BULUTO IRRIGATION SCHEME

IRRIGATION MANAGEMENT MANUAL



MARCH 2022 Version 3.0

Ministry of Agriculture and Fisheries (MAF) Japan International Cooperation Agency (JICA)

CONTENTS

Introduction		1
Section A:	Hand Manual	3
Section B:	Operation of Headworks	5
Section C:	Operation of Main Canal	9
Section D:	Periodical Maintenance2	21
Section E:	Annual Maintenance2	24
Section F:	Operation Records3	32

Introduction

This manual is prepared by updating the original manual in 2019, considering the actual operation methods by the gatekeepers and reflecting past experience after handing over the facilities. Major revised points include i) Changing of the operation method of the scouring sluice gate, returning to the initial operation method after completion of the repair works at the downstream of the apron, ii) Simplifying control indicators to make water distribution be easy, and iii) Applying rotational irrigation operation for fair and effective water distribution. Sections A, B, C, and F were revised and simplified from the original manual, while Sections D and E remain unchanged in this manual.

Original manual; BULUTO IRRIGATION SCHEME

OPERATION AND MAINTENANCE MANUAL (Draft), December 2019, Ministry of Agriculture and Fisheries, Japan International Cooperation Agency

Comparison between the existing manual and this updated manual is tabulated as below

Original Manual in 2019	Updated in 2022	
Section A: Hand Manual	Revised	
Section B: O&M of Headworks	Revised	
Section C: O&M of Main Canal	Revised	
Section D: Periodical Maintenance	Unchanged	
Section E: Annual Maintenance		
Section F: Operation Records	Revised	
ANNEX 1: Layout of Buluto Irrigation Scheme		
ANNEX 2: Water Distribution Schedule	Deleted	
ANNEX 3: Off-take Gate and Water Control		

Comparison of Contents

General

The general concept of the irrigation operation of the Buluto Irrigation Scheme is summarized as below;

- 1) In principle, irrigation water should flow continuously for 24 hours for the overall system operation.
- 2) Rotational irrigation is introduced. The area is divided into two rotation blocks, ie. upstream (Laleia Municipality) and downstream (Vemasse Municipality) with the boundary at off-take OT.7.
- 3) For dry season planting, the planting application system will be adopted.
- 4) The irrigation facilities of the project should be operated by the authorized persons only. The responsible persons are summarized below.

	Headworks	Main Canal	Secondary & Tertiary	On-farm Water
			Canals	Management
Irrigation Officer, MAF		Supervision 8	& Monitoring	
WUA		Planning & Coordination		
Gate Keeper	*	*-	Cooperation	
Kabu-wee			→ ★ ←	Cooperation
Farmer				→ ★

★ : Responsible person



Section A: Hand Manual

Operation Procedures at the Headworks

- Operation Checking Time
 - ✓ Morning : 7:00 am.
 - ✓ Afternoon : 4:00 pm
 - ✓ Evening: 7:00 pm
- Morning Operation at the Headworks

 ✓ Check headworks status
 - ✓ Flush sediment if necessary
 - ✓ Keep the intake gates open / adjust water level at the irrigation canal gates
- > Afternoon Operation at the Headworks
 - ✓ Check headworks status
 - ✓ In case of flood, follow the emergency operation procedure
 - ✓ Otherwise, keep intake gates open
- > Night Operation at the Headworks
 - ✓ Check headworks status
 - Open the scouring sluice gates (SSG) at 50 cm if necessary, in case of heavy rain is expected
 - Adjust the intake gates, if necessary, in case of heavy rain is expected

Note: Record operations and water level at all times

Operation Procedures for the Main Canal (Normal Irrigation Period)

Operation Checking Time
 From 8:00 to 16:00

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- Operation Checking Points (Off-takes) ✓ Water level checking points shown in the Recording Form 2
 - ✓ Water level at Gauge 2 should be recorded every day.



- ✓ If any excess water distribution is observed, the gate opening should be adjusted.
- Occasional Operation
 - ✓ In case a Kabu-wee or WUA requests to increase, or decrease the water flow to the area, the gatekeeper should check the conditions and adjust the gates.

