED GRAVEL (GW)
About 27% of fine to coarse rounded sand, around 72% of fine to coarse rounded gravel with cobbles and around 1% of fines.

Authorized Signatory

Delete as appropriate (Manager / Engineer / Supervisor)
On-Be half of RMS - East Timor

MATERIAL TESTING CENTRE

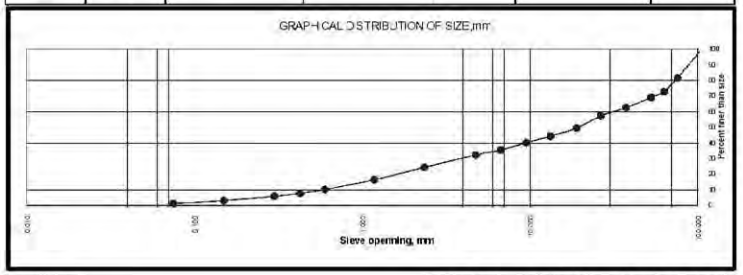
P.O. Box 130, Comoro River Road, Dili, East Timor
Office Tel. +670 3 313813, Fax. +670 3 312407
Email: lopee@rmseandc.com.au
Web Site: www.rmseandc.com.au

REPORT ON SOIL CLASSIFICATION

CLIENT:	NTCI		TEST REPORT NO:	RMS-QC-LAB-2012-483
PROJECT:	Vemasse River		DATE OF REPORT:	17-Dec-12
PROJECT REF. NO:	Not Applicable		DATE RECEIVED:	4-Dec-12
LOCATION:	Vemasse		DATE TEST STARTED:	6-Dec-12
SOURCE / MATERIAL TYPE:	Sediment trap	River Material	DATE TEST FINISHED:	8-Dec-12
DATE SAMPLED:	4-Dec-12		TEST PERFORMED BY:	Graciano
SAMPLED BY:	Lope, Graci & Andy	TEST METHOD:	Please see remarks.	

SIEVE ANALYSIS

Sive Size, mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
106.00	100	-		Natural Moistur Content, %	-		
75.70	82	-		Liquid Limit, %	-		
53.00	73	-		Plastic Limit, %	-		
53.00	69	-		Pasticity Index, %	-		
37.50	63	-		Emerson Class No.	-		
26.50	57	-		Specific Gravity,	-		
19.00	50	-					
13.20	44	-					
9.50	40	-					
6.70	36	-					
4.75	33	-					
2.36	25	-					
1.18	17	-					
0.600	10	-					
0.425	8	-					
0.300	6	-					
0.150	3	-					
0.075	1.4	-					



REMARKS

WELL GRADED GRAVEL (GW)
About 72% of fine to coarse rounded sand, around 72% of fine to coarse rounded gravel with cobbles and around 1% of fines.

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(2) Grain-Size Analysis among the proposed intake facility

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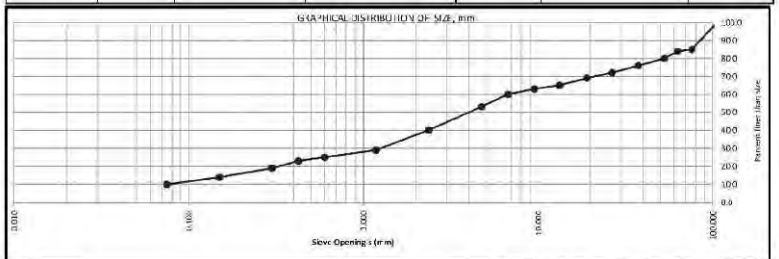
REPORT ON SOIL CLASSIFICATION

CLIENT:	NTCI		TEST REPORT NO :	RMS-QC-LAB-2012-482
PROJECT	Vemasse River		DATE OF REPORT :	17-Dec-12
PROJECT REF. NO:	Not Applicable		DATE RECEIVED	4-Dec-12
LOCATION :	Vemasse		DATE TEST STARTED	6-Dec-12
SOURCE / MATERIAL TYPE :	Main Canal	Rover Material	DATE TEST FINISHED	8-Dec-12
DATE SAMPLED :	4-Dec-12		TEST PERFORMED BY :	Gracisc
SAMPLED BY :	Lopo, Grad & Andy	Test Method :	Please see remarks.	

SIEVE ANALYSIS							
Sive Size, mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
106.00	100	-		Natural Moistur Contene, %	-		
75.70	85	-		Liquid Limit, %	-		
63.00	84	-		Plastic Limit, %	-		
53.00	80	-		Flasticity Limit, %	-		
37.50	76	-		Emerson Class No.	-		
26.50	72	-		Specific Gravity,	-		
19.00	69	-					
13.20	65	-					
9.50	63	-					
6.70	60	-					
4.75	53	-					
2.36	40	-					
1.18	29	-					
0.600	25	-					
0.425	23	-					
0.300	19	-					
0.150	14	-					
0.075	10.0	-					



REMARKS:

WELL GRADED GRAVEL (GW)
About 27% of fine to coarse rounded sand, around 72% of fine to coarse rounded gravel with cobbles and around 1% of fines.

Authorized Signatory

Delete as accompanie (Manager / Engineer / Supervisor)
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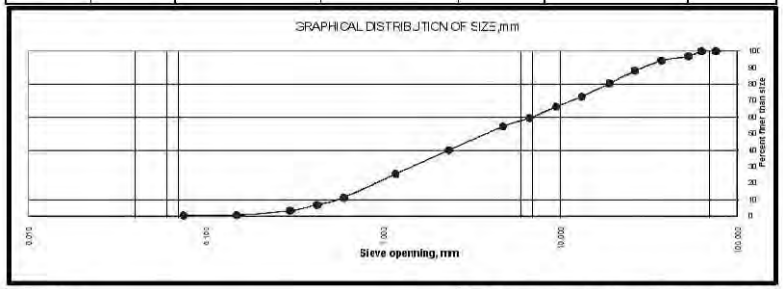
REPORT ON SOIL CLASSIFICATION

CLIENT:	NTCI		TEST REPORT NO:	RMS-QC-LAB-2012-484
PROJECT:	Vemasse River		DATE OF REPORT:	17-Dec-12
PROJECT REF. NO:	Not Applicable		DATE RECEIVED	4-Dec-12
LOCATION:	Vemasse		DATE TEST STARTED	6-Dec-12
SOURCE / MATERIAL TYPE:	Intake Site River Right	River Material	DATE TEST FINISHED	8-Dec-12
DATE SAMPLED:	4-Dec-12		TEST PERFORMED BY:	Graciano
SAMPLED BY:	Client	TEST METHOD:	Please see remarks.	

SIEVE ANALYSIS							
Sive Size,mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
106.00	100	-		Natural Moistur Content, %	-		
75.70	100	-		Liquid Limit, %	-		
63.00	100	-		Plastic Limit, %	-		
53.00	97	-		Plasticity Index, %	-		
37.50	94	-		Emerson Class No.	-		
26.50	88	-		Specific Gravity,	-		
19.00	81	-					
13.20	72	-					
9.50	66	-					
6.70	59	-					
4.75	54	-					
2.36	40	-					
1.18	26	-					
0.600	11	-					
0.425	7	-					
0.300	3	-					
0.150	1	-					
0.075	0.5	-					



REMARKS:

WELL GRADED SAND WITH GRAVEL (SW)
About 54% of fine to coarse rounded sand, around 46% of fine to coarse rounded gravel and around 0.5% of fines. Gray color

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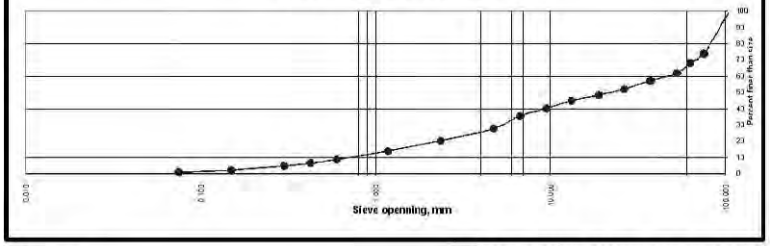
REPORT ON SOIL CLASSIFICATION

CLIENT:	NTCI	TEST REPORT NO:	RMS-QC-LAB-2012-482
PROJECT:	Vemasse River	DATE OF REPORT:	17-Dec-12
PROJECT REF. NO:	Not Applicable	DATE RECEIVED:	4-Dec-12
LOCATION:	Vemase	DATE TEST STARTED:	6-Dec-12
SOURCE / MATERIAL TYPE:	River Left Surface / River Material	DATE TEST FINISHED:	8-Dec-12
DATE SAMPLED:	4-Dec-12	TEST PERFORMED BY:	Graciano
SAMPLED BY:	Lope, Graci & Andy	TEST METHOD:	Please see remarks.

SIEVE ANALYSIS

Sive Size,mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
106.00	100	-		Natural Moistur Content, %	-		
75.70	74	-		Liquid Limit, %	-		
63.00	68	-		Plastic Limit, %	-		
53.00	62	-		Plasticity Index, %	-		
37.50	57	-		Emerson Class No.	-		
26.50	52	-		Specific Gravity,	-		
19.00	48	-					
13.20	45	-					
9.50	40	-					
6.70	36	-					
4.75	28	-					
2.36	20	-					
1.18	14	-					
0.600	9	-					
0.425	7	-					
0.300	5	-					
0.150	2	-					
0.075	1.0	-					

GRAPHICAL DISTRIBUTION OF SIZE,mm



REMARKS:

WELL GRADED GRAVEL (GW)
About 27% of fine to coarse rcundac sand around 72% of fine to coarse rounded gravel with cobbles and around 1% of fines.

Authorized Signatory

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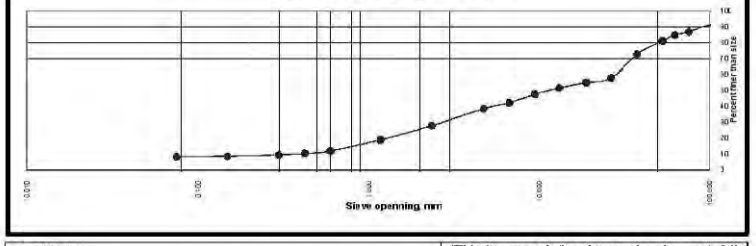
REPORT ON SOIL CLASSIFICATION

CLIENT:	NTCI	TEST REPORT NO:	RMS-QC-LAB-2012-485
PROJECT:	Vemasse River	DATE OF REPORT:	17-Dec-12
PROJECT REF. NO:	Not Applicable	DATE RECEIVED:	4-Dec-12
LOCATION:	Vemase	DATE TEST STARTED:	6-Dec-12
SOURCE / MATERIAL TYPE:	Intake Site River Middle / River Material	DATE TEST FINISHED:	8-Dec-12
DATE SAMPLED:	4-Dec-12	TEST PERFORMED BY:	Graciano
SAMPLED BY:	Client	TEST METHOD:	Please see remarks.

SIEVE ANALYSIS

Sive Size,mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
300.00	100	-		Natural MoisturContent, %	-		
106.00	92	-					
75.70	87	-		Liquic Limit, %	-		
63.00	85	-		Plastic Limit, %	-		
53.00	81	-		Plasticity Index, %	-		
37.50	73	-		Emerson ClassNo.	-		
26.50	58	-		Specific Gravity,	-		
19.00	55	-					
13.20	52	-					
9.50	48	-					
6.70	42	-					
4.75	39	-					
2.36	28	-					
1.18	19	-					
0.600	12	-					
0.425	11	-					
0.300	10	-					
0.150	9	-					
0.075	8.5	-					

GRAPHICAL DISTRIBUTION OF SIZE,mm



REMARKS:

WELL GRADED SAND WITH GRAVEL (SW)
About 54% of fine to coarse rounded sand, around 46% of fine to coarse rounded gravel and around 0.5% of fines. Gray color

Authorized Signatory

Delete as appropriate (~~Manager / Engineer /~~ Supervisor)
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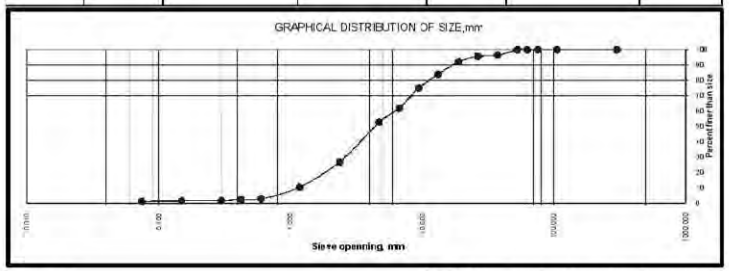
Web Site: www.rmseandc.com.au

REPORT ON SOIL CLASSIFICATION

CLIENT:	NTCI			TEST REPORT NO:	RMS-QC-LAB-2012-486
PROJECT:	Vemasse River			DATE OF REPORT:	17-Dec-12
PROJECT REF. NO:	Not Applicable			DATE RECEIVED:	4-Dec-12
LOCATION:	Vemasse			DATE TEST STARTED:	6-Dec-12
SOURCE / MATERIAL TYPE:	Intake Site River Middle Surface	River Material		DATE TEST FINISHED:	8-Dec-12
DATE SAMPLED:	4-Dec-12			TEST PERFORMED BY:	Graciano
SAMPLED BY:	Client	TEST METHOD:	Please see remarks.		

SIEVE ANALYSIS							
Sive Size mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
300.00	100	-		Natural Moistur Content, %	-		
106.00	100	-		Liquid Limit, %	-		
75.70	100	-		Plastic Limit, %	-		
63.00	100	-		Plasticity Index, %	-		
53.00	100	-		Emerson Class No.	-		
37.50	96	-		Specific Gravity,	-		
26.50	96	-					
19.00	92	-					
13.20	84	-					
9.50	75	-					
6.70	62	-					
4.75	53	-					
2.36	27	-					
1.18	11	-					
0.600	3	-					
0.425	3	-					
0.300	2	-					
0.150	2	-					
0.075	1.4	-					



REMARKS:

WELL GRADED GRAVEL WITH SAND (GW)
About 52 % of fine to coarse rounded sand, around 47 % of fine to coarse rounded gravel with cobbles and around 1.4 % of fines. Gray color

Authorized Signatory

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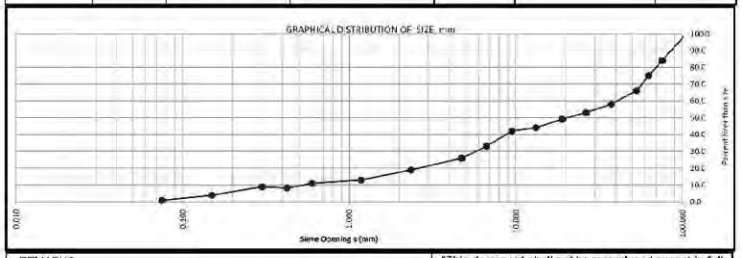
REPORT ON SOIL CLASSIFICATION

CLIENT:	NTCI			TEST REPORT NO:	RMS-QC-LAB-2012-482
PROJECT:	Vemasse River			DATE OF REPORT:	17-Dec-12
PROJECT REF. NO:	Not Applicable			DATE RECEIVED:	4-Dec-12
LOCATION:	Vemasse			DATE TEST STARTED:	6-Dec-12
SOURCE / MATERIAL TYPE:	Dike Protection	River Material		DATE TEST FINISHED:	8-Dec-12
DATE SAMPLED:	4-Dec-12			TEST PERFORMED BY:	Graciao
SAMPLED BY:	Lope, Graci & Andy	Test Method:	Please see remarks.		

