Annex-4: SOP of Data Management of Pipeline Drawings

List of SOP

SOP Number	Name of the procedure
GIS-OP1-W01	Input of distribution pipes of as-built drawings into GIS
GIS-OP1-W02	Input of house connections of as-built drawings into GIS
GIS-OP1-W03	Confirmation of distribution pipes information on GIS
GIS-OP1-W04	Confirmation of house connections information on GIS
GIS-OP2-W01	Converting the data from ArcGIS into EPA-net.
GIS-OP2-W01	Hydraulic analysis with EPA-net.
GIS-OP2-W01	Input of design data into the GIS
GIS-OP3-W01	Input of leakage repair record into GIS

OP1	As-built Drawings into GIS
OP2	Design Drawings making and converting into GIS
OP3	Leak repair record into GIS

Standard Operating Procedure

SOP No.	GIS-OP1-W01	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Input of distribution pipes of as-built drawings into GIS		[Work category] Making as-built drawings
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - ArcGIS 10.2 [Folder] -

Work step		Key point to work
1	For the input operation method, refer to Manual "GIS+EPAnet Operation Manual".	
2	Enter the position and shape of pipe / valve into GIS based on as-built drawings. (Make sure to enter the plan view from directly above.)	Be sure to refer to the as-built drawings that has been approved by pipe section, T/S office or NRW management section.
3	If the position and shape of the existing pipe and road are different, correct it in GIS.	
4	If you remove the valve, be sure to check with pipe section or T/S office.	
5	Connect the new pipe and the existing pipe with one node.	
6	Enter the attribute information for pipes and valves.	Refer to page 134 of "GIS+EPAnet Operation Manual" for the recommended attribute information list.

Formulation		Amendment		
Date	15th, Dec., 2020	Date	Approved by	Modification
Prepared by				
Approved by				

Standard Operating Procedure

SOP No.	GIS-OP1-W02	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Input of house connections of as-built drawings into GIS		[Work category] Making as-built drawings
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - ArcGIS 10.2 [Folder] -

	Work step	Key point to work
1	For the input operation method, refer to Manual "GIS+EPAnet Operation Manual".	
2	Enter the position and shape of house connection and valve from the branch to the meter and meter into the GIS. (Make sure to enter the plan view from directly above.)	Be sure to refer to the as-built drawings / house connection installation sheet that has been approved by T/S office or NRW management section.
3	If the position and shape of the existing pipe(distribution and house connection) and road are different, correct it in GIS.	
4	If you remove the valve, be sure to check with pipe section or T/S office.	
5	Enter the attribute information for house connections and valves.	Refer to page 134-136 of "GIS+EPAnet Operation Manual" for the recommended attribute information list.

Formulation		Amendment		
Date	15th, Dec., 2020	Date	Approved by	Modification
Prepared by				
Approved by				

Standard Operating Procedure

SOP No.	GIS-OP1-W03	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Confirmation of distribution pipes information on GIS		[Work category] Making as-built drawings
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - ArcGIS 10.2 [Folder] -

	Work step	Key point to work
1	For the input operation method, refer to Manual "GIS+EPAnet Operation Manual".	
2	The staff of the GIS section displays the attributes of distribution pipes and valves in GIS and confirms that there is no difference between the displayed contents in GIS and the as-built drawings.	
3	If a difference is found, correct it according to SOP No. "GIS-OP1-W01".	
4	The GIS manager extracts one sample - in-ten pipes and valves and performs the same confirmation in the above two(2) work step.	Sampling inspection procedure by manager. The manager should check the data using GIS.
5	If a difference is found, correct it according to SOP No. "GIS-OP1-W01".	

Formulation		Amendment		
Date	15th, Dec., 2020	Date	Approved by	Modification
Prepared by				
Approved by				

Standard Operating Procedure

SOP No.	GIS-OP1-W04	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Confirmation of house connections information on GIS		[Work category] Making as-built drawings
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - ArcGIS 10.2 [Folder] -

	Work step	Key point to work
1	For the input operation method, refer to Manual "GIS+EPAnet Operation Manual".	
2	The staff of the GIS section displays the attributes of house connections, meters and valves in GIS and confirms that there is no difference between the displayed contents in GIS and the as-built drawings.	
3	If a difference is found, correct it according to SOP No. "GIS-OP1-W01".	
4	The GIS manager extracts one sample - in-ten connections, meters and valves and performs the same confirmation in the above two(2) work step.	Sampling inspection procedure by manager. The manager should check the data using GIS.
5	If a difference is found, correct it according to SOP No. "GIS-OP1-W01".	

Formulation		Amendment		
Date	15th, Dec., 2020	Date	Approved by	Modification
Prepared by				
Approved by				

Standard Operating Procedure

SOP No.	GIS-OP2-W01	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Converting the data from ArcGIS into EPA-net.		[Work category] Making a hydralic analysys model for pipe design
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - ArcGIS 10.2 - shp2epa.exe - Node-Matching Ver1.0.exe - EPA-net 2.0 - Microsoft Excel [Folder] -

	Work step	Key point to work
1	Copy the pipe information of the planning target area to the design layer in GIS.	
2	Making SHP-file and DBF-file of pipe data from the ArcGIS.	ID of pipe shoud be unique.
3	Converting the data from SHP-file into EPA-net.	Utilizing shp2epa.exe.
4	Converting the data from line-data into network-data of the EPA-net.	Utilizing Node-Matching Ver1.0.exe. Launch the software in situation that "SmallBasicLibrary.dll" is in the same holder.
5	Setting diameter and length according to the DBF-file.	
6	Setting customer demand on each node.	If according to the 2025 or 2040 of the M/P, population growth and increase of water consumption(m3/cpd) are required as analysys consition.

Formulation		Amendment		
Date	15th, Dec., 2020	Date	Approved by	Modification
Prepared by				
Approved by				

Standard Operating Procedure

SOP No.	GIS-OP2-W01	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Hydraulic analysis with EPA-net.		[Work category] Selection of suitable diameter of pipe
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - EPA-net 2.0 [Folder] -

	Work step	Key point to work
1	Execution of hydraulic analysis.	Operations and calculations by referring to manual "GIS+EPAnet Operation Manual".
2	Selecting suitable diameter (trial and error)	Pressure should be secured within the YCDC water pressure standard.
3	Confirmation of water pressure at the end of the pipeline by the manager.	Within the YCDC water pressure standard.

Formulation		Amendment		
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Approved by				

Standard Operating Procedure

SOP No.	GIS-OP2-W01	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Input of design data into the GIS		[Work category] Making design drawings
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - ArcGIS 10.2 - EPA-net 2.0 [Folder] -

Work step		Key point to work
1	Input diameter set in the hydraulic analysis model into GIS.	Enter in the pipe of the design layer described in "GIS-OP2-W01".
2	(If there are any changes,) input valve operation information (opening and closing) set in the hydraulic analysis model into the valve of GIS.	
3	Enter "Design work name and date and time" information in the remarks column of the pipe and valves in the design layer.	
4	Confirmation by the manager of above GIS attribute data of design.	The manager should check the data using GIS.

Formulation		Amendment		
Date	15th, Dec., 2020	Date	Approved by	Modification
Prepared by				
Approved by				

Standard Operating Procedure

SOP No.	GIS-OP3-W01	GIS Section, Engineering Department (Water and Sanitation)
[Name of the procedure] Input of leakage repair record into GIS		[Work category] Making leakage repair map
[Outline of the procedure] OP1: Asbuilt Drawings into GIS OP2: Design Drawings making and converting into GIS OP3: Leak repair record into GIS		[Software] - ArcGIS 10.2 [Folder] -

	Work step	Key point to work
1	For the input operation method, refer to Manual "GIS+EPAnet Operation Manual".	
2	Enter the following information in leak-record layer of the GIS.	The leak-record layer has already been on the GIS, but if you create a new one, check with the manager.
3	Enter the position of repair work into GIS based on repair record of T/S office.	Be sure to refer to the repair record that has been approved by T/S office or NRW management section.
4	If the position and shape of the existing pipe and road are different, correct it in GIS.	
5	Enter the attribute information for repair record.	Refer to page 134 of "GIS+EPAnet Operation Manual" for the recommended attribute information list.

Formulation		Amendment		
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Annex-5: Non-Revenue Water Management

Annex-5.A: SOP for Non-Revenue Water

Annex-5.B: Guidelines and Manuals of Non-Revenue Water Management

Annex-5.C: Non-Revenue Water Management Plan (Provisional)

Annex-5.D: Training Plan of Training Center for NRW Management

Annex-5.A: SOP for Non-Revenue Water

List of SOPs relating to NRW

No.	Name of Standard Operating Procedures
SOP－01	Plane Table Survey
SOP－02	Pavement Cutting Line Marking
SOP－03	How to check digging depth and so on
SOP－04	Construction Signboard
SOP－05	Pipe laying
SOP－06	Pressure Test
SOP－07	Drilling for service connection
SOP－08	Back Fill
SOP－09	Material management
SOP－10	Equipment management
SOP－11	Pipe Line Drawing
SOP－12	Pressure Measurement
SOP－13	Flow Measurement
SOP－14	Leakage Volume Measurement
SOP－15	Leak Detection
SOP－16	Leak Correlator
SOP－17	Minimum Night Flow Measurement
SOP－18	Night Step Test
SOP－19	Customer Survey
SOP－20	DMA Monitoring
SOP－21	Meter Function Check
SOP－22	Survey of Damage Meters
SOP－23	Leakage Record
SOP－24	Daily Report
SOP－25	Tasks of NRW Section
SOP－26	Valve Box installation

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		Verifier	
		Approval	

1.Title

Plane Table Survey

2.Objectives & Scope

To make geographical map with scale which can be used as a basic data for creating “Design drawing” and “As-built drawing”.

3.Abbreviations and Definitions

NRW ; Non- Revenue Water

4.Tasks, Responsibilities and Accountabilities

Tasks	Person	Responsibility
Setting marks at the place from where all of survey points are visible	Staffs of the Project	Project Manager
Preparing necessary material for plane table survey	〃	〃
Carrying out “Plane Table Survey” at mark by mark	〃	〃
Making drawings (Mapping)	〃	〃

5. Procedure

1) Prepare necessary items such as Tripod and Stand, Plane Table, Pointer (Staff), Compass, Scales Ruler, Alidade, Spirit Level, U-Frame, Plumb bob, Pin, A3 paper, Paper tape, Measuring Tape, Pencil.
2) Organize totally (3) persons: (1) for holding pointer (staff), (2) for measuring tape and Alidade.
3) Setting marks as a reference point at the place from where all of survey points are visible.
4) When setting marks at junctions or corners, you must select the place have good visibility and do not prevent traffic.
5) Set up Tripod at the marks (reference point).
6) Set up Tripod and Plane Table with adjusting height as best for person in charge.
7) Put A3 Paper on plane table with a paper tape surely.
8) Adjusting the plane table horizontally by using spirit level.
9) Search the North by compass after calibration the Compass.
10) Set plumb bob over specific point marked on the road, and set A3 paper on the table by pins considering survey position from that point.
11) Write northern direction on the paper by using compass.
12) Turn a screw little which fix a table and tripod to adjust the plane table as necessary.
13) Set a northern direction to upper side of A3 paper and tighten the screw.
14) To carry out plane table survey as following;
    (a) Survey point should be decided from the place which seems to be never changed such as drain trench, boundary between road and private premises, electricity pole, or drain man-hole. (Survey point 1,2,3,4…)
    (b) Set a pointer (staff) at survey point and capture that pole by using Alidade with touching to the pin on the paper, then fix the Alidade.

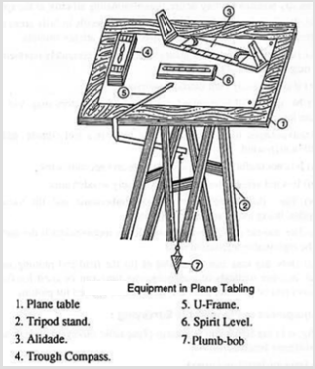
(c) Adjust survey point where the pole is set in line, then fix the Alidade.
(d) Draw a line lightly if the base point and survey point (Staff) are inline, and note the measured distance by measure tape by 1:500 scale.

15) Continue to survey for all points, then a geographical map will be created.
16) Once the station point is changed, check the location of the original and the new point from both sides.
(a) In the checking process, write the distance between the first point and the new point from the new point on the map firstly.
(b) Then, set up Tripod and Plane Table at the new point and search the North and Level the Plane Table. (refer to Step 5, 6, 8)
(c) Keep the Alidade with touching both of a pin set as the new point and the original point on the map, and rotate plane until when you find the pointer (original point) through the Alidade, then fix the table.
17) Define a scale based on the area you want to draw, and note that scale on the map.
18) Legend should be at the bottom-left of the drawing.

6. Related Documents

No

7. Related Forms



8. References

Google

9. Attachments

No

1. Title

Pavement Cutting line drawing

2. Objectives & Scope

To draw a cutting line on a road in each project area with considering road condition according to regulation/rule which prescribe trench width for every pipe size.

3. Abbreviations and definitions

N/A

4. Tasks, Responsibilities and Accountabilities

No.	Tasks	The Person in charge	Responsibility
1	Prepare necessary equipment to draw pavement cutting line	Assigned staff for material management	Supervisor of project
2	Draw a marking line depending on the ground conditions	Assigned staff for material management	Supervisor of project

5. Procedure

(1) Prepare necessary equipment before drawing line such as Tape, Chalk, Nylon rope, and Marking spray.
(2) Draw a line on the road along the center of new pipe according to design drawing.
(3) Measure and mark guide points for cutting lines both side the line which drawn in (2). Distance between each cutting line is decided based on pipe diameter.
(4) For drawing lines at least three persons is required.
(5) Construction signboard must be set at entrance of the road of working place.
(6) All staff must wear safety equipment. (Safety shoes, Helmet, Safety vest)

6. Related Documents

7. Related Forms

8. References

9. Attachments

1. Title

How to check digging depth width and depth

2. Objectives & Scope

To dig for piping work in proper way. This SOP shows a digging method about digging depth, width or pipe laying depth, which were applied for Yankin pilot project. Those are different from YCDC standard.

3. Abbreviations and Definitions

4. Tasks, Responsibilities and Accountabilities

Tasks	Person	Responsibility

5. Procedure

(5.1) Decide a digging depth and width depending on a situation of construction area such as pipe material, diameter, road, or traffic.

(5.2) Design backfill layer. In case of Yankin pilot project, crusher-run layer (for 0 – 40mm) was prepared for paved road such as Mau Kaung road, Shwe Yin Mar road, Mya Nandar road, Damayone road to prevent from road subsidence.

(5.3) Pipe depth (Ground to top of installed pipe) and pipe material of Yankin pilot project are following.

→Mau kaung Road : Ductile Iron Pipe (K) Φ150mm ⇒ −0.9m(3feet)

→Dama Yone lane : Rubber Ring PVC Φ100mm ⇒ −0.9m(3feet)

→Shwe Yin Mar lane : Rubber Ring PVC Φ100mm ⇒ −0.9m(3feet)

→Aung Chantar Road : Rubber Ring PVC Φ150mm ⇒ −0.9m(3feet)

→Mya Nandar lane : Rubber Ring PVC Φ100mm ⇒ −0.9m(3feet)

(5.4) Select digging width in 0.5m for smaller than 4inch(Φ100mm), and 0.6m for 6inch(Φ150mm).

*Those are to secure workspace for workers who laying pipeline with tools.

*Those width are required at least to tamp enough by tamper in order to prevent subsident.

(5.5) Digging depth for pipe laying work are following. (Also pipe depth are mentioned in 5.3)

- Mau kaung Road : Ductile Iron Pipe (K) Φ150mm ⇒ −1.10m
- Dama Yone lane : Rubber Ring PVC Φ100mm ⇒ −1.05m
- Shwe Yin Mar lane : Rubber Ring PVC Φ100mm ⇒ −1.05m
- Aung Chantar Road : Rubber Ring PVC Φ150mm ⇒ −1.10m
- Mya Nandar lane : Rubber Ring PVC Φ100mm ⇒ −1.05m

Digging depth are decided based on the formula shown in below.

Digging depth = Pipe laying depth + Outer diameter of pipe + bedding sand

Ex) Φ100mm= 0.9m + (≒)0.10m + 0.05m = 1.05m

Ex) Φ150mm= 0.9m +(≒) 0.15m + 0.05m = 1.10m

Bedding sand is to protect pipes from load or shock from outside. Thickness of sand layer is 0.05mm along the trench. Sand for that should be river sand which doesn't contain salt to prevent corrosion.

(5.6) Then, backfill sand layer around installed pipe until 0.10m above top of the pipe despite any pipe material.

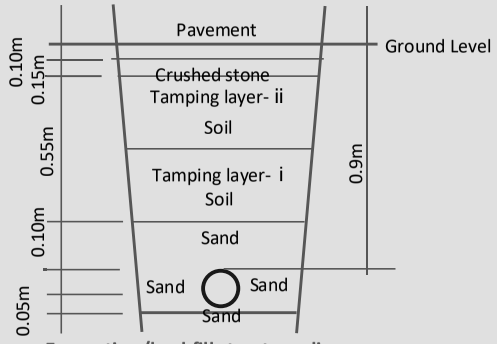
(5.7) Backfill with construction soil over sand layer, but never use soil which contains large size stones or much water.

(5.8) Backfill by soil for 0.55m between sand layer and crusher-run layer. This layer should be tamped 2 times every 0.3m by using tamping machine.

(5.9) Backfill by crusher-run for 0.15m over soil layer and tamping enough.

(5.10) Pave and restore original road condition after piping work and pressure test (to confirm no-leakage) finished.

(5.11) Standard road structure is following.



Excavation/backfill structure diagram

6. Related Documents

N/A

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……Section	Effective Date:	
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7. Related Forms

8. References

9. Attachments

NRW_SOP-03_How_to_check_digging_depth_and_so_on_(en)Engineering Department (Water & Sanitation) 4/12/2021 1:55 PM

Yangon City Development Committee Engineering Department (Water & Sanitation) .....Water Supply..... Division .....NRW..... Section	SOP Code No:	EDWS-NRW-04
	Version No:	00
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	Verifier	
	Approval	

1. **Title**

   Setting up “Construction signboard”

2. **Objectives & Scope**

   The purpose is to inform the construction and to keep safe in the workplace.

3. **Abbreviations and definitions**

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person in charge	Responsibility
Setting up construction signboard	Operating staff and supervisor of the construction	supervisor of the construction

5. **Procedure**

   5.1 Construction signboard should have following information,
   - a. Name of supervisor
   - b. Contact Phone Number
   - c. Type of Construction

   5.2 Font size should be big enough to be visible.

   5.3 The “construction signboard” must be placed both side of nearest junctions or corners of a road where construction is implemented before construction start.

   5.4 If it needs to close traffic, sign of “traffic closed” or “bypass line (with arrows to guide)” must be set up at entrance (junction or corner) of the road.

   5.5 Sandbags should be placed on the lower legs of the Construction Signboard to settle.

   5.6 “Safety Cone” and “Safety Cone Bar” must be set up properly to prevent pedestrians from enter the workplace.

6. **Related Documents**

   N/A

7. **Related Forms**

   N/A

8. **References**

   N/A

9. **Attachments**

   N/A

NRW_SOP-04_Construction+Signboard(en) Engineering Department (Water & Sanitation) 4/12/2021 1:56 PM

	Yangon City Development Committee Engineering Department (Water & Sanitation) Water Supply Division NRW Section	SOP Code No:	EDWS-NRW-05
		Version No:	00
		Effective Date:	March
		Pages:	1 of 3
		Developer	
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		Approval	

1. **Title**

   Pipe Laying & Jointing

2. **Objective & Scope**

   Proper pipe laying and use suitable material according to design drawing.

3. **Abbreviations and Definitions**

   (DIP - Ductile Iron Pipe)
   (RRVP- Unplasticized Polyvinyl Chloride Pipe With rubber ring type joints)
   (HDPE- High Density Polyethylene)

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person	Responsibility

5. **Procedure**

(5.1) Preparation

(a) Preparations for DIP piping - (Tools & Parts)

Push ring, Lubricant, Rubber ring, Bolts & Nuts, Ratchet, Torque Wrench, check gate

(b) Preparations for RRVP piping - (Tools & Parts)

Lubricant, brush, towel, V- Jacking, TH Grip, Ratchet, Check gate

(c) Preparations for HDPE piping - (Tools & Parts)-

EF-Controller, Cold-ring, scraper, chain cramp, scraper

(5.2) Pipe laying & jointing work of *DIP K type*

A) Carry required pipe material (pipe and joints) on that day to construction site.
B) Clean inside of socket and spigot of DIPs and confirm there is no dirt etc.
C) Carry and pipes near the construction site and put it with the logo side up.
D) Confirm depth of a trench and bedding sand for new pipes based on design drawing.
E) Set sling belts on both side of DIP. Confirm security of crane and equipment for hanging, then unload DIP into the trench slowly and carefully with confirming jointing point.

F) DIP has socket and spigot to joint pipes. For straight line, basically socket should be set on upstream side and spigot should be set on downstream side. Then insert a spigot into a socket.
G) Paste lubricant around the spigot before insertion. Then, set normal push ring and rubber ring.
   - If a tee joint or a bend pipe are used, special push ring must be used instead of normal push ring to prevent separation.
H) Confirm the insertion length by line marked on spigot side.
I) Set rubber ring between first line and second line marked on spigot side, then, send the rubber ring uniformly into the socket.
J) Insert T-bolts and nuts into holes on the socket and tighten those.
   - Necessary number of bolts is different by pipe diameter. (Ex. 3 or 4 inches ⇒ Bolt ×4pieces, 6 inches ⇒ Bolt × 6pieces)
K) To tighten evenly, screw nuts lightly as temporal first, then tighten opposing nuts alternately every 2-3 times.
L) Confirm tightening torque is 100N by torque wrench.