Emergency Operation Procedures

- Emergency Measures Catering to :
 Heavy rainfall.
 - ✓ Flood
- Operation Method
 - In case of emergency, operations at the headworks are to be carried simultaneously by the gatekeepers
 - In case of heavy rain or flood, gatekeepers must remain present at the headworks until the flood is over
- Operation Procedures during Peak Flood (when the river water rises above 100 cm)
 - ✓ Close intake gates immediately
 - ✓ Open scouring sluice gates
- Post-Peak Flood Operation Procedures (when the river water level is below 100 cm)
 - ✓ Close scouring sluice gates
 - ✓ Open intake gates when water level is less than 80 cm
 - ✓ Otherwise, keep intake gates closed

Operation Procedures for the Main Canal (Rotational Irrigation Period)

- Operation Time
 At 6:00 Full open or close/adjust the check gate at OT.7
- Operation Checking Time
 From 8:00 to 16:00

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- Rotational Operation During upstream turn (Rotation Block 1)
 - Check and adjust the water depth at all the Check gates from OT.1 to OT.7.
 - Check and adjust the gate opening and water overflow depth at the Offtake gates from OT.1 to OT.7.
 - During downstream turn (Rotation Block 2)
 - Confirm all the offtake gates closed from OT.1 to OT.7.
 - Confirm all the check gates fully opened from OT.1 to OT.7.
 - Check and adjust all the check gates and offtake gates from OT.8 to OT.15/16.
- Occasional Operation
 - In case a Kabu-wee requests to increase, or decrease the water flow to the area, the gatekeeper should check the conditions and adjust the gates.
- Note: Record the rotational operation and water level at all time (Recording Form 2 and 3)

Time			Activity	Recording Form	Responsible Person	
7:00	\sim	8:00	1	Check water condition at Intake and Irrigation Canal Gates	Form-1	All GKs
8.00		16.00	2	Water Level check at Off-takes selected (Check canal condition simultaneously)	Form-2	
8:00		10:00	*	Other works based on necessity		All GKS
16:00	\sim	17:00	3	Check water condition at Intake and Irrigation Canal Gates	Form-1	All GKs
19:00	\sim	20:00	4	Check water condition at Intake and Irrigation Canal Gates	Form-1	On duty*
20:00	\sim	7:00	*	Emergency response		On duty*

Daily Activity Timetable of Irrigation Management for Gate Keepers(GKs) (Normal Operation)

Daily Activity Timetable of Irrigation Management for Gate Keepers(GKs)

	Time			Activity	Recording Form	Responsible Person
6:00	\sim	7:00	1	Open or Close/Adjust of Check gate at OT.7	Form-3	On duty*
7:00	\sim	8:00	2	Check water condition at Intake and Irrigation Canal Gates	Form-1	On duty*
8.00		3		Water Level check at Off-takes selected (Check canal condition simultaneously)	Form-2	
8:00	$3:00 \sim 16:00$		* Other works based on necessity			All GKS
16:00	\sim	17:00	4	Check water condition at Intake and Irrigation Canal Gates	Form-1	All GKs
19:00	\sim	20:00	5	Check water condition at Intake and Irrigation Canal Gates	Form-1	On duty*
20:00	\sim	7:00	*	Emergency response		On duty*

(Rotational Operation)

Remarks

"On duty" : Gatekeepers should rotationally work on Sunday, Saturday, and overtime other than normal working hours.

Gatekeepers who work on Sunday and/or Saturday should take day-off during weekdays.

Section B: Operation of Headworks

< General Layout >



< Scouring Sluice Gate (SSG) >





- Whenever sediment is observed in front of the intake gates, gates (SSG) shall be opened to flush sediment.
- During flood time, when water level at the upstream of the headwork rises to higher than EL.46.80 m (Reading of the staff gauge No.3 and No.4 at the intake, 100 cm), SSGs shall be fully opened.
- After water level at the upstream of the headwork decreases lower than EL.46.80 m and there is no fear of rising again judging from weather forecast or raining records, SSGs shall be closed.
- Particularly during night-time when gatekeepers are not in the operation house, SSGs shall be opened by 50 cm during the rainy season



< Intake Gate >



< Irrigation Canal Gate>



- Irrigation canal gates shall be opened / adjusted according to the annual intake discharge schedule (as shown in the next page)
- Water level to meet the intake discharge (by reading of the staff gauge (Gauge 2) at the irrigation canal gates).