SIEVE ANALYSIS							
Sive Size, mm	Percent Passing	Specification limits		PROPERTIES 1	Result	PROPERTIES 2	Result
		Lower Limit	Upper Limit				
106.00	100	-		Natural Moistur Contene, %	-		
75.70	84	-		Liquid Limit, %	-		
63.00	75	-		Plastic Limit, %	-		
53.00	66	-		Plasticity Limit, %	-		
37.50	58	-		Emerson Class No.	-		
26.50	53	-		Specific Gravity,	-		
19.00	49	-					
13.20	44	-					
9.50	42	-					
6.70	33	-					
4.75	26	-					
2.36	19	-					
1.18	13	-					
0.600	11	-					
0.425	8.2	-					
0.300	9	-					
0.150	4	-					
0.075	1	-					



REMARKS

WELL GRADED GRAVEL (GW)
About 27% of fine to coarse rounded sand, around 72% of fine to coarse rounded gravel with cobbles and around 1% of fines.

Authorized Signatory

Delete as appropriate (Manager / Engineer / Supervisor)
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A7 - 12

Appendices 8 Hydrological Survey and Data

Buluto Hydrological Survey and Data Collection

- Final Report
- July 2013

Prepared for NTC International Consultant, INC,

Prepared by PEC-Consulting, LDA

Table of Contents

2. Introduction and Scopes

2.1 Background

Government of Timor Leste (GoTL) has asked technical assistance to JICA for irrigation system rehabilitation in order to increase the rice production that is low across the nation. The Buluto irrigation scheme locates at the boundary of the Manatuto and Baucau Districts is one of those irrigation schemes.

Present intakes have been constructed with riverbed material with fascine; hence intake capacity was unstable due to destruction of the intake facilities and deposition of the river sediment in the canal. The rehabilitation of the existing irrigation facilities will effectively improves water supply condition to the beneficial area. In response to the request by the Government of RDTL, the Japan International Cooperation (JICA) has been implementing the Preparatory Survey on the Project for Rehabilitation and Improvement of Buluto Irrigation Scheme has been from October 2012.

Hydrological survey is part of the preparatory survey that will provide the hydrological data for a reliable design of the irrigation system. In November, 12, 2012, NTC (Consultant Company on behalf of JICA) engaged the PEC-Consulting LDA to conduct the hydrological data collection for the project, which include field work of gauge meter installation in the pears, and continue monitoring and data collection from period of November 2012- June 2013. Furthermore, make of collected data to develop hydrological rating curve for Laleia River

This final report is the summary of hydrological data collection and the use of data for developing the design curve of hydrological flow estimation. More importantly, the data collected by this work was also used to determine the flow resistance of the river which was further used in the estimation of the maximum water depth of the selected return period of flood.

2.2 Project Site

The measurement site locates at Laleia River at the Laleia Bridge, as can be seen from figure 1 below. The total width of Laleia River is roughly 180 meter and several small streams do exist during the low flow condition. The total flow contributing area into the measurement point (catchment) was estimated to be 537 km^2, which is considered as a large catchment.

Considering the wide of the river and existing of small stream that forms the entire Laleia River, the measurement gauge was established by following the existence of the small streams. Three measurement gauges were established to accommodate the small streams and wide river section.

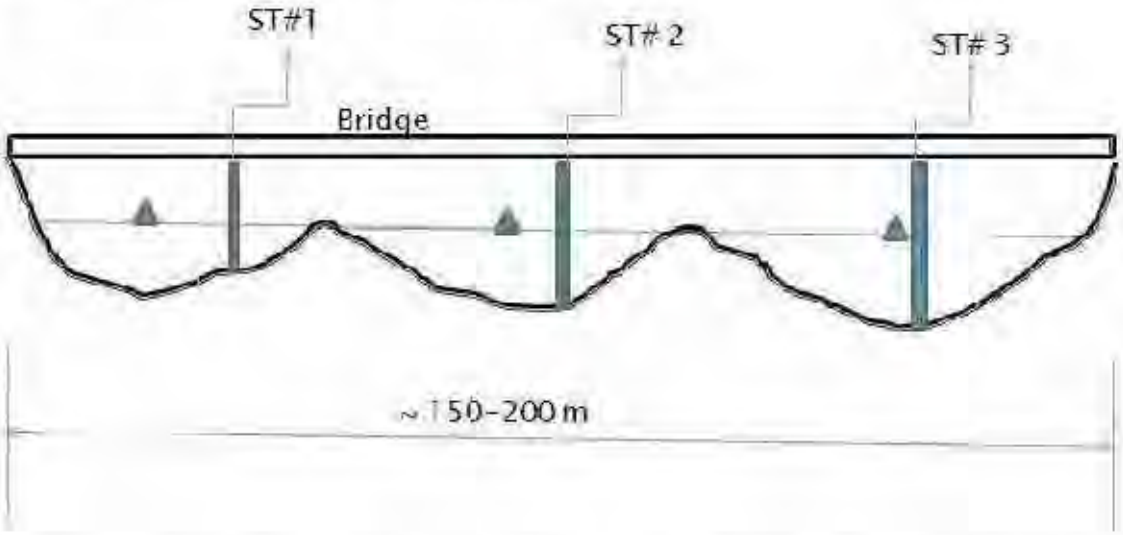
Figure 1. Project Site and Laleia Catchment System

This lowest point of the measurement is also the concentrated flow in Laleia River. Roughly, the condition of the river bed can be represented in the following figure.

Figure 2 Sub-Section of Laleia River for Hydrological Survey Purpose

It was measured that the distance of one pier to the next is roughly about 15.57 meters and total piers are 11, exclude the two concrete structures at both side of the river bank (left and right banks). Therefore, the total length was determined to be 180 m. Considering the width of River and exiting small stream, it was decided to place the measurement meters in three different place, which also known as station (ST).The measurement sites were conceptually, represented by the following figure.

Figure 3. Measurement section in Laleia River



The baseline data of each station such as zero elevation of meter and invert elevation need to be determined. The topographical survey was conducted to collect the baseline data for the further calculation of the actual water depth.

2.3 Scope of Work:

The purpose of the discharge measurement survey is to obtain the flow condition of the Laleia River that is main water source for the Buluto Irrigation Scheme. The survey is composed of following
Works;

- Installation of meters in the river segment
- Water Stage Observation
- Velocity Measurement
- Cross section area estimation
- Rating Curve
- Discharge Estimation
- Manning's Coefficient Estimation

3. Data Collection and Analysis

3.1 Field Reconnaissance

Field reconnaissance was conducted by PEC-Consulting team to the site in order to collect the necessary information in the field installation phase and also to set a common agreement/understanding between the PEC-consulting and NTC project team. In addition, the field trip was also to introduce the project to local leaders such as chief Suco, the head of police sub-station, and some degree of wider community, who will be a beneficiary to the project in many years to come.

Moreover, some baseline data related the River system was observed which give an information to design the measurement units such as how many small stream exist in the low flow condition. The following facts were observed the field reconnaissance:

1. River width is big, with effective flow width roughly 120-190 meters
2. The river bed consist of boulder, sand, silt, and very small degree of plants
3. Two -small streams during the low flow condition do exist
4. The water level measurement were decided to be placed in the lowest point in each small stream
5. Additional measurement section was decided at the end of the bank (eastside of River)
6. Some desktop investigation was conducted to determine the contributing area of watershed, which is 537 KM^2

3.2 Baseline data and Established sites

As indicated from the previous sub-section that three measurement section were decided and the meters need to be placed in each section so that the level of water can be read. The selected point of measurement was next to a prier, as the meter will be bolted unto the prier. The important basic information is:

- Elevation of the zero value of meter
- Elevation of the lowest point of the stream

The meters were installed in each sub-section of the river to collect the water level data. The generator and hummer drill were deployed from Dili by the PEC-Consulting team to install the meter onto the wall of each pier.

Figure 4 Water-Stage meter

The gauge meter was made from metal sheet with the scale as shown from the above figure, with the maximum 1 meter. Because the maximum depth of the river is roughly 3 meter, four gauge meters would be needed in each subsection, By installing one gauge meter unto the top of another's. The procedure of installation is summarized as follows:

- Drill the hole unto the wall with the equal size drill pits with the bolts

Figure 5 Using Hammer Drill to drill holes to place the bolts

- Put the meter onto the wall and puts nuts, washers unto the bolts

Figure 6. Bolt the meters unto the wall

- Write the actual height of the meter from bottom to top

Figure 6. Re-scale the meter gauges

The stage-meter in each sub-section can be seen from the following figures:

Figure 7. Station #1 (sub-Section 1) at the pier no.1

At the first station, the zero reading stage begins at 0.4 meter above the existing water table. The water depth was measured to be around 0.1 meter (10 cm). The elevation value at zero reading was measured to be 21.25 m and therefore the invert elevation of this channel was about 20.75 meter.

The second measurement station was placed at the pier #3. Most of existing water flows in this sub-section and also the sub-section seems to be the lowest river bed. The zero reading of the stage-meter was place at above the water table and the maximum depth of the existing water table was measured to be 0.2 meter.

Figure 8. Station #2 at the pier no. 3

The elevation at zero reading of stage was estimated to be 20.2 m and therefore the invert elevation of this sub-section of the river bed was calculated to be 20 m

The third or last station proposed was located at the end of the river or pier #11, (closed to the other end of the river). The condition of existing sub-section has no flow and the level is well above the other two sub-sections.

Figure 9 Station #3 at Pier no. 11 (near the river bank)

The elevation at zero reading of stage was estimated to be 21.25 m and therefore the invert elevation of this sub-section of the river bed was calculated to be 20.4 m

Summary of basic information of each point of measurement:

Table 1: Basic information of each Station

Station	Elevation	Invert Elevation, m	Zero-depth, m
ST-1 at pier # 1	21.25	20.85	0.4
ST-2 at pier # 3	20.2	19.85	0.35
ST-3 at pier # 11	21.25	20.7	0.55

The above table will be very useful in the actual value of water depth, from the water level read by the meters installed above. For instance, if the water level reading at meter says 1 meter for station #1, means that the absolute water depth is equal to 1.4 meters. This is only the case for no siltation and condition remains the same as compares to the original system.

3.3 Daily Water Stage Observation

Once the meters were installed in the station, one can read the water level. Stage reading of water level will be conducted twice a day, at 9 a.m. and 5 p.m. every day from period of November 17, 2012 to June 30 2013. Reading will start on November 17, 2012 and continues to June 30, 2013. A designated reader will be hired locally in Laleia and trained to perform the task. Results from the reading will be reported weekly to the contractor's team every month. The following table show the raw data of the water level measured from the meter installed for each station.

Table 2: Raw Data of Daily Reading of Stage level

No	DD/ MM/ YYYY	TIME	ST # 1, m	ST # 2, m	ST # 3, m
1	17/11/2012	9:00	0	0	0
		17:00	0	0	0
2	18/11/2012	9:00	0	0	0
		17:00	0	0	0
3	19/11/2012	9:00	0	0	0
		17:00	0	0	0
4	20/11/2012	9:00	0	0	0
		17:00	0	0	0
5	21/11/2012	9:00	0	0	0

		17:00	0	0	0
6	22/11/2012	9:00	0	0	0
		17:00	0	0	0
7	23/11/2012	9:00	0	0	0
		17:00	0	0	0
8	24/11/2012	9:00	0	0	0
		17:00	0	0	0
9	25/11/2012	9:00	0	0	0
		17:00	0.02	0.40	0
10	26/11/2012	9:00	0	0	0
		17:00	0	0	0
11	27/11/2012	9:00	0	0	0
		17:00	0	0	0
12	28/11/2012	9:00	0	0	0
		17:00	0	0	0
13	29/11/2012	9:00	0	0	0
		17:00	0.40	1.6	0
14	30/11/2012	9:00	0	0.20	0
		17:00	0	0.84	0
15	1/12/2012	9:00	0	0.12	0
		17:00	0	0.6	0
16	2/12/2012	9:00	0	0	0
		17:00	0.40	0.10	0
17	3/12/2012	9:00	0	0.2	0
		17:00	0	0	0
18	4/12/2012	9:00	0	0	0
		17:00	0	0	0
19	5/12/2012	9:00	0	0	0
		17:00	0	0	0
20	6/12/2012	9:00	0	0	0
		17:00	0	0	0
21	7/12/2012	9:00	0	0.10	0
		17:00	0.10	0.6	0
22	8/12/2012	9:00	0	0.4	0
		17:00	0	0	0
23	9/12/2012	9:00	0	0	0
		17:00	0	0	0
24	10/12/2012	9:00	0	0	0
		17:00	0	0.8	0
25	11/12/2012	9:00	0.2	0.18	0
		17:00	0	0.10	0

26	12/12/2012	9:00	0	0.14	0
		17:00	0.6	0.12	0
27	13/12/2012	9:00	0.2	0.16	0
		17:00	0.10	0.12	0
28	14/12/2012	9:00	0.2	0.10	0
		17:00	0	0.80	0
29	15/12/2012	9:00	0	0.40	0
		17:00	0.80	1.m	0
30	16/12/2012	9:00	0.40	0.80	0
		17:00	0.8	0.20	0
31	17/12/2012	9:00	0.10	0.34	0
		17:00	0.6	0.30	0
32	18/12/2012	9:00	0.60	0.86	0
		17:00	0.40	1.1	0
33	19/12/2012	9:00	0.50	0.90	0
		17:00	0.181	0.70	0
34	20/12/2012	9:00	0.46	0.62	0
		17:00	1.0	1.0	0
35	21/12/2012	9:00	0.88	0.92	0
		17:00	0.90	1.0	0
36	22/12/2012	9:00	0.60	0.86	0
		17:00	0.22	0.38	0
37	23/12/2012	9:00	0.16	0.32	0
		17:00	0.4	0.14	0
38	24/12/2012	9:00	0.70	1.0	0
		17:00	0.60	0.94	0
39	25/12/2012	9:00	0.50	0.74	0
		17:00	0.42	0.52	0
40	26/12/2012	9:00	0.70	0.48	0
		17:00	0.8	0.30	0
41	27/12/2012	9:00	0.16	0.42	0
		17:00	0.20	0.50	0
42	28/12/2012	9:00	0.34	0.60	0
		17:00	0.10	0.60	0
43	29/12/2012	9:00	0.64	0.32	0
		17:00	0.64	0.32	
44	30/12/2012	9:00	0.40	0.2	0
		17:00	0.8	0.7	0
45	31/12/2012	9:00	0.5	0.3	0
		17:00	1.5	1.8	0
46	1/1/2013	9:00	0.90	0.75	0

		17:00	0.94	0.84	0
47	2/1/2013	9:00	0.80	0.66	0
		17:00	0.40	0.34	0
48	3/1/2013	9:00	0.30	0.24	0
		17:00	0.76	0.68	0
49	4/1/2013	9:00	0.26	0.20	0
		17:00	0.76	0.62	0
50	5/1/2013	9:00	0.88	0.90	0
		17:00	1.8	1.9	1
51	6/1/2013	9:00	0.86	0.82	0.2
		17:00	0.70	0.60	0.15
52	7/1/2013	9:00	0.36	0.22	0
		17:00	0.44	0.40	0
53	8/1/2013	9:00	0.18	0.14	0
		17:00	0.13	0.11	0
54	9/1/2013	9:00	0.40	0.60	0
		17:00	0.20	0.30	0
55	10/1/2013	9:00	0.18	0.14	0
		17:00	0.20	0.22	0
56	11/1/2013	9:00	0.24	0.26	0
		17:00	0.60	0.56	0
57	12/1/2013	9:00	0.80	0.84	0
		17:00	0.94	0.62	0
58	13/1/2013	9:00	0.40	0.44	0
		17:00	0.38	0.40	0
59	14/1/2013	9:00	0.30	0.30	0
		17:00	0.80	0.84	0
60	15/1/2013	9:00	0.80	0.80	0
		17:00	0.40	0.78	0
61	16/1/2013	9:00	0.44	0.76	0
		17:00	0.46	0.74	0
62	17/1/2013	9:00	0.68	0.72	0
		17:00	0.62	0.70	0
63	18/1/2013	9:00	0.60	0.70	0
		17:00	0.58	0.68	0
64	19/1/2013	9:00	0.30	0.84	0
		17:00	0.34	0.84	0
65	20/1/2013	9:00	0.24	0.86	0
		17:00	0.18	0.86	0
66	21/12013	9:00	0.16	0.70	0
		17:00	0.17	0.68	0