(5.3) Pipe laying & jointing of *RRVP*

A) Carry required pipe material (pipe and joints) on that day to construction site.
B) Clean inside of socket and spigot of RRVPs and confirm there is no dirt etc.
C) Carry and pipes near the construction site and put it with the logo side up.
D) Confirm depth of a trench and bedding sand for new pipes based on design drawing.
E) Hold both side of RRVP and unload into the trench slowly and carefully with confirming jointing point.
F) RRVP has socket and spigot to joint pipes. For straight line, basically socket should be set on upstream side and spigot should be set on downstream side. Then insert a spigot into a socket.
G) Before a jointing work, check condition of socket and rubber ring inside of socket. Clean socket and spigot by brush.
H) Clean a jointing part and paste lubricant on spigot (especially on taper part). Then, joint by jacking tool (V-Jack) with confirming its position vertically and horizontally.
   - If a tee joint or a bend pipe are used, TH-Grip must be used.
I) TH-grip must be set at socket and spigot of tee-joint or bend pipe and also at jointing parts of straight pipes of upstream and downstream side.
J) Confirm the insertion length by line marked on spigot side.
K) Confirm the jointing work is proper or not by using check-gauge. (top-bottom, right-left)
L) (If you need to cut pipe) Cut at right angle to pipe axis by using saw and chamfer around cutting end of the pipe.

(5.4) Pipe laying & jointing of HDPE

A) Carry required pipe material (pipe and joints) on that day to construction site.
B) Clean inside of socket and spigot of HDPEs and confirm there is no dirt etc.
C) Carry and pipes near the construction site and put it with the logo side up.
D) Confirm depth of a trench and bedding sand for new pipes based on design drawing.
E) Dig and secure enough space underground to conduct HDPE electro-fusion jointing work.
F) Scrape jointing part by a scrapper and clean there by acetone or alcohol paper.
G) Mark index line to check proper insertion length.

H) Hold both side of HDPE and unload into the trench slowly and carefully with confirming jointing point.
I) Check pipe axis in the trench and insert a pipe to existing socket. Then check insertion length by using “insertion and fix” .
J) Prepare EF controller and generator to conduct electric fusion.
K) Set a cable to terminal of EF controller and EF socket.
L) Read bar code which attached every pipe or joints by bar code reader on EF controller. (Duration, Diameter, resistance number）
M) Setting will be done automatically by bar code reader.
N) Press “start”
O) Indicators on socket will be comes up to surface and “Confirm jointing property” will be displayed on screen of EF controller.
P) Cooling time will be displayed on screen. Do not touch jointing part until cooling finished.
Q) (If you need to cut HDPE pipe) Cut at right angle to pipe axis by using PE cutter after marking cut line.

6. Related Documents
N/A

7. Related Forms
N/A

8. Reference
N/A

9. Attachment
N/A

1. **Title**
Pressure Test

2. **Objectives & Scope**
(1) Objective
To check leakage at jointing parts between pipes or other facilities due to bad jointing work or low-quality material for every construction.
(2) Scope
This work is applied only for new pipe laying work or pipe replacement work.

3. **Abbreviations and definitions**
N/A

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person in charge	Responsibility
Pressure test	NRW sec. / Township office	
Reporting	NRW sec. / Township office	

5. **Procedure**
5.1 Prepare equipment, material, and tools for pressure test
- Manal test pump or engine driven pump
- Two set of saddle clamp (depends on target pipe size of the test)
- Drilling machine（If necessary）
- Pipes and fittings for connecting saddle clamp and Manual Test Pump
- Storage tank and hose for collecting water
- Two set of pipe wrench
- Two set of valve key

5.2 Select a location and section. This work should be done by engineer in charge and responsible person of a project.
5.3 Close valves to stop water flow into test section. Then, check carefully the valve closed.
5.4 Secure enough water for pressure test in advance.

5.5 Select a place to set manual pressure pump from low place, and a place to release air from high elevation place on the target pipe. Set saddle clamps and pipes/hoses on those 2 places, one for transferring water and the other for releasing air. For tapping, use a drilling machine.

5.6 Connect test pump and saddle clamp after drilling work to send water into target pipe by operating test pump.

5.7 Install service pipe with appropriate length on saddle clamp to release air. Also install a valve for drain and air releasing.

5.8 Start transferring water into target pipe until the pipe fulfilled keeping the valve for air releasing open. Keep sending water until all air inside released.

5.9 Close the valve for air releasing if all the air inside released.

5.10 All preliminary work finished, continue transferring water until it reaches to target pressure.

5.11 Close a valve of test pump when the indicator of pressure gauge reached to target pressure (decided by length and pipe diameter). Then, wait planned time and watch moving of the indicator to know leaks happened or not. It is better to use a pressure gauge which can measure 1MPa in maximum.

5.12 If the indicator keeps the pressure during test time. (pressure is not reducing.)

- There is no leakage on pipes tested.

5.13 If the indicator decreased during test time. (pressure is reducing)

ⅰ. The indicator decreased a bit and stopped decreasing.

⇒ In this case, the air might not be released perfectly.

⇒ Open the valve for air releasing and test again.

ⅱ. The indicator keeps decreasing.

⇒ In this case, there might be leakage on target pipe.

⇒ Check every jointing points visually on site by using (as-built) drawing.

⇒ If leakage found, repair it immediately.

6. Related Documents

N/A

7. Related Forms

N/A

8. References

N/A

9. Attachments

N/A

1. Title

Drilling work for service connection

2. Objective & Scope

Drilling for branching service pipe from distribution pipe

3. Abbreviations & definitions

N/A

4. Tasks, Responsibilities and Accountabilities

Tasks	Person in charge	Responsibility
Setting up construction signboard	Operating staff and supervisor of the construction	supervisor of the construction

5. Procedure

1) Check material type (DI, HDPE, PVC) of target pipe and prepare drilling machine set. Confirm all parts for the drilling machine are stored in a box.
2) Confirm motor wrench, adapter, rachet wrench, drilling machine, tapping bit, and hose are stored in the box.
3) Prepare appropriate saddle clamp depending on target pipe material / diameter.
4) Before installing saddle clamp, clean installation part on target pipe surface in advance.
5) Install bottom part of a saddle clamp first, then install top part. Valve of the saddle clamp should be placed on top. Then, tighten bolts & nuts alternately and equally.
6) Remove a cap of the valve on top of saddle clamp. Set the removed cap to side screw which is for connecting service pipe.
7) Confirm open/close condition of the valve before setting a drilling machine. If it is closed, open the valve not to obstruct tapping bit insertion.
8) Use an adapter which is selected depending on diameter of service pipe to set drilling machine on the valve of saddle clamp.
9) Set the drilling machine on the adapter. Then, set the hose for drain. (to check water flow from drilled hole)
10) Operate the drilling machine and send a tapping bit until surface of distribution pipe.
11) Confirm the tapping bit reached to pipe surface (cannot send the bit more). Then, turn one round in reverse to have short distance between the bit and distribution pipe.

12) From that position, send the tapping bit by using rachet wrench. Turn rachet wrench 4-5 times in 45 degrees, and turn 1/8 a body of drilling machine to down the body.
13) Load of turning will be light when the drilling finished. If you open the valve in this condition and water from drain hose can be checked. Also, chips of DI can be seen from the hose if you drill on DIP pipe.
14) Close a valve for drain and reverse-turn the spindle of the drilling machine to up tapping bit. Then, close the valve of saddle clamp when the tapping bit is sent up to top of the drilling machine.
15) Reverse-turn the body to remove drilling machine.
16) After removing drilling machine, remove the cap (used in 6) and set and tighten to the valve on top of the saddle clamp.
17) Service pipe should be installed to male screw of side of the saddle clamp by using branch socket for PP or VP×GP Union for PVC.

6. Related Documents

7. References

8. Attachments

1. Title

Backfill on pipe laying work

2. Objectives & Scope

- To prevent road subsidence by proper backfilling.
- Backfill by using sand for protecting pipes to prevent damage by load from vehicles.

3. Abbreviations and definitions

N/A

4. Tasks, Responsibilities and Accountabilities

Tasks	Person	Responsibility

5. Procedure

5.1. Lay bedding sand for 0.05m under installed pipes.
5.2. Lay protection sand for 0.1m over the pipes.
5.3. Backfill with dug soil between 0.1m(done by 5.2) sand layer and crusher-run, if the dug soil is fine (NOT including rocks, stones, or much water.)
5.4. Tamping must be done every 0.3m for dug soil layer by rammer. If the soil layer is more than 0.3m, tamping work and backfilling must be done in turns.
5.5. For asphalt or concrete paving, crusher-run should be laid for more than 0.2m between soil layer and surface pavement. Tamping work is also needed for this crusher-run layer.
5.6. If there is no pavement, more than 0.2m crusher-run should be laid as a surface layer for preventing subsidence due to loads from vehicles.
5.7. Each process mentioned above must be recorded by photo. (No one can check backfilled layer after completion of the work.)

6. References

7. Attachments

1. Annex 1: Framework for developing SOPs

Material Management

2. Objectives & Scope

(1) Prepare material for construction based on design drawing.

(2) Check and manage material balance (in and out).

3. Abbreviations and definitions

HDPE - High Density Polyethylene

RRVP – Polyvinyl Chloride Pipe

DIP - Ductile Iron Straight Pipe

PE - Polyethylene

4. Tasks, Responsibilities and Accountabilities

Tasks	The person in charge	Responsibility
Create management list by Excel	Assigned staff for material management	Material management in charge
Before Material required to prepare selection	Assigned staff for material management	Material management in charge

5. Procedure

5.1 Create material management list by EXCEL based on a design drawing.
5.2 Check the material every morning and evening and establish a system for purchase additional material every two weeks.
5.3 Keep purchased material in a safe place. (Avoiding theft)
5.4 Warehouse for purchased material should be near the construction site.
5.5 Check material balances every day.

5.6 A staff in charge of material management must check use and return of every material.
5.7 Request the material manager to purchase additional material depending on the construction progress.
5.8 Prepare material list by EXCEL or handwriting for purchase based on work type. (including name, amount, size, diameter, or shape)
5.9 List necessary items of the day and transport those to construction site.
5.10 Record the transported items into the material list.
5.11 Record used items into the list.
5.12 Record transported items correctly every day in order to be able to check the stocks of all material anytime.
5.13 After checked balances of material, prepare necessary items again for coming day.

6. Related Documents

7. Related Forms

8. References

9. Attachments

	Yangon City Development Committee Engineering Department (Water & Sanitation) .... Division ....NRW.......Section	**SOP Code No:**	EDWS-NRW-10
		Version No:	00
		Effective Date:	April 12, 2021
		Pages:	1
		Developer	
		Verifier	
		Approval	

1. **Titele**

Equipment and Tools Managements

2. **Objectives & Scope**

1. To set up equipment and tools management system to prevent equipment and tools from broking or missing due to lack of care.

3. **Abbreviations and definitions**

HDPE Pipe = High Density Polyethylene Pipe
PVC Pipe = Polyvinyl Chloride Pipe
DI Pipe = Ductile Iron Pipe
GI Pipe = Galvanized iron Pipe

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person	Responsibility
Prepare construction schedule	Related Staff	Site In charge
Pick up necessary equipment and tools from design drawing and work procedure	Related Staff	Site In charge
Manage equipment and tools	Related Staff	Site In charge

5. **Procedure**

1 Prepare list of equipment and tools according to planned construction schedule.

2 Check daily use equipment and tools based on design drawing and construction schedule.

3 Prepare necessary equipment and tools before starting construction.
(Equipment = Generator, Drilling Machine, Engine Cutter, etc.)
(Tools = Torque wrench, Chain Pipe wrench, Monkey spanner, Ratchet wrench, etc.)

4 Record used equipment and tools on that day and check the numbers of those equipment and tools are same at taking out or return time.

5 Maintenance work for those equipment and tools are needed as well.
(oil replacement is ok or not, total operation hours etc.)

6 At the end of the work, need to check and clean the equipment and tools before returning. After cleaning, dry up with towel to avoid corrosion. All equipment and tools must be returned to a certain place.

6. **Related Documents**

7. **Related Forms**

8. **References**

9. **Attachments**

1. Annex 1: Framework for developing SOPs

Creating a water distribution pipe completed drawing

2. Objectives & Scope

1) Plot planned or constructed distribution pipeline into plane map (standard scale = 1/500) properly and store that data.
2) Utilize the data for maintenance of pipeline, planning of development plan or pipeline design by recording as Geographic Information System (GIS).

3. Abbreviations and definitions

DIP : Ductile Iron Pipe
HDPE : High Density Polyethylene Pipe
PVC : Polyvinyl Chloride Pipe

4. Tasks, Responsibilities and Accountabilities

Tasks	Person	Responsibility
1. Prepare scaled topographic survey map to draw design/completion drawing.	Relevant staff	Responsible person
2. Define appropriate scale for a drawing. (E.g. 1:500, 1:250, etc.)	〃	〃
3. Record off-set of installed pipes such as valves or bend to set those position. (Off-set: distance from two objects which might not be moved for a long time)	〃	〃
4. Record a branched location of service connection	〃	〃
5. Set legend for design/completion drawings in advance.	〃	〃
6. Draw pipeline, valves, bends, tee bends, and facilities such as hydrant on the drawing.	〃	〃
7. Drawing should be north upward. If it is difficult to set that, describe north direction on the drawing.	〃	〃

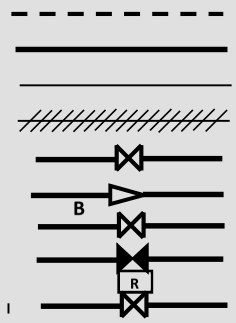
5. Procedure

1) Prepare scaled topographic survey map to draw design/completion drawing.

2) Draw drawings according to the rules of design/completion drawings.
3) To draw pipeline, pipe center, bend, valve, tee joint, or reducer can be pointed based on the distance from base point such as road shoulder, fence, or drain onto A1 or A2 paper. Branched point of customer service pipe must be marked accurately according to measured distance from the nearest valve etc.
4) Set the legend of drawings according to the drawing rule.
5) Draw drawings according to the rules of design/completion drawings. To draw pipeline, pipe center, bend, valve, tee joint, or reducer can be pointed based on the distance from base point such as road shoulder, fence, or drain onto A1 or A2 paper. Branched point of customer service pipe must be marked accurately according to measured distance from the nearest valve etc.
   a) Decide number of pages and size of the drawing depending on project area. If all area of the project cannot be drawn into one page, use 2 or more pages by dividing the project area. (pipeline must be divided at straight line)
   b) Completion drawing includes detail diagram or off-set diagram. Those diagrams should be considered to decide size of the drawing.
   c) Layout of completion drawing are following.
   - ✓ Write the project name at the head of the drawing.
   - ✓ Set the guide map of the project area at upper right. (north upward)
   - ✓ Set direction symbol near the guide map.
   - ✓ Describe project name, period, client (such as YCDC), contractor, responsible person, page, drawer name, and date etc. at lower right.
   - ✓ Set scaled topographical map at the center of the paper and draw pipeline. (Over-pass or under-pass cannot be drawn in the plane drawing so that detail diagrams should be prepared for such cases)
   - ✓ Detail diagram or off-set diagram should be noted in the plane drawing. Those diagrams can be written by free scale.
   - ✓ Draw cross section of backfill（Scale:1/20～1/30）

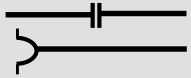
   d) Sample of legends.

Distribution pipe (Newly installed) ⇒Φ50mm～ Φ75mm ⇒
Distribution pipe (Newly installed) ⇒Φ100mm～Φ400mm ⇒
Existing distribution pipe ⇒Φ50mm～Φ400mm ⇒
Removed pipe ⇒Φ50mm～Φ400mm ⇒
Valve ⇒ Φ50mm～Φ400mm ⇒
Reducer ⇒ Φ50mm～Φ400mm ⇒
Butterfly Valve Φ50mm～Φ400mm ⇒
Closing Valve Φ50mm～Φ400mm ⇒
Pressure Reducing Valve ～Φ400mm ⇒



Flange Φ50mm～Φ400mm ⇒

DIP Socket Φ75mm～Φ400mm ⇒



6. Related Documents

N/A

7. Related Forms

N/A

8. References

N/A

9. Attachments

N/A

1. Title

Pressure Measurement

2. Objectives & Scope

(1) Measure water pressure to design new pipeline network (DMA)
(2) This SOP describe the case in Yankin Township, 13 ward, NRW-Reduction Pilot Project

3. Abbreviations and Definitions

4. Tasks, Responsibilities and Accountabilities

Tasks	Person	Responsibility

5. Procedure

(5.1) Select pressure measurement point on existing pipeline.
(5.2) Check water inlet line, supply hours, and valve operation relating to pressure measurement point set in (5.1) on pipeline map.
(5.3) Execute test digging around pressure measurement point to confirm existing pipe situation such as material or diameter etc. Then, judge the point is good for pressure measurement or not.
(5.4) Plan measurement work with considering traffics, then prepare tools or equipment for measurement.
(5.5) Pressure measurement step

I. Install a saddle clamp (select by pipe material/diameter) to existing pipe.
II. Set drilling machine onto a saddle clamp and tap.
III. After tapping, set service pipe to pressure gauge or pressure logger.
IV. After setting pressure gauge/logger, to prevent robbing or rainwater, protect the equipment carefully. In addition, set traffic control equipment to prevent cars into measurement point.

Equipment for Pressure Measurement are following.

- Saddle Clamp with valve for branch
- Drilling Machine
- HDPE Pipe or PVC Pipe & accessories
- Pressure Gauge (0.5 Mpa or 1.0Mpa), or Pressure Logger

(5.6) Pressure measurement work should be continue for one week at least to confirm actual water pressure transition of target pipeline. To check water pressure transition continuously, logger type pressure gauge is required.

(5.7) End of planned measurement period, pick up data logger.
(5.8) After picked up all equipment, remove service pipe and set a cap for saddle clamp. Ensure to close valve of saddle clamp.
(5.9) Backfill and tamp at the place dug for pressure measurement work.
(5.10) Confirm and analyze collected data.

6. Related Documents

7. Related Forms

8. References

9. Attachments

	Yangon City Development Committee Engineering Department (Water & Sanitation) Water supply Division NRW Section	SOP Code No:	EDWS-NRW-13
		Version No:	00
		Effective Date:	April 12, 2021
		Pages:	1 of 2
		Developer	
		Verifier	ACE/DYCE
		Approval	CE

1. Title

Flow measurement by using ultrasonic flowmeter

2. Objectives & Scope

1. To measure water flow and velocity on target pipe
2. Results of the measurement will be utilized for NRW management or planning.

3. Abbreviations and definitions

N/A

4. Tasks, Responsibilities and Accountabilities

Tasks	Person in charge	Responsibility
Prepare ultrasonic flowmeter		
Conduct flow measurement		
Receive and check the results		

5. Procedure

5.1 Decide measurement place.
5.2 Check the equipment. (Flow meter, flow meter detector UP10 AST: pipe size 65 to 500 used and UP04 AST: Pipe size 300 to 5000, Cable for flowmeter, Mounting hardware, Detector grease. Battery. Battery checker, Battery cable, Battery charging cable, tape measure, steel tape, permanent maker, waste cloth, Wire bush, sheet, weight, piping specification…)
5.3 Clean up the pipe.
5.4 Installation Wizard and select file and input file name
5.5 Pipe size setting input pipe diameter by diameter itself or circumference of pipe. You can select which way you want by direction button for example: (pipe condition) set (Diameter, Circumference)
5.6 Pipe material select material of the pipe from default choices or user defined by direction or numeric button for example: (pipe condition) set (material…. PVC, Carbon Steel, Copper…)
5.7 Thickness of pipe input pipe thickness by numeric button directly.
Example: (pipe condition) set (Thickness ……mm)
5.8 Lining Material select material of the lining from default choices or user defined by direction or numeric button. (Lining Condition) (none, pvc, motor)
5.9 Thickness of lining (……mm)

5.10 Fluid selection from default choices or user defined by direction or numeric button. (Type) (water, sea water)

5.11 Transducer type from default choices by direction or numeric button.
(Transducer type) set (UP50 AST, UP10 AST, UP04 AST)

5.12 Target pipe must be clean before set a sensor. (or you cannot get accuracy)

5.13 Select sound path sections (Z-path method, V- path method, W-path method)
V- path method this type method is effective for application of measurement on the larger pipe or measurement for attenuating fluid against ultrasonic, because of transducers distance is relatively shorter, so please select this method when V-path method installation is impossible.

5.14 Z-path method this method is typical.

5.15 W-path method may be effective on smaller pipe.

5.16 Flow rate unit setting (m^3/s, m^3/min, L/s)

5.17 Decimal point position (xxx. xx, xxxx.xx)

5.18 Detector mounting

(1) Transducer distance setting set distance between transducer on mounting fixture in accordance with the main unit calculation.

(2) set mounting fixture onto the pipe warp the mounting chain around the pipe and hook an end link with the hook knob arrangement (Roll chain around the pipe, hook the chain at appropriate length)

(3) add couplant and set transducers to mounting fixture add silicone grease as acoustic couplant onto surface of transducers.

(4) set cable with the transducer and the main unit connect cable with the transducer.

5.19 Start Measurement

6. Related Documents

Manual of ultra-sonic flowmeter. (like as leak correlator SOP)

7. Related Forms

N/A

8. References

If you have a sample of analysis in Excel format. Please refer that.

9. Attachments

Also, attach that EXCEL file.

1. Title

Leakage volume measurement on distribution pipe or service pipe

2. Objectives & Scope

1) To check a reason of leakage.
2) To measure leakage volume per unit time and to analyze in pipe diameter, material, pressure, and leak factor.
3) To record the result and utilize it as a reference for estimate leakage volume of other water leaks.
4) To utilize the results for planning to reduce leakage.

3. Abbreviations and definitions

N/A

4. Tasks, Responsibilities and Accountabilities

Task	Person in charge	Responsibility
Leakage volume measurement	T/S office staff Staffs of section relating to NRW	

5. Procedure

1) Confirm existing pipes around the happened leakage by pipeline map or other documents.
2) Prepare equipment for measurement
   - Measuring cup with scale (1 litter)
   - Funnel, bucket (10 - 20 litter size), plastic bag, plastic sheet for collecting water leak, etc.
   - Timer or watch for time counting
   - Shovel and drain pump
   - Guard fence or cone to keep safe, ladder.
3) Confirm a situation of the leakage on site.
   - Leakage from underground pipe
   - Leakage from on-ground pipe
   - Confirm the pipe where a water leak happened is distribution pipe or service pipe
   - If the leak happened from underground pipe, the leak water should be collected and measured on ground and estimate leakage volume. The supervisor of a project should judge it is possible to dig at the leak point for collecting and measuring leak water.