< Annual Intake Discharge Schedule >

Month	Nov	Dec	Jan-Feb	Mar-Apr	May	Jun-Jul	Aug-Oct
Intake Discharge (m ³ /sec)	0.6	1.2	1.9	1.2	1.2	1.2	0.6
Water Depth of Main Canal (Gauge 2 at Headworks)	38 cm	60 cm	80 cm	60 cm	60 cm	60 cm	53 cm

< Sand Flush Gate >



Sand flushing operation at a side of canal



- Sand flushing operation shall be conducted at least once a week.
- 2. When sand flushing operation is required during the irrigation period, one of these gates shall be opened and the same side of the irrigation canal gate shall be closed at the same time.
- 3. When sand flushing operation is required during the irrigation period while irrigation supply is stopped, both of the flush gates shall be opened and the irrigation canal gates shall be closed at the same time, but all the intake gates shall be fully opened during desilting operation.
- Deposits are to be flowing down with water flow. Manpower may be needed to stir deposits at the bottom by sticks or poles.

Section C : Operation of Main Canal

< Emergency Gate >



- 1. In case of any fatal accidents or severe damage to the canal, the gate of the emergency outlet shall be opened and the check gate downstream of the main canal shall be closed to stop the water flow to the downstream.
- When it is confirmed that there is no more danger to the downstream canal or there is no danger as to the safety of the canal or to life, the check gate shall be opened and gate at the emergency outlet shall be closed.

The major points for the ordinary operation of the main canal are summarized below.

< Check Gate >

- 1. Prior to the initial water supply, all the check gates shall be fully opened.
- Raise the water level upstream by adjusting gate opening gradually in case a diverted water level is not enough.
- 3. Water level at the upstream of the check gate is adjusted by reading staff gage (Gauge 2).
- 4. Required water level at each offtake is shown in the attached Table -1.

< Offtake Gate >



- The offtake gate shall be adjusted to meet the scheduled discharge by the opening of gates judging from a reading of staff gauge (Gauge 3) above the measurement weir.
- 2. In case of complete overflow at the weir, overflow water depth at the weir shall be applied for adjusting diversion discharge.
- 3. Required water level at each offtake is shown in the attached Table -1.

< Basic Operation Rule >

- Based on the irrigation schedule agreed among the WUAs, the gates of the main canal are opened, adjusted, and closed by the gate keepers.
- Gates should be usually locked and only the authorized persons having a key can operates the gates.
- > The gatekeepers inspect the gate regularly and adjusts as required.
- The gatekeepers should adjust to meet the prefixed required discharge with reading of the actual discharge.
- > Measured discharge should be properly recorded in the form given by the WUA.

Gate Operation Procedure

< Check Gate >



< Offtake Gate >



Required Water Level for Gate Operation for Normal Irrigation Period (Gauge Reading No.2 and 3)

			Gauge 2	Gauge 3		
	Secondary		U/S of Check Gate	Water Despth		
Off-take No.	Canal	Sta. No.	(cm)	above Weir		
			(CIII)	(cm)		
No.0		No0+ 125	88 cm	(011)		
No.1	No.1 S.C	No1+ 067	97 cm			
No.1-2		No1+472	76 cm	5 cm		
No.2	No.2 SC	No2+280	76 cm	7 cm		
No.3	No.3 SC	No3+0	72 cm	9 cm		
No.3-1		No3+712	72 cm	6 cm		
No.4	No.4 SC	No4+297	72 cm	9 cm		
No.4-1		No4+806	72 cm	4 cm		
No.4-2		No5+297	72 cm	4 cm		
No.5	No.5 SC	No5+798	72 cm	15 cm		
No.7	No.7 SC	No6+323	72 cm	11 cm		
No.8	No.8 SC	No6+723	72 cm	10 cm		
No.9	No.9 SC	No6+773	63 cm	11 cm		
No.9-1		No7+673	63 cm	6 cm		
No.9-2		No8+373	63 cm	6 cm		
No.9-3		No9+073				
No.10	No.10 SC	No9+557	110 cm	8 cm		
No.11	No.11 SC	No9+973	110 cm			
No.12	No.12 SC	No10+820	52 cm	14 cm		
No.13	No.13 SC	No11+123	52 cm	16 cm		
No.13-1		No11+323	52 cm	11 cm		
No.14	No.14 SC	No11+523	38 cm	16 cm		
No.15	No.15 SC	No12+323	38 cm	8 cm		
No.16	No.16 SC		38 cm	7 cm		
	Of	f take gate				
		-				
		\perp				
	Gauge 2 Gauge 3					
			Flow			
		L	V			