67	22/1/2013	9:00	0.16	0.68	0
		17:00	0.14	0.64	0
68	23/12013	9:00	0.20	0.60	0
		17:00	1.7	1.5	0
69	24/1/2013	9:00	1.0	1	0
		17:00	1.2	1	0
70	25/1/2013	9:00	0.12	0.4	0
		17:00	0.10	0.6	0
71	26/1/2013	9:00	0.14	0.4	0
		17:00	0.10	0.4	0
72	27/1/2013	9:00	0.10	0.8	0
		17:00	0.10	0.94	0
73	28/1/2013	9:00	0.10	0.20	0
		17:00	1.40	0.40	0
74	29/2013	9:00	1	0.38	0
		17:00	1.2	0.34	1
75	30/1/2013	9:00	1	0	0.94
		17:00	0.92	0.95	0.80
76	31/1/2013	9:00	0.86	0.88	0.72
		17:00	0.80	0.82	0.24
77	1/2/2013	9:00	0.70	0.72	0
		17:00	0.66	0.70	0
78	2/2/2013	9:00	0.90	0.98	0
		17:00	0.66	0.7	0
79	3/2/2013	9:00	0.80	0.96	0
		17:00	0.74	0.93	0
80	4/2/2013	9:00	0.34	0.86	0
		17:00	0.30	0.84	0
81	5/2/2013	9:00	0.30	0.82	0
		17:00	0.24	0.80	0
82	6/2/2013	9:00	0.22	0.76	0
		17:00	0.20	0.72	0
83	7/2/2013	9:00	0.14	0.6	0
		17:00	0.12	0.4	0
84	8/2/2013	9:00	0.12	0.4	0
		17:00	0.10	0.2	0
85	9/2/2013	9:00	0.10	0.2	0
		17:00	0.8	0.2	0
86	10/2/2013	9:00	0.8	0.4	0
		17:00	0.8	0.6	0
87	11/2/2013	9:00	0.8	0.2	0

		17:00	0.6	0.2	0
88	12/2/2013	9:00	0.14	0.2	0
		17:00	0.20	0.30	0
89	13/2/2013	9:00	0.18	0.22	0
		17:00	0.40	0.60	0
90	14/2/2013	9:00	0.20	0.2	0
		17:00	0.22	0.4	0
91	15/2/2013	9:00	0.30	0.10	0
		17:00	0.32	0.12	0
92	16/2/2013	9:00	0.30	0.14	0
		17:00	0.80	0.60	0
93	17/2/2013	9:00	0.76	0.56	0
		17:00	0.72	0.52	0
94	18/2/2013	9:00	0.60	0.40	0
		17:00	0.90	0.86	0
95	19/2/2013	9:00	0.74	0.72	0
		17:00	0.70	0.66	0
96	20/2/2013	9:00	0.60	0.68	0
		17:00	0.62	0.50	0
97	21/2/2013	9:00	0.64	0.58	0
		17:00	0.90	0.1	0
98	22/2/2013	9:00	0.88	0.90	0
		17:00	0.60	0.70	0
99	23/2/2013	9:00	0.30	0.28	0
		17:00	0.42	0.35	0
100	24/2/2013	9:00	0.40	0.30	0
		17:00	0.36	0.22	0
101	25/2/2013	9:00	0.28	0.26	0
		17:00	0.60	0.70	0
102	26/2/2013	9:00	0.58	0.68	0
		17:00	0.52	0.66	0
103	27/2/2013	9:00	0.40	0.62	0
		17:00	0.38	0.60	0
104	28/2/2013	9:00	0.10	0.30	0
		17:00	0.8	0.30	0
105	1/3/2013	9:00	0.20	0.10	0
		17:00	0.20	0.10	0
106	2/3/2013	9:00	0.16	0.10	0
		17:00	0.14	0.18	0
107	3/3/2013	9:00	0.12	0.16	0
		17:00	0.80	1	0

108	4/3/2013	9:00	0.58	0.90	0
		17:00	0.50	0.70	0
109	5/3/2013	9:00	0.84	0.96	0
		17:00	0.78	0.70	0
110	6/3/2013	9:00	0.60	0.70	0
		17:00	0.56	0.68	0
111	7/3/2013	9:00	0.54	0.65	0
		17:00	0.40	0.50	0
112	8/3/2013	9:00	0.42	0.50	0
		17:00	1	1	0
113	9/3/2013	9:00	o.94	0.89	0
		17:00	1	1	0
114	10/3/2013	9:00	0.80	0.82	0
		17:00	0.90	0.96	0
115	11/3/2013	9:00	0.72	0.70	0
		17:00	0.4	0.44	0
116	12/3/2013	9:00	0.65	0.64	0
		17:00	0.62	0.6	0
117	13/3/2013	9:00	0.30	0.36	0
		17:00	0.74	0.84	0
118	14/3/2013	9:00	0.58	0.62	0
		17:00	1	1	0
119	15/3/2013	9:00	0.90	0.94	0
		17:00	0.80	0.86	0
120	16/3/2013	9:00	0.62	0.58	0
		17:00	0.40	0.4	0
121	17/3/2013	9:00	0.30	0.20	0
		17:00	0.54	0.6	0
122	18/3/2013	9:00	0.42	0.68	0
		17:00	0.30	0.34	0
123	19/3/2013	9:00	0.28	0.20	0
		17:00	0.26	0.6	0
124	20/3/2013	9:00	0.24	0.24	0
		17:00	0.33	0.36	0
125	21/3/2013	9:00	0.22	0.28	0
		17:00	0.20	0.24	0
126	22/3/2013	9:00	0.20	0.22	0
		17:00	0.18	0.2	0
127	23/3/2013	9:00	0.18	0.20	0
		17:00	0.16	18	0
128	24/3/2013	9:00	0.16	0.18	0

		17:00	0.14	0.14	0
129	25/3/2013	9:00	0.14	0.12	0
		17:00	0.13	0.1	0
130	26/3/2013	9:00	0.10	0.80	0
		17:00	0.30	0.34	0
131	27/3/2013	9:00	0.28	0.30	0
		17:00	0.60	0.7	0
132	28/3/2013	9:00	0.58	0.70	0
		17:00	0.54	0.66	0
133	29/3/2013	9:00	0.50	0.64	0
		17:00	0.48	0.62	0
134	30/3/2013	9:00	0.70	0.74	0
		17:00	0.6	0.7	0
135	31/3/2013	9:00	0.64	0.68	0
		17:00	0.62	0.66	0
136	1/4/2013	9:00	0.30	0.36	0
		17:00	0.40	0.5	0
137	2/4/2013	9:00	0.38	0.48	0
		17:00	0.36	0.42	0
138	3/4/2013	9:00	0.34	0.4	0
		17:00	0.56	0.58	0
139	4/4/2013	9:00	0.54	0.54	0
		17:00	0.50	0.52	0
140	5/4/2013	9:00	0.48	0.50	0
		17:00	0.44	0.46	0
141	6/4/2013	9:00	0.38	0.4	0
		17:00	0.36	0.38	0
142	7/4/2013	9:00	0.34	0.36	0
		17:00	0.30	0.32	0
143	8/4/2013	9:00	0.70	0.72	0
		17:00	0.68	0.70	0
144	10/4/2013	9:00	0.30	0.40	0
		17:00	0.30	0.38	0
145	11/4/2013	9:00	0.32	0.34	0
		17:00	0.30	0.32	0
146	12/4/2013	9:00	0.20	0.24	0
		17:00	0.18	0.22	0
147	13/4/2013	9:00	0.18	0.20	0
		17:00	0.16	0.20	0
148	14/4/2013	9:00	0.14	0.18	0
		17:00	0.12	0.16	0

149	15/4/2013	9:00	0.10	0.14	0
		17:00	0.8	0.12	0
150	16/4/2013	9:00	0.8	0.10	0
		17:00	0.6	0.18	0
151	17/4/2013	9:00	0.6	0.8	0
		17:00	0.6	0.8	0
152	18/4/2013	9:00	0.6	0.8	0
		17:00	0.4	0.8	0
153	19/4/2013	9:00	0.4	0.6	0
		17:00	0.4	0.6	0
154	20/4/2013	9:00	0.2	0.4	0
		17:00	0.2	0.4	0
155	21/4/2013	9:00	0	0.4	0
		17:00	0	0.2	0
156	22/4/2013	9:00	0	0.2	0
		17:00	0	0	0
157	23/4/2013	9:00	0	0	0
		17:00	0	0	0
158	24/4/2013	9:00	0	0	0
		17:00	0	0	0
159	25/4/2013	9:00	0	0	0
		17:00	0	0	0
160	26/4/2013	9:00	0	0	0
		17:00	0	0	0
161	27/4/2013	9:00	0	0	0
		17:00	0	0	0
162	28/4/2013	9:00	0	0	0
		17:00	0	0	0
163	29/4/2013	9:00	0	0	0
		17:00	0	0	0
164	30/4/2013	9:00	0	0	0
		17:00	0	0	0
165	1/5/2013	9:00	0	0	0
		17:00	0	0	0
166	2/5/2013	9:00	0	0	0
		17:00	0	0	0
167	3/5/2013	9:00	0	0	0
		17:00	0	0	0
168	4/5/2013	9:00	0	0	0
		17:00	0	0	0
169	5/5/2013	9:00	0	0	0

		17:00	0	0	0
170	6/5/2013	9:00	0.30	0	0
		17:00	0.30	0.36	0
171	7/5/2013	9:00	0.20	0.30	0
		17:00	0.15	0.26	0
172	8/5/2013	9:00	0.10	0.2	0
		17:00	0	0	0
173	9/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
174	10/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
175	11/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
176	12/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
177	13/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
178	14/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
179	15/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
180	16/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
181	17/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
182	18/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
183	19/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
184	20/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
185	21/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
186	22/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
187	23/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
188	24/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
189	25/2013	9:00	0.00	0	0
		17:00	0.00	0	0

190	26/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
200	27/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
201	28/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
202	29/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
203	30/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
204	31/5/2013	9:00	0.00	0	0
		17:00	0.00	0	0
205	1/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
206	2/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
207	3/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
208	4/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
209	5/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
210	6/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
211	7/6/2013	9:00	0.00	0	0
		17:00	0.30	34	0
212	8/6/2013	9:00	0.30	0.36	0
		17:00	0.40	0.40	0
213	9/6/2013	9:00	0.30	0.38	0
		17:00	0.28	0.3	0
214	10/6/2013	9:00	0.20	0.22	0
		17:00	0.16	0.18	0
215	11/6/2013	9:00	0.10	0.14	0
		17:00	0.80	0.10	0
216	12//6/2013	9:00	0.4	0.6	0
		17:00	0.00	0	0
217	13/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
218	14/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
219	15/6/2013	9:00	0.00	0	0

		17:00	0.00	0	0
220	16/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
221	17/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
222	18/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
223	19/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
224	20/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
225	21/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
226	22//6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
227	23/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
228	24/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
229	25/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
230	26/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
231	27/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
232	28/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
234	29/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0
235	30/6/2013	9:00	0.00	0	0
		17:00	0.00	0	0

The arithmetic average of the stage height was calculated by adding the zero value of water depth, which was presented from the previous table. Stage height of the station #1 will be adjusted by 0.4 m and station #2 by 0.35 meter. The absolute value of stage-height which will be used in the calculated of discharge are presented in the following table.

Table 3 The Adjusted Hydrological Data Using Baseline Data and average height

MM-YY	DD	S1, m	S2, m	S3, m
Nov-12	17	0.4	0.35	0.55
Nov-12	18	0.4	0.35	0.55
Nov-12	19	0.4	0.35	0.55
Nov-12	20	0.4	0.35	0.55
Nov-12	21	0.4	0.35	0.55
Nov-12	22	0.4	0.35	0.55
Nov-12	23	0.4	0.35	0.55
Nov-12	24	0.4	0.35	0.55
Nov-12	25	0.41	0.55	0.55
Nov-12	26	0.4	0.35	0.55
Nov-12	27	0.4	0.35	0.55
Nov-12	28	0.4	0.35	0.55
Nov-12	29	0.6	1.15	0.55
Nov-12	30	0.4	0.87	0.55
Dec-12	1	0.4	0.71	0.55
Dec-12	2	0.6	0.4	0.55
Dec-12	3	0.4	0.35	0.55
Dec-12	4	0.4	0.35	0.55
Dec-12	5	0.4	0.35	0.55
Dec-12	6	0.4	0.35	0.55
Dec-12	7	0.45	0.7	0.55

Dec-12	8	0.4	0.55	0.55
Dec-12	9	0.4	0.35	0.55
Dec-12	10	0.4	0.75	0.55
Dec-12	11	0.5	0.49	0.55
Dec-12	12	0.7	0.48	0.55
Dec-12	13	0.55	0.49	0.55
Dec-12	14	0.5	0.8	0.55
Dec-12	15	0.8	1.05	0.55
Dec-12	16	1	0.85	0.55
Dec-12	17	0.75	0.67	0.55
Dec-12	18	0.9	1.33	0.55
Dec-12	19	0.7405	1.15	0.55
Dec-12	20	1.13	1.16	0.55
Dec-12	21	1.29	1.31	0.55
Dec-12	22	0.81	0.97	0.55
Dec-12	23	0.68	0.58	0.55
Dec-12	24	1.05	1.32	0.55
Dec-12	25	0.86	0.98	0.55
Dec-12	26	1.15	0.74	0.55
Dec-12	27	0.58	0.81	0.55
Dec-12	28	0.62	0.95	0.55
Dec-12	29	1.04	0.67	0.55
Dec-12	30	1	0.8	0.55
Dec-12	31	1.4	1.4	0.55
Jan-13	1	1.32	1.145	0.55

Jan-13	2	1	0.85	0.55
Jan-13	3	0.93	0.81	0.55
Jan-13	4	0.91	0.76	0.55
Jan-13	5	1.74	1.75	1.05
Jan-13	6	1.18	1.06	0.725
Jan-13	7	0.8	0.66	0.55
Jan-13	8	0.555	0.475	0.55
Jan-13	9	0.7	0.8	0.55
Jan-13	10	0.59	0.53	0.55
Jan-13	11	0.82	0.76	0.55
Jan-13	12	1.27	1.08	0.55
Jan-13	13	0.79	0.77	0.55
Jan-13	14	0.95	0.92	0.55
Jan-13	15	1	1.14	0.55
Jan-13	16	0.85	1.1	0.55
Jan-13	17	1.05	1.06	0.55
Jan-13	18	0.99	1.04	0.55
Jan-13	19	0.72	1.19	0.55
Jan-13	20	0.61	1.21	0.55
Jan-13	21	0.565	1.04	0.55
Jan-13	22	0.55	1.01	0.55
Jan-13	23	1.35	1.4	0.55
Jan-13	24	1.5	1.35	0.55
Jan-13	25	0.51	0.85	0.55
Jan-13	26	0.52	0.75	0.55

Jan-13	27	0.5	1.22	0.55
Jan-13	28	1.15	0.65	0.55
Jan-13	29	1.5	0.71	1.05
Jan-13	30	1.36	0.825	1.42
Jan-13	31	1.23	1.2	1.03
Feb-13	1	1.08	1.06	0.55
Feb-13	2	1.18	1.19	0.55
Feb-13	3	1.17	1.295	0.55
Feb-13	4	0.72	1.2	0.55
Feb-13	5	0.67	1.16	0.55
Feb-13	6	0.61	1.09	0.55
Feb-13	7	0.53	0.85	0.55
Feb-13	8	0.51	0.65	0.55
Feb-13	9	0.85	0.55	0.55
Feb-13	10	1.2	0.85	0.55
Feb-13	11	1.1	0.55	0.55
Feb-13	12	0.57	0.6	0.55
Feb-13	13	0.69	0.76	0.55
Feb-13	14	0.61	0.65	0.55
Feb-13	15	0.71	0.46	0.55
Feb-13	16	0.95	0.72	0.55
Feb-13	17	1.14	0.89	0.55
Feb-13	18	1.15	0.98	0.55
Feb-13	19	1.12	1.04	0.55
Feb-13	20	1.01	0.94	0.55