- If the leak volume is small and supervisor judge it is possible to measure, responsible staffs set safety guards for preventing passenger from accident.
- Dig around leak into 1.0m – 1.5m along the pipe, depth should be -0.45m (-1.5m from ground) below the pipe, and width should be 1.0m avoiding other pipes or structures, then expose the pipe completely.
- Mark the leak point with color painting on exposed pipe and take a photo of the leakage.
- To enter the dug hole, ladder must be used to prevent from falling accident, and helmet must be worn.
- Prepare equipment for collecting leak water depending on leak volume.
- If you measure leak volume from distribution pipe on-ground, set safety guards in the process mentioned above.
- For the leakage from service pipe, check a position of valve. Then, carry out measurement work for underground or on-ground as well as for distribution pipe.

4) Re-confirm the preparation work of every staffs
   - Timekeeper: Timer or stopwatch
   - Leak water collecting: Equipment for collecting leak water
   - Leak volume measuring: Equipment for volume measuring
   - Recorder: Recording format
5) Start measurement work
   - Start leak water collecting when the timekeeper says “start”.
   - Duration of measurement should be decided between 30sec – 10 min depending on leak volume.
   - If the size of leakage is so big, collecting work should be carried out a collector and support staff.
   - Stop collecting work when the timekeeper says “stop”.
   - Staff in charge of measuring pours collected water into the measuring cup and measure leak volume.
   - Recorder notes the result, measurement duration and leak volume per unit time, in recording format.
6) Measurement should be carried out three times and take an average volume.
7) Situation of the leakage or measurement work should be recorded by photo or movie.

6. Related Documents

7. Related Forms

8. Reference

9. Attachment

1. **Title**

Leak Detection

2. **Objectives & Scope**

（1） Prevention of leakage which is to survey point and to repair work.

（2） To make a ”Leak Detection Plan” which can be used for a map of existing pipe on each township after training in training yard.

3. Abbreviations and Definitions

NRW - Non-Revenue Water
BPF - Frequency
NR - Noise Reduction
NF - Noise Filter

4. Tasks, Responsibilities and Accountabilities

Tasks	Person	Responsibility
1）To survey Leakage with Noise isolation leakage Detector (DNR-18)	Assigned staff for NRW section	AE / EE

5. Procedure

（a）Prepare items such as projection or completion drawing of distribution pipe.

（b）To check Noise-isolation Leakage Detector body and accessories before survey.

- Main body DNR-18 x 1 ・ Pickup sensor x 1 ・ Head Phone x1
- C-cell battery x 4 & Confirm of battery capacity
- Shoulder belt x 1 ・Vibration sensing rod x 1

（c）To turn on the power to the body of DNR-18 and set survey date and time.

（d）To set Frequency based on each set point such as BPF, NF, and NR as shown on EDWS-NRW-OP-W4-A1.

（e）To adjust the length of the cable of pickup sensor and set the body with connector.

（f） After connecting the body, check the sound and Hand switch.

(g) Leakage sounds have four factors such as flow, impact, friction and vibration of pipe. Frequency distribution should not show a constant value, because four factors have different sound quality. For this reason, leakage survey should be done at night when surrounding noise is as small as possible because this survey needs comprehensive judgement such as capture on ground, acoustic perception and on-site condition.

(h) To survey leakage sound using pickup sensor while moving with a small width along existing pipe. At this time, put on the hand switch after pickup sensor placed on the ground.

(i) If there is a lot of noise such as transformer of electric pole and passing of vehicle,the combination of BPF, NF and NR treatment can improve the accuracy of capturing the lost water temperature.

(j) Capture volume is can be controlled with Pickup sensor or press the button:(+),(-).

(k) It is assumed that there is a leakage near the place which leakage sound is the most highest.

6. Related Documents

No

7. Related Forms

8. References

9. Attachments

No

1. Title

Leak detection by using “Leak Correlator”

2. Objectives & Scope

a. To detect and reduce leakage, and to repair leak point.

b. This SOP only for detection work, not for leak volume measurement or NRW calculation.

c. This detection work should be executed if you find leakage by Minimum Night Flow or Night Step Test.

3. Abbreviations and definitions

NRW - Non-Revenue Water

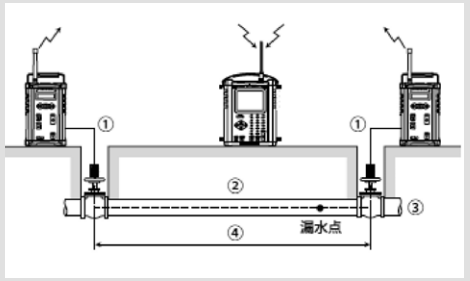
4. Tasks, Responsibilities and Accountabilities

Tasks	Person in charge	Responsibility
Detect leaks by Leak Correlator	NRW section staff	AE/ EE

5. Procedure

a. Prepare a detail pipeline map (drawing) of target area.

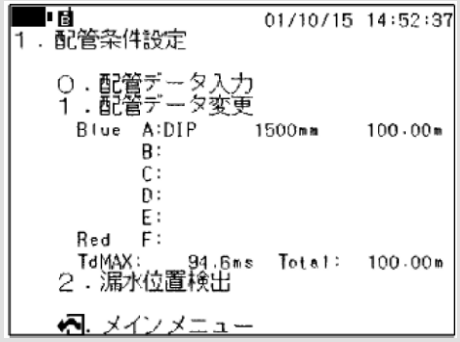
b. Set sensors (red & bule) on valves placed both end of target line. (As below)



※Only sensors are IP68 (Main unit is not water-proof)

c. Confirm length, pipe material, diameter of target pipe between two sensors.
(e.g., Total=100m: PVC 50mm=20m, PVC 75mm= 50m, PE 75mm=30m)

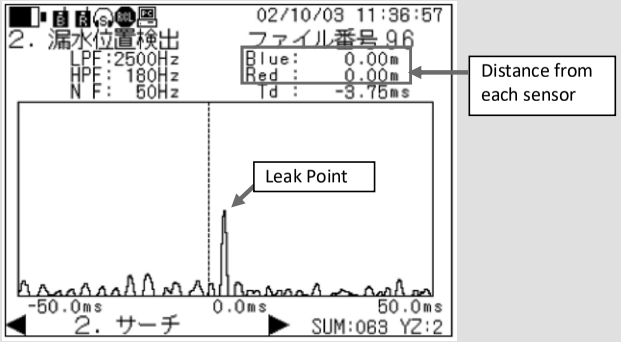
d. Input the data confirmed in “step 3” to “Pipe Data Setup Category” by main unit of Leak Correlator.



e. Input data according to EDWS-NRW-OP-W3-A1.

f. Select Leak Correlator on the main menu.

g. Check the distance between leak point to sensor A or B shown in the display.



h. If any error happen, check EDWS-NRW-OP-W3-A1 and solve according to it.

i. Work should be carried out during mid-night. (Quiet time)

j. Conduct leak survey work by leak detector (SOP-15) based on the result of this leak correlator survey.

k. Survey result must be recorded in leakage repair record just after this survey finished, then send the record to NRW Management Section.

l. All equipment must return to original storage place.

6. Related Documents

User's Manual of Leak correlator

7. Related Forms

Leakage repair record

8. References

9. Attachments

Leakage repair record

	Yangon City Development Committee Engineering Department (Water & Sanitation) Water Supply Division NRW Section	SOP Code No:	EDWS-NRW-17
		Version No:	00
		Effective Date:	March
		Pages:	1 of 2
		Developer	
		Verifier	
		Approval	

1. **Title**

   Minimum Night Flow (MNF)

2. **Objectives & Scope**

   (1) The aim of this work is to screen for the presence of water leakage and estimate leak volume in the distribution system by installing a flow meter at the uppermost part of the inlet of the distribution system in the study area and measuring the amount of water flowing into the system.

   The target of the work is the water distribution pipelines that distribute water within the area by pipeline with DMA formed or one-way pipeline.

   The survey will be conducted during the midnight hours (Am2:00 to Am4:00) when the water supply usage is expected to be the lowest in a day.

   (2) This SOP is only applied for NRW management section and associated townships.

3. **Abbreviations and Definitions**

   DMA - District Metering Area
   NRW - Non-Revenue Water
   MNF - Minimum Night Flow

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person in charge	Responsibility
1) Conducting MNF	Staff of NRW management section Staff of associated townships	AE / EE T/S staff in charge of flow measurement

5. **Procedure**

   (5.1) Confirm whether the existing pipeline forms DMA by Network and whether the existing pipeline can be measured by single pipeline by using the pipeline map etc., in the target area where be measured MNF.

   (5.2) Check the consistency between the pipeline information confirmed by the pipeline map and the pipeline installation status, the presence or absence of installing a flow meter in the target area. In the case of no flow meter is installed, make a tentative decision about the point where the MNF measurement based on the local conditions.

   (5.3) Determine as the official measurement point when the point is judged to be measurable MNF for trial excavation carried out to the lower 1.5 feet of the buried pipeline therefore there is no ground water or influent water from drain at the tentatively determined measurement point.

   (5.4) Prepare such as checking the operation of the Ultrasonic Flow Meter, battery and its accessories necessary for MNF measurement. Keep in mind that the parts to be used depend on the pipe diameter of the pipeline.

   (5.5) Excavate at each measurement point before the start time on the day of measurement. The size of the excavation shall be large enough to ensure sufficient space for installing work of the flowmeter.

   (5.6) As a preliminary preparation for installing the Ultrasonic Flow Meter on the pipe, clean the outside surface of the pipe where the Ultrasonic Flow Meter is to be installed and confirm that there are no foreign materials.

   (5.7) Install the Ultrasonic Flow Meter at the pipe and set the time to measure the flow rate when it is ready.

   - ➔ Set up the Ultrasonic Flow Meter follow EDWS-NRW-OP-W?
   - ➔ The measurement time is essentially 12 hours, from 8:00 pm to 8:00 am.
   - ➔ Set up the logging cycle of the Ultrasonic Flow Meter to 10 seconds.

   (5.8) Create a Graph by inputting the flow rate obtained from the measurement into Excel. Confirm the transition of the distribution water inflow within the 12 hours of measurement and the period of minimum flow time from graph data.

   (5.9) It can be judged that there is no leakage from measured pipeline at the time when the flow rate was zero.

   (5.10) If a certain amount of water is continuously flowing in, leakage from the pipeline is suspected and needs to be repaired. Determine the leakage section by night step test and find out the leakage point by leakage survey later.

   (5.11) If the minimum inflow is not zero but a small amount, it due to water use at nighttime by residents in the study area or inflow into storage tanks. In such cases, it is desirable to confirm the presence or absence of leakage by Step Test as with the case of (5.10).

6. **Related Documents**

   EDWS-NRW-OP-W? (Flow Measurement)

7. **Related Forms**

   N/A

8. **References**

   N/A

9. **Attachments**

   N/A

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1. **Title**

   Night Step Test

2. **Objectives & Scope**

   (1) The aim of this work is to confirm the presence or absence of leakage in the section of pipeline to check the change in the amount of water flow into each pipeline by switching valve installed at the upstream side of each distribution pipeline during the nighttime when the water supply is not in use at the areas judged to have potential for leakage based on Minimum Night Flow measurements.

   (2) This SOP is only applied for NRW management section and associated townships.

3. **Abbreviations and Definitions**

   DMA - District Metering Area
   NRW - Non-Revenue Water
   NST - Night Step Test
   MNF - Minimum Night Flow

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person in charge	Responsibility
1) Conducting MNF	Staff of NRW management section Staff of townships	AE / EE T/S staff in charge

5. **Procedure**

   (5.1) Confirm the presence or absence of valve, its location and the presence or absence of Flow Meter at inlet of the water distribution channel for each of the pipelines conducted NST by the pipeline map of the area where NST is to be conducted.

   (5.2) Check the pipeline map to confirm where the Valve needs to be installed for the NST and install the Valve. And switch all the valve to be operated to check the

opening/closing direction and operation status. In addition, check for abnormalities in the meter's weighing function where a flow meter is installed.

(5.3) After installing the valves for NST, assign a number (e.g. Valve No. 1 to Valve No. 8) to each valve to ensure accurate and efficient communication of switching the valve operations on the day of NST.

(5.4) Install Flow Meter or Ultrasonic Flow Meter for checking the amount of water distributed into the area on the day of NST.

(5.5) Determine implementation procedure of NST, start time and person in charge.

Flow monitor ⇒ 1 person
Valve operation ⇒ 6 – 8 people (2people/team)
NST supervisor ⇒ 1 person
Determine implementation procedure about switching valve.
Communicate by using radio or cell phone remotely.

(5.6) Confirm the schedule of construction work or the presence or absence of water supply at nighttime in the area before the day of NST. And give local resident notice that prepared for stopping water supply to store water in tanks due to close water distribution pipelines during the NST.

(5.7) In the case of logging the inflow rate by using the Ultrasonic Flow Meter, set the unit of the flowmeter display to Liter per Minute and the interval for Logging set to be 10 seconds.

(5.8) If the flow rate is grasped in advance by Minimum Night Flow Measurement, monitor changes in the inflow rate of each pipeline using this flow rate as a reference value carefully.

(5.9) Conduct NST at the time of day when amount of water used is expected to be lowest.

(5.10) The switching valve operator close all valves installed on pipeline in the area as instructed by the NST supervisor. And when closing the valve, confirm the closing status of the valve based on the disappearance of the sound of running water by using an acoustic bar (listening stick).

(5.11) The flow monitor records the changes in the inflow water quantity when all the Valves are closed.

(5.12) The valve operator close valves by supervisor instruction step by step. Generally, valves are closed from upstream side.

(5.13) The flow monitor check flow rate every time when the valve closed.

(5.14) Note pipelines which is suspected to have leakage when all procedures are finished.

(5.15) Check flow rate change for suspicious pipeline again.

(5.16) After the survey, open valves to distribute water and check leakage visually. If there is leakage on ground, mark at that point by color paint.

(5.17) After NST finished, open all valves very slowly by supervisor instruction not to occur turbid water.

(5.18) If there is a drainage pipe, wash out from that drainage pipe and check no turbid contains after NST.

(5.19) Record the result of NST on pipeline map and execute leak survey by using leak detector later day.

6. Related Documents

N/A

7. Related Forms

N/A

8. References

N/A

9. Attachments

N/A

1. Title

Customer Survey

2. Objectives & Scope

The objective of customer survey is to collect information of customers, water demand and water usage for each township.

(Scope)

It is limited for staffs of NRW Management Section, Township and District offices, and assigned personnel.

3. Abbreviations and definitions

1. NRW	Non-Revenue Water
2. TW	Tube Well
3. FD	Flat (Domestic)
4. FC	Flat (Commercial)

4. Tasks, Responsibilities and Accountabilities

Tasks	Person in charge	Responsibility /Accountability
Planning a Customer Survey	AE	EE/ACE
Preparing a format for Customer Survey by Excel	SAE &Staffs	AE/EE/ACE
Carrying out a customer survey	SAE &Staffs	AE/EE/ACE

5. Procedure

5.1 Planning Customer Survey

A) Prepare the location map (EDWS-NRW-OP-A1) and customer list (EDWS-NRW-OP-A2) of target area of the customer survey in advance.

B) Organize the members based on the work volume and area of the survey.

5.2 Preparation of format for Customer Survey by using Excel

A) Prepare a format for customer survey by using Excel table as EDWS-NRW-OP-A3.

5.3 Carrying out a customer survey

A) Open the valve and check the customer's water meters whether it is working or not, meter units in the table compare the units from bill, customers meters exist (or) not exist.

B) Draw in Location Map 2(House Hold Map) of customer survey area as EDWS - NRW-OP-A4.

C) Computerize customer survey data with excel table by using customer survey data on paper in order to have more exact data.

D) Calculate summary data of customer survey according to each title with excel formula.

5. Related Documents

N/A

7. Related Forms

1. EDWS-NRW-OP-A1
2. EDWS-NRW-OP-A2
3. EDWS-NRW-OP-A3
4. EDWS-NRW-OP-A4

8. References

N/A

9. Attachments

N/A

1. **Title**

DMA Monitoring

2. **Objectives & Scope**

（1） To check and manage DMAs set up by each project and keep DMAs isolated from other area.

（2） This SOP only applied for NRW management section and T/S office.

3. **Abbreviations and Definitions**

DMA - District Metering Area

NRW - Non-Revenue Water

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person in charge	Responsibility
1） DMA Monitoring	T/S staffs NRW section staff	AE / EE T/S staff in charge

5. **Procedure**

（5.1） For target DMA, after initial DMA set up work finished, confirm whether any construction which made any connections to other area or not.

（5.2） If an inter-connection to other area has made, confirm pipeline situations around target DMA. Then, decide to expand the DMA area or isolate again from connected area.

（5.3） After confirmation of DMA status, calculate NRW ratio every month by checking flow rate (get from flow meter) and customer data.

（5.4） Monitor NRW ratio based on NRW ratio which got just after DMA set up.

（5.5） A result of monitoring should be recorded in NRW Management List.

（5.6） If the NRW ratio increasing compared to initial ratio, carry out Minimum Night Flow measurement or Night Step Test to check leakage.

6. Related Documents

SOP of Minimum Night Flow, SOP of Night Step Test, SOP of Leak Detection

7. Related Forms

8. References

9. Attachments

1. Title

Meter Function Test & Creating Damage Meter Check List

2. Objective & Scope

1. Perform meter function check properly to replace broken meter to new meter to promote commercial loss reduction.
2. This SOP is only for staffs in charge of Commercial Loss Management.

3. Abbreviations and definitions

NRW – Non-Revenue Water
X, N, O - X = unreadable, N = No Meter, O = Normal

4. Tasks, Responsibilities and Accountabilities

5. Procedures

No	Tasks	Persons	Responsibilities
1.	Meter Function Test	AE	EE / ACE
2.	Damage Meter Check List	Staffs	EE / ACE

5.1 Meter Function Test

(1) Select target area for Meter Function test
(2) Take a Customer List of the area selected in (1) from Computer Section.
(3) Establish a Meter removing and re-installing team depend on the size of Meter Function Test Area, and the testing period and make a implementation plan according to EDWS-NRW-OP-W4-A-1
(4) Prepare a plan drawing which has customer ID, address etc.
(5) Site survey by plan drawing. Explain survey items to team members in advance.
(6) Write/revise house number, road name, customer name, present or absent, water meter, use or not use YCDC water, closed or open house etc., on the plan drawing.
(7) Copy prepared plan drawing for team members.
(8) Prepare the test meter, timer, joints, and water hose and pipe to connect a meter for the test. Also, break down the following assignments.
    ① Test meter reader
    ② Customer meter reader
    ③ Timekeeper
    ④ Recorder
(9) Remove the meters according to the plan drawing. Write the house number on the removed meter.
(10) Write down the initial value of test meter and customer meter. Initial readings and Final Readings value need to be changed from m^3 to L.
(11) Connect test meter and customer meter with the hose.
(12) Start the test when all the members ready.
    ① Before starting the test, decide test duration. (30 sec. or 1 min.)
    ② Open the valve on test meter when the timekeeper gives “start” sign. (sending water to a meter and the test meter)
    ③ Close the valve when timekeeper gives “stop” sign.
    ④ Record a flow volume both of test meter and customer meter.
    ⑤ Test should be carried out 2 times for each meter.

⑥ If there is much difference between first test and second test, carry out third test.

(13) Re-install customer meter after the test finished.
(14) The recorder confirms the test result by checking value of test meter and customer meter, one by one.
(15) If the difference value is negative sign(-), impeller of customer meter is turning well. If the difference value is positive sign(+), impeller of customer meter is over turning due to degradation of spindle.
(16) Tolerance level should be ±< 5%, compare to test meter, according to EDWS-NRW-OP-W4, F-1.
(17) Confirm meter-reading value from township office is appropriate by comparing to test result.
(18) If receive the result to display CE.
(19) Clean up the Test Meter and other equipment.

5-2 Damage Meter Check List

(1) Take a damage meter check list from township (X, N, O) monthly according to EDWS-NRW-OP-W4, F- 1
(2) Construct the Damage Meter Check List according to EDWS-NRW-OP-W4, A-2.
(3) Construct (3) times a year at least. If receive the result to display CE.
(4) According to the result,make the meter function test which is the most of the damage meter occur township about one time a year.
(5) NRW section,Township office and House Connection cooperate must do meter Function Test to Improve the Commercial Loss.

6. Related Documents

Technical Assistant Team's Lecture

7. Related Forms

(1) EDWS-NRW-OP-W4, F-1 Standard Meter tolerance
(2)EDWS-NRW-OP-W4, F-2 damage meter list

8. References

Technical Assistant Team's Lecture & On Job Training at N/Okkalapa (Nya) Ward

9. Attachments

(1) EDWS-NRW-OP-W4-A-1 Meter Function Test Area Plan
(2) EDWS-NRW-OP-W4, A-2 Damage Meter Check List

1. Title

Survey of damage meters throughout the city

2. Objectives & Scope

(1) Periodically invetigate the damage rate of customer meters installed.
(2) Only for NRW Management Section and Township staffs.

3 Abbreviations and Definitions

1. NRW – Non-Revenue Water
2. Broken Meter - It is impossible to perform the original function of the meter due to external factors.
3. Unreadable Meter - Water meter cannot be read due to dirt on the pointer board.
4. No Meter - Customer removing meter
5. T/S - Town ship

4. Tasks, Responsibilities and Accountabilities

No	Tasks	Persons	Responsibilities
1	Instruct each township regarding damage meter survey cooperration	AE	EE / ACE
2	Summarize and report the information provided by each T/S every 3 months.	Staff	EE / ACE

5. Procedure

5.1 Explain difficulties on confirmation work for grasping actual revenue water volume due to damaged meter to T/S officers.

5.2 Explain following survey items to T/S

A) Broken Meter ⇒ Cannot read indicators due to damage
B) Unreadable Meter ⇒ Cannot read indicators due to algae etc.
C) No Meter ⇒ Meters are removed by customers
D) Meter position ⇒ Meters are installed where meter-readers cannot read.

5.3 T/Ss survey all customers in those categories every 3 months and submit the survey result to NRW section.

5.4 NRW-Section compile collected data and summarize the numbers of damaged meter of whole Yangon city every 3 months.

5.5 For “Normal” meters which are judged by T/S staff, NRW section pick up 100 units from each T/S and execute meter function test for it by using electric test meter after scheduling.

5.6 Calculate meter damage ratio of “Normal” meters based on the result of meter function test in 5.5.

5.7 NRW section consider improvement plan on meter replacement/management to reduce commercial loss based on the damaged meter ratio.

5.8 To consider improvement plan, confirm each T/S are using which distribution line, and prioritize a T/S which is using purified water.

6. Related Documents

7. Related Forms

8. References

9. Attachments

1. **Title**
   Leakage record

2. **Objectives & Scope**
   (1) To perform effective and appropriate physical loss reduction work.
   (2) This SOP only applied for the staffs in charge of Physical Loss reduction work.