Q = 1.2 m3/sec

Required Water Level for Gate Operation for the Period with Less Water Requirement (Gauge Reading No.2 and 3)

Off-take No.	Secondary Canal	Sta. No.	Gauge 2 U/S of Check Gate (cm)	Gauge 3 Water Despth above Weir (cm)
No.0		No0+ 125	88 cm	
No.1	No.1 S.C	No1+ 067	97 cm	
No.1-2		No1+472	76 cm	3 cm
No.2	No.2 SC	No2+280	76 cm	4 cm
No.3	No.3 SC	No3+0	72 cm	6 cm
No.3-1		No3+712	72 cm	4 cm
No.4	No.4 SC	No4+297	72 cm	6 cm
No.4-1		No4+806	72 cm	2 cm
No.4-2		No5+297	72 cm	2 cm
No.5	No.5 SC	No5+798	72 cm	9 cm
No.7	No.7 SC	No6+323	72 cm	7 cm
No.8	No.8 SC	No6+723	72 cm	7 cm
No.9	No.9 SC	No6+773	63 cm	7 cm
No.9-1		No7+673	63 cm	4 cm
No.9-2		No8+373	63 cm	4 cm
No.9-3		No9+073		
No.10	No.10 SC	No9+557	110 cm	5 cm
No.11	No.11 SC	No9+973	110 cm	
No.12	No.12 SC	No10+820	52 cm	9 cm
No.13	No.13 SC	No11+123	52 cm	7 cm
No.13-1		No11+323	52 cm	7 cm
No.14	No.14 SC	No11+523	38 cm	10 cm
No.15	No.15 SC	No12+323	38 cm	6 cm
No.16	No.16 SC		38 cm	4 cm
	Gau	Off take gate	uge 3 Flow	

Required Water Level for Gate Operation for the Period with Maximum Water Requirement (Gauge Reading No.2 and 3)

			Gauge 2	Gauge 3
Off take No	Secondary Canal	Sta No	U/S of Check Gate	Water Despth
OII-lake NO.		Sta. NO.	(cm)	above Weir
				(cm)
No.0		No0+ 125	88 cm	
No.1	No.1 S.C	No1+ 067	97 cm	
No.1-2		No1+472	76 cm	7 cm
No.2	No.2 SC	No2+280	76 cm	9 cm
No.3	No.3 SC	No3+0	72 cm	12 cm
No.3-1		No3+712	72 cm	8 cm
No.4	No.4 SC	No4+297	72 cm	13 cm
No.4-1		No4+806	72 cm	5 cm
No.4-2		No5+297	72 cm	9 cm
No.5	No.5 SC	No5+798	72 cm	20 cm
No.7	No.7 SC	No6+323	72 cm	15 cm
No.8	No.8 SC	No6+723	72 cm	14 cm
No.9	No.9 SC	No6+773	63 cm	16 cm
No.9-1		No7+673	63 cm	8 cm
No.9-2		No8+373	63 cm	8 cm
No.9-3		No9+073		
No.10	No.10 SC	No9+557	110 cm	11 cm
No.11	No.11 SC	No9+973	110 cm	
No.12	No.12 SC	No10+820	52 cm	18 cm
No.13	No.13 SC	No11+123	52 cm	16 cm
No.13-1		No11+323	52 cm	16 cm
No.14	No.14 SC	No11+523	38 cm	22 cm
No.15	No.15 SC	No12+323	38 cm	12 cm
No.16	No.16 SC		38 cm	9 cm
	Of	f take gate		
	Of	f take gate		
	Gauge	_2 ∎ Ga	uge 3	
		_		
			$\langle \rangle$	
		1Y		