Feb-13	21	1.17	0.69	0.55
Feb-13	22	1.14	1.15	0.55
Feb-13	23	0.76	0.665	0.55
Feb-13	24	0.78	0.61	0.55
Feb-13	25	0.84	0.83	0.55
Feb-13	26	0.95	1.02	0.55
Feb-13	27	0.79	0.96	0.55
Feb-13	28	0.85	0.65	0.55
Mar-13	1	0.6	0.45	0.55
Mar-13	2	0.55	0.49	0.55
Mar-13	3	0.86	0.93	0.55
Mar-13	4	0.94	1.15	0.55
Mar-13	5	1.21	1.18	0.55
Mar-13	6	0.98	1.04	0.55
Mar-13	7	0.87	0.925	0.55
Mar-13	8	1.11	1.1	0.55
Mar-13	9	1.37	1.295	0.55
Mar-13	10	1.25	1.24	0.55
Mar-13	11	0.96	0.92	0.55
Mar-13	12	1.035	0.97	0.55
Mar-13	13	0.92	0.95	0.55
Mar-13	14	1.19	1.16	0.55
Mar-13	15	1.25	1.25	0.55
Mar-13	16	0.91	0.84	0.55
Mar-13	17	0.82	0.75	0.55

Mar-13	18	0.76	0.86	0.55
Mar-13	19	0.67	0.75	0.55
Mar-13	20	0.685	0.65	0.55
Mar-13	21	0.61	0.61	0.55
Mar-13	22	0.59	0.56	0.55
Mar-13	23	0.57	0.54	0.55
Mar-13	24	0.55	0.51	0.55
Mar-13	25	0.535	0.46	0.55
Mar-13	26	0.6	0.92	0.55
Mar-13	27	0.84	0.85	0.55
Mar-13	28	0.96	1.03	0.55
Mar-13	29	0.89	0.98	0.55
Mar-13	30	1.05	1.07	0.55
Mar-13	31	1.03	1.02	0.55
Apr-13	1	0.75	0.78	0.55
Apr-13	2	0.77	0.8	0.55
Apr-13	3	0.85	0.84	0.55
Apr-13	4	0.92	0.88	0.55
Apr-13	5	0.86	0.83	0.55
Apr-13	6	0.77	0.74	0.55
Apr-13	7	0.72	0.69	0.55
Apr-13	8	1.09	1.06	0.55
Apr-13	9	1	1.03	0.55
Apr-13	10	0.7	0.74	0.55
Apr-13	11	0.71	0.68	0.55

Apr-13	12	0.59	0.58	0.55
Apr-13	13	0.57	0.55	0.55
Apr-13	14	0.53	0.52	0.55
Apr-13	15	0.85	0.48	0.55
Apr-13	16	1.1	0.49	0.55
Apr-13	17	1	1.15	0.55
Apr-13	18	0.9	1.15	0.55
Apr-13	19	0.8	0.95	0.55
Apr-13	20	0.6	0.75	0.55
Apr-13	21	0.4	0.65	0.55
Apr-13	22	0.4	0.35	0.55
Apr-13	23	0.4	0.35	0.55
Apr-13	24	0.4	0.35	0.55
Apr-13	25	0.4	0.35	0.55
Apr-13	26	0.4	0.35	0.55
Apr-13	27	0.4	0.35	0.55
Apr-13	28	0.4	0.35	0.55
Apr-13	29	0.4	0.35	0.55
Apr-13	30	0.4	0.35	0.55
May-13	1	0.4	0.35	0.55
May-13	2	0.4	0.35	0.55
May-13	3	0.4	0.35	0.55
May-13	4	0.4	0.35	0.55
May-13	5	0.4	0.35	0.55
May-13	6	0.7	0.53	0.55

May-13	7	0.575	0.63	0.55
May-13	8	0.45	0.45	0.55
May-13	9	0.4	0.35	0.55
May-13	10	0.4	0.35	0.55
May-13	11	0.4	0.35	0.55
May-13	12	0.4	0.35	0.55
May-13	13	0.4	0.35	0.55
May-13	14	0.4	0.35	0.55
May-13	15	0.4	0.35	0.55
May-13	16	0.4	0.35	0.55
May-13	17	0.4	0.35	0.55
May-13	18	0.4	0.35	0.55
May-13	19	0.4	0.35	0.55
May-13	20	0.4	0.35	0.55
May-13	21	0.4	0.35	0.55
May-13	22	0.4	0.35	0.55
May-13	23	0.4	0.35	0.55
May-13	24	0.4	0.35	0.55
May-13	25	0.4	0.35	0.55
May-13	26	0.4	0.35	0.55
May-13	27	0.4	0.35	0.55
May-13	28	0.4	0.35	0.55
May-13	29	0.4	0.35	0.55
May-13	30	0.4	0.35	0.55
May-13	31	0.4	0.35	0.55

Jun-13	1	0.4	0.35	0.55
Jun-13	2	0.4	0.35	0.55
Jun-13	3	0.4	0.35	0.55
Jun-13	4	0.4	0.35	0.55
Jun-13	5	0.4	0.35	0.55
Jun-13	6	0.4	0.35	0.55
Jun-13	7	0.55	0.53	0.55
Jun-13	8	0.75	0.73	0.55
Jun-13	9	0.69	0.69	0.55
Jun-13	10	0.58	0.55	0.55
Jun-13	11	0.85	0.47	0.55
Jun-13	12	0.6	0.65	0.55
Jun-13	13	0.4	0.35	0.55
Jun-13	14	0.4	0.35	0.55
Jun-13	15	0.4	0.35	0.55
Jun-13	16	0.4	0.35	0.55
Jun-13	17	0.4	0.35	0.55
Jun-13	18	0.4	0.35	0.55
Jun-13	19	0.4	0.35	0.55
Jun-13	20	0.4	0.35	0.55
Jun-13	21	0.4	0.35	0.55
Jun-13	22	0.4	0.35	0.55
Jun-13	23	0.4	0.35	0.55
Jun-13	24	0.4	0.35	0.55
Jun-13	25	0.4	0.35	0.55

Jun-13	26	0.4	0.35	0.55
Jun-13	27	0.4	0.35	0.55
Jun-13	28	0.4	0.35	0.55
Jun-13	29	0.4	0.35	0.55
Jun-13	30	0.4	0.35	0.55

This data will be used in the calculation of average daily discharge in each station.

3.4 Bi-Monthly Observation

Current of the stream was measured on semi-monthly basis (twice a month) for the period of the project (November 2012 to June 2013). Measurement will be conducted for two different conditions of water depth – when depth of water is less than 0.75 meter and when depth of water is greater than 0.75 meter. When water depth is less than 0.75 meter, measurement will be conducted at 60% depth from the surface whereas when water depth is greater than 0.75 meter, measurement will be taken at two points in vertical direction – at 20% and 80% depths from the surface. The data of the average value of water depth, velocity, width, flow are, and respective discharges are presented in the following table (Table 4 & Table 5).

Table 4: Semi-monthly Discharge Observation (For various water depth) at Station #1

DD/ MM/ YYYY	Water level, m	Velocity m/s	Width, m	Area, m^2	Discharge, m^3/s
	S1	S1	S1	S1	S1
17/ 11/ 2012	0.10	0.20	2.00	0.20	0.04
29/ 11/ 2012	0.10	0.24	2.00	0.20	0.05
08/ 12/ 12	0.20	0.30	0.50	0.10	0.03
27/ 12/ 2012	0.36	0.98	18.60	6.70	6.56
29/ 12/ 2012	0.37	1.15	27.20	10.06	11.57
11/ 1/ 2013 : 14:00	1.00	1.20	29.50	29.50	35.40
11/ 1/ 2013: 15:00	1.20	1.50	29.50	35.40	53.10
15/ 1/ 2013	1.3	1.4	44.2	57.46	80.44
30/ 1/ 2013	0.4	1.013	13	5.20	5.27
12/ 02/ 12	0.33	0.1	13	4.29	0.43
27/ 2/ 2012	0.15	0.49	13	1.95	0.96
11/ 03/ 13	0.8	1.5	13	10.40	15.60
27/ 3/ 2013	0.3	0.53	10	3.00	1.59
12/ 4/ 2013	0.35	1.1	28.6	10.01	11.01

26/ 4/ 2013	0.25	0.6	28.6	7.15	4.29
12/ 5/ 2013	0.2	0.8	28.6	5.72	4.58
26/ 5/ 2013	0.25	0.45	28.6	7.15	3.22
12/ 6/ 2013	0.23	0.4	28.6	6.58	2.63
26/ 6/ 2013	0.23	0.4	28.6	6.58	2.63

Table Semi-monthly Discharge Observation (For various water depth) at Station #2

DD/ MM/ YYYY	Water level, m	Velocity m/s	Width m	Area m2	Discharge, m3/s
	S2	S2	S2	S2	S2
17/ 11/ 2012	0.38	0.50	9.30	3.53	1.76
29/ 11/ 2012	0.33	0.38	9.30	3.07	1.18
08/ 12/ 12	0.41	0.60	9.50	3.90	2.34
27/ 12/ 2012	0.45	0.10	4.00	1.80	0.18
29/ 12/ 2012	0.50	0.22	6.00	3.00	0.66
11/ 1/ 2013 : 14:00	0.70	1.40	9.00	6.30	8.82
11/ 1/ 2013: 15:00	1.20	1.50	9.00	10.80	16.20
15/ 1/ 2013	1.6	1.35	15.6	24.96	33.70
30/ 1/ 2013	0.4	1.24	51.8	20.72	25.69
12/ 02/ 12	0.255	0.95	49.8	12.70	12.06
27/ 2/ 2012	0.33	0.83	69.4	22.90	19.01
11/ 03/ 13	0.4	0.977	46.8	18.72	18.29
27/ 3/ 2013	0.34	0.91	46.8	15.91	14.48
12/ 4/ 2013	1.2	1.1	31.36	37.63	41.40
26/ 4/ 2013	0.6	0.84	31.2	18.72	15.72
12/ 5/ 2013	0.45	0.75	31.2	14.04	10.53
26/ 5/ 2013	0.4	0.67	31.2	12.48	8.36
12/ 6/ 2013	0.35	0.5	31.2	10.92	5.46
26/ 6/ 2013	0.35	0.5	31.2	10.92	5.46

Table Semi-monthly Discharge Observation (For various water depths) at Station #3

DD/ MM/ YYYY	Water level, m	Velocity m/s	Width m	Area m^2	Discharge, m^3/s
	S3	S3	S3	S3	S3
17/ 11/ 2012	0	0	0	0	0
29/ 11/ 2012	0	0	0	0	0
8/ 12/ 2012	0	0	0	0	0
27/ 12/ 2012	0	0	0	0	0
29/ 12/ 2012	0	0	0	0	0
11/ 1/ 2013 : 14:00	0	0	0	0	0
11/ 1/ 2013: 15:00	0	0	0	0	0
15/ 1/ 2013	0	0	0	0	0
30/ 1/ 2013	0	0	0	0	0
12/ 2/ 2012	0	0	0	0	0
27/ 2/ 2012	0	0	0	0	0
11/ 3/ 2013	0	0	0	0	0
27/ 3/ 2013	0	0	0	0	0
12/ 4/ 2013	0	0	0	0	0
26/ 4/ 2013	0	0	0	0	0
12/ 5/ 2013	0	0	0	0	0
26/ 5/ 2013	0	0	0	0	0
12/ 6/ 2013	0	0	0	0	0
26/ 6/ 2013	0	0	0	0	0

S = Station; N = Number of Station

The H and Q from the above table will be used to derive the relationship between the H and Q for the estimation of daily discharge.

Note that no water was flowed through the station #3 and therefore no data was taken from this site.

3.5 High Flow Observation

High flow observation is necessary to collect data for the development of stage-discharge relations. Communication between the local staff and PEC-Consulting will be established to provide necessary information on the likelihood of high intensity rain event that will potentially produce high flow condition. Based on information from local staff and ground

Table 5: High Flow Observation during the Survey Time Frame

DD/MM/YYYY	Water level, m			Discharge, m3/s			Total Flow
	S1	S2	S3	S1	S2	S3	
11/1/2013: 14:00	1	0.7	0	35.4	8.82	0	44.22
11/1/2013: 15:00	1.2	1.2	0	53.1	16.2	0	69.3
15/1/2013	1.3	1.6	0	99.01	33.70	0	132.7
26/2/2012	0.15	0.33	0	0.96	19.01	0	19.96
12/3/2013	1.3	0.35	0	25.35	15.44	0	40.79
26/3/2013	0.35	0.36	0	1.855	15.35	0	17.21
11/4/2013	0.45	0.4	0	2.93	16.02	0	18.94
27/4/2013	0.42	1.24	0	13.93	46.66	0	60.6
5/5/2013	0.28	0.52	0	7.61	13.79	0	21.4
24/5/2013	0.3	0.45	0	4.72	10.53	0	15.25
8/6/2013	0.25	0.43	0	3.72	8.72	0	12.44

Similar clarification could be drawn which is to point out that the no flow was observed in the station #3.

3.6 Scatter Plot of H-Q relation

The relationship between the height and discharge were plot in the following figures, which shows the trend of the polynomial equation to be derived.

Table 6 Average height and Discharge at Station #1

DD/ MM/ YYYY	Water level, m S1	Discharge, m3/s S1
17/ 11/ 2012	0.10	0.04
29/ 11/ 2012	0.10	0.05
08/ 12/ 12	0.20	0.03
27/ 12/ 2012	0.36	6.56
29/ 12/ 2012	0.37	11.57
11/ 1/ 2013 : 14:00	1.00	35.40
11/ 1/ 2013: 15:00	1.20	53.10
15/ 1/ 2013	1.3	80.44
30/ 1/ 2013	0.4	5.27
12/ 02/ 12	0.33	0.43
27/ 2/ 2012	0.15	0.96
12/ 03/ 13	0.8	15.60
26/ 3/ 2013	0.3	1.59

12/ 4/ 2013	0.35	11.01
26/ 4/ 2013	0.25	4.29
12/ 5/ 2013	0.2	4.58
26/ 5/ 2013	0.25	3.22
12/ 6/ 2013	0.23	2.63
26/ 6/ 2013	0.23	2.63

Figure 10 Polinomial Equation of stage-discharge relation

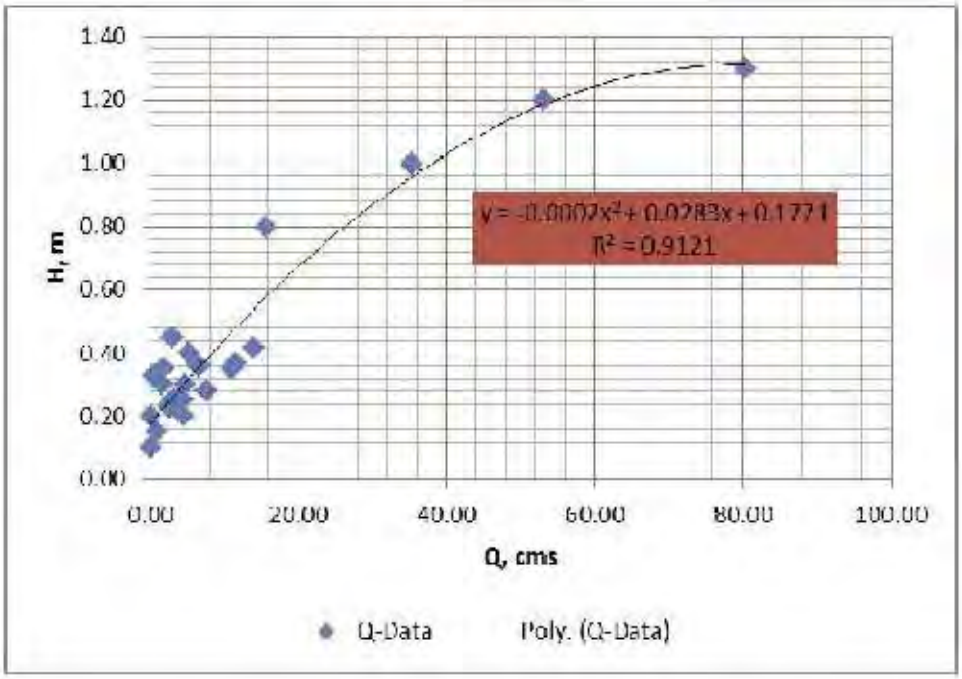
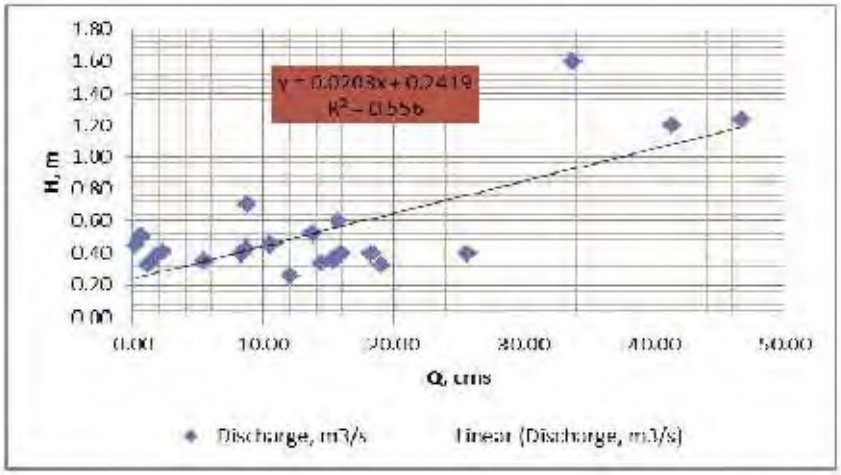