3. **Abbreviations and Definitions**

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person	Responsibility
1. Recording in leakage record	Staff	EE / ACE
2. Plotting leakage information into GIS map	Staff	EE / ACE

5. **Procedure**
   (5.1) Recording on leakage record format
   (a) Complete recording work of leakage happened in T/S until third week in every month according to EDWS-NRW-OP-W3-F1.
   (b) Add the collected records into list according to EDWS-NRW-OP-W3-F2.
   (5.2) Mark leakage data(point) into townships map.
   (5.3) Organize collected data by categories according to EDWS-NRW-OP-W3-F2, and make Pie Chart.

6. **Related Documents**
   N/A

7. **Related Forms**
   EDWS-NRW-OP-W3-F1
   EDWS-NRW-OP-W3-F2

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EDWS-NRW-OP-W3-F3

8. Reference

9. Attachment

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1. **Title**

Daily Report

2. **Objectives & Scope**

1) Record the construction work in detail daily.
2) Record used material (type, material kind, etc.), and sketch pipeline installed that day.
3) If a worker had an accident, record what happened, the reasons, and situations when the accident happened.

3. **Abbreviations and Definitions**

EDWS = Engineering Department Water And Sanitation

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person in charge	Responsibilities
Recording in daily report format	Staffs in charge	Supervisor of a project

5. **Procedure**

Record following items to report about daily work in a project.

（5.1）Record date, work place, whether, and work items daily.

（5.2）Record name and number of workers, staffs or labours every day.

（5.3）Record used material, consumable items with name, size, kinds.

（5.4）Record piping work with sketch and photos.

（5.5）If some special case happened, record reasons, situations and what you did against the problem.

（5.6）Submit those (you can use Form1) to supervisor.

6. **Related Documents**

N/A

7. **Related Forms**

N/A

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8. References

N/A

9. Attachments

N/A

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1. **Title**

Role of NRW Management Section

2. **Objectives & Scope**

(1) Make Short-term, mid-term and long-term plan and implement that plan to reduce Non-Revenue Water.

(2) Only for activities of NRW section

3. **Abbreviations and definitions**

(1) DMA - District Metering Area
(2) FOC - Free of Charge
(3) NRW - Non Revenue Water

4. **Tasks, Responsibilities and Accountabilities**

Tasks	Person in charge	Responsibility
1. Making Short , Mid , Long – term plan	AE	EE / ACE
2. Reduce Physical Loss	Staff	EE / ACE
3. Reduce Commercial Loss	Staff	EE / ACE
4. Office work and Duties	Staff	EE / ACE

5. **Procedure**

(5.1) Make Short, Mid or Long – term plan

A) Make NRW reduction plan based on PI Data analysis according to EDWS-NRW-OP-W1

B) Prepare action plan before implementing NRW Reduction Plan according to EDWS-NRW-OP-W2.

(5.2) Physical Loss reduction

A) Execute NRW Reduction Projects according to EDWS-NRW-OP1.

B) Create format of leakage record and record all leakage repair work based on the records submitted by T/S office according to EDWS-NRW-OP-W3 and EDWS-NRW-OP-W4.

(5.3) Commercial Loss reduction

A) Update customer data by business categories every 6 months to grasp actual water supply situation by T/Ss according to EDWS-NRW-OP-F1.

B) Execute "meter function test" to check water meter function. Besides, survey and collect damaged meter and record in "Damage Meter Check List". Carry out this work according to EDWS-NRW-OP-W4.

C) Collecting water consumption data of parks, public toilet (including public facilities), donation tanks, and FOC according to EDWS-NRW-OP-F2.

D) Check the reason and volume of water transportation by water truck and record that information. (important task)

E) Execute data monitoring & analysis and calculate NRW ratio (and water balance) for all areas in which NRW-Reduction projects were carried out. Refer EDWS-NRW-OP-F3.

F) Monitor and manage DMAs according to EDWS-NRW-OP-F4.

G) Check and solve non-metered Customer

(5.4) Office work and Duties

A) Record daily work according to EDWS-NRW-OP-F5.

B) Refer Admin department SOP

6. Related Documents

Lecture - How to make SOP?
Technical Assistant Team's Lecture.

7. Related Documents

(7.1) EDWS-NRW-OP-F1
(7.2) EDWS-NRW-OP-F2
(7.3) EDWS-NRW-OP-F3
(7.4) EDWS-NRW-OP-F4
(7.5) EDWS-NRW-OP-F5

8. References

Phnon Penh Water Supply Authority's Lecture in 2017, September

9. Attachments

1. Title

Valve box installation

2. Objectives & Scope

To protect water meter from external impact or unrelated person.
This SOP is only for worker or staff in charge of piping work (distribution pipe)

3. Abbreviations and definitions

N/A

4. Tasks, Responsibilities and Accountabilities

Tasks	Person in charge	Responsibility
Valve box installation	Workers or staffs of each project	Supervisor of project

5. Procedure

(1) Prepare material for valve box installation work as follows.

- Bricks
- Valve Box
- *Basement (Precast)*
- *Sand*
- *Cement*
- *Tamper*
- *Level*

(2) Fill sand until flange of a valve, and tamp.

(3) Set crushed-stone on the sand and tamp again.

(4) Make basement by mortar which made by 1:1 (sand:cement) for 5cm in circle.

(5) Measure a distance between road and the basement. Adjust depth of surface of basement to be 0.93m(Valve box height) + 0.1m(Brick thickness) = 1.03m in total.

(6) Set bricks on the crashed-stone in circle with using 16 pieces as second foundation. (a piece = half of a brick)

(7) Check again that distance between brick and road is more than 1.03m.

(8) Check the height and level of valve box, then, set valve box tentatively to check it doesn't higher than road surface.

(9) Remove valve box once and fix bricks by mortar.

(10) Set concrete base on the second foundation.

(11) Check level of the concrete base. If it is not horizontal, adjust the level by mortar.

(12) Then, set valve box onto the concrete base.

(13) Set the valve spindle to be center of the valve box.

(14) Backfill and tamp around valve box carefully, after fix the valve box position.

6. Related Documents

7. Related Forms

8. References

9. Attachments

Annex-5.B: Guidelines and Manuals for Non-Revenue Water Management

(5.B1) Guideline of Design and Installation of Water Supply Equipment

［Purpose］

This guideline stipulates what is necessary when designing and constructing water supply equipment installed by citizens in order to use tap water supplied by YCDC.

［Scope of application］

The scope of this guideline is the water supply equipment from the connection point with the water pipe to the water meter or the tank installed for receiving water.

［Design］

（Purpose of water supply）

Confirm the purpose of use of water supply.

- ❏ Water for single house ➪ Branch water supply pipe diameter＝Meter diameter × 1
- ❏ Water for apartment house ➪ Branch water supply pipe diameter＞Meter diameter × n
- ❏ Water for single commercial facility
  ➪ Branch water supply pipe diameter＝Meter diameter × 1
- ❏ Water for composite facility
  ➪ Branch water supply pipe diameter＞Meter diameter × n
- ❏ Water for composite facility ＋ Water for apartment house
  ➪ Branch water supply pipe diameter＞Meter diameter × n

（Selection of water supply method）

Select a water supply method according to the purpose of using water supply and the business Form of the building or facility.

Direct water supply	A method of supplying water to the end water taps by the water pressure of the distribution pipe.
Tank type water supply	This is a method of supplying water by providing a water tank that can store 50% or more of the daily water supply. Used to avoid the effects of water outages at facilities that use a large amount of water at one time or facilities that use water continuously. In the design, be sure to install a ball tap that has a mechanism to stop the water when the water level in the tank reaches the maximum water level.

【Reference】**- I**

※ Example of installing a ball tap in a tank

（Calculation of water supply pipe diameter and determination of meter diameter）

① **Calculation of maximum daily water consumption**

➪ Calculate the maximum daily water consumption required for calculating the water supply pipe from the type of work, the number of water supply users, and the water supply time.

「Calculation example」

§-1：Concept of planned water consumption and water supply pipe diameter

In the case of a house. （【Reference- II】－See table

❑ Usage Pattern ➪ Housing

❑ Water supply method ➪ Direct water supply

❑ Amount of water used ➪ 200L/$_{\text{person}\cdot\text{day}}$

❑ Water supply time ➪ 10 hour/$_{\text{day}}$

A: Planned daily water consumption＝4 person×200L/person・day ＝**800L/** day・10hour

【Reference】- II　Concept of water supply time and planned daily water consumption

	Usage pattern	Amount of water used (L/day)	Supply time (h／day)	Water supply target	Calculated personal per unit
1	Housing Condominium	200～400 L/ person・day 200～350 L/ person・day	10 hour / day 15 hour / day	Resident personnel	0.16 person/m^2
2	Office	60～100 L / person・day	9 hour / day	Number of employees	0.20 person/m^2
3	Factory	60～100 L / person・day	Working time / day+ 1 hour / day	Number of employees	Standing work 0.20 person/m^2 Sitting work 0.30 person/m^2
4	Hospital	1,500～3,000 L / Bed・day 30～ 60 L / m^2・day	16 hour / day	Number of beds Total floor area	
5	Hotel	350～ 450L / Bed・day 60～100L/person・day	12 hour / day 12 hour / day	Guest room Employee	
6	Caffe	25～ 35L/ person・day 55～130L/ person・day	10 hour / day 10 hour / day	Guest Store floor area	
7	Restaurant	55～130L/ person・day 110～530L/ person・day	10 hour / day 10 hour / day	Guest Store floor area	
8	Department Store	15～ 60L/ m^2	10 hour / day	Store floor area Guest＋Employee	
9	School	70～100L/ person・day	9 hour / day	Teacher Student	
10	Station	10L / 1,000 person・day 60～ 100L/ person・day	16 hour / day 16 hour / day	Customers Employees	Excluding car wash water
11	Temple Church	10L/ person・day 100～150L/ person・day	2 hour / day 15 hour / day	Worshipers Monk	
12	Library	25L/ person・day 60～ 100L/ person・day	6 hour / day 9 hour / day	User Employee	

② Calculation of water supply pipe diameter

➪ Determine the diameter of the water supply pipe and the diameter of the water meter from the calculated maximum daily water consumption and water supply usage time.

「Calculation example」

❑ Amount of water used ➪ 200L/$_{person \cdot day}$　❑ Water supply time ➪10 hour/$_{day}$

B：Amount of water used per unit ＝ 800L/$_{day \cdot 10\ hour}$ ÷ 3,600$_{sec}$＝ **0.22L/$_{sec}$**

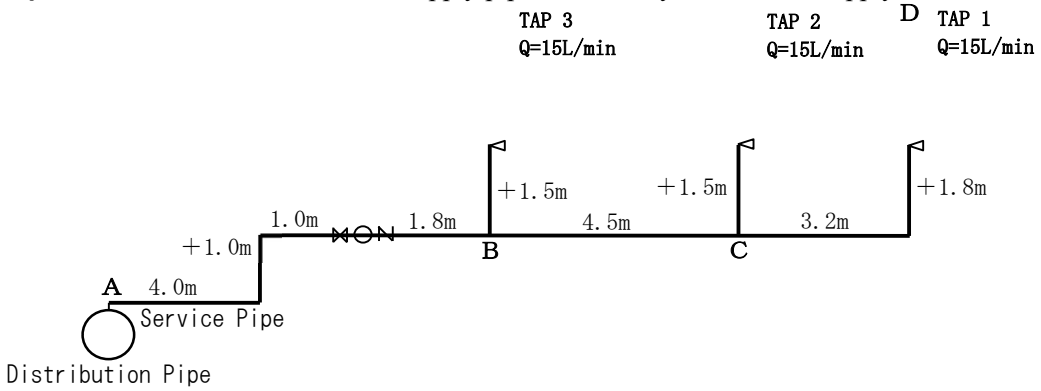
i　Based on the amount of water used per unit time, check the pipe diameter in the Weston official chart (Applicable to φ50mm or less) where the velocity of water

flowing in the water supply pipe is in the range of 1.0m～2.0m.

ii Calculate the section flow rate of each section on the water supply equipment design drawing. Based on the confirmed water supply pipe diameter, calculate the water head loss of the water supply pipe, fittings and accessories caused by friction loss, and the direct water head loss due to the height difference.

Finally, the total water head loss is calculated by adding the water heads required for the use of the tap attached to the end of pipeline.

§-2: Calculation method of water supply pipe diameter by direct water supply.



「Example」

-1. Calculate the required floe rate for each section on the planned water supply pipeline considering the ratio of simultaneous use.

[Section D-C] ➪ Q＝（15L／min） ×1 / 1＝15L/min

[Section C-B] ➪ Q＝（15L／min×2）×2 / 2＝30L/min

[Section B-A] ➪ Q＝（15L／min×3）×2 / 3＝30L/min

-2. Using Weston's official chart, check the diameter of the water supply pipe that can supply o.5l/sec of water at point A under the condition that the water flow velocity is 2.0m or less.

-3. Check the hydraulic gradient at the flow rate in each section based on the calculated water supply pipe diameter from Weston official chart.

[Section D-C] ➪ Q＝15L／min（=0.25L/sec）➪ I ＝ 65‰

[Section C-B] ➪ Q＝30L／min（=0.50L/sec）➪ I ＝190‰

[Section B-A] ➪ Q＝30L／min（=0.50L/sec）➪ I ＝190‰

-4. Calculate the pipe length of each section and the converted length of joints and accessories from the water supply equipment piping design drawing,

Calculate the total pipe length by adding the section length and the conversion length.

Calculate the water head loss for each section by multiplying the calculated total pipe length by the hydraulic gradient confirmed from Weston official chart.

[Section D - C] ➪ Pipe length ＝1.8m＋3.2m＝5.0m

Conversion pipe length＝3.0m＋0.75m×2＋0.24m＝4.74m

Total pipe length ＝5.0 m＋4.74m＝9.74m

➪ Hydraulic gradient I ＝65‰

➪ Section water head loss $h_{D\sim C}$＝9.74m×65×1/1000＝0.633m

➪ Direct water head loss $h_{D\sim C}$＝1.8m

➪ Section total water head loss ＝0.633m＋1.8m＝2.433m **(i)**

[Section C - B] ➪ Pipe length ＝4.5m

Conversion pipe length ＝0.24m

Total pipe length ＝4.5m＋0.24m＝4.74m

➪ Hydraulic gradient I ＝190‰

➪ Section water head loss $h_{C\sim B}$＝4.74m×190×1/1000＝0.900m

➪ Direct water head loss $h_{C\sim B}$＝0.0m

➪ Section total water head loss ＝0.900m **(ii)**

[Section B - A] ➪ Pipe length ＝1.8m＋1.0m＋1.0m＋4.0m＝7.8m

Conversion pipe length＝8.0m＋0.15m＋0.75m×2＋3.0m＝12.65m

Total pipe length ＝7.8m＋12.65m＝20.45m

➪ Hydraulic gradient I ＝190‰

➪ Section water head loss $h_{B\sim A}$＝20.45m×190×1/1000＝3.885m

➪ Direct water head loss $h_{B\sim A}$＝1.0m

➪ Section total water head loss ＝3.885m＋1.0m＝4.885m **(iii)**

-5. Calculate the total water head loss of the planned water supply equipment based on the calculation result.

Total water head loss＝**i**＋**ii**＋**iii**＝ 8.218m

-6. Compare the planned minimum hydraulic pressure of the distribution pipe with the calculated total water head loss of the water supply equipment.

Hydraulic pressure of the distribution pipe

＝15.000m（0.15Mpa）－①

Total water head loss of the water supply equipment

＝ 8.218m －②

Required water head at the end of the water supply equipment

＝ 5.000m －③

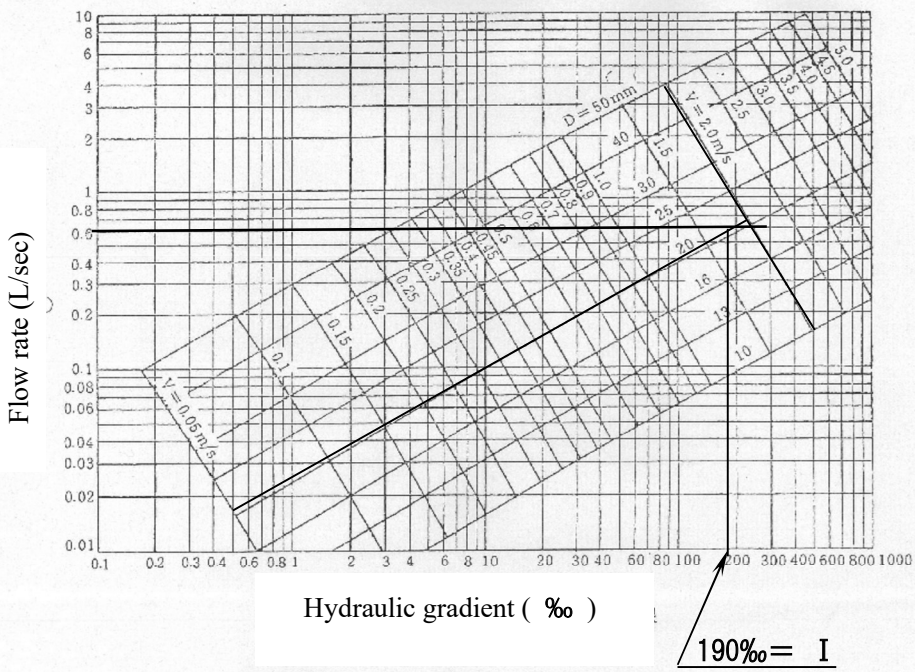
Total water head loss of water supply equipment pipeline

＝13.218m（②＋③）

∴ ① ＝ 15.0m ＞ ②＋③＝13.218m

It can be judged that the φ20mm water supply pipe diameter planned from the above plan is appropriate.

【 Reference 】－III　　Weston official chart（Applies to φ50mm or less）

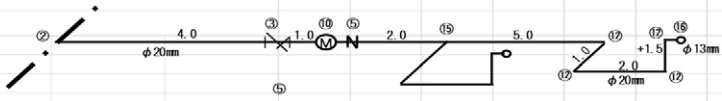


If the pipe diameter is 75mm or more, the pipe diameter can be calculated from the official Hazen Williams chart that illustrates the relationship between floe rate, water flow velocity, and hydraulic gradient.

【 Reference 】－IV　　Chart of the converted length of joints and accessories

Conversion length of straight pipe when water head loss when passing through water supply installment is used as loss head when flowing through straight pipe

Water supply installment \ Diameter	φ13mm	φ20mm	φ25mm	φ30mm	φ40mm	φ50mm	φ75mm	φ100mm	φ125mm	φ150mm	φ200mm	φ250mm	
Tee joint for branch					0.26	0.23	0.22	0.23		0.22	0.22	0.21	①
Saddle snap tap	1.0	3.0	4.0										②
Througth valve (sub valve)	1.5	2.0	3.0										③
Check valve (sigle type)	1.6	1.5	1.2		1,.0	1.6							④
Check valve (angle type)	1.2	1.6	2.0	2.5	3.1	4.0	5.7	7.6	10.0	12.0	15.0	19.0	⑤
Ball valve	0.37	0.29	0.23										⑥
Stop valve	4.5	6.0	7.5	10.5	13.5	16.5	24.0	37.5	42.0	49.5	70.0	90.0	⑦
Gate valve	0.12	0.15	0.18	0.24	0.30	0.39	0.60	0.81	0.99	1.20	1.40	1.70	⑧
Water Meter(Tangential flow impellar type)	3.0	8.0	12.0		20.0								⑨
Water Meter(Waltman type)						20.0	10.0	30.0		90.0			⑩
90° Elbow joint	0.60	0.75	0.90	1.20	1.50	2.10	3.00	4.20	5.10	6.00	6.50	8.00	⑪
45° Elbow joint	0.36	0.45	0.54	0.72	0.90	1.20	1.80	2.40	3.00	3.60	3.70	4.20	⑫
Tee joint (direct current side)	0.18	0.24	0.27	0.36	0.45	0.60	0.90	1.20	1.50	1.80	4.00	5.00	⑬
Tee joint (branch side)	0.90	1.20	1.50	1.80	2.10	3.00	4.50	6.30	7.50	9.00	14.00	20.00	⑭
Water supply Tap	3.0	8.0	8.0										⑮
90° Bend(Large curvature)					1.00	1.50	3.00	4.00		6.00	8.00	12.00	⑯
45° Bend(Large curvature)							1.50	2.00		3.00	4.00	6.00	⑰
90° Bend(Small curvature)							1.50	2.00		3.00	4.00	6.00	⑱
45° Bend(Small curvature)								1.00		1.50	2.00	3.00	⑲
Ball Tap (Single type)	38.0	23.0	27.0										⑳
Ball Tap (Double type)					25.0	22.0	83.0	77.0		64.0			
Reducer	0.5	0.5	0.5	1.0	1.0								々



Total length of straight pipe = 4.0+1.0+2.0+5.0+1.0+2.0+1.5 = 16.5m

Conversion length of straight pipe = ② + ③ + ⑩ + ⑤ + ⑮ + ⑫ + ⑫ + ⑫ + ⑯

= 3.0 + 2.0 + 8.0 + 1.5 + 0.24 + 0.75 * 4 + 3.0

= 20.74 m

∴ Total length = 37.24 m ⇨ Find the hydraulic gradient

Hydraulic gradient= 48‰ ⇨ Head loss=37.24*48*1/1000+1.5=3.288m

【Reference】- V

※ Standard water consumption that is the basis for calculating the meter diameter

Diameter	Maximum daily water consumption	Maximum hourly water consumption	Appropriate range of water usage
φ 13mm	10 m^3	2.0 m^3/h	0.10 ～ 0.80 m^3/h
φ 20mm	**15** m^3	**3.0** m^3**/h**	**0.20 ～ 1.60** m^3**/h**
φ 25mm	20 m^3	4.0 m^3/h	0.23 ～ 1.80 m^3/h
φ 40mm	60 m^3	7.5 m^3/h	0.60 ～ 0.48 m^3/h
φ 50mm	160 m^3	20.0 m^3/h	2.00 ～ 20.00 m^3/h
φ 75mm	320 m^3	40.0 m^3/h	4.00 ～ 40.00 m^3/h
φ 100mm	480 m^3	60.0 m^3/h	6.00 ～ 60.00 m^3/h
φ 150mm	720 m^3	90.0 m^3/h	18.00 ～ 90.00 m^3/h
φ 200mm	1,200 m^3	150.0 m^3/h	30.00 ～150.00 m^3/h
φ 250mm	1,800 m^3	230.0 m^3/h	42.50 ～230.00 m^3/h

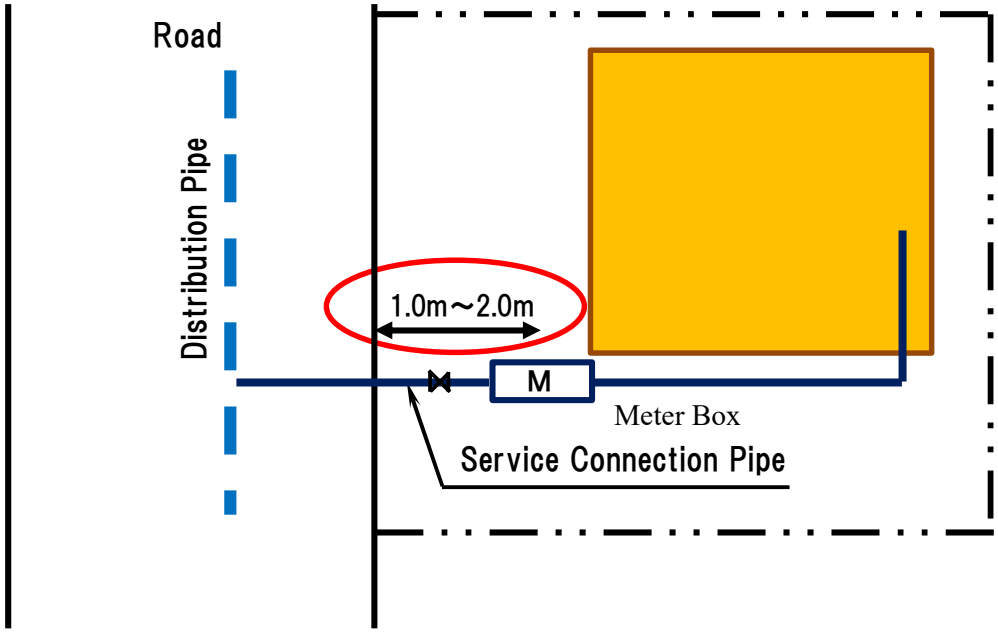
［Construction of water supply equipment］

（Installation position of water meter）

・ Single house ➪ The location of the meter shall be the entrance to the road, within 1.5m to 2.0m from the road boundary, and a place where meter reading work can be easily performed.
Install the meter box in a dry place to avoid external impact, and install it horizontally in it.
Install meters away from sewage ditches so that water is not Contaminated.