Rotational Operation of Main Canal

< Introduction of Rotational Irrigation >

For the rotational irrigation, the area is divided into two blocks, i.e., upstream (Laleia Municipality) and downstream (Vemasse Municipality) with the boundary at offtake OT.7

SC13

(Downstream)

< Flow Diagram >



< Rotation Operation Period >

Rotation irrigation operation shall be applied when intake water discharge is less than 1.0-1.2 m³/sec (April and May in the normal year), while normal operation (simultaneous irrigation with continuous flow) shall be applied during the other periods.

< Rotation Cycle >

Daily	Rotation			
		Rotation Block 1	Rotation Block 2	
		(Laleia)	(Vemasse)	
1st Day	06:00~06:00	On	Off	
2nd Da	y 06:00~06:00	Off	On	
3rd Da	06:00~06:00	On	Off	
4th Da	06:00~06:00	Off	On	
5th da	06:00~06:00	On	Off	
6th da	06:00~06:00	Off	On	
7th da	06:00~06:00	On	Off	
8th da	06:00~06:00	Off	On	

The rotation cycle should be discussed among all the stakeholders, and the consensus should be obtained in the WUA meeting.

< Gate Operation for Rotational Irrigation >





Rotational Operation of Secondary Canal

< Irrigation of Secondary and Tertiary Canals>

1) Simultaneous Irrigation (Continuous flow)



In the simultaneous irrigation with continuous flow, fair and timely water distribution is only possible with the cooperation and collaboration of the farmers



Farmers having their farms located upstream are irrigating excess water so that farmers downstream receive no water.



If upstream farmers suddenly stop irrigating, the channel will overtop in the downstream.



2) In the secondary and tertiary canals, water is to be distributed on a rotational basis. The flow size entering is equal to the sum of the flow rates delivered to the farmers.

Division boxes (or any diversion points) on the secondary and tertiary canals should be opened or closed on an ON/OFF basis according to the rotation schedule.





- Division boxes / diverting place on the secondary and tertiary canals should be opened or closed ON/OFF basis according to the rotation schedule.
- ON/OFF operation is executed using stoplog, or any of local materials, such as wooden boards, sandbags, banana leaves, or blocking with soil, and so on.

Preparatory Works for Irrigation

Prior to the commencement of the irrigation, the following preparatory works shall be done for proper operation, monitoring, recording, and reporting of the Buluto Irrigation Scheme.



SECTION D: PERIODICAL O&M

Periodical O&M consists of (a) Adjusting water level of headwork (b) water distribution in accordance with the **Water Distribution Schedule** and (c) cleaning, in particular screens at the Intake and at the entrance of box culvert.

WATER DISTRIBUTION: It is a simple task but is difficult to realize in a fair and equitable way. Determination of the MAF staff and a deep understanding of the community is the key. The O&M Team headed by the MAF is responsible for this task. As a tool, Check List and O&M Record are attached.

CHECK LIST

Table 3 Daily Operations

No	Diago	Mo	rning
INO	Place	Operator	Operation
1	Headwork	Check the sediments in front of the	In case there are many sediments, flash
		intake.	the sediments by opening the Scouring
			Sluice Gate according to the
			"OPERATION OF HEAD WORKS".
2	Intake	Check the remain of debris in front of	In case there are remains of debris,
		screens	remove these by manual (hands).
3	Sand Trap	Check the quantities of deposits	In case the deposit is remarkable, open
	(desilting)		one of the sand flushing gates and
	Basin		close the irrigation canal gate of the
			same side for a while. The bottom of the
			basin will be stirred by manpower with a
			stick or a pole, if necessary.
4	Irrigation Canal	Check the water level at the	Adjust the gate opening to required
	Gate	downstream of the Irrigation Canal	discharge if necessary and record the
		Gate by reading the staff gage.	water level in the notebook.
5	Off-take gates	Check the water level at measuring	Open and close off-take gates to adjust
		weir and check the discharge through	discharge to be a required one, if
		off-takes.	necessary.
6	Check gates	Check the water level at both upstream	Adjust the gate opening of the check
		and downstream of the check gate.	gate to adjust discharge to be a
			required one, If necessary.
7	The entrance	Check remains of debris in front of the	In case there are remains of debris,
	of box culvert	entrance of the box culvert.	these have to be removed.