Table 7 Average height and Discharge at Station #2

DD/ MM/ YYYY	Water level, m	Discharge, m3/s
	S2	S2
17/ 11/ 2012	0.38	1.76
29/ 11/ 2012	0.33	1.18
08/ 12/ 12	0.41	2.34
27/ 12/ 2012	0.45	0.18
29/ 12/ 2012	0.50	0.66
11/ 1/ 2013 : 14:00	0.70	8.82
11/ 1/ 2013: 15:00	1.20	16.20
15/ 1/ 2013	1.60	33.70
30/ 1/ 2013	0.40	25.69
12/ 02/ 12	0.26	12.06
27/ 2/ 2012	0.33	19.01
12/ 03/ 13	0.40	18.29
26/ 3/ 2013	0.34	14.48
12/ 4/ 2013	1.20	41.40
26/ 4/ 2013	0.60	15.72
12/ 5/ 2013	0.45	10.53
26/ 5/ 2013	0.40	8.36
12/ 6/ 2013	0.35	5.46
26/ 6/ 2013	0.35	5.46

Figure 11: Stage-Discharge relation at Station #2



The rating curve for station #3 can not be derived as the data is not available and this limitation will affect the usage of rating curve for the prediction of discharge from the measured height.

4. Stage-Discharge and Discharge Calculation

4.1 Rating Curve (H versus Q)

The polynomial equal of discharge versus stage for station #1 can be represented by the following power function.

$$H = -2x10^{-3}Q^2 + 0.0283Q - 0.1771$$

With $R^2 = 0.91$

While the equation for station #2 is not promising as the trend approach to linear equation.

$$H = 0.0203Q - 0.242$$

With $R^2 = 0.56$

These two equations were used to calculate the average daily discharge of Laleia River from the average daily water height, which was observed daily.

4.2 Daily Discharge Calculation

The above curve of discharge relation to the height will be used to calculate the daily discharge from the daily height observation. The daily discharge from period of November 2012 to June 2013 can be seen from the following table.

Table 8 Daily average flow of Laleia River from Period of November 2012 to June 2013

M-Year	DD	H1, m	H2, m	H3, m	Q1, cms	Q2, cms	Total Flow, cms
Nov-12	1				-	-	-
Nov-12	2				-	-	-
Nov-12	3				-	-	-
Nov-12	4				-	-	-
Nov-12	5				-	-	-
Nov-12	6				-	-	-

Nov-12	7				-	-	-
Nov-12	8				-	-	-
Nov-12	9				-	-	-
Nov-12	10				-	-	-
Nov-12	11				-	-	-
Nov-12	12				-	-	-
Nov-12	13				-	-	-
Nov-12	14				-	-	-
Nov-12	15				-	-	-
Nov-12	16				-	-	-
Nov-12	17	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	18	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	19	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	20	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	21	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	22	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	23	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	24	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	25	0.41	0.55	0.55	5.43	14.67	20.11
Nov-12	26	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	27	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	28	0.40	0.35	0.55	5.21	9.20	14.41
Nov-12	29	0.60	1.15	0.55	11.94	31.08	43.03
Nov-12	30	0.40	0.87	0.55	5.21	23.42	28.63
Dec-12	1	0.40	0.71	0.55	5.21	19.05	24.25
Dec-12	2	0.60	0.40	0.55	11.94	10.57	22.51
Dec-12	3	0.40	0.35	0.55	5.21	9.20	14.41
Dec-12	4	0.40	0.35	0.55	5.21	9.20	14.41
Dec-12	5	0.40	0.35	0.55	5.21	9.20	14.41
Dec-12	6	0.40	0.35	0.55	5.21	9.20	14.41
Dec-12	7	0.45	0.70	0.55	6.46	18.78	25.24
Dec-12	8	0.40	0.55	0.55	5.21	14.67	19.88
Dec-12	9	0.40	0.35	0.55	5.21	9.20	14.41
Dec-12	10	0.40	0.75	0.55	5.21	20.14	25.35
Dec-12	11	0.50	0.49	0.55	8.01	13.03	21.04
Dec-12	12	0.70	0.48	0.55	17.02	12.76	29.78
Dec-12	13	0.55	0.49	0.55	9.83	13.03	22.86
Dec-12	14	0.50	0.80	0.55	8.01	21.51	29.52
Dec-12	15	0.80	1.05	0.55	23.23	28.35	51.58
Dec-12	16	1.00	0.85	0.55	39.07	22.88	61.94
Dec-12	17	0.75	0.67	0.55	19.98	17.95	37.94

Dec-12	18	0.90	1.33	0.55	30.58	36.01	66.59
Dec-12	19	0.74	1.15	0.55	19.40	31.08	50.48
Dec-12	20	1.13	1.16	0.55	51.80	31.36	83.15
Dec-12	21	1.29	1.31	0.55	70.10	35.46	105.56
Dec-12	22	0.81	0.97	0.55	23.92	26.16	50.07
Dec-12	23	0.68	0.58	0.55	15.91	15.49	31.41
Dec-12	24	1.05	1.32	0.55	43.74	35.73	79.47
Dec-12	25	0.86	0.98	0.55	27.50	26.43	53.94
Dec-12	26	1.15	0.74	0.55	53.93	19.87	73.80
Dec-12	27	0.58	0.81	0.55	11.07	21.78	32.85
Dec-12	28	0.62	0.95	0.55	12.87	25.61	38.48
Dec-12	29	1.04	0.67	0.55	42.78	17.95	60.73
Dec-12	30	1.00	0.80	0.55	39.07	21.51	60.58
Dec-12	31	1.40	1.40	0.55	84.38	37.92	122.30
Jan-13	1	1.32	1.15	0.55	73.86	30.95	104.81
Jan-13	2	1.00	0.85	0.55	39.07	22.88	61.94
Jan-13	3	0.93	0.81	0.55	33.01	21.78	54.79
Jan-13	4	0.91	0.76	0.55	31.38	20.42	51.79
Jan-13	5	1.74	1.75	1.05	137.20	47.49	184.69
Jan-13	6	1.18	1.06	0.73	57.21	28.62	85.83
Jan-13	7	0.80	0.66	0.55	23.23	17.68	40.91
Jan-13	8	0.56	0.48	0.55	10.03	12.62	22.65
Jan-13	9	0.70	0.80	0.55	17.02	21.51	38.53
Jan-13	10	0.59	0.53	0.55	11.50	14.13	25.63
Jan-13	11	0.82	0.76	0.55	24.61	20.42	45.03
Jan-13	12	1.27	1.08	0.55	67.66	29.17	96.82
Jan-13	13	0.79	0.77	0.55	22.56	20.69	43.25
Jan-13	14	0.95	0.92	0.55	34.68	24.79	59.47
Jan-13	15	1.00	1.14	0.55	39.07	30.81	69.88
Jan-13	16	0.85	1.10	0.55	26.76	29.72	56.48
Jan-13	17	1.05	1.06	0.55	43.74	28.62	72.36
Jan-13	18	0.99	1.04	0.55	38.17	28.07	66.24
Jan-13	19	0.72	1.19	0.55	18.17	32.18	50.35
Jan-13	20	0.61	1.21	0.55	12.40	32.72	45.12
Jan-13	21	0.57	1.04	0.55	10.44	28.07	38.51
Jan-13	22	0.55	1.01	0.55	9.83	27.25	37.09
Jan-13	23	1.35	1.40	0.55	77.72	37.92	115.64
Jan-13	24	1.50	1.35	0.55	98.55	36.55	135.10
Jan-13	25	0.51	0.85	0.55	8.35	22.88	31.23
Jan-13	26	0.52	0.75	0.55	8.70	20.14	28.85
Jan-13	27	0.50	1.22	0.55	8.01	33.00	41.00

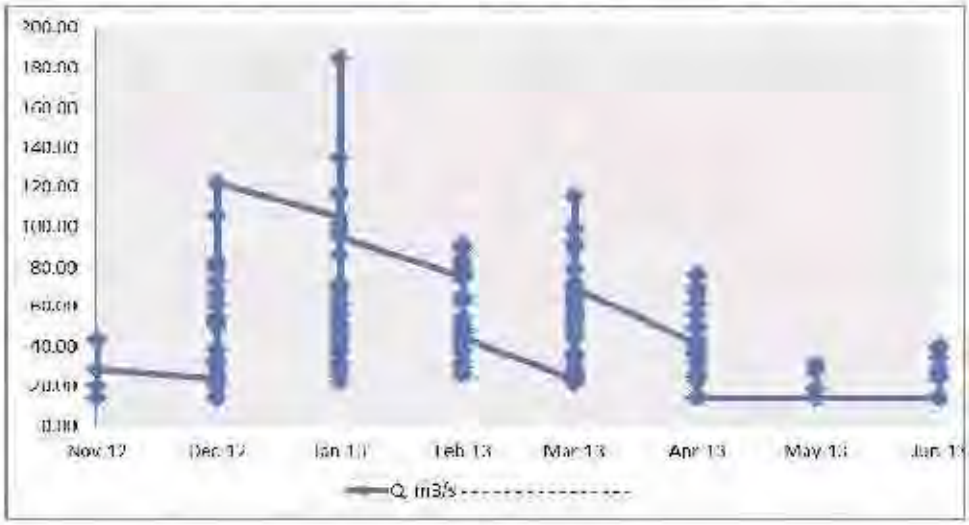
Jan-13	28	1.15	0.65	0.55	53.93	17.41	71.33
Jan-13	29	1.50	0.71	1.05	98.55	19.05	117.60
Jan-13	30	1.36	0.83	1.42	79.03	22.19	101.22
Jan-13	31	1.23	1.20	1.03	62.90	32.45	95.35
Feb-13	1	1.08	1.06	0.55	46.67	28.62	75.29
Feb-13	2	1.18	1.19	0.55	57.21	32.18	89.38
Feb-13	3	1.17	1.30	0.55	56.10	35.05	91.15
Feb-13	4	0.72	1.20	0.55	18.17	32.45	50.62
Feb-13	5	0.67	1.16	0.55	15.38	31.36	46.73
Feb-13	6	0.61	1.09	0.55	12.40	29.44	41.84
Feb-13	7	0.53	0.85	0.55	9.07	22.88	31.95
Feb-13	8	0.51	0.65	0.55	8.35	17.41	25.76
Feb-13	9	0.85	0.55	0.55	26.76	14.67	41.44
Feb-13	10	1.20	0.85	0.55	59.45	22.88	82.33
Feb-13	11	1.10	0.55	0.55	48.69	14.67	63.36
Feb-13	12	0.57	0.60	0.55	10.64	16.04	26.68
Feb-13	13	0.69	0.76	0.55	16.46	20.42	36.88
Feb-13	14	0.61	0.65	0.55	12.40	17.41	29.81
Feb-13	15	0.71	0.46	0.55	17.59	12.21	29.80
Feb-13	16	0.95	0.72	0.55	34.68	19.32	54.00
Feb-13	17	1.14	0.89	0.55	52.86	23.97	76.83
Feb-13	18	1.15	0.98	0.55	53.93	26.43	80.36
Feb-13	19	1.12	1.04	0.55	50.75	28.07	78.82
Feb-13	20	1.01	0.94	0.55	39.98	25.34	65.32
Feb-13	21	1.17	0.69	0.55	56.10	18.50	74.60
Feb-13	22	1.14	1.15	0.55	52.86	31.08	83.94
Feb-13	23	0.76	0.67	0.55	20.61	17.82	38.43
Feb-13	24	0.78	0.61	0.55	21.90	16.31	38.21
Feb-13	25	0.84	0.83	0.55	26.03	22.33	48.37
Feb-13	26	0.95	1.02	0.55	34.68	27.53	62.21
Feb-13	27	0.79	0.96	0.55	22.56	25.89	48.45
Feb-13	28	0.85	0.65	0.55	26.76	17.41	44.17
Mar-13	1	0.60	0.45	0.55	11.94	11.94	23.88
Mar-13	2	0.55	0.49	0.55	9.83	13.03	22.86
Mar-13	3	0.86	0.93	0.55	27.50	25.07	52.57
Mar-13	4	0.94	1.15	0.55	33.84	31.08	64.92
Mar-13	5	1.21	1.18	0.55	60.59	31.90	92.49
Mar-13	6	0.98	1.04	0.55	37.28	28.07	65.35
Mar-13	7	0.87	0.93	0.55	28.26	24.93	53.18
Mar-13	8	1.11	1.10	0.55	49.71	29.72	79.43
Mar-13	9	1.37	1.30	0.55	80.35	35.05	115.40

Mar 13	10	1.25	1.24	0.55	65.25	33.54	98.80
Mar 13	11	0.96	0.92	0.55	35.54	24.79	60.33
Mar 13	12	1.04	0.97	0.55	42.30	26.16	68.46
Mar 13	13	0.92	0.95	0.55	32.19	25.61	57.80
Mar 13	14	1.19	1.16	0.55	58.32	31.36	89.68
Mar 13	15	1.25	1.25	0.55	65.25	33.82	99.07
Mar 13	16	0.91	0.84	0.55	31.38	22.60	53.98
Mar 13	17	0.82	0.75	0.55	24.61	20.14	44.75
Mar 13	18	0.76	0.86	0.55	20.61	23.15	43.76
Mar 13	19	0.67	0.75	0.55	15.38	20.14	35.52
Mar 13	20	0.69	0.65	0.55	16.19	17.41	33.59
Mar 13	21	0.61	0.61	0.55	12.40	16.31	28.71
Mar 13	22	0.59	0.56	0.55	11.50	14.95	26.45
Mar 13	23	0.57	0.54	0.55	10.64	14.40	25.04
Mar 13	24	0.55	0.51	0.55	9.83	13.58	23.41
Mar 13	25	0.54	0.46	0.55	9.26	12.21	21.47
Mar 13	26	0.60	0.92	0.55	11.94	24.79	36.74
Mar 13	27	0.84	0.85	0.55	26.03	22.88	48.91
Mar 13	28	0.96	1.03	0.55	35.54	27.80	63.34
Mar 13	29	0.89	0.98	0.55	29.79	26.43	56.23
Mar 13	30	1.05	1.07	0.55	43.74	28.89	72.63
Mar 13	31	1.03	1.02	0.55	41.83	27.53	69.36
Apr 13	1	0.75	0.78	0.55	19.98	20.96	40.95
Apr 13	2	0.77	0.80	0.55	21.25	21.51	42.76
Apr 13	3	0.85	0.84	0.55	26.76	22.60	49.37
Apr 13	4	0.92	0.88	0.55	32.19	23.70	55.88
Apr 13	5	0.86	0.83	0.55	27.50	22.33	49.83
Apr 13	6	0.77	0.74	0.55	21.25	19.87	41.12
Apr 13	7	0.72	0.69	0.55	18.17	18.50	36.67
Apr 13	8	1.09	1.06	0.55	47.68	28.62	76.30
Apr 13	9	1.00	1.03	0.55	39.07	27.80	66.87
Apr 13	10	0.70	0.74	0.55	17.02	19.87	36.89
Apr 13	11	0.71	0.68	0.55	17.59	18.23	35.82
Apr 13	12	0.59	0.58	0.55	11.50	15.49	26.99
Apr 13	13	0.57	0.55	0.55	10.64	14.67	25.32
Apr 13	14	0.53	0.52	0.55	9.07	13.85	22.92
Apr 13	15	0.85	0.48	0.55	26.76	12.76	39.52
Apr 13	16	1.10	0.49	0.55	48.69	13.03	61.72
Apr 13	17	1.00	1.15	0.55	39.07	31.08	70.15
Apr 13	18	0.90	1.15	0.55	30.58	31.08	61.66
Apr 13	19	0.80	0.95	0.55	23.23	25.61	48.84