【Reference】－VI

Example of meter installation in a single house area



（**Branch connection from distribution pipe**）

For branch connection from the water distribution pipe, be sure to use a saddle clamp for water service pipe connection work of 40mm or less in order to protect the opening for branching and prevent water leakage from the branch.

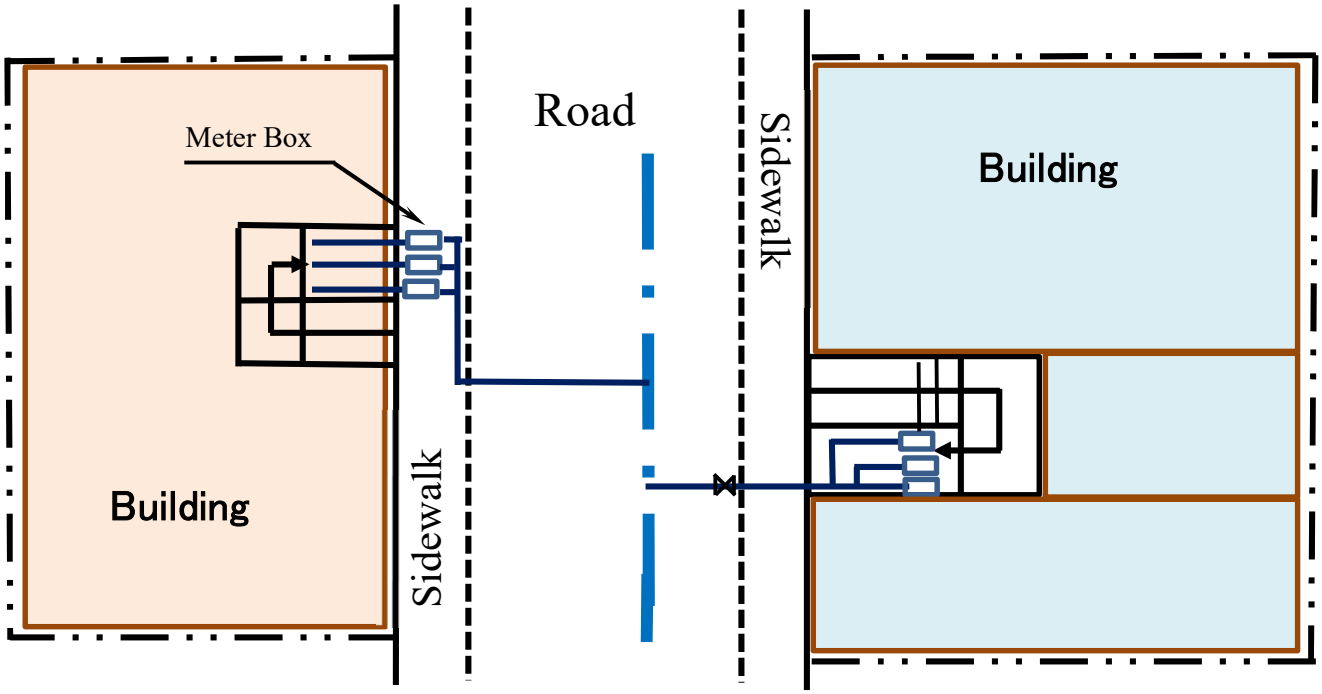
Use a dedicated drilling machine to open the pipes.

※ Preparing to install the meter
（Stop valve＋Meter＋Check valve）

※ Example of meter installation

・ **Apartment house** ➪ If it is difficult to secure a place to install the meter in the building grounds, consult with the Waterworks Bureau and make it a place inside the building that does not interfere with meter reading work.

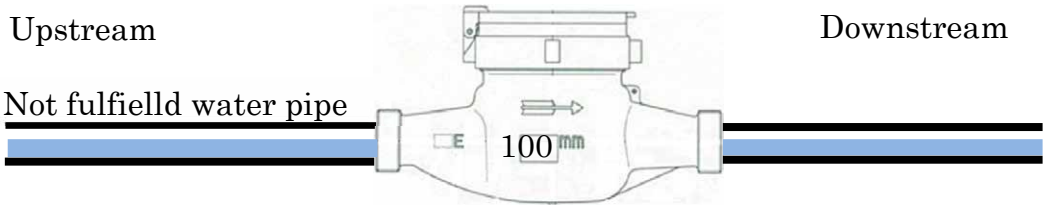
【Reference】 －VII　　Example of meter installation in a apartment house area



（**Installation position of large-diameter meter**）

・ When installing a water meter of φ75mm or more, the inside of the water meter must be completely filled with water at all times. In the downtown area, there are many cases where the inside of large-diameter water meter is not filled due to insufficient water supply. Insufficient water causes a state of poor rotation of the large-diameter water meter, and it has been confirmed that it is not possible to accurately detect the amount of water used. In this situation, in order to correctly detect the amount pf water used, install the large-diameter water meter so that it is lower the piping position on the upstream and downstream sides of the large-diameter water meter installation position.

Cannot measure the amount of water used due to insufficient flow rate



（**Water supply pipe**）

・ **Pipe material** ➪ The material of the water supply pipe will be selected based on the Material standards set by YCDC.
When selecting the pipe material to be used, consider the diameter of the pipe to be used and the purpose of use, and select a material that has sufficient strength against impacts caused by external pressure.

・ **Pipe joint** ➪ Only YCDC licensed technicians can be join the water supply pipes.
Pipe joining of water supply pipes should be done by using appropriate fittings for each pipe type and pipe diameter used and by appropriate

technology.
For PVC pipes that are TS-jointed using a glue, pay sufficient attention to apply the glue to unnecessary parts and check the retention of the fixing time after jointing.

- **Pipe laying** ➪ When lay water supply pipes in the road, secure a pipe laying depth that can be sufficiently withstand the load and impact from vehicles passing on the road.
  As a general rule, pipes should be laying in the soil because resin Pipes such as PVC pipes and PE pipes are deteriorated by ultraviolet rays. Do not lay water supply pipes in places where tap water may be contaminated ditches and sewage ditches.
- **Prohibition of connection with well water pipe and prohibition of use as shared pipe**
  ➪ There are many connections and sharing of well water pipes due to insufficient supply of tap water. As tap water will be supplied in the future that clears the water quality items as drinking water by injecting chlorine, etc., ground water pumped from wells installed by customers and tap water should be mixed and used.
  Never go because it leads to pollution of tap water.

（**Water supply accessories**）

- Water stop valve ➪ Be sure to install a water stop valve suitable for the water pressure used at the branch position from the water distribution pipe, on the upstream side of the meter, and on the upstream side of equipment that requires maintenance and supervision, such as boilers and water heaters installed in the water supply equipment., Install a box so that the water stop valve install in the soil can be operated at all times.
- Check valve ➪ The check valve is installed for the purpose of preventing backflow in the water meter and preventing contamination of tap water due to backflow of water laid and stored in the tank.
  Since there are several types of check valves depending on their internal mechanism, an appropriate check valve must be selected according to the purpose of the situation. In principle, the check valve installed to prevent backflow inside the meter should be installed on the downstream side of the water meter.
- Water tap ➪ The tap is attached to the end of water supply equipment to use tap water. In addition, there is a hot water mixing tap that is used in common with hot water supply.
  These taps shall be made of a material that has sufficient water stopping mechanism and durability, and does not contaminate tap water. In addition, it should never be used as a mixed tap with well water because tap water maybe

・ Pump ➪ Pumps installed for the purpose of pumping water to high tanks and for ensuring the amount of water received from water distribution pipes with low water pressure shall have appropriate specifications according to the purpose of use.
The pump should be installed on the downstream side of the meter, and the necessary distance should be provided between the meter and the pump so that the function of the meter is not adversely affected by the pulsation of the pump.

（**Installation position of water receiving tank**）

・**Underground tank** ➪ Do not install underground tanks near sewage ditches and sewage storage tanks that may contaminate tap water.
In addition, the structure shall be such that groundwater and contaminated water does not flow in or permeate.

・**Ground tank** ➪ When installing the tank at a low position on the ground, build a foundation with sufficient strength so that the tank will not collapse due to the weight of the filled tank. Also, reserve 2 feet of space at the bottom of the tank for maintenance of the bottom of the tank.

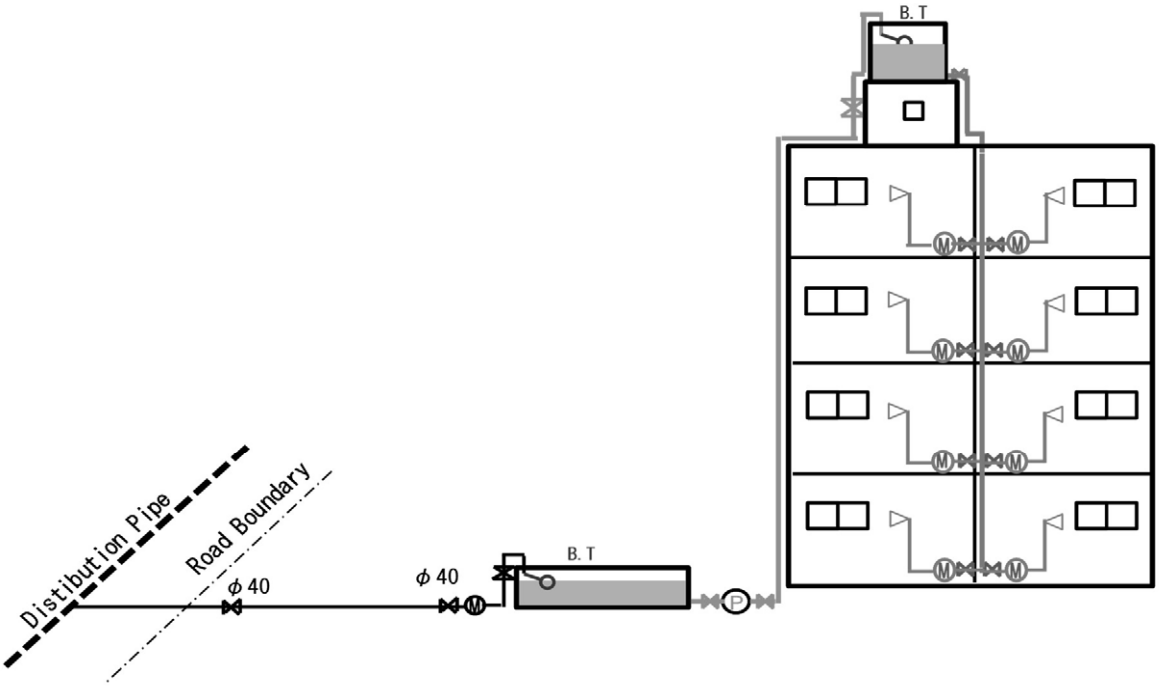
・**High tank** ➪ When installing a tank on the roof of building or at a high position on the ground and using the gravity difference from the tank to secure the water supply pressure, the water supply pressure required at the water tap installed at the highest position on the top floor of the building is secured. Install the tank at a position that can be secured from.

（**Water receiving tank capacity**

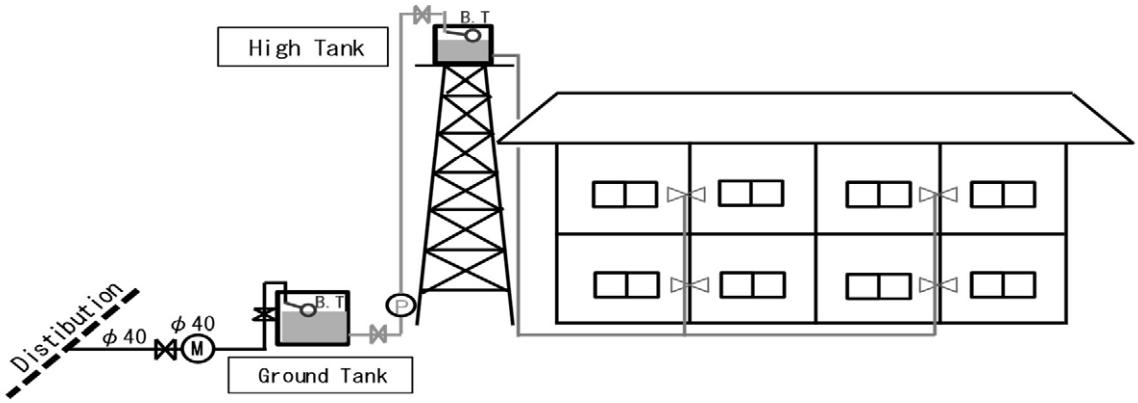
・ The standard capacity of the water receiving tank is 4/10 to 6/10 of the planned daily Water volume.
The volume ratio of the effective water storage amount to the capacity of the water receiving tank body is about 70% to 80%.
The effective water storage amount is the amount of water between the highest and lowest water levels in the water volume section stored in the tank.

【Reference】－VIII **Water supply pattern example**

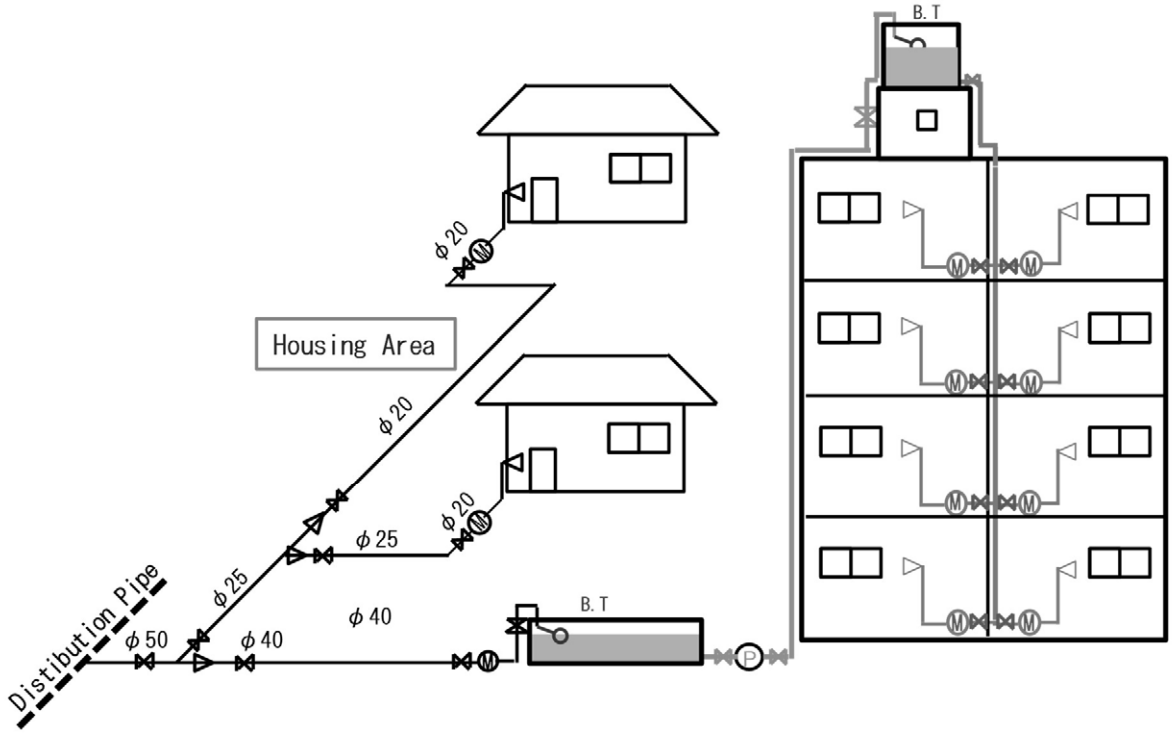
❑ Tank type water supply Water supply for apartment house life



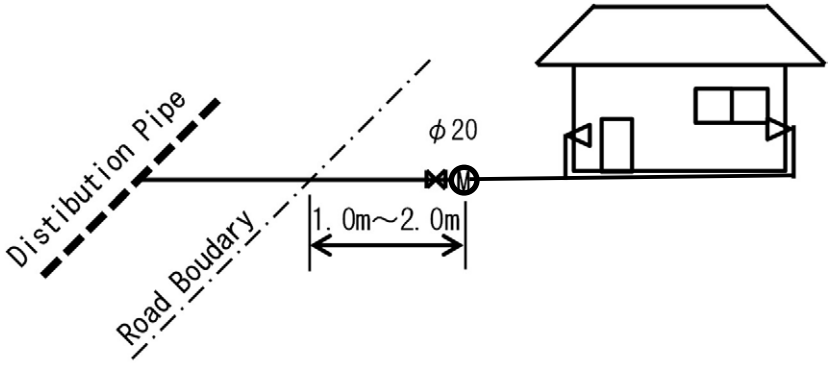
❑ Tank type water supply Hospitals, Medical facilities