PERIODICAL CLEANING:

Cleaning of screens at the Intake and screen in front of box culvert shall be carried out frequently. Careful observation and continuous practice is the key to optimizing the operation. Some instruction for each structure is summarized below.

INTAKE: The main work is to remove deposits (sand and small stones) and secure the proper water flow into the irrigation system. A good combination of cleaning work at the intake and basin is required.

RAINY SEASON: While cleaning the intake basin, totally close the intake gate and fully open the scoring sluice gate. If the river flow is strong enough, the deposit might be naturally flushed.

SAND TRAP (DESILTING) BASIN needs frequent cleaning, once a week. Sands and gravels shall be removed by intake water flow. In principle, the intake gate shall be opened fulltime to maximize the conveyance of water. During the rainy season, the gatekeeper may stay at the intake and close the gate in case of a flood to avoid damages and excess sediment. Settling capacity of the basin is 400m³ (Depth 1m x Width 8m x Length 50m).

	1. Open the intake gate and drain water in the basin		
	2. Open one of sand flushing gate		
Operation	3. Close same side of irrigation canal gate		
Frequency	4. Sediments at bottom of the basin shall be stirred by manpower with stick or pole if		
	necessary.		
	5. This operation shall be repeated alternately		
	Once a week (during the rainy season, more frequent cleaning may be needed).		
	Annual cleaning in November		

SECONDARY CANALS: Cleaning and maintenance of each secondary canal are under the responsibility of the respective members and Kabuwee. It is, however, necessary for the

MAF staff to keep monitoring the canals and providing instruction to the responsible

Kabuwee. Otherwise, the conveyance of water becomes difficult.

	1. MAF Staff: monitor a condition (sedimentation) of each secondary canal; instruct					
	the Kabuwee to take an action.					
Operation	2. Kabuwee: organize the periodical cleaning once a month.					
Operation	3. Kabuwee /MAF: if necessary, organize a joint inspection. Identify critical points for					
	the poor conveyance of water by transect-walk from the off-take to the end of the					
	canal.					
Fraguanay	Once a month: Periodical cleaning					
Frequency	Once a year: Annual cleaning (thorough cleaning of the entire secondary canal)					
Tools	Shovels					

SECTION E: ANNUAL MAINTENANCE AND CLEANING

ANNUAL MAINTENANCE AND CLEANING shall be conducted in every November to December. A rough schedule and budget shall be prepared in advance (November) considering a **priority** and **sequence**. The basin with the adjacent canal and siphon is always the **top priority**. A **sequence of works** and resource mobilization is the key to complete several tasks within limitation. Tasks are categorized into two: (a) **sequential task** shall be arranged in order. (b) **Independent task** DOSE NOT use heavy equipment. Hired laborers can do the jobs with occasional supervision in parallel with other tasks.

The sequence of Task (An example from 2017)

Week	Sequential Task	Independent Task(without Heavy Equipment)				
1	Cleaning Basin (If necessary)	Siphon Cleaning Canal	Grass cutting			

THE GATES are designed to operate at ease (one-hand operation).

Lubrication is essential to maintain its quality: inject grease in the gearbox annually.

Vandalism such as destruction of lock is sadly common. Regular visit and alerting is needed.

Maintenance of gates shall be done in accordance with the instruction manual stipulated by the manufacturers.