Apr-13	20	0.60	0.75	0.55	11.94	20.14	32.09
Apr-13	21	0.40	0.65	0.55	5.21	17.41	22.61
Apr-13	22	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	23	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	24	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	25	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	26	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	27	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	28	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	29	0.40	0.35	0.55	5.21	9.20	14.41
Apr-13	30	0.40	0.35	0.55	5.21	9.20	14.41
May-13	1	0.40	0.35	0.55	5.21	9.20	14.41
May-13	2	0.40	0.35	0.55	5.21	9.20	14.41
May-13	3	0.40	0.35	0.55	5.21	9.20	14.41
May-13	4	0.40	0.35	0.55	5.21	9.20	14.41
May-13	5	0.40	0.35	0.55	5.21	9.20	14.41
May-13	6	0.70	0.53	0.55	17.02	14.13	31.15
May-13	7	0.58	0.63	0.55	10.85	16.86	27.71
May-13	8	0.45	0.45	0.55	6.46	11.94	18.40
May-13	9	0.40	0.35	0.55	5.21	9.20	14.41
May-13	10	0.40	0.35	0.55	5.21	9.20	14.41
May-13	11	0.40	0.35	0.55	5.21	9.20	14.41
May-13	12	0.40	0.35	0.55	5.21	9.20	14.41
May-13	13	0.40	0.35	0.55	5.21	9.20	14.41
May-13	14	0.40	0.35	0.55	5.21	9.20	14.41
May-13	15	0.40	0.35	0.55	5.21	9.20	14.41
May-13	16	0.40	0.35	0.55	5.21	9.20	14.41
May-13	17	0.40	0.35	0.55	5.21	9.20	14.41
May-13	18	0.40	0.35	0.55	5.21	9.20	14.41
May-13	19	0.40	0.35	0.55	5.21	9.20	14.41
May-13	20	0.40	0.35	0.55	5.21	9.20	14.41
May-13	21	0.40	0.35	0.55	5.21	9.20	14.41
May-13	22	0.40	0.35	0.55	5.21	9.20	14.41
May-13	23	0.40	0.35	0.55	5.21	9.20	14.41
May-13	24	0.40	0.35	0.55	5.21	9.20	14.41
May-13	25	0.40	0.35	0.55	5.21	9.20	14.41
May-13	26	0.40	0.35	0.55	5.21	9.20	14.41
May-13	27	0.40	0.35	0.55	5.21	9.20	14.41
May-13	28	0.40	0.35	0.55	5.21	9.20	14.41
May-13	29	0.40	0.35	0.55	5.21	9.20	14.41
May-13	30	0.40	0.35	0.55	5.21	9.20	14.41

May-13	31	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	1	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	2	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	3	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	4	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	5	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	6	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	7	0.55	0.53	0.55	9.83	14.13	23.96
Jun-13	8	0.75	0.73	0.55	19.98	19.60	39.58
Jun-13	9	0.69	0.69	0.55	16.46	18.50	34.96
Jun-13	10	0.58	0.55	0.55	11.07	14.67	25.74
Jun-13	11	0.85	0.47	0.55	26.76	12.48	39.25
Jun-13	12	0.60	0.65	0.55	11.94	17.41	29.35
Jun-13	13	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	14	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	15	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	16	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	17	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	18	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	19	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	20	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	21	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	22	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	23	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	24	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	25	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	26	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	27	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	28	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	29	0.40	0.35	0.55	5.21	9.20	14.41
Jun-13	30	0.40	0.35	0.55	5.21	9.20	14.41

Figure 12 . Average Daily discharge at Laleia River during the period of observation



4.3 Manning's Coefficient Estimation

The estimation manning's coefficient or N value is very important in the hydraulic design of the system. For the uniform steady state condition, the discharge in any giver river can be calculated by the following equation, which can also be used to calculate the discharge for non-uniform flow by modifying the head loss due to bed friction (Jarrett and Petsch 1985)

$$Q = \frac{1}{n} A R^{2/3} S_f^{1/2}$$

Where: Q = discharge

N = manning's coefficient

A = cross section area

R = hydraulic radius

The friction slope, S_f is defined as follow:

$$s_f = \frac{h_f}{L} = \frac{\Delta h + \Delta h_v - k(\Delta h_v)}{L};$$

Where:

Δh= the difference elevation of water surface

Δh_v= the difference friction loss due to velocity at two points = $\frac{(V_2^2 - V_1^2)}{2g}$

K = coefficient of extraction (0.5 or 1). Note that the selection K value does not affect very much on the estimated manning's coefficient.

L = the length between each reach station

Field measurement need to be established in order to collect the require data for the estimation of the N value. To do that, minimum two measurement station (upstream and downstream) would be needed. Fort this work, we proposed two points of measurement (Upstream and Downstream).

The estimation of manning's coefficient of Laleia River was based on two assumption:

- The energy gradient of 1/200
- Based on direct measurement of energy gradient, which was 1/100

Table 9 Field data collected and Calculated N based on Friction slope 1/200

Date of data taken	W, m	V, m/s	D, m	P, m	A, m2	Rh, m	Q, cms	N
29-Dec-12	33.2	0.94	0.4	34	13.28	0.390588	12.23	0.041
11/1/2013	38.5	1.5	1.2	40.9	46.2	1.129584	69.3	0.051
15/1/2013	56	1.39	1.37	58.74	76.72	1.306095	124.58	0.052
30/1/2013	64.8	1.194	0.4	65.6	25.92	0.395122	30.93	0.032
12/2/2013	62.8	0.72	0.28	63.36	17.584	0.277525	11.84	0.017
27/2/2013	82.4	0.802	0.32	83.04	26.368	0.317534	19.29	0.058
3/12/2013	76.3	1.26	0.78	77.86	59.514	0.764372	36.57	0.042
26/3/2013	56.8	0.85	0.33	57.46	18.744	0.32621	14.83	0.038

The calculation in the above table suggested that manning coefficient of Laleia River during the flood event is in the range of 0.03-0.05.

Regardless of the method, the field data collection of discharge, cross section area of flow, perimeter, and depth are need in order to calculate the manning's' coefficient.

Figure 13. Plan view of the cross section

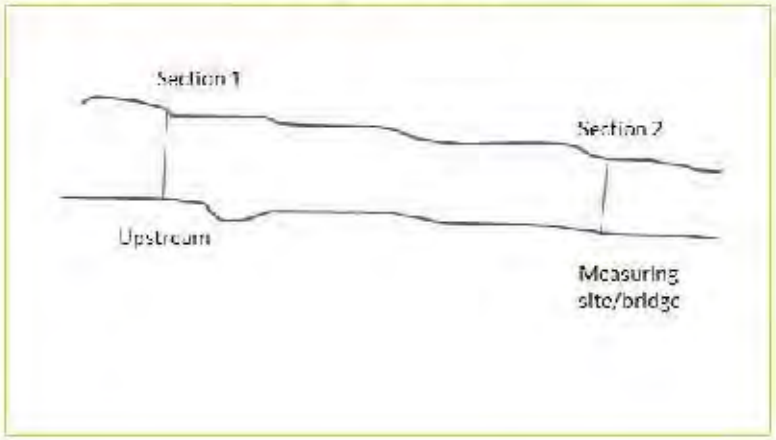
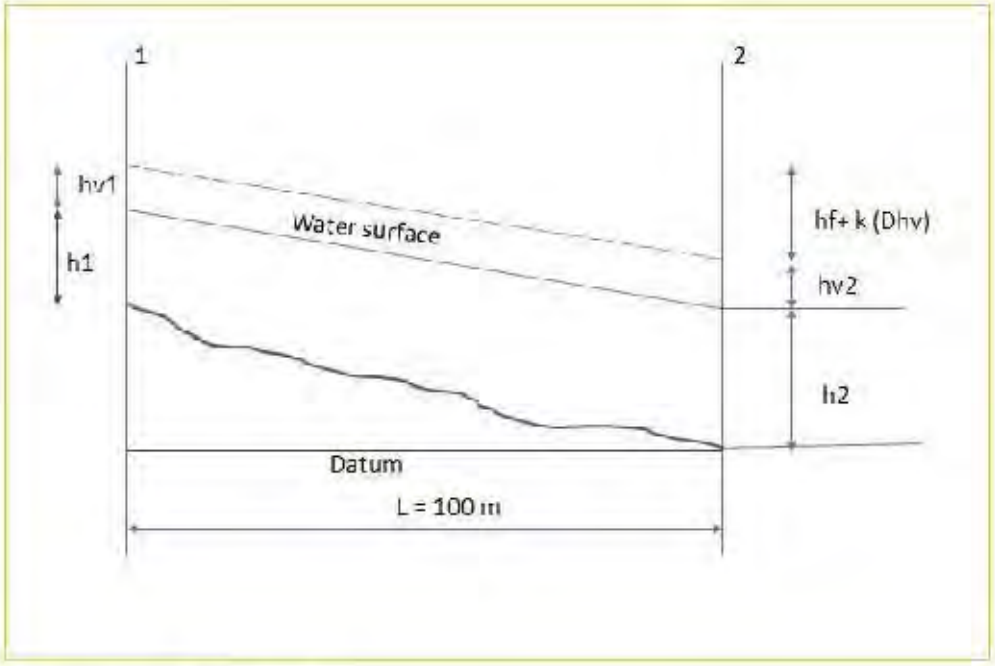


Figure 14. Detail of plan view of the cross section



Procedure to be followed:

1. Give/draw the profile of river with the measured data
2. Calculation of perimeter
3. Calculation of cross section
4. Calculation of flow
5. Calculation of energy gradient
6. Calculation of N value

Equation use to calculate the N:

$$n = \frac{1}{Q}\sqrt{\frac{(h_1 + h_{v_1}) - (h_m + h_{v_m}) - \sum_{i=2}^{m}(k_{i\ i-1}\Delta h_{v_{i\ i-1}})}{\sum_{i=2}^{m}\frac{L_{i-1,i}}{Z_{i-1}Z_i}}}$$

Where:

$$Z = AR^{2/3}$$

For m = 2, the above equation can be simplified as followed:

$$n = \frac{1}{Q_1}\sqrt{\frac{(h_1 + h_{v1}) - (h_2 + h_{v2}) - K_{1,2}\Delta h_{v1,2}}{\frac{L_{1,2}}{Z_{1,2}Z_2}}}$$

Table 10: N value of Laleia River for friction slope 1/200 (based on measurement of two points)

Date of data taken	N	N-Based on Measurement (dH = 0.5 m)
29-Dec-12	0.041	0.041
11/ 1/ 2013	0.051	0.051
15/1/2013	0.052	0.065
30/1/2013	0.032	0.038
12/2/2013	0.048	0.040
27/2/2013	0.058	0.043
3/12/2013	0.042	0.032
26/3/2013	0.038	0.048

The result suggest that the manning coefficient is range from 0.032-0.06, with the average at 0.045

If the friction slope was assumed 1/100, then the manning coefficient is presented in the following table:

Table 11 Manning's Coefficient for the Friction slope of 1/100

Date of data taken	W, m	V, m/s	D, m	P, m	A, m^2	Rh, m	N-Based on Measurement (dH = 1 m)
29-Dec-12	33.2	0.94	0.4	34	13.28	0.3906	0.056
11/1/2013	38.5	1.5	1.2	40.9	46.2	1.1296	0.072
30/1/2013	64.8	1.194	0.4	65.6	25.92	0.3951	0.045
12/2/2013	62.8	0.72	0.28	63.36	17.584	0.2775	0.056
27/2/2013	82.4	0.802	0.32	83.04	26.368	0.3175	0.0497
3/12/2013	76.3	1.26	0.78	77.86	59.514	0.7644	0.037
26/3/2013	56.8	0.85	0.33	57.46	18.744	0.3262	0.054

The range of manning coefficient is in the range of 0.035-0.06, with the average of 0.042

The fluctuation of N (Manning's coefficient) is inevitable due to change of flow regime and change in the nature of the flow path, flow area, and flow depth. However, the current observation on the manning variability has not given some idea on the trend of the manning's coefficient in relation to the magnitude of the discharge.

Therefore, the computation of the flood depth of design flood discharge of certain ARI (Average Return internal) was based on the average N values determined from the field observation. Even so, there is still one remaining unknown data that may affect some degree to the calculation of the water depth of the design flood discharge, which is the surface water elevation different between the two points of measurement.

It is possible that the elevation difference between the upstream and downstream (at the bridge) has elevation difference between 0.5 and 1.0 meter. This assumption will provide the friction slope of 1/200 and 1/100 respectively. Therefore, the calculation of manning's coefficient and later the flood depth of certain design flood discharge were based on friction slope of 1/200 and 1/100. However, the different in the final result (N and H) is fairly significant, which will affect further steps in the design and construction.

Therefore, it is suggested to measure the elevation different between the two points of measurements and use the value that is very close to the measurement. The finding of

Manning's coefficient of Laleia River was compared with other river which already measured in the past.

Table 12 Comparison of V value of Laleia River to other major river

River	N-value (Range)
Laleia	0.03-0.06
Clark Fork above Missoula, Mont	0.03
Columbia River at Vernita	0.027
Ohio	0.035

Table 13: typical N values for some major River in California

No.	Stream and location	Drainage area (sq mi)	Length of reach (ft)	Discharge (cfs)	Hydraulic radius (ft)	Manning n
1	2	3	4	5	6	7
1	Austin Creek near Cazadero.	63.1	288.0 290.5 295.0 303.0	5,050 1,370 858 672	5.90 2.70 2.01 1.38	0.036 .033 .036 .038
2	Cache Creek at Yolo.	1,138	270.0	2,130 944 277	4.26 2.62 1.02	.020 .022 .028
3	Middle Fork Eel River below Black Butte River, near Covelo.	367	309.5	2,010 1,350	4.88 1.54	.035 .043
4	Kaweah River at Three Rivers.	418	372.0	1,050 839 405	2.14 1.94 1.45	.071 .067 .088
5	Kings River below North Fork.	1,342	531.0 533.0 536.0	3,690 3,630 3,200 2,440	3.70 3.56 3.49 3.40	.064 .059 .064 .066
6	Merced River at Clarks bridge near Yosemite.	.....	248.0 256.0 248.0 254.0 248.0	1,340 1,340 1,650 983 1,170 686 622	3.62 3.60 3.48 3.18 2.96 2.08 2.68	.044 .035 .036 .052 .050 .038 .064
7	Merced River at Happy Isles bridge, near Yosemite.	181	180.0 200.0 220.0	1,950 1,950 1,990 1,840	4.38 3.93 3.74 3.28	.050 .038 .037 .050

Typical N values of Natural River with the channel type and condition were suggested by Chow, 1959 and summarized in the following table.