❑ Combined method of direct type and tank type



❑ Direct water supply type Water supply for single house

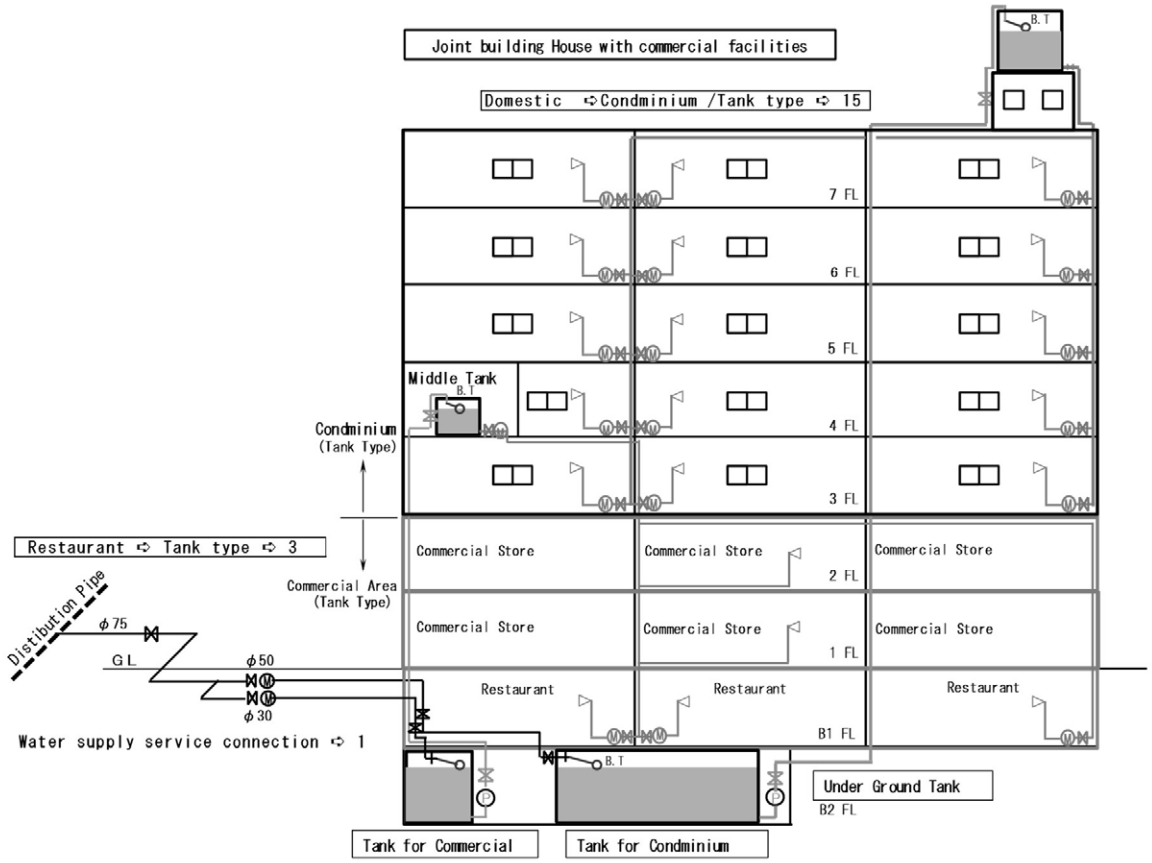

Distibution Pipe
Road Boudary
φ20
M
1.0m～2.0m

❑ Tank water supply according to usage　Commercial facility & Condominium

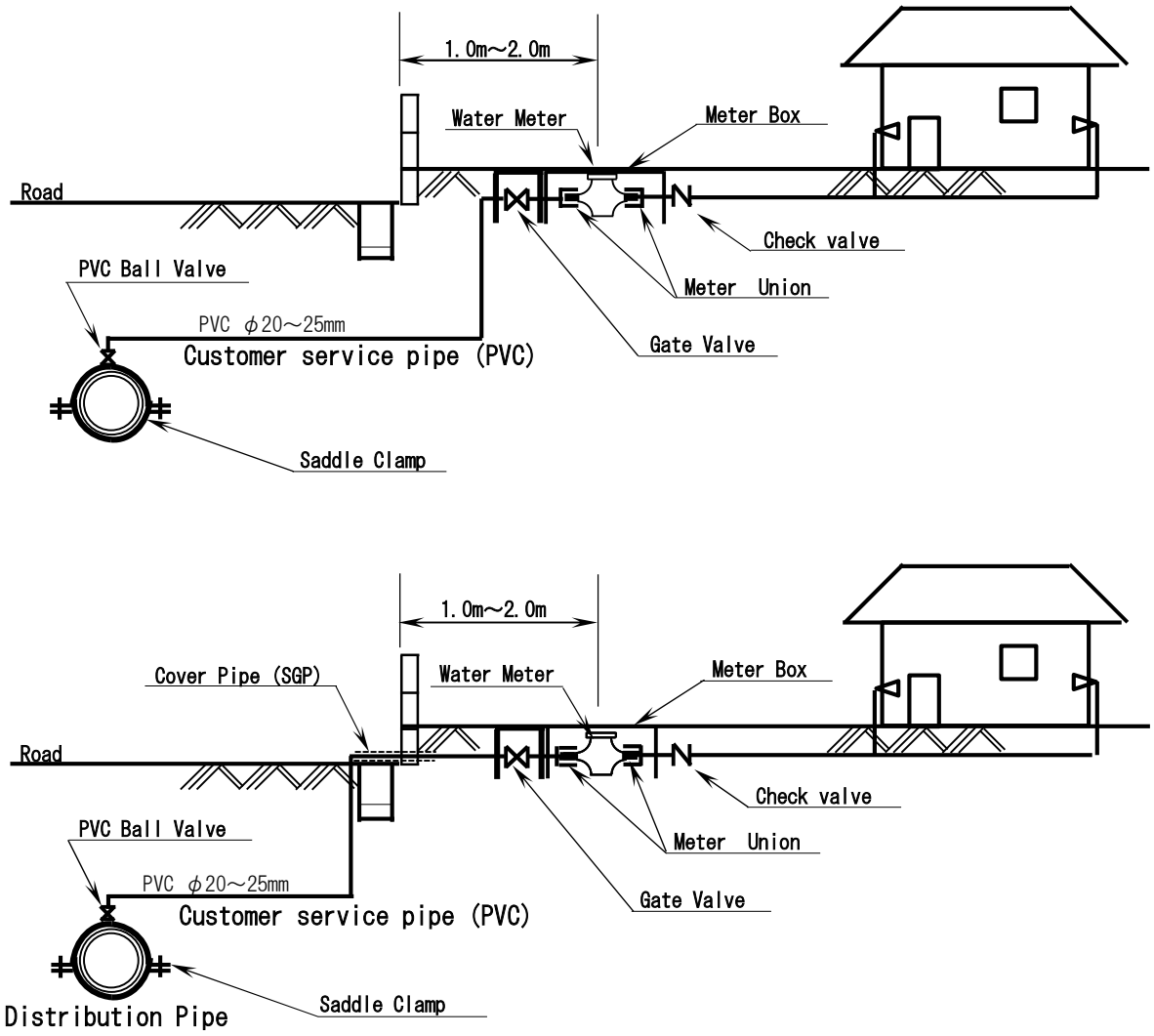
As shown in the figure below, when condominium and commercial facilities coexist in the same building, the amount of water used may change depending on the business form of the commercial facility in which you move in, so tap water is generally used. Separate the supply system.

In addition, water meters will be installed on the upstream side of the each water receiving tanks.

In many cases, a meter is installed for each user for the purpose of managing the amount of water used by each customer of condominium and the amount of water used by each tenant of commercial facilities.



❑ Water supply equipment standard construction drawing - ①



(5.B2) Inspection Guideline of Installation of Water Supply Equipment

1. Objective

   This inspection objective stipulates the inspection work for the construction of water supply equipment in Yangon, which was approved by YCDC's EDWS.

2. Water supply equipment construction

   Water supply equipment construction is a facility designed and constructed by qualified person approved by the mayor, and receives water from water distribution pipes, etc. maintained by YCDC.

3. Inspection

   The inspection will be conducted by YCDC regarding whether the pipe materials and equipment used, and the construction method conform to the water supply equipment construction standards set by YCDC for the water supply equipment construction designed and constructed by qualified personnel approved by the mayor. The inspection categories are pre-completion inspections, completion inspections, re-inspections, etc., and the inspections is carried out in response to the "water supply equipment construction inspection application" submitted by the construction contractor.

4. Inspector

   The inspector is appointed by the CE of EDWS from those who are judged to have sufficient knowledge and technical capabilities for water supply equipment.

5. Inspector ID

   CE grants an inspector ID to the appointed inspector.

   The inspector must always carry the inspector's ID card while engaged in the inspection work, and show it when requested by the water supply equipment owner or construction personnel.

6. Inspection fee

   The inspection fee will be collected from the water supply equipment owner for each inspection of pre-completion inspection, completion inspection, and re-inspection in accordance with the water supply regulation fee rules set by YCDC.

7. Implementation of inspection

   The inspection will be conducted on-site in the presence of the contractor based on the water supply equipment construction completion drawing submitted together with the water supply equipment construction inspection application form.

8. Notification of inspection date and time

   Regarding the inspection date and time, the inspector will notify the contractor after confirming the submitted water supply equipment construction completion drawing.

9. Entry into private land

   The inspector may enter the private land and the building only after sunrise and before sunset with the consent of the owner of the land and building if it is judged necessary for work.

10. Inspection item

    Inspection of water supply equipment construction is carried out according to the following procedure.

Confirmation of water supply equipment construction contents.

- ❏ Confirm the construction contents with the water supply equipment construction application drawing and the construction completion drawing.
  - i The contents of construction are new installation, remodeling (expansion, partial removal) of water supply equipment, and abolition of equipment.
- ❏ Check the type of water supply equipment and the number of installations.
  - ii If a device that requires water supply pressure is installed, check the water discharge pressure at the terminal water supply device position.
  - iii Confirm the water supply equipment for commercial purposes such as restaurants and cafe have an appropriate water supply pipe diameter because the simultaneous usage rete differs depending on the usage pattern.
- ❏ Confirmation of installation of water storage tank
  - i Check if there are underground water storage tanks, above-ground water storage tanks, elevated water storage tanks, etc., and confirm that an automatic water stop device is installed at the inflow part to each tank.
  - ii Be sure to ensure that an effective distance is maintained between the full water level of the water storage tank and the inlet of the water supply pipe to prevent backflow to the water supply pipe.
  - iii In the water supply equipment where the water storage tank is installed, the water supply device is up to the inlet to the tank.
- ❏ Confirmation of water supply pipe branch position and branch pipe diameter.
  - i Confirm the pipe type, pipe diameter and pipe laying position of the water pipe that is the supply source from the water distribution pipe management map managed by EDWS and the water supply equipment construction completion drawing.
  - ii Regarding the confirmation of the branch position from the water distribution pipe to the water supply service pipe, the site is confirmed and the branch pipe diameter by the construction photograph etc.
- ❏ Confirmation of water stop vale and customer meter installation position.
  - i Confirmation that a water stop valve is installed on the upstream side of the customer meter.
  - ii Confirmation that a water stop valve is installed within 1.0m from the boundary between the road and the residential land.
  - iii Install the customer meter within a range of 1.0m to 2.0m from the boundary between the road and the residential land near the entrance and in a place where meter reading is easy, and confirm that is installed horizontal in the meter box.
- ❏ Confirmation of material used
  - i Confirmation that materials such as water supply pipes and water supply equipment used for construction conform to the material standards by YCDC.
  - ii Especially for the branching point from the water distribution pipe, confirm the use of the branching saddle specified by YCDC and the construction of the hole using the drilling machine.
- ❏ Water pressure test.
  - i Conduct a water pressure test to check for water leakage in the newly installed water supply

equipment

ii The water pressure test is carried out using a test pump prepared by the contractor.

iii The test water pressure and the water pressure retention time are determined separately according to the water supply pipe diameter.

❑ Confirmation of water flow.

i Confirmation of water flow from the water distribution pipe by opening the stop valve on the upstream side of the customer water meter.

❑ Pass / fail judgement construction inspection.

i Judge the pass/ fail of water supply equipment construction by construction inspection and perform necessary processing.

❒ Procedure after the inspection is completed.

i The water supply equipment that has completed the construction inspection will hand over the information necessary for future information management to each section in charge.

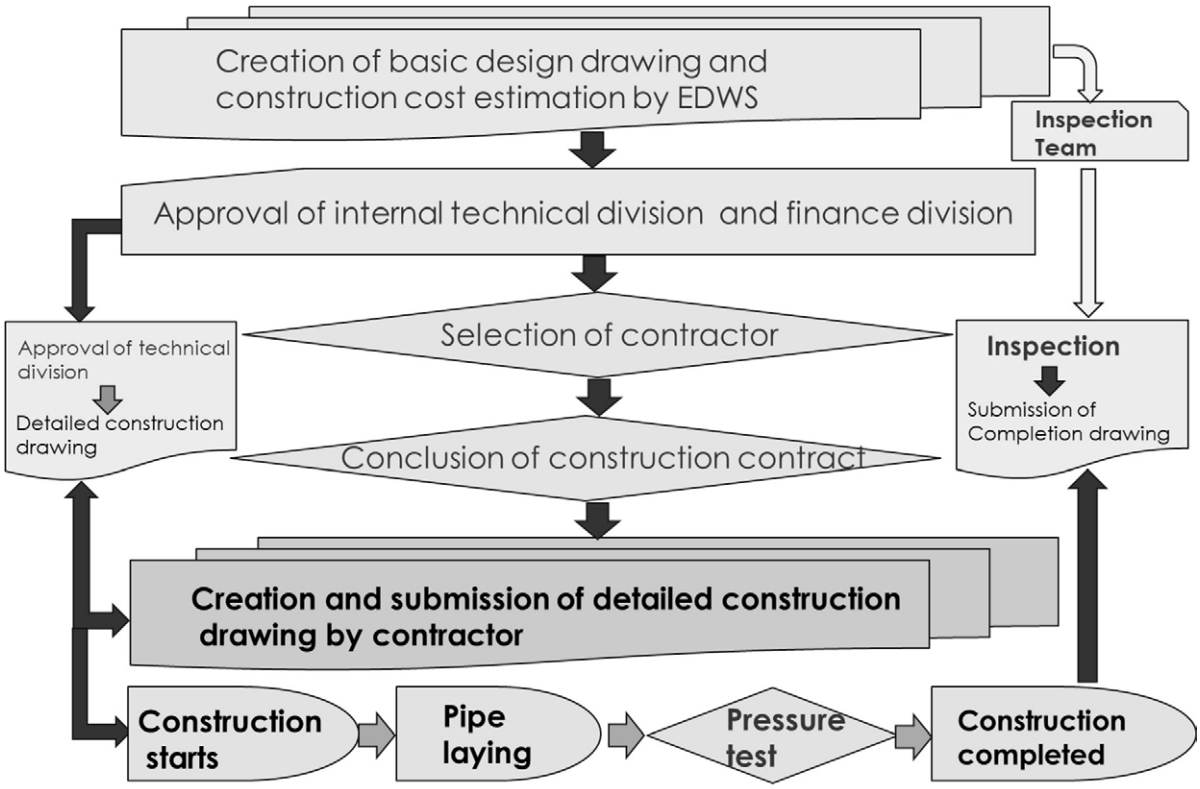
(5.B3) Procedure of Completion Inspection for Distribution Line

[Purpose]

Completion inspection for distribution pipe laying work constructed by WRAWSA is to confirm whether the contractor or the engineer has used appropriate material based on the design specifications and construct in proper method.

The purpose is to confirm a quality that guarantees the useful life of the water supply facility.

[Workflow (Design - Inspection)]



[Required Documents]

1. Construction completion notification
2. Construction completion drawing
3. Construction material usage statement
4. Water pressure test pass
5. Construction photo book
6. Copy of construction contract (or instructions)
7. Copy of construction cost estimate
8. Copy of the license certificate of the engineer responsible for construction

［**Procedure of inspection**］

1. **Confirmation of construction contract**

When you receive the completion notification of the construction, confirm the construction period stated in the construction contract and the matters stated in the special specifications.

2. **Confirmation of construction cost estimate**

Construction cost create at the time of design to confirm whether the type of pipe used for construction, pipe diameter and accessories used for joining pipes meet the quality requirements based on the design drawing and special specifications Check the contents of the calculation documents.

3. **Confirmation of the license certificate of the engineer responsible for construction**

For the person in charge of supervising the construction work, to complete the prescribed training of YCDC stipulated in the "Rules for Contractors for Water Pipe Construction, etc." established by YCDC, and then to certify that the person is qualified for the necessary skills. The inspector must check a certification of the supervisor.

4. **Confirmation of construction completion notification (Document format needs to be examined)**

- Construction subject
- Construction site
- Construction period（start～completion）
- Contractor name
- Name of engineer responsible for construction

5. **Confirmation of construction completion drawing (Need to consider drawing style)**

- Collation with construction design drawing (Site location map & Pipeline plan view)
- Confirmation of laying pipe diameter and total pipe length
- Confirmation of pipe laying position
- Confirmation of the position of attached equipment

6. **Material statement used for construction**

- Confirm the quality of pipe materials such as DIP, HDPE, PVC and pipeline accessories are observed YCDC standard or not.
- Confirm the ISO standard compliant product certificate submitted by the manufacture.

7. **Confirmation of water pressure test pass**

If the length of the pipeline is long, or the pipeline is laid in multiple roads, the water pressure test on each pipeline should be conducted under to the inspector's instructions after the valves are installed at the points of each pipeline. Inspector shall check the certificate of water pressure test which is issued if it passed the pressure test.

Water Pressure Test-Pressurization time

Pipe Length / Pipe Diameter(mm)	D I P, P V C, H D P E				
	~ <400	≦400 ~ <700	≦700 ~ <1300	≦1300 ~ <1600	≦1600 ~
Φ 75					
Φ 100	30minutes		1 houre		
Φ 150	≦Pressurization time		≦Pressurization time		
Φ 200					
Φ 300			2 houre		
Φ 400			≦Pressurization time		
Φ 500					
Φ 600					
Φ 700					
Φ 800			4 houre		
Φ 900			≦Pressurization time		
Φ1000					

Test pressure : 0.75Mpa
➪ ≦400mm
Test pressure : 0.50Mpa
➪ ≧900mm

※ The test water shall be tap water
※ The water pressure gauge used for the test can measure up to 1MPa and display scale memory is 0.02Mpa.

8. **Confirmation of construction photo book**

Confirm the following items with the construction photos.

- Excavation width and depth at the time of construction
- Depth of pipe
- Backfilling of protective sand
- Compaction work of soil at the time of backfilling
- Restoration thickness of pavement

Make sure that the construction photo includes a signboard which shows date and the site places. Photos must be taken for following items.

① **Local situation before the construction**

- Planned pipe laying position
- Longitudinal piping position (Road width measurement)
- Road intersection
- Canal, Ditch

② **Construction start status**

- Installation of construction signs
- Pavement cutting and demolition work
- Pipe laying work excavation work (Mechanical excavation, Manual excavation)

- Excavation width and excavation depth
- Sand laying work on the excavation bottom (thickness = by YCDC standard)
- Pipe laying work (show the laying depth by measurement tape)
- Quality label printed on the surface of the pipe
- Protective sand backfilling work on pipes(t=0.1m)
- Soil backfilling work
- Backfill compaction work (Every 0.3m layer)
- Temporary pavement work
- Main pavement work

9. **Completion report of construction completion inspection**

Report to CE by the prescribed report that the completed construction inspection has been completed based on the inspection procedure established by YCDC. Afterwards, the construction completion drawing is sent to the section in charge of recording and storage.

［Inspector］

The inspector shall be appointed by the CE from among those who have sufficient knowledge and skills regarding the water supply business and who are recognized to be able to make fair judgements.

Annex-5.C: Non-Revenue Water Management Plan (Provisional)

Non-Revenue Water (NRW) Management Plan

(Provisional)

May 2021

NRW Management Section
JICA Expert Team

Table of Contents

Annex

1. NRW Projects Implemented
2. Mid-term Plan to reduce NRW by improving commercial loss

1. Target Non-revenue Water Ratio

1.1. Overall Service Level Targets of YCDC

The overall level target was planned in the M/P in 2014, revised in the preparatory Survey for greater Yangon Water Supply Improvement Project (Phase II) in 2017 (hereinafter, M/P-F/S-Phase II), and further revised internally by YCDC in 2019 (hereinafter, M/P 2019). The overall level target of YCDC area up to 2040 in M/P 2019 is given in the table below and the water resource development plan is shown in Figure 1-1.

Table 1-1:Overall Service Level Target

Overall Service Level Target of YCDC Area

Item		Unit	2011 (Past)	2014 (Census)	2020	2025	2030	2035	2040
Population		Million	5.14	5.21	5.90	6.64	7.41	8.14	8.90
Service Coverage Rate		%	37	35	46	56	64	71	80
Served Population		Million	1.92	1.84	2.70	3.73	4.71	5.79	7.02
Per Capita Consumption (Dom+Non Dom)	Urban *1	LPCD	166	185	220	250	278	305	333
	Suburbs *2	LPCD	100	115	143	167	195	222	250
Non-revenue Water Rate		%	66	66	46	35	26	20	15
Leakage Rate		%	50	50	33	25	18	13	10
Daily Maximum Water Demand		MGD	148	156	197	267	342	433	554
Existing Production Capacity		MGD	140 (-8)	185 (+29)	215 (+18)	215 (-52)	215 (-127)	215 (-218)	215 (-339)
Water Pressure		MPa	0.075 MPa			More than 0.15 Mpa			
Supply Duration		Hour	8 hrs. on Average			24 hrs.			
Water Quality Improvement		-	Not drinkable		Drinkable				

Source: Population/Served Population and MGD; Yangon's Urban Development Master Plan, March 2018, and NRW/others; Water Master Plan 2014. *1: CBD, IUR, ORZ, NS and OS. *2: SoCBD and NewS

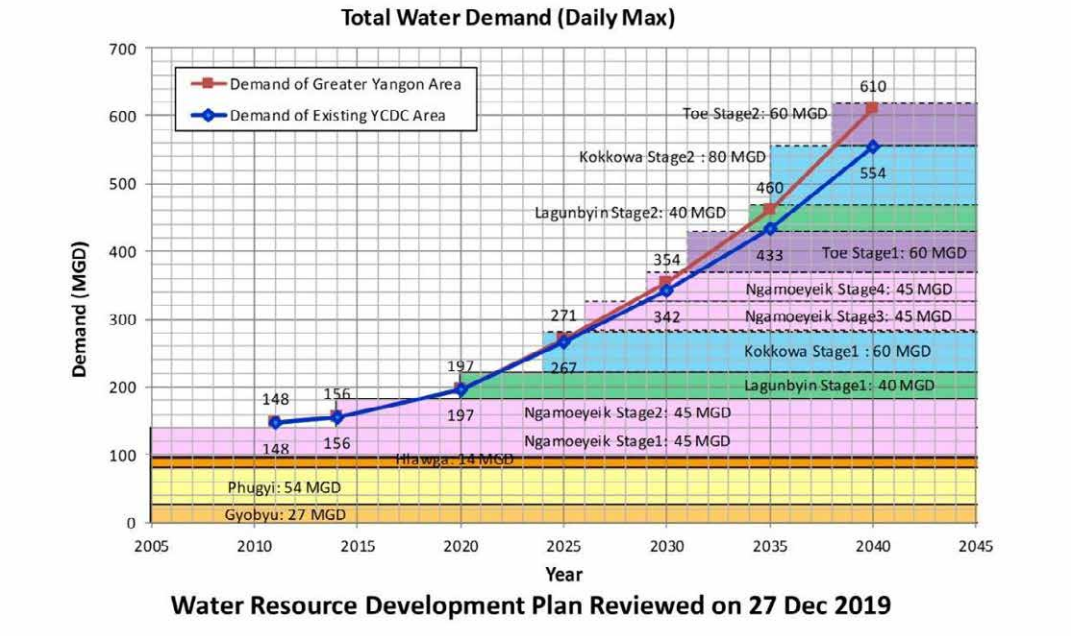


Figure 1-1: Water Resource Development（M/P 2020 revised ver.）

1.2. Target of NRW

In the M/P, the target of NRW is planned as below.

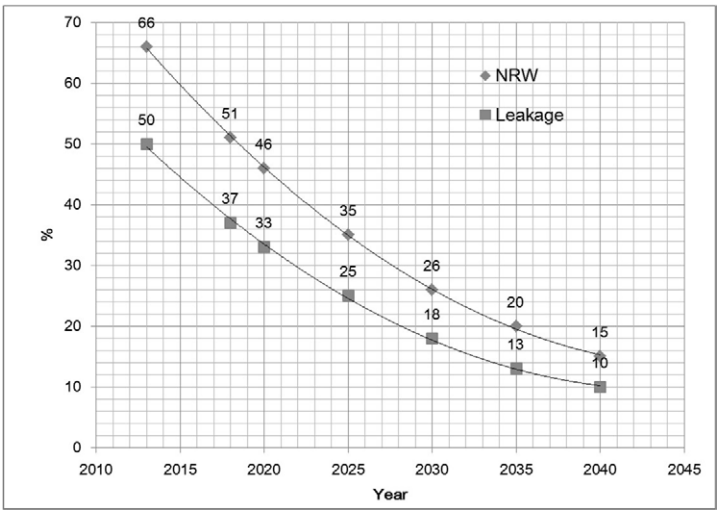


Figure 1-2:Target Level of NRW Ratio and Leakage Ratio

Table 1-2:Target Level of NRW Ratio and Leakage Ratio

Items	2013	2018	2020	**2025**	2030	2035	2040
Non-revenue Water Rate (%)	66	51	46	**35**	26	20	15
Leakage Rate (%)	50	37	33	**25**	18	13	10

2. Existing Situation of NRW Management

2.1. Causes of NRW in Yangon by IWA table

The causes of NRW in case of Yangon city are shown in Figure 2-1.