Refer to the all-item Instruction Manual:

	To inject grease in the gearboxes once a year
Maintenance	To paint the gates for prevention of rust (occasional, every
	five years)
	4 units at the Intake (Sluice Scoring Gate and the Main Gate)
Items	4 units at the First Scoring Gate,
	2 units at the Second Scoring Gate
Frequency	Once a year
Tools	Wrenches and a grease gun
Cost	\$25 for 1 bucket of grease, \$30 for paints



Photo 1. Check of gearbox and supply of grease

Lubricant

- Life and performance of this equipment depend greatly on the control of lubricant, therefore please check the amount of lubricant every time before the operation of equipment.
- In the normal usage condition, please change the lubricant oil every two years. And in case lubricant oil is deteriorated by frequent use, change it even if the usage period is less than two years.
- Lubricant oil to be used

Manufacturer	Brand name					
Showa Shell Sekiyu K.K.	Shell Tellus S2M32					
JX Nippon Oil & Energy	Super Hyrando 32					
Idemitsu Kosan Co., Ltd.	Daphne Super Hydro 32A					
Mobil oil	Mobil DTE24					
Cosmo Oil Co., Ltd.	Cosmo Hydro AW32					

ISO VG 32 or equivalent (Mineral oil family)

[Cautions]

- Usage condition of lubricant oil in the list shall be in the ambient temperature of 0~40°C.
- At the time of delivery, Shell Tellus S2M32 is filled.
- Please use the equivalent brand for the other source per the table.
- · Oil volume

			(Unit L)
Model	Oil volume	Model	Oil volume
CP10S	4.5	CP20D	5.0
CP20S	12.3	CP30D	19.4
CP30S	12.8	CP40D	26.0
CP40S	13.0	CP55D	26.0

Grease

- In order to attain smooth meshing of rack bar and pin gear, please apply grease to the pin portion of rack bar.
- Please apply grease to the coupling of connecting rod.
- Please apply grease periodically depending upon the operation term. (Please apply normally once every three months)
- (Please apply grease to connecting rod once every 2 years normally)
 Grease to be used

LINGI NO. 1 or equivalent						
Manufacturer	Brand name					
Showa Shell Sekiyu K.K.	Alvania EP Grease 1					
JX Nippon Oil & Energy	Epnoc Grease AP (N)1					
Idemitsu Kosan Co., Ltd.	Daphne Eponex Grease SR1					
Mobil oil	Mobilux EP1					
Cosmo Oil Co., Ltd.	Dynamax EP1					

[Cautions]

As for the brand from other manufacturer, please use equivalent brand per the table

DROP STRUCTURES (DROP): Drifts (wood and rubbish) are often stuck at the structures and cause overflow and erosion of backfills.

Gravels tend to be deposited behind the structures that cause further erosion. Careful monitoring and regular cleaning are required.

Maintenance	To remove gravels
Frequency	Once a year and occasionally
Equipment	Casual Labour
Cost	Marginal. labor 3 man-day

Siphon and Calvert Canal: The Siphon of nine (9) meters length and box culvert of 500 m requires annual cleaning, one of the heaviest tasks of the Buluto irrigation scheme.

First, the water inside has to be pumped up. Due to its structure, only manual work can be done and yet a limited number of laborers can be deployed.

Perhaps two (2) men inside at one time and three (3) other counterparts pulling up sand from the outside.

Inside the Calvert Canal, a little deposit is expected, unlike the Siphon.

EXTRACTING WATER: The pump SHALL be set in the Siphon close to the water level: DO NOT set the pump at a high place which results in poor extraction.

Duration	0.5 days
Equipment	1 set of pump & tube
Cost	\$5: Fuel \$10/ day (10 litres/ day x 4days)

DESILTING: This is a labor-intensive hard task. About 1 carrier enters the Siphon with each wheelbarrow.

One to two worker(s) with a shovel(s) stands by inside to load sand onto the wheelbarrow.

The carrier forwards to the entrance of the wheelbarrow.

Then, other workers standby outside pull up the wheelbarrows.

Sand is dumped in the main canal that is to be removed by the excavator later.

Note: Safety First, when cleaning the Siphon. Ventilation (air)!

The inside of the siphon is dark and narrow: width1.0 m, height1.0m, a harsh working place.