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Table 14: Generalized Mannings coefficient by Chow, 1959

Table 1 Suggested Manning *n* for natural streams (Chow, 1959).

Type of channel and description	Minimum	Normal	Maximum
Stream on plain			
Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
Same as above, but more stones and weeds	0.030	0.035	0.040
Clean, winding, some pools and shoals	0.033	0.040	0.045
Same as above, but more stones and weeds	0.035	0.045	0.050
Clean, winding, some pools and shoals, weeds and more stones	0.045	0.050	0.060

Laleia River is natural that has stone, gravel, and sand that formed the bed, which typically have resistance coefficient (N) in the range of 0.03 to 0.06

4.4 Design Flood Height Estimation

5-year ARI

100-year ARI

Using the formula of manning's equation to calculate the water depth, as follow:

$$Q_T = \frac{1}{n}(WD_T)\left(\frac{WD_T}{W+2D_T}\right)^{2/3} S_f^{1/2}$$

Because the equation is non-linear, the process of trial and error should be employed to determine the depth (D).

$$f(D_T) = Q_T - \frac{1}{n}(WD_T)\left(\frac{WD_T}{W+2D_T}\right)^{2/3} S_f^{1/2}$$

Where: T = average return period of design, year

W = river wide

D = depth of water (from the water surface to the river bed)

Sf = friction loss

QT = design flow

N = 0.042

Trial D value for *f (D)* approach to zero:

Table 15 Calculate Flood Design depth of Laleia River (based on assumption that Sf = 1/200)

Design ARI, yr	Q, cms	n	W, m	Sf	H, m
5	800	0.042	190	0.005	1.75
100	1500	0.042	190	0.005	2.56

For Sf = 1/100

Table 16 Calculated flood depth of different Sf (Sf=1/100)

Design ARI, yr	Q	n	W, m	Sf	H
5	800	0.042	190	0.01	1.42
100	1500	0.042	190	0.01	2.06

Table 17: Summary table of Flood depth with different S_f

S_f	Q, cms	Flood Depth , m
1/200	800	1.75
	1500	2.56
1/100	800	1.42
	1500	2.16

5. Finding and Conclusions Remarks

The hydrological data include stage-height (H), discharge (Q), and characteristics of Laleia river (N) were measured and determine in this project from period of November 2012 to June 2013. The raw data collected was used to derive the relationship between the stage height (H) and discharge of river (Q). The polynomial equations derived were then used to calculate the average daily discharge from the daily height observation during the period of observation.

The manning's coefficient that estimated from the field measurement was used to calculate the flood design height for 5- and 100-year return internal, which may be further used as an indication in the design of the hydrological structure of irrigation system in Buluto schemes.

Long-term continues data collection may be necessary to establish more general polynomial equation of stage (H) and discharge (Q) relation. Note that river characteristics such as flow area, flow depth kept changed from one storm to the other due to some existing flood protection work alone the river which affect heavily the measurement. The existing flood protection work moved bed material at upstream of point measurement to the side of the river. The storm would remove the bed material and store back to the river but exactly along the point of measurement; thus the increasing the height of the bottom of the river (at the point of measurement) as compare to the baseline data (the original where the site was established). In order to generalize a polynomial equation for Laleia River, more long-term measurement would be needed.

6. Annexes

6.1 Data Table (Excel file): File attched

6.2 Figures

6.3 Digital Photographs (Digital file attached)

Appendices 9 Monitoring Form

Monitoring Form - Construction Stage (every month)

Month: _____

Reporter: _____

Date: _____

Item (rate)	Reporter	Monitoring Report	Judgment by MAF*
Air pollution	Contractor	Visual observation of dust at the construction sites: (□ No air pollution / □ Probable air pollution => describe below)	☐ A ☐ B ☐ C
Water pollution	Contractor	Visual observation of turbidity of water in the Laleia river at the bridge:: (□ No water pollution / □ Probable water pollution => describe below)	☐ A ☐ B ☐ C
Waste	Contractor	Volume of disordered waste at the construction sites: (□ No waste problem / □ Probable waste problem => describe below)	☐ A ☐ B ☐ C
Soil pollution	Contractor	Visual observation of soils at the construction sites: (□ No soil pollution / □ Probable soil pollution => describe below)	☐ A ☐ B ☐ C
Noise and vibrations	Contractor	Physical observation of noise and vibration at the construction sites: (□ No noise or vibration problems / □ Heavy noise of vibration => describe below)	☐ A ☐ B ☐ C
Involuntary resettlement	District Agr., Local Gov.	Record of meeting with residents: (to be attached) Records of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C

Item (rate)	Reporter	Monitoring Report	Judgment by MAF*
Land use & utilization of local resources	District Agr., Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Water usage	District Agr.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Existing social infrastructures & services	Contractor	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Social institutions	District Agr., Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Misdistribution of benefits & damages	District Agr., Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Local conflicts of interest	District Agr., Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Accidents	Contractor	Record of accidents: (□ No accident / □ Accidents occurred => describe below)	☐ A ☐ B ☐ C

Remarks: Judgment by MAF: "A" = Confirmed as no problem; "B" = To be re-examined; "C" = To be solved

Note:

- The reporters (Contractor, District Agriculture Offices, and Local Administrations) shall fill the monitoring form every month, and submit it to the National Directorate of Irrigation and Water Management of the MAF.

- The National Directorate of Irrigation and Water Management of the MAF shall evaluate the report. If there are items to be re-examined, the Directorate shall inform the reporters to make detailed survey on the items. In case of any serious problems occurred, the Directorate shall take countermeasure to solve the problems in cooperation with related agencies.

Monitoring Form - Operation Stage (every three months)

Duration: _____

Reporter: _____

Date: _____

Item (rate)	Reporter	Monitoring Report	Judgment by MAF*
Hydrometeor	District Agr.,	Visual observation of water flow at the new intake weir in the Laleia river: (□ No significant change / □ Significant change => describe below)	☐ A ☐ B ☐ C
Involuntary resettlement	District Agr., Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Social institutions	District Agr., Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Misdistribution of benefits & damages	Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
	District Agr.	Record of irrigation water supply: (□ Supplied as planned / □ Not supplied as planned => describe below)	☐ A ☐ B ☐ C
Local conflicts of interest	Local Gov.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
	District Agr.	Record of irrigation water supply: (Same as above)	

Remarks: Judgment by MAF: "A" = Confirmed as no problem; "B" = To be re-examined; "C" = To be solved

Note:

- The reporters (Contractor, District Agriculture Offices, and Local Administrations) shall fill the monitoring form every three months, and submit it to the National Directorate of Irrigation and Water Management of the MAF.
- The National Directorate of Irrigation and Water Management of the MAF shall evaluate the report. If there are items to be re-examined, the Directorate shall inform the reporters to make detailed survey on the items. In case of any serious problems occurred, the Directorate shall take countermeasure to solve the problems in cooperation with related agencies.

Appendices 10 Environmental Check List

Environmental Check List

Category / Item	Check Item	Check	Reason / Mitigation Measure
Permit and Explanation			
EIA and environmental permit	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Yes (b) (No) (c) (No) (d) No	(a) The MAF submitted the application form for environmental license to the National Directorate of Environment, and prepares the IEE report required under the law of the RDTL. (b) (c) The process for environmental license is going on, and has no problems so far. The license might be issued before the detailed design stage. (d) Not necessary.
Explanation to local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders been reflected to the project design?	(a) Yes (b) Yes	(a) The MAF and local administrations held consultation meetings to explain the framework and potential impacts of the project. (b) Comments on land acquisition and allocation of irrigation water were taken into account for layout of the facilities.
Examination of alternatives	Have alternative plans of the project been examined with social and environmental considerations?	Yes	Shape of canals: The width of the canals was reduced by changing the cross section of canals from trapezoid to rectangle or by installing box culvert in the portion of residential area along the main canal. Layout of maintenance road: The length of the roads was reduced by use of existing roads for maintenance at some sections.
Pollution Control			
Water quality	(a) Are considerations given to water pollution of river water and groundwater by effluent or leachates from agricultural lands? Are adequate use/disposal standards for fertilizers, agrochemicals, and livestock wastes established? Is a framework established to increase	(a) No (b) Yes	(a) (b) The Project has no effect on water quality in general. Only turbidity of water of the Laleia river shall be monitored during the construction stage.

Category / Item	Check Item	Check	Reason / Mitigation Measure
	awareness of the standards among farmers? (b) Is a monitoring framework established for water pollution of rivers and groundwater?		
Waste	(a) Are wastes properly treated and disposed of in accordance with the country's regulations?	(a) Yes	(a) Waste shall be managed in accordance with the law of Timor-Leste. The monitoring on water shall be carried out during at the construction sites.
Soil contamination	(a) Are there possible impacts in irrigated lands, such as salinization of soils will result? (b) Are adequate measures taken to prevent soil contamination of irrigated lands by agrochemicals, heavy metals and other hazardous substances? (c) Are any agrochemicals management plans prepared? Are any usages or any implementation structures organized for proper use of the plans?	(a) Yes (b) NA (c) NA	(a) No negative impact has been reported in the existing irrigation area and no additional impact is anticipated due to the rehabilitation project. (b) Because the project rehabilitate and improve irrigation systems only, the agrochemical management is not applicable.
Noise and vibration	(a) Do construction sites generate noise and vibration affecting to the residents? (b) Is there a possibility of noise or vibration problem in the new irrigation system?	(a) No (b) No	(a) Although serious impact on noise and vibration is not expected monitoring of noise and vibration level at the construction sites shall be carried out. (b) There are no facilities to generate significant noise and vibration.
Subsidence	(a) Is there a possibility of subsidence caused by extraction of groundwater?	(a) No	(a) No groundwater extraction is planned in the Project.
Odor	(a) Are there any odor sources? Is there a possible odor problems affecting the inhabitants?	(a) No	(a) This project will not generate any odor.
Natural environment			
Protected area	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) No	(a) There is no protected area in the project area.
Ecosystem	(a) Does the project area encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project area encompass the	(a) No (b) No (c) No	(a) The project area falls outside of the forest. (b) Habitats of rare species are not included in the project area.

Category / Item	Check Item	Check	Reason / Mitigation Measure
	protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) Is there a possibility that the project will result in the loss of breeding and feeding grounds for valuable wildlife? (d) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(d) Yes	(c) Breeding sites and feeding grounds of rare species are not lost by the project. (d) The project does not impact.
Hydrometeor	(a) Is there possible impact on the flow of the Laleia river?	(a) Yes	(a) After construction of the intake weir in the Laleia river, the water flow might be changed in stream courses and discharge. it shall be monitored during the operation stage.
Topography and geology	(a) Do the project affect topographic features of the project area? (b) Do the project affect geologic features of the project area?	(a) No (b) No	(a) No significant impact is anticipated on topographic conditions, because layout of the irrigation canals was changed not to excavate hills so much. (b) No impact is anticipated on geologic conditions.
Social environment			
Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is expected, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(a) Yes (b) Yes (c) Yes (d) Yes (e) (No) (f) (No) (g) Yes (h) Yes (i) Yes (j) Yes	(a) Land acquisition (about 19 ha) of mainly forest and farmland is necessary to canals and maintenance road construction in some portions. The area to be acquired is minimized to arrange the layout of the facilities. (b) The public consultation meetings were carried out by the MAF. (c) The MAF prepares plan on land acquisition under the laws of the RDTL. (d) The MAF prepares necessary compensations on land acquisition under the laws of the RDTL. (e) (f) The MAF prepares shall prepare document on land acquisition under the laws of the RDTL soon. (g) The MAF surveyed land owners and started to talk with them about land acquisition. (h) The MAF prepares necessary organization and budget on land acquisition under the laws of the

Category / Item	Check Item	Check	Reason / Mitigation Measure
	(g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		RDTL. (i) The MAF plans to hold regular meetings with the residents during the construction and operation period. (j) The MAF and local administrations prepare grievance redress mechanism relating to land acquisition.
Living and livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the allotment will result in inequitable distribution or usurpation of land and available resources? (c) Is there a possibility that the allotments will result in inequitable distribution or usurpation of water rights and available resources? (d) Is there a possibility that the water use by the project will adversely affect downstream fisheries and water use? (e) Is there a possibility that water-borne or water-related diseases will be introduced? Is adequate consideration given to public health education, if necessary?	(a) No (b) No (c) No (d) No (e) No	(a) The stable and efficient irrigation water supply makes crop production larger. (b) This rehabilitation project does not affect land use. (c) The project aims more effective water use for irrigation, and water right of the Laleia river is given to the project through MAF's arrangement. (d) This rehabilitation project does not adversely affect economic activities in the downstream of the Laleia river. (e) No significant affect is expected because of no reservoir or ponds planned.
Cultural heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) No	(a) The project does not give impact because there are no such heritages in the project area.
Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) No	(a) The project will not entail significant changes to the present landscape.
Ethnic minorities and indigenous people	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources	(a) No (b) No	(a) (b) There are no ethnic minority groups in the project area. The project will not change the rights of any groups in relation to land other resources.

Category / Item	Check Item	Check	Reason / Mitigation Measure
	respected?		
Working condition	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country? (b) Are tangible safety considerations in place for individuals involved in the project? (c) Are intangible measures being planned and implemented for individuals involved in the project? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) No (b) Yes (c) Yes (d) Yes	(a) (b) (c) (d) The implementation of the project considers the safety of the working individuals by conducting proper trainings on safety. Adequate trainings are given for equipment handling to avoid accidents. Security staffs are stationed in strategic location for proper implementation of safety in the project area.
Others			
Impact during construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment, are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Yes (b) Yes (c) Yes (d) Yes	(a) (b) (c) (d) The MAF and local administrations carry out regular monitoring during the construction stage. These measures will be executed so that it is less impacted.
Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Yes (b) Yes (c) Yes (d) Yes	(a) Monitoring program by the MAF would be conducted. (b) Refer to the monitoring plan. (c) Monitoring framework would be established by the MAF including the budget plan. (d) Refer to the monitoring plan.

Appendices 11 Record of Public Consultation Meeting

(1) Record of Meeting on 16th November 2013

Minutes of meeting on the Preparatory Survey for the Project for Rehabilitation of Buluto Irrigation Scheme in the Democratic Republic of Timor-Leste

[Date & hour] 16th November 2012,10:30-12:10

[Venue] Laleia Sub District Administration Office

[Attendance] 35 parsons, refer to Appendix

[Record of Meeting]

The JICA Survey Team (The Survey team) held the Public Meeting (Stakeholder Meeting) for the stakeholders in Laleia Sub District of Manatuto District concerned the Preparatory Survey for the Project for Rehabilitation of Buluto Irrigation Scheme.

After self introduction of the Survey team and guests, the Survey team explained on the objectives, outline and notable issues of the Project. Following that, Questions and Answers session were held. The meeting summary is as below.

1. Opening Address by Deputy Administorator of Laleia Sub District

2. Presentation on the Project by Consultants leader

Explanation of the objectives, outline and notable issues of the Project

3. Questions and Answers, Comment

- Attendant side talked to solve problem on coordination of irrigation water allocation in the project area in accordance with rules in local community.
- Furthermore, attendant side requested to leave three existing traditional irrigation canals and each intake facilities in the right side along Laleia river in the project area after completion of project irrigation facilities.
- The team asked for understanding that to unify the said three traditional irrigation canals and intake facilities will be national policy in order to advance as technical irrigation system.

- Inhabitant in the area requested to modify alignment of the proposed canal indicated by wooden pegs at present. The reason was the line indicated between the person's living place and farming plot therefore the canal would be block a passage of both places. The Survey team explained such comment will be caught at the time of land boundary confirmation survey in the field and others be scheduled for start from next week.

- Some attendants commented that in cases in which the alignment of proposed canal will be located within 2 to 3 meters from field plot band would be accepted. However, the person said that the location of alignment would be set out 10 meter from the band would be disagreed with the plan.

- One of the attendants requested the team to move the canal alignment to mountain side more due to reduce the provided canal area for new canal construction.