Table 2-1:Causes of NRW in case of Yangon City

Non-Revenue Water	Unbilled Authorized Consumption	Such as Pipeline Flushing, Fire Fighting, Utility Use (FOC)		
	Water Losses	Real (Physical) Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage on Service Connections up to Customers' Meters	
			Leakage and Overflows at Utility's Storage Tanks	
		Apparent (Administrative/ Commercial Losses)	Unauthorized Consumption	Illegal Connection
				Meter by-Pass
				Meter Tampering
			Metering Inaccuracies	Under-Registration
				False Reading
				Data Handling Errors

2.2. Estimation of NRW Ratio in Entire City

(1) Calculation of NRW

The flow monitoring system in transmission system was established in the Project. The system started operation from Oct.2019. The following shows calculation method of NRW for September in 2020 based on the monitoring flow data and billing data.

1) Distribution amount in the whole city (System Input)

The total system input is 205.59 MGD.

Table 2-2:Distribution amount whole Yangon City (System Input)

Flow meter stations		Summary (MGD)
PYAPS-WF2	Pyawbwesu Outlet	22.86
HLAP1-WF1	Hlawga66 PS1	68.10
HLAP2-WF1	Hlawga42 PS2	12.91
NAUPS-WF1	NWTP2 SPT Outlet	87.33
NAUPS-WF2	NWTP1 SPT Outlet	
NAUPS-WF3	NWTP1 Main Outlet	
NAUPS-WF4	NWTP2 Main Outlet	
TubeWell		14.39
Total Supply Amount		**205.59**

2) Billed consumption

The total revenue water is 73.14 MGD.

Table 2-3:Billed consumption (Revenue water) amount

	Connection (Nos.)	Revenue (kyat/month)	Revenue without Maintenance Cost (kyat/month)	Consumption (m3/day)	Consumption (MGD)
Flat	35244	63618000		24098	5.302
Domestic	260099	551959883	525949983	199223	43.829
Commercial	26979	168586480	165888580	50269	11.059
Dept Domestic	1453	117137076	116991776	44315	9.749
Dept Flat	1	3240000		1227	0.270
Dept Commercial	113	16853070	16841770	5104	1.123
FE Domestic	123	55225080	55102080	4174	0.918
FE Flat	1	270000		20	0.005
FE Commercial	297	71621000	71324000	2702	0.594
Other (2019-20)					0.290
Total Revenue (9-2020)	**324310**				**73.14**

3) Estimated NRW

The NRW ratio in September 2020 is approx.64% as shown below.

System Input Volume	Non-Revenue Water	NRW Ratio
205.59(MGD)	132.45(MGD)	**64.42%**

(2) Estimated NRW Ratios

The Estimated NRW ratios from November 2019 to September 2020 are show below. The average NRW ration in 2020 was 64.2 %.

Table 2-4:NRW ratio of Yangon City (Nov. 2019~Sep.2020)

Item	2019		2020								
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
System input volume (MGD)	215.5	215.5	215.5	215.5	215.5	215.5	213.3	211.0	212.5	209.7	205.6
Revenue water volume (MGD)	80.7	79.7	78.8	83.9	75.3	78.0	73.1	76.5	73.7	72.3	73.1
NRW volume (MGD)	134.8	135.8	136.7	131.6	140.2	137.5	140.2	134.5	138.7	137.4	132.4
NRW ratio (%)	62.5	63.0	63.4	61.1	65.1	63.8	65.7	63.7	65.3	65.5	64.4

2.3. Issue of Water Meters

To understand the NRW situation in Yangon, NRW Management Section and T/S offices carried out following activities.

(1) Broken/un-readable meter survey

WRAWSA distributes raw water without treatment for more than 50% of their water supply from three reservoirs of Gyobyu, Phugyi and Hlawga. The raw water, which is distributed to customers directly,

contains the impurities such as shells, small fish, and waterweed. Many water meters lose accuracy of flow measurement function due to the impurities even during their warranty period. Because of this situation, the C/P and the Expert (the Team) carried out customer's meter survey in 2018. A result of this survey is as follows.

- Meter removed due to malfunction: 2.7%
- Malfunction meter: 8.8%
- Cannot read due to dirt: 13.2%
- **Total malfunctioned or removed meter: 24.7 %.**

(2) Water meter function test

To grasp the actual rate of existing water meter functioned and the accuracy, NRW Management Section carried out meter function test in Yankin T/S, 13ward using potable test bench. The result is shown in below. The Team found some water meters are installed at unreadable or inappropriate location or even inside drain.

1) Target houses

- Total number of houses = 321 (nos.)
- The number of houses supplied by YCDC = 208 (nos.) (Service Coverage = 65%)

2) Survey result:

- Meters which cannot be removed = Approx. 30%
- Unreadable because of meter broken or defacement = Approx. 7%
- Assumed inaccurate meter (Accuracy error: more than ±5%) = Approx. 41%
- Assumed accurate meter functioned well (Accuracy error: within ±5%) = Approx. 16%*

(*Within the nominal instrument standard accuracy / Japan)

48 % of the surveyed meters are unreadable or error exceed the standard. Therefore, it was appeared that the effect of commercial loss caused by water meter is large. In addition, 30% of the meters cannot removed for various reasons, which indicates there are many cases of meter installation without considering maintenance of water meter. Out of these meters, some % may be inaccurate meters.

2.4. Current Human Resources Capacity of NRW Management

At the present, mainly NRW management section responsible for NRW management activities. As a NRW management capacity of WRAWSA, NRW management section was assessed at the end of TA project finished as follows.

(1) Capacity Assessment (Organization, Core)

Table 2-5:Result of capacity assessment (Organization)

Capacity Assessment of Organization 【Field; NRW 】

Technical Capacity

Category	Items	Base line 1	2	3	4	5	Cund line 1	2	3	4	5	Remark (criteria)	Baseline	End-line
A. Material Standard	A1. Material standard for newly pipe laying and repairing is established.				x					x		[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]	4	4
	A2. Inspection of procured materials.				x					x		[1. Unnecessary, 2. Never implemented, 3.Conducting when its needed , 4. Inspect all the procured materials , 5. Inspect & record all the procured materials]	4	4
B. Design Standard	B1. Design standard for newly pipe laying and repairing is established.				x					x		[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]	4	4
C. Estimation Standard	C1. Estimation standard for newly pipe laying and repairing is established.				x					x		[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]	4	4
D. Construction Standard	D1. Construction standard for newly pipe laying and repairing is established.				x					x		[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]	4	4
E. Inspection Standard	E1. Completion inspection standard for newly pipe laying and repairing is established.			x					x			[1. Not existing, 2. In the planning phase for establishment, 3. Existing (but necessary for improvement), 4. Existing (Applying when it needed), 5.Periodically up-to-date]	3	3
F. Technical Training	F1. Training for design, estimation, etc. are implemented.			x						x		[1. Not existing, 2. Training for new employees, 3. Occasionally, 4. Implement if it necessary 5. Implement according to training plan.]	3	4
	F2. Technical training for construction are implemented.			x						x			3	4
	F3. Training for leak detecting are implemented.			x						x			3	4
	F4. Training for measuring leakage volume are implemented.	x								x			1	4
G. Information Management	G1. Grasp the information (pipe position, material, laying date, etc.) of the area in charge.			x							x	[1. No record, 2.No record (but necessary), 3. Grasp information of the area in charge, 4. Record on piping map, 5.Making a ledger and record on it]	3	5
	G2. Pipe information is recorded accurately		x							x		[1. No record, 2.Recorded (entrusted by the person in charge), 3. Record with memory 4. Recording regularly, 5.Recording regularly with construction record]	2	4
H. Equipment	H1. Equipment for pipe laying and repairing is prepared.				x						x	[1. Nothing, 2. Using old equipment, 3. Procure when it necessary, 4. Essential equipment is prepared 5. Up-to-date equipment]	4	5
I. Technical Level	I1. Technical level of workers	x									x	[1. Only Field survey 2. Basic planning&design 3. Detail design & estimation 4. Define a diameter with hydraulic analysis, 5. Making DMA & Distribution Network]	1	5

(2) Capacity Assessment (Organization, Technical)

Table 2-6:Result of capacity assessment (Core)

Category	Items	Item	Base line	End line	Remarks
A. Planning, Monitoring	1. There is annual action plan of section	Annual action plan	1	3	Work directed by CE is always priorized over voluntary action plans
	2. Planned activities are monitored regularly.	Plan monitoring system	1	3	The content of the activity has not reached regular monitoring by revords.
	3. The business activities are compiled as a report periodically.	Periodical reporting	1	3	Only a limited number of staff are resposible for recording and reporting the content of business activities.
B. Budget management	1. Budget is requested based on planning.	Planned budget request	1	2	Since most of the activities are directly is instructed by the CE, business methods for voluntary activity proposals and budget requests have not been established.
	2. Execution of budget is periodically monitored.	Budget implementation monitoring	1	4	Execution of the project budget is carried out smoothly because the section head has a wealth of knowledge regarding the estimation of project costs.
C. Staffing	1. The number of staff is adequate for assigned duties.	Adequate staff	1	3	The number of staff is many, but the number of maile staff who can perform technical work in the field is insufficient.
	2. Duties and responsibilities of each staff is clear.	Clear duties	1	2	Technically advanced work is concentrated on some higly qualified staff. The issue is the leveling of business content.
D. Communication	1. Annual action plan is shared among members of the section/office.	Plan staff sharing	1	3	Information is shared within the section regarding the decided activities.
	2. There are regular occasions to share information among the members.	Staff meeting	1	3	Share information as needed within the section.

2.5. Organization of NRW Management Section

NRW Management Section was established in January 2017 to manage all relating works to NRW management. This section consists of “Physical loss team”, NRW planning and monitoring team” and “Commercial loss management team”.

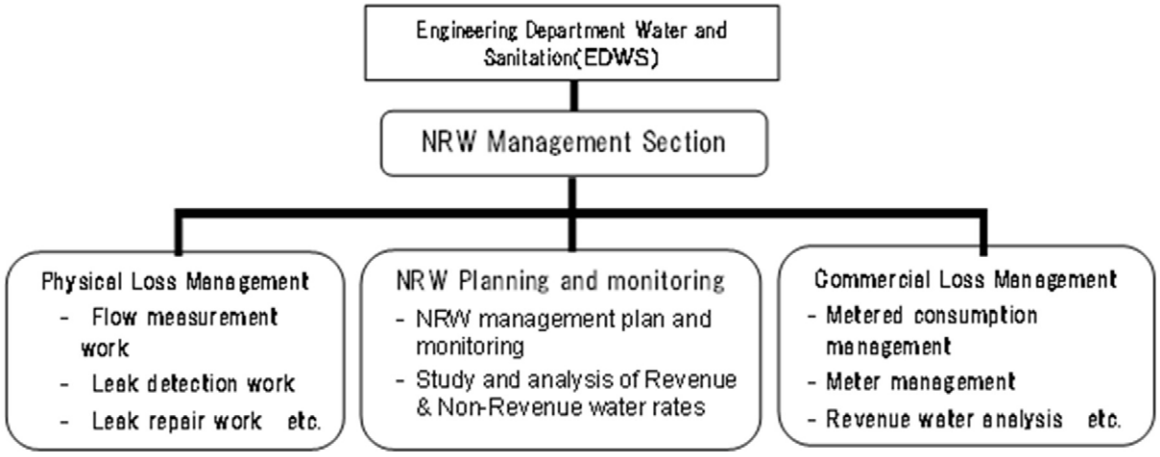


Figure 2-1 : Organization chart of NRW Management Section

Table 2-7 : Duties of NRW Management Section

Section	Team	Duties
NRW Planning and Monitoring	-	● Study and analysis of Revenue & NRW rates – To study and analyze "Metered consumption", "Unmetered consumption", and "Ineffective water" etc. ● Planning of specific survey and study for NRW management ● Formulation of NRW management plan and monitoring the progress of plan – To formulate 5year/10year NRW management plan and monitor the progress of plan, if required revising the plan.
Commercial Loss Management	-	● Checking and studying on the causes of inaccurate monthly meter reading data and guidance for collection of customer movement. – To check the accuracy of the data of meter reading of each T/S with T/S staff members, and prescribe and perform corrective actions. ● Study of water charge collection rate of each T/S – To check the water charge collection rate and the reason of nonpayment through the monthly meter reading data. Study and give guidance on how to collect the water charge, etc. ● Analysis of water meter condition and reporting. Guide T/S staff members based on the analysis. ● Quarterly Analysis of revenue water on the basis of monthly meter reading – To analyze Revenue & NRW from the data of monthly meter reading and leakage volume, and report the outcome quarterly, and provide the results to NRW Planning and Monitoring Section.
Physical Loss Management (Leakage)	Flow measurement	● Water flow measurement of main distribution system – To measure water flow (by Ultrasonic flow meter) at fixed points periodically by main water distribution system in the city. – To analyze the water balance between the water supply and demand, and provide the information to "NRW Planning and Monitoring Section". ● Establishment of "Model district for water flow measurement" – To measure water flow and leakage and the change of water flow volume resulting from leakage repair etc. To collect and analyze the information above to estimate NRW rate in other areas.
	Leak detection	● Leakage patrol and detection – To formulate an annual leakage detection plan.

Section	Team	Duties
		− To detect leakage visually in the daytime and by using detector in the nighttime.
	Leak repair	● Instruction of leakage repair and inspection on site − To instruct T/S to repair the leakage detected, and inspect the repairing work according to guidelines prepared. ● Leakage record − To repair leakage as needed, and report the water leak volume to "NRW Planning and Monitoring Section". ● Provide materials and equipment for leakage repair − To keep the tools and equipment for leakage repair, and provide them as needed.

3. On-going NRW Reduction Measures

3.1. Distribution network rehabilitation and NRW management projects

Distribution network rehabilitation and NRW management projects were implemented by donors and WARWAS. The detailed project information is given in Annex 1. The outline of these projects are shown in Figure 3-2. The following are summary of NRW ratios before and after the project.

- Before the project: 67%
- After the project: 14%

The NRW reduced can be reduced below 10% in Japanese projects in Yanin if whole water network is replaced with good technology.

Table 3-1: Completed projects, On-going NRW management activities

No.	Project	Area (T/S)	Year	Player	Connections	Length of replaced pipe(km)	NRW reduction (%)
1.	The Project for Urgent Improvement of Water Supply System in Yangon	Yankin	2016	JICA	1944	8	70→8.2
2.	NRW reduction DMA pilot project in Yangon	Insein	2016	Manila & Mitsubishi	315	5.5	52→17.3
		South Okkalapa			496	5.6	56→12.3
3.	Water supply and sanitation improvement advisor	Yankin	2015	JICA Expert	271	5.6	75→15
4.	NRW reduction project in Mayangone township	Mayangone	2015	Japan grass root	292	5	76.6→32
5.	PROJECT FOR IMPROVEMENT OF WATER SUPPLY MANAGEMENT OF YCDC	Yankin	2020	JICA TA	311	2.1	86.1→5.5
6.	North Okkalapa T/S ward-2 NRW reduction project	North Okkalapa	2018	YCDC	2670	20.6	51.2→7.1
	Average						67→14

3.2. NRW Pilot Projects in Yankin in the Project

The result of NRW reduction and outline of Yankin Pilot Project is shown below.

Project period	Jan,2019 – Jan,2020
Pipe length replaced	2.13km
Connection nos.	311 (Households) * 93 applying permission
NRW ratio before and after	86.1% → 5.5%

Before the NRW reduction pilot project in Yankin 13-ward, NRW ratio of the area was estimated as 86.1%. After pipe replacement work with existing meters, it decreased to 51.1%. Then all customer meters were replaced to new meters. As a result, the NRW ratio of pilot area decreased to 5.5%.

Table 3-2:NRW ratio (Before & After the pilot project)

Item	Before project	After project (1st: With existing meter)	After project (2nd: With new meter)
System input volume (m^3/month)	22,926	13,141	11,719
Revenue water (m^3/month)	3,190	6,424	11,079
Non-revenue water(m^3/month)	19,736	6,717	640
NRW ratio (%)	86.1	51.1	5.5

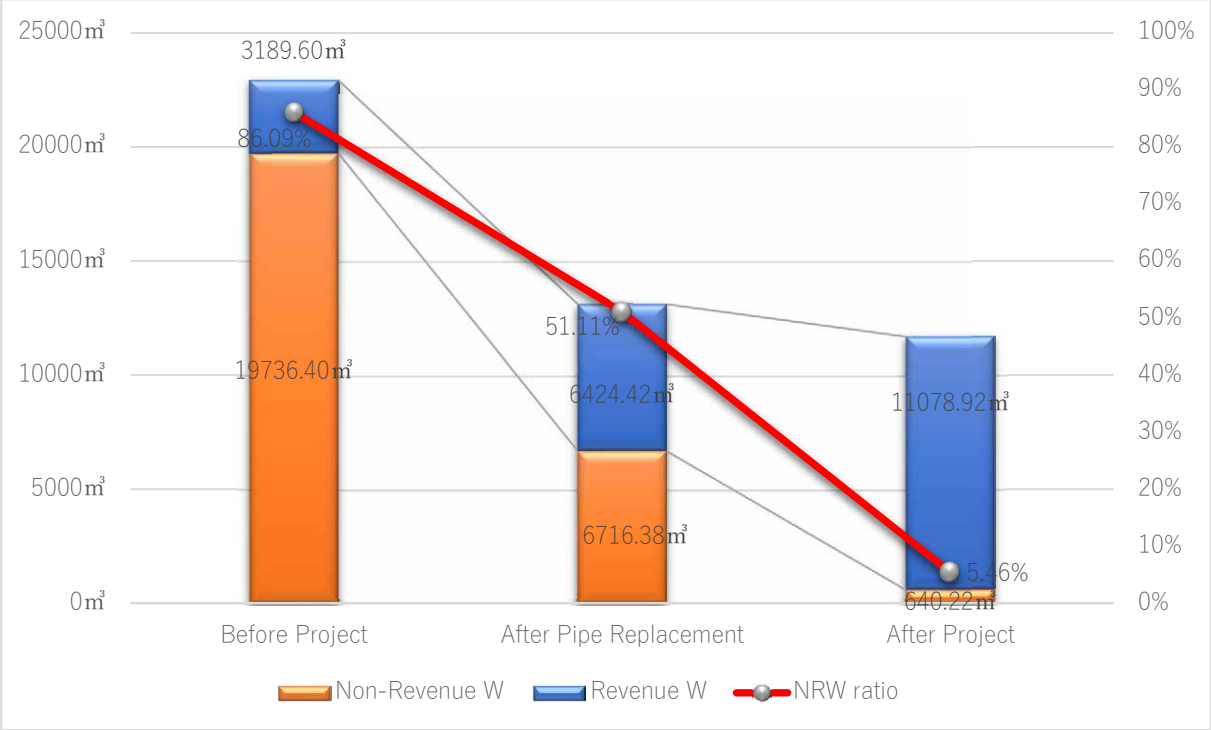


Figure 3-1:NRW ratio (Before & After the pilot project)

Afterwards, NRW Management Section continuously monitor NRW, and the NRW ratios are shown in Figure 3-1. The NRW ratio was getting to increase. NRW Management Section needs to confirm the reasons why NRW was increasing, prepare countermeasures, and implement them.

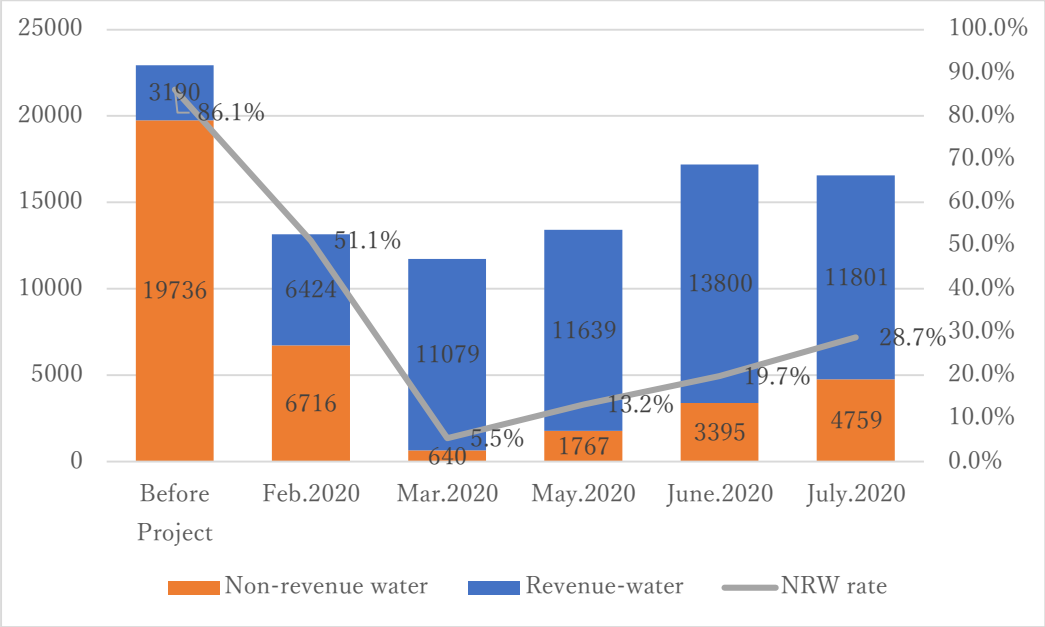


Figure 3-2:NRW ratio of Yankin pilot project

3.3. Cost benefit analysis of NRW activities in Pilot Project

(1) Cost benefit analysis of physical loss measures of Yankin pilot project

The main purpose of Yankin pilot project is to learn appropriate construction technology. To achieve this purpose, Japanese materials were selected for the pilot project. For physical loss measures, materials shown in table below were procured such as pipes, jointing tools, drilling machine etc. In this cost calculation, the costs paid by YCDC such as cost of civil work or labour were not included since these cost data were not able to receive from the C/P.