Duration	1-3 days
Inputs	3 Labourers, 3 each shovel & wheelbarrow,
Cost	

Erosion of Slope and Seepage from Embankment:

This describes repair for masonry and inverts concrete of the main irrigation canal at the embankment area in case of water leaking.

Joint and Crack of Masonry

Masonry Canal has structural joints. There is a potential occurrence of crack at masonry and invert concrete. Water will seep out from joints and cracks. When water seepage is observed from the embankment slope, seeping water must be stopped immediately and close joint and crack. If seeping water is neglected, the canal will collapse.

Especially settlement of the main canal at high embankment area will be expected and cracks will occur due to the settlement of embankment soil.

Inspection and maintenance should always be executed.



Photo. 2. High embankment (No.8+500)



Photo.3. Embankment Area (No.4+800)

- 28 -

Inspection

Frequently	Condition	Check Point	Method	Measure	Inspector
Daily Inspection	with Water	Is there water seepage from embankment Slope?	Visual	stop water and repair	WUA water User

Repair Procedure

Flow of Repair



Check Embankment Slope

During water supplying at the canal, gatekeeper on duty should walk carefully along the main canal and inspect the condition of the canal structure visually every day.

Checkpoints

- Water level
- Water flow
- Gate opening
- Invert concrete condition
- Masonry condition

• Embankment slope condition: Water seepage from the slope , the collapse of the slope

Especially high embankment area, from No. 8+000 to No.9+000



Water Seepage

When water seepage is observed, stop water supply and repair water seepage.

Gatekeeper should close the intake gate and open the gate at the emergency outlet at upstream then, water supply should be stopped to prevent overflow from the canal.

Gatekeeper should inform the condition to the MAF staff.

Check for Crack

There are usually some small damages at canal structure near water seepage.

They are so small and should be found. The search for the damage should be done cautiously.

Search is as below

- opening and gap of joint of masonry
- void area and crack of masonry
- · opening and crack of invert concrete

Repair

Damage should be repaired by using mortar or repair mortar, i.e. PCC, SIKA GROUT, and SIKA MONO TOP manually.

Repairing of Slope

Soil should be spread and compacted manually at the eroded slope.

Water Supply

After curing the repaired part, the water supply should be resumed and inspection should be executed.

If there is still water seepage, water supply should be stopped and search for damage shall be done again.



Photo.4 Rehabilitation Works

Section F: Operation Records

Recording Form 1

Operation Record at Headworks

Record-keeping is the first step to enhance accountability and transparency. In accordance with the Regulations, Gatekeepers shall regularly (preferably monthly) inform present O&M status to the MAF Manatuto and Baucau office. Each document shall be duly prepared by the gate keepers.

Year / Tinan; _ Month/Fulan; Irrigation Canal Gate / Kanál Portaun Irrigasaun Water Level / Nivel-bee Scoring Sluice gate / Portaun satan bee mota Intake Gate / Portaun Intake Date/ Data Time/ Oras Signature/ Asinatura Observation/ Intake/ Intake Main Canal/ Observasaun Kanál Boot No 1 No 1 No 2 No 1 No 2 No 3 No 4 No 2 (cm) (cm)

Note:			
Status of gate:	"Open" or "Close"	Estatutu hosi portaun:	"Loke" ka "Taka"
Observation:	Please write in other issue related O&M	Observasaun:	Favor Hakerek asuntu seluk iha relasaun ho O&M
	Flushing time, for example, "15minutes in the morning"		Tempu fase, exemplu; "Minutu is iha dader"
	Remove rubbish, for example "remove rubbish in the morning"		Hasai foer, exemplu "Hasai foer iha dader"
	Flood, for example, "Flood at the last night"		Bee ulun/inundasaun, exemplu "inundasaun iha kalan"

Recording Form 2

Water Level Record at Intake and Off-take

Year:

Dete	T '	Intake		Off-take (cm)							
Date 1 m	Time	(cm)	No.1	No.4.1	No.7	No.9.2	No.13.1	No.14	No.15/16	Signature	Remarks





Recording Form 3

Rotational Operation Record

Year

			Rotation Block 1	Rotation Block 2
No.	Date	Time	Laleia	Vemasse
			(ON or OFF)	(ON or OFF)
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