- In accordance with request of local inhabitants, the team consented to hold a traditional ceremony before the commencement of geological survey at proposed weir site. For this, the team asked for someone's presence of land owner or local key person.

- The survey team requested prohibition to all attendants to remove survey pegs of canal alignment placed by the team.

4. Closing remarks by Deputy Administorator of Laleia Sub District

Attendant List

	Name	Organization, Position
1	Oiraco Da Costa	Chefe Suco Laleia
2	Cosme Ximenes	MAE / OGL
3	Tito Clementis Da Silva	
4	Joao Gusmao	
5	Luciano Pereir	
6	Joao Elueomu F	
7	Antonio G Lops	
8	Floronco Md Barreiu	
9	Hideto Daiko	JICA TL
10	Youichi Yamauchi	Agriculture Promotion Adviser
11	Deolindo De Olivela	MAP
12	Ryosuke Sakanashi	JICA Study Team
13	Mitsuo Nishiya	JICA Study Team
14	Tomoaki Koyama	JICA Study Team
15	Motoo Taki	JICA Study Team
16	Marcelo C Ds	USP Manatuto
17	Katsuhiko Komatsu	JICA Study Team
18	Antonio Dc Bai	
19	Rita Da Costa	
20	Aurrlia Dc Gus	
21	Agapito Viegas	
22	Julio Gusmao	
23	Jose Da Costa	
24	Vicenti Gusmao	
25	Carlito Da Costa	
26	Vicenti Do Viegas	
27	Estefauia De Sousa	
28	Alcino De Sousa	
29	Jose Hengurici D.S	
30	Dowinggos Joao L Da Costa	Coote / Extensitnista Laleia
31	Alcino Olo Silva	Veteranos
32	Nivio Sapurnino Lopes	Staff Irrigation Maf
33	Takahiro Kato	JICA Study Team
34	Francisco A.X.D.C	Map/ Irrigacao
35	Gaspan Jdef Costa	Chefe Suco Hola-Raloa

(2) Record of Meeting on 22th November 2013

Minutes of meeting on the Preparatory Survey for the Project for Rehabilitation of Buluto Irrigation Scheme in the Democratic Republic of Timor-Leste

Date : November 22nd, 2012

Venue: Office of Vemasse Tasi Village

Attendants: 21 parsons, refer to Appendix

1. Introduction

At first, Mr. Sakanashi as a Leader of JICA Consultant Team greets and welcomes for all participants who attend on this public consultation. On this consultation, JICA Consultant Team also appreciates for Mr. Vicente as an official of Irrigation and Water Management Department, MAF, and expresses his grateful for all attendants. After that Mr. Sakanashi kindly pleases to Mr. Vicente for providing a speech at ones opening the Preparatory Public Consultation. (Tetum version Material of the Preparatory Public Consultation was shared by the Team for all attendants)

2. Opening

As a greeting, Mr. Vicente attempts to really appreciate for JICA Team and all attendants on conducting public consultation as well as the preparatory survey which will be done by JICA. He urges to all participants to listen well the presentation will be presented by Mr. Sakanashi so that if having question or suggestion please don't hesitate deliver it to the Study Team and we are going to look for the adequate solution in order to cannot be impacted to this survey.

Mr. Vicente says that this program is realized incorporation between Government of Japan and Timor Leste but the principle investment of Irrigation scheme is funded by the people of Japan through JICA to the beneficiaries area like Vemasse and Laleia sub districts. This survey is a first stage of Japanese Grant Aid which led by Mr. Sakanashi and Team for beneficiary site. Otherwise last week we already fixed meeting schedule which conducting today consequently require much attention from Stakeholders, Village chiefs, Hamlet chiefs and important role also the farmers and land owners on attending this consultation. Finally, we kindly ask to The Leader of JICA Study Team to present the survey plan and thank you very much.

3. Three Main matters Presented by Leader of JICA Study Team; Mr. Sakanashi

1) Planning Survey and Design of Irrigation Scheme

2) Land Acquisition

3) Licenses and Corporation by Land owner, Aldeia and Village Chiefs

4. Discussing section

Mr. Jacinto Da Silva: (Local Water Association)

Firstly, I just inform to the JICA Consultant Team that the land owner did not agree even the alignment stick had install because the stick installed in the middle of their rice field, the land owners prefers to move the stick to the edge of field.

Secondly, as a Local Water Association member, I already informed to the land owners for attending on this consultation so that they could know detailed of survey plan and then deliver information which provided by Government to all farmers and land owners but some of them complain that they don't want if the canal will construct crossing by the middle of rice field because can be narrowing their rice field area and some of them also say that the construction canal its self is more strong or not because even already constructed but the quality is low then broken caused by flood when the rainy season water flow uncontrolled run everywhere to hit rice field.

Mr. Sebastião (Deputy Administrator of Vemasse sub district)

He unsatisfied about participation of beneficiary related on attending this meeting because there is no local authority including: Village, Aldeia Chiefs and land owners. He suggests that for the next future meeting, we try to invite them again for participating in the meeting so that they can get more information about the survey which will be done by JICA Consultant Team then they could be provided their suggestion because without them we cannot decide anything.

The Deputy Administrator also suggests that for the next future meeting in Vemasse, please after conducted meeting the JICA consultant team with the local authority and land owner will go directly to the project site to identify the owner of land.

Responded by Mr. Sakanashi as Presenter

The alignment of sticks is set just for survey matter in this case we need to conform the land owner and local leader to assist us on identifying which one as the land owner in this survey, its means that site for irrigation construction is not decided yet so that we really need land owner and local authority to allow for this survey, please share this information to the related beneficiary.

Regarding the canal quality, the Team is considering enhancement of the quality for main

canal using a masonry lining canal type.

According to Deputy Administrator, I kindly expect that Administrator can be organized Village chief, Aldeia chiefs and land owners and share information because we have just short time to this survey.

Mr. Benjamin (MAF District/Fishery Department)

He also comments about the land acquisition is acquired time to resolve so that propose to the local authority especially Administrator to conduct the internal meeting could be involved the local authority and land owner which not participated on this meeting so that may easy find out any kinds of solution then invite JICA Study Team to conduct meeting and survey in the next future.

The second suggestion is the canal which to be installed at the site more to upstream in the Vemasse river, please kindly move a little bit to upstream because if install in the site more to downstream the farmland which located at upstream cannot obtain water for their rice field so that may discriminate the farmer who the rice field located in upstream.

Thirdly, according to the presentation of Mr. Sakanashi on design of main canal and maintenance road with total width 12 meters, my suggestion is, if acceptable, to reduce the width to be 9 meters only so that cannot consume so much land area.

Responds from Mr. Sakanashi

I greed with this opinion, Mr. Administrator please kindly organize your internal meeting after that inform to JICA Study Team to follow up. In other hand regarding to the site which located at the Vemasse bridge, this is still survey and we will decide when the result of water quantity and water head studying allowed us to install canal more upstream area in order to be not discriminated farmer who farmland located in the upstream area of bridge. And the suggestion to reduce the width of main canal and maintenance road, if the main canal is near with the existing road it's ok we can install only canal so that the width can be 9 meters therefore even no near existing road so we have to construct main canal and maintenance road because in the future Government of Timor Leste and JICA will establish Water Management Association to maintain irrigation canal so it's easy to do maintenance.

Mr. Luciano (Irrigation staff of MAF district of Baucau)

On behalf of all local authority and District Government I would like to express our sorry to The JICA Consultant Team for lacking participation of land owner and Suco, Aldeaia chiefs. He requests that for the next meeting it must be organized and participated well by local authority and land owner so that easy to decided some decision related to the irrigation

project.

5. Closing

Mr. Vicente as an official of Irrigation & Water Management Department, MAF I express my grateful for the presentation of Mr. Sakanashi, I am expecting in the next meeting will be smoother and gained maximal participation of land owner and local leader related. I urge to all participants who attended this presentation please inform to who not attend in this meeting to elaborate, collaborate, corporate and contribute in this project. Finally thanks for everything and on behalf of Government and JICA Study Team will hear from your result of internal meeting and to follow up whatever your decision and officially close this consultation.

Mr. Sakanashi

Thank you for your participation and we are waiting for your follow up action on the next future meeting.

Attendant List

	Name	Organization, Position
1	Tomoaki Koyama	JICA Study Team
2	Kat subhiko Komatsu	JICA Study Team
3	Matoo Taki	JICA Study Team
4	Mitsuo Nishiya	JICA Study Team
5	Maria Cacilda Ximenes	Translator
6	Amancio Bruno	Translator
7	Cancio Soares	Ariculture
8	Apolinario	Agricultur
9	Bonifasio	Extensionit
10	Romaldo Freitas	Agricultur
11	Hermenegildo Correia	Agricultur
12	Francisco A.X.D.C	Teknika Irigasaun
13	Jancinto da Silva	Agriculture
14	Antonio Jose Lopez	CRP Baucau
15	Luciano Pereira	Irrigasaun Baucau
16	Benjamin Freitas	MAP Baucau
17	Joao Freitas	MAP Vemasse
18	R. Shakanashi	JICA Study Team
19	Sebastiao F. De. A	OGL
20	Vicente H. Guterres	DNIGA
21	Domingos da Silva	DNDL

(3) Record of Meeting on 12th December 2013

Minutes of Meeting on the Preparatory Survey on the Project for rehabilitation and improvement of Buluto Irrigation Scheme in the Democratic Republic of Timor-Leste

Date: December 12th, 2012

Venue: Office of Vemasse Tasi Village

Attendants: 47 parsons, refer to Appendix

In this meeting is chaired by Mr. Carlos Freitas as a Vemasse Village Chief and Mr. Luciano as a chief of Irrigation section of Baucau. At first Mr. Carlos attempts to identify and check land owner which affected by Irrigation canal in Vemasse in consultation with Mr.João da Costa Freitas who as guider for Land Acquisition survey. After identified, some of land owner cannot attend because do others activity, so another meeting will conduct by village chief at December 14th, 2012.

Mr. Luciano explains to all attendants about the process of gaining this project, at first Government of Timor-Leste (MAF) already employed Indonesia Consultant to do survey for Buluto irrigation canal which had been located in Area of Laleia and Vemasse including others sub district in Baucau district. Therefore Buluto Irrigation scheme is chosen by Government of Japan in cooperate with Government of Timor Leste, although this survey is a part of Japanese Grant Aid. In order to implement the irrigation survey especially on land acquisition survey acquire land permitted by Land owner, so in this meeting please express your thinking about this case and we have to provide our land because we are the one as beneficiary of this project. Finally Mr. Luciano pleases to JICA Study Team to explain the alignment canal which affected to rice field.

Mr. Sakanashi, Chief consultant of the JICA Survey Team explained through show the alignment map of canal especially main canal is very important for construction with a width about 12 meter; around 7 m for main canal and 5 m for maintenance road, this survey is a preparatory study prior to Japanese Grant Aid before implementation of construction period at first we have to identify land owner which affected by irrigation canal, the purpose for settlement of alignment stick along to existing canal and at cross of rice field is a method to survey alignment canal. Mr. Sakanshi also explained that the important issue was the land owner provided their land when construction would be conducted and this is not the final survey, so we try to make conclusion at June, 2013 as the final survey. So now, we already identified the land owner then the next step is all listed name will discuss with Directorate of Irrigation and Water Management Dept. to have land owner approval, so in a part of Japanese side is waiting to land owner approval. In other hand, Mr. Kato, another team member reinforced by supplementary explanation that Japanese side only provides irrigation

water, please consider providing your approval, on relating to completion of irrigation scheme JICA also needs land for demonstration field and WUA office in order to as soft component program through capacity building. After that Mr. Kato asked to all farmer who ever cultivated hybrid paddy rice, otherwise he explain hybrid paddy rice is required more fertilizer and water for growing.

Discussion section

Mr. Agustinho João da Silva asks about upstream of road site, how you can provide water when the rice field more up than main canal therefore important is upstream also have to access for water.

Responded by Mr. Kato; regarding to upstream can't access water because gravity of water level will be lower 1.5 up to 2 m than ground level around the area. After that Mr. Sakanashi adds more respond that when JICA Study Team discussed with Government of Timor-Leste on this issue, the upstream is end of Government Timor-Leste so MAF will has counter plan to construct canal from Vemasse river to irrigate that field, so JICA only focuses on Buluto Irrigation Scheme.

Mr. Kato said on Swamp near sea area was difficult to cultivate due to poor drainage, so it is used for drainage flow area, it is OK for excluding in this project.

Responded by Mr. Jacinto Soares; It is no problem because that area for longtime ago unused for paddy cultivation.

Suggestion and question; Mr. Cosme as the land owner urges for all land owner to provide their land but still unclear about width area of canal its takes 12 meter in maximum, is the width including inside the rice field or not?

Additional explanation by Assistant of the Team on accordance with JICA Study Team; the width which we are talking now is main canal, the width including for maintenance road therefore if there is existing road closely with main canal so not necessary to construct maintenance road, the construction just focus on irrigation canal around 7 meters. On other hand the width which mentioned is not including for secondary or tertiary canals, it’s depended on further study and design in Japan, even there is stock of budget so the main canal just construct the concrete canal then just expand the width for a little bit and secondary and tertiary will be improved same as existing earth canal in principal.

Mr. Antonio Lopes try to answer the hybrid paddy seeds it is certain required more water and fertilizer so who want to cultivate this variety must concentrate on commercial business. So there is advantage and disadvantage for local variety (sion) and hybrid, otherwise local variety is not gained more production if compare with hybrid.

Closing

Mr. Carlos closes the meeting and urges to who attended this meeting to inform them so that they can attend meeting at December 14, 2012 or other option I just send the vice Village chief to confirm and get acceptance. As a conclusion; who is not attended in this meeting only few percent and 90% of land owner agreed to provide their land.

Attendants List

No	Name	Organization/Position
1	Carlos Freitas	Village Chief of Vemasse Tasi
2	Domingos da Silva	Representative of sub district Adm. Office
3	Bonefacio de Fátima	Sub district Extension worker
4	Jacinto da Silva	Coordinator of Traditional WUA of Vemasse
5	João da Costa Freitas	Vice of Village Chief
6	Romualdo da Costa Freitas	Community member
7	Aleixo Faria	Community member
8	Paulino da Costa Faria	Community member
9	Duarte Assunção C. Freitas	Hamlet Chief of Raha
10	João de Fátima Seran	Community member
11	Domingos Soares	Community member
12	Afonso Manuel Freitas	Teacher
13	Joanico Paecheco	Farmer
14	Hermenegildo Correia	Farmer
15	Domingos Belo	Farmer
16	Vitor Freitas	Farmer
17	Salvador da Silva	Farmer
18	Cosme Freitas	Farmer
19	Alfredo de Fátima Freitas	Farmer
20	Guilherme Soares	Farmer
21	Joaninho Freitas	Student
22	Maria Rosalia	Farmer
23	Lucas Soares	Farmer
24	Nazario Freitas	Farmer
25	Domingos I. Freitas	Land Owner
26	Feliciano da Silva	Farmer
27	Francisco D.C Freitas	Farmer
28	Tomas S. Freitas	Farmer

29	João da Silva	Farmer
30	Salvador Soares	Farmer
31	Tomas Kehi	Farmer
32	Agustinho Z. Freitas	Farmer
33	Jóse da Costa Freitas	Farmer
34	Tomoaki Koyama	JICA Study Team
35	Ryosuke Sakanashi	JICA Study Team
36	Takahiro Kato	JICA Study Team
37	Amancio Bruno	Asst. Surveyor of JICA Study Team
38	António Jóse Lopes	Crops Section of Baucau MAF
39	Luciano Pereira	Irrigation Section of Baucau MAF
40	Fernando M. Freitas	Farmer
41	Domingos L. Freitas	Farmer
42	Epoliano Freitas	Traditional WUA member
43	João Gaspar da Costa	Land Owner
44	Paulino Soares	Hamlet Chief
45	Filomeno Freitas	Farmer
46	Domingos Freitas	Traditional WUA member/Crala
47	Francisco Xavier	Traditional WUA member/Uai-Gae