Items	Material/Equipment cost (JPY)	Material/Equipment cost (USD) 1USD=110JPY
Material cost (Pipe, Joint, Saddle clamp etc.)	14,456,614	131,424
Equipment (Drilling machine, etc.)	3,342,110	30,383
Total cost	17,798,724	**161,807**

Reduced physical loss volume is shown below, which was calculated at the time of. The reduction water volume of physical loss (1st measurement: with existing meter) is 13,020 (m^3/month) as shown in the table below. Estimated cost benefit of physical loss reduction is as following.

Physical loss reduction volume	Cost	Cost/Benefit
13020(m^3/month)	161807 (USD)	**80.46(m^3/month/1000USD)**

(2) Cost benefit analysis of commercial loss measures of Yankin pilot project

To reduce commercial loss, water meter where commercial loss mainly happen should be replaced to proper meter and meter installation place should be where meter readers can read meter easily and precisely. The cost of commercial measures of pilot project is shown below. A new meter and two meter-unions which are installed in both side of water meter are counted as commercial loss cost. As well as physical loss, the cost of civil work or labours was not included.

Items	Material/Equipment cost (JPY)	Material/Equipment cost (USD) 1USD=110JPY
Material cost (Meter, Union)	900,340	8,285
Total Cost	900,340	8,285

218 exiting customer meters of all YCDC customers in the area were replaced to new meter in the pilot project. Reduced commercial loss volume is shown the table below, which was calculated at the time of (2nd measurement: with new meter). Although Japanese import material was used for the pilot project, price of a meter which is able to be procured locally or YCDC standard model is not far differ from the Japanese meter. Therefore, this cost can be taken as a reference value for local cost.

Commercial loss reduction volume	Cost	Cost/Benefit
6,076(m^3/month)	8,285 (USD)	**733.37(m^3/month/1000USD)**

(3) Cost benefit analysis in case of local material

This pilot project was carried out by using only Japanese material and equipment not only for distribution pipe laying but also service pipe branching work. It is much different from actual project costs of a project which is using local material so that the estimated cost is not suit for actual economic level of Yangon. It is difficult to know the cost of civil work or labours so that we estimated a cost in case of using local material with following criteria.

- Based on comparison of Japanese material and local material, 30% of construction cost shown above is estimated as total cost of a construction by using local material. Therefore, we use this ratio and estimate cost benefit analysis with local material.
- For the cost of equipment which is difficult to procure locally such as drilling machine, we applied Japanese equipment cost. One of six year with reference to useful life of general construction equipment was applied as the depreciation cost.
- For the cost of commercial measures, as mentioned above, the difference of cost is not much between Japanese material and local material so that Japanese material cost is applied.

A result of cost benefit analysis is shown below.

Items	Japanese Material/Equipment cost (USD)	Local Material/Equipment cost (USD)
Material cost (Pipe, Joint, Saddle clamp etc.)	131,424	39,427
Equipment (Drilling machine, etc.)	30,383	5,059
Total Cost	**161,807**	**44,486**

Cost and benefit of physical and commercial losses are calculated in the table below.

Item	Reduction volume (m^3/month)	Cost (USD)	Cost/Benefit **(m^3/month/1000USD)**
Physical loss	13,020	44,486	**276.68**
Commercial loss	6,076	8,285	**733.37**
Total	19,096	52,771	**361.87**

(4) Cost recovery in case of using local materials

The required months for cost recovery are estimated based on current water tariff (88 kyat/m^3) of Yangon city as the table below.

The current water tariff of YCDC is set at quite low. As a reference, the cost recovery period is estimated using water tariff rate of Mandalay city. The result is shown in the table below, cost recovery periods are estimated as 18 months for total loss reduction and 8.8 months for commercial loss reduction.

Table 3-3: Estimation of cost recovery period based on pilot project

Items	Total	Physical loss	Commercial loss
①Cost (USD)	52,771	44,486	8,285
②Reduction volume (m^3/month)	19,096	13,020	6,076
③Cost recovery per month (kyat/month) = reduction volume (m^3/month) x (88kyat)	1,680,448	1,145,760	534,688
④Cost recovery per month(USD) （100USD = 130,000kyat）	1,293	882	411
⑤Cost recovery period (month) (①/④)	40.8	50.4	20.1
Reference: Cost recovery period estimated with water tariff of Mandalay city	18.0	22.2	8.8

Note: Only material and equipment cost (exclude civil work, labours cost)

If civil work cost is added, physical loss measure needs more payback period. However, the civil work

cost of commercial loss measure is much less than those of physical loss measure. Therefore, commercial loss measure is much efficient in NRW measures. Commercial loss measure returns much return with less investment cost. WRAWSA need to consider the commercial loss measure at the initial stage of NRW to reduce NRW quickly.

3.4. NRW Management Model by DMA

The NRW management model (including commercial loss) was formulated based on the pilot project in Yankin as shown in below. After the Project, it is necessary for the C/P to set up DMAs with reference to the model below.

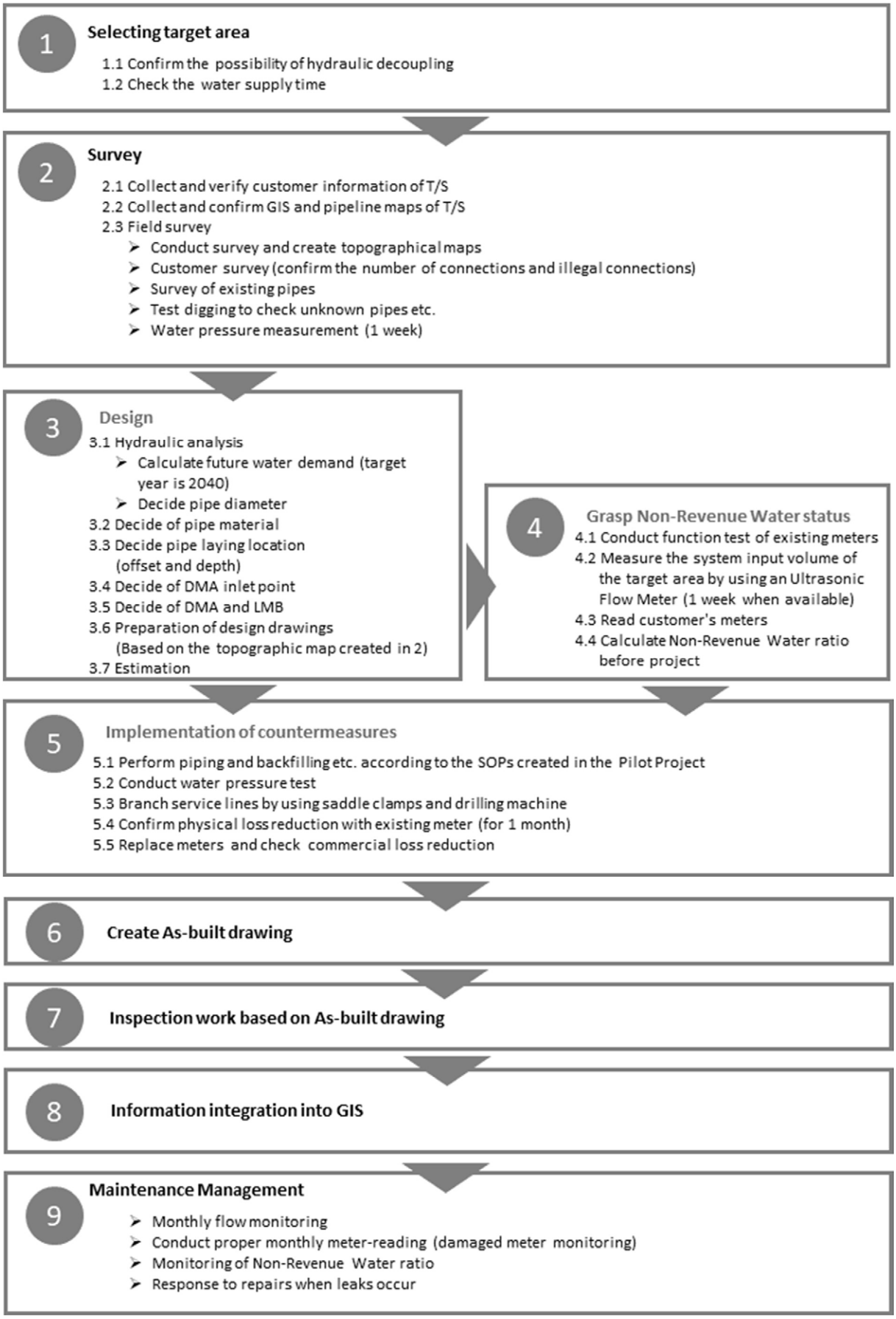


Figure 3-3:NRW management model by DMA construction

3.5. On-going NRW Reduction Projects

Served population of each distribution zone is shown in Table 3-4, and on-going NRW reduction projects are shown in Figure 3-4. Distribution lines, service lines and water meters will be replaced and NRW ratio and supply services will be improved in zone1, 7, 8, 9, 10 and a part of zone3 by the on-going projects.

On the other hand, zones2 to 6, red framed, neither NRW ratio nor the water supply services will improve as untreated reservoir water and untreated water other than Nyaughnapin WTP will continue to be supplied through the old distribution pipe.

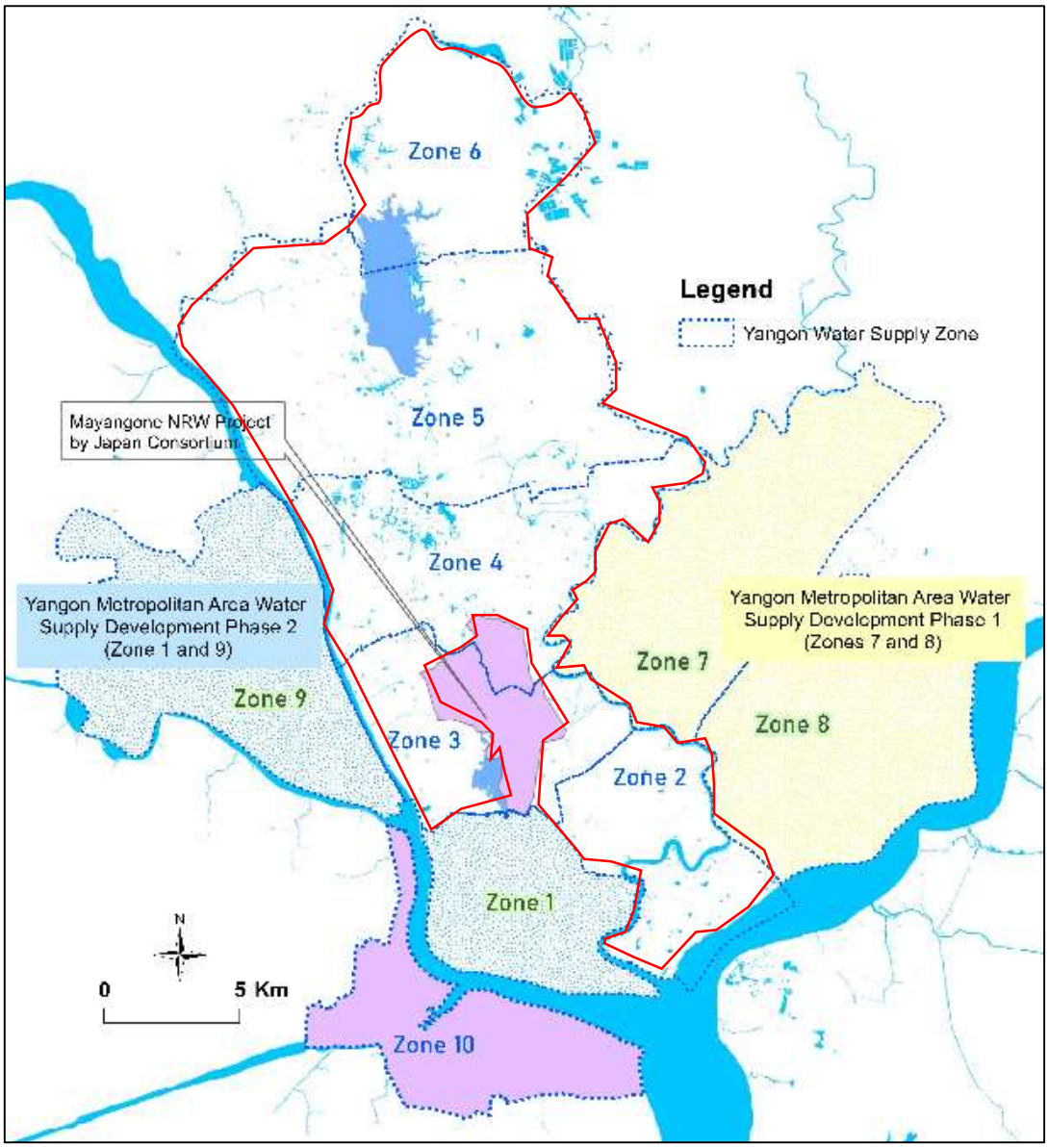


Figure 3-4:On-going NRW reduction project by zone

Table 3-4:Target of water supply service by distribution zone

Zone	Planned population served (thousand)		Project	
	2020	2040	Description	Completion (assumed)
1	798	927	JICA Yen loan Ph2	2028
2	466	602	-	
3	613	775	Mayangon NRW project (part of area)	2025
4	702	874		
5	357	579	-	
6	136	210	-	
7	581	1,277	JICA Yen loan Ph1	2022
8	455	801	JICA Yen loan Ph1	2022
9	512	776	JICA Yen loan Ph2	2028
10	95	200	Yangon South Water supply Improvement	
Total	4,713	7,023		

Source: revised M/P 2019

3.6. Other related activities

This chapter will be updated by WRAWSA.

4. NRW Management Plan

4.1. Proposed NRW Management Measures

4.1.1. Activities and components of NRW management

NRW management section is managing “Unbilled Authorized Consumption” and “Water Losses” separately. As for management of “Unbilled Authorized Consumption”, NRW management section confirms the volume such as pipe flushing, fire-fighting and Utility use (FOC).

As physical loss management, leak survey on transmission pipe and distribution pipe is conducted. In addition, we survey leaks from service line branched point to customer meter and also manage overflow from reservoirs.

Moreover, as commercial loss, unknown branches and branches before water meter are checked as illegal connections by NRW management section. And broken meters are also confirmed. Meter-readers confirms human errors or mis-writing of read value.

4.1.2. Mid and long-term measures

As a long-term plan, a Master Plan was prepared with the support of JICA in 2014, and Non-Revenue Water reduction targets up to 2040 have been formulated and are being implemented.

Table 4-1 Non-revenue Water Rate and Leakage Rate

Items	2020	2025	2030	2035	2040
Non-revenue Water Rate (%)	46	35	26	20	15
Leakage Rate (%)	33	25	18	13	10

Source: Master Plan 2014

Based on the long-term plan, the following mid-term plan was formulated and implemented. For NRW management activities such as water Demand calculation, hydraulic analysis, DMA Network Design calculation and NRW rate monitoring will be continuously implemented. For Commercial Loss management, WRAWSA will continue to work on technology, site surveys, meter data management and mapping and drawing management.

Table 4-2:NRW mid-term action plan

Category	Policy	No	Objective
NRW Management	Improve information accuracy	1	Create and update pipeline map
		2	Collect basic data regarding NRW management
	Grasp actual NRW situation	3	Grasp NRW rate periodically by data collecting on distribution and effective water (revenue, non-revenue)
		4	NRW management in existing DMA
Physical Loss	Proactive leak prevention	5	Design/construct DMA system in pipe network
		6	Pipe laying at proper location to prevent leakage
		7	Prevent leakage at branch point
		8	Implement water pressure test to prevent leakage

	Reactive leak prevention	9	Efficient leak detection/repair on existing transmission/distribution pipe
		10	Repair leakage in proper repair method
		11	Record every leakage repair work
Commercial Loss	Measure exact water consumption	12	Grasp situation of existing meter function
		13	Install meter at proper location
		14	Water meter maintenance by EDWS
		15	Maintain measurement accuracy of water meter
		16	Solve non-metered customer
		17	Secure function of large size meter
		18	Proper meter-reading to get exact consumption
		19	Fairness in collecting water charge
		20	Eliminate illegal connections
		21	Decrease broken rate of new meter

4.1.3. Short term measures

Based on mid-long-term plan shown above, short-term plan was formulated as follows.

Table 4-3:Short -Term Plan

Improve information accuracy	1.	Conduct completion inspection (with guideline)
	2.	Formulate as-built drawing guideline
	3.	Start creating as-built drawing
	4.	Discussion with T/S engineers to formulate the data format
	5.	Training for township staffs about data format
	6.	Township staffs shall record exact customer consumption by monthly and data check by NRW section.
Grasp actual NRW situation	1.	Install water meters at Public facilities
	2.	Calculate NRW rate with collecting customer consumption from Computer section.
	3.	Collect the consumption data from all townships every month
	4.	Collect the water supply amount of tube well including machine operation data.
	5.	To test the customer meter according to the record of damage meter (function test)
	6.	Re-check with the patrol team on ground (Read or not)
Commercial Losses	1.	To prevent meter from damage, service connections which are in the drain will re-locate to the proper location
	2.	Conduct function test in some pilot area.
	3.	To install meter systematically at proper location and suitable place. (E.g., If meters are installed under ladder, it should be installed vertically)
	4.	Prioritize to do the function test in the high-water usage and high-rate damage meter area
	5.	To change metered system that collected with flat rate. Establish a water meter for customers and bill a rate based on the amount of water used.
	6.	Need to measure pressure and flow rate and check the existing large meter whether can work or not and also for new installation of large size meter
	7.	Training on meter reading to meter reader
Proactive leak prevention	1.	Consider pipe replacement work if frequent leaks happened on the same pipeline. (Utilize leakage record)
	2.	Introduction appropriate technical method of construction and proper materials for branch part.
	3.	Compulsory to follow the training
	4.	Pressure test with test kits (hammer tester) exclude transmission pipe

Reactive leak Repair	1.	To give the leakage record with photo
	2.	To show the leakage point on drawing base on the measurement of at least two points
	3.	To create the leakage point map

4.2. Physical Loss Management Plan (rehabilitation or replacement)

4.2.1. NRW reduction by on-going large donor projects

The following large project are on-going to replace existing pipelines and water meters along with installation of new pipes and meters. The Expert assumed NRW ratio after the completion of the project and completion year as follows.

Table 4-4: Major on-going major rehabilitation large project with DMA (Assumption)

Project	Target Area (Zone)	Assumed completion year	Assumed NRW ratio (After project)	Remarks
Lgyunpyin (Yen loan Phase 1)	7, 8	2023	20	
Mayangone (Grand aid project)	Part of Zone 3.	2025	30	Not all areas are target area of the project so that this zone's NRW ration reduction will be small on average.
Kokkowa (Yen loan Phase2)	1, 9	2028	10	

The Expert roughly estimated NRW ratio in entire city after completion of these projects based the percentage of the service population in 2020 by zone. If these projects are completed, it may possible to reduce NRW up to 54.5 % in 2025 and 34.3 5 in 2030.

Table 4-5: Estimated NRW Ratio after completion of the major projects

Zone	Planned population served (thousand)	% of population	Existing NRW	Estimated NRW after completion of NRW projects								
	2020		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	798	16.9%	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	10	10
2	466	9.9%	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2
3	613	13.0%	64.2	64.2	64.2	64.2	64.2	30	30	30	30	30
4	702	14.9%	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2
5	357	7.6%	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2
6	136	2.9%	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2
7	581	12.3%	64.2	64.2	64.2	20	20	20	20	20	20	20
8	455	9.7%	64.2	64.2	64.2	20	20	20	20	20	20	20
9	512	10.9%	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	10	10
10	95	2.0%	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2
Total	**4,715**	**100.0%**	**64.2**	**64.2**	**64.2**	**54.5**	**54.5**	**49.4**	**49.4**	**49.4**	**34.3**	**34.3**

4.2.2. NRW reduction roll-out plan by WRAWSA

(1) Reduction of NRW by DMA Concept

WRAWSA will renew the existing pipes while forming the DMA as a basic policy. Leakage repair work will continue to be carried out as a response to incidents, but since most of the factors causing leakage are due to poor construction and material quality, and new leaks occur frequently, the reduction effect

of leakage repairs is small.
Therefore, physical loss will be reduced mainly by replacing existing pipes through DMA set up works.
The DMA construction work is carried out in separate areas by WRAWSA or by donors.

This plan excludes areas that will be developed by donor projects and sets targets for DMA construction project by WRAWSA.

(2) New DMA construction

1) Target ratio of NRW reduction

If all pipes and water meters are replaced in the project, the NRW ratio can be reduced less than 10% as a result of Yankin grant aid project, Yankin pilot project (Ward 13) and North Okkalapa Ward 2 NRW reduction project. It is expected that the NRW ratio of **10%** or less can be achieved after construction, regardless of the area, by appropriate piping work and conducting water pressure tests to check presence of leaks.

2) Implementation body

For the time being, as an implementation policy, it is assumed that NRW management section which has completed technical transfer through TA project NRW reduction project will be in charge of the planning, design, construction supervision of NRW reduction project by DMA.
The responsibility of NRW management measures is shown as below.

Table 4-6:The responsibility of NRW management measures

Division / Section	Responsibility for NRW reduction work
NRW Management Section	− NRW rate monitoring for existing DMAs − DMA setting up project − Survey, Planning, Design, Construction (tentative) − Collect and analyze leakage records − Meter replacement − Inspection work for piping work
Township office	− Pipe installation/rehabilitation work − Leak repair work − Leakage record − Check and correct errors on customer list − Damaged meter check − Inspection work for piping work

3) DMA set up

a) Base NRW project

NRW reduction pilot project in Yankin T/S 13 ward was carried out between Jan 2019 and Jan 2020. Totally 2DMAs were set up in whole of the 13ward including the pilot area. Additionally, YCDC's own NRW reduction projects for North Okkalapa T/S Ward 2 (3DMA) in FY 2018 and North Okkalapa T/S Nya ward in FY 2019 were implemented and completed. These projects were carried out by NRW

management section and took approximately one year to complete construction.
Implementation scale and period of DMA construction will be set based on the result of North Okkalapa T/S Ward 2 project which was implemented by WRAWSA own fund. In addition, Yankin pilot project shall be utilized.

Table 4-7:North Okkalapa T/S Ward 2 project (3 DMA)

	North Okkalapa T/S (Ward 2)	Yankin pilot project (Ward 13 Ward)
Project period	FY2018	Jan,2019 – Jan,2020
Pipe length replaced	20.1km	2.13km
Connections (meter replaced)	2,670 (Households)	311 (Households),*93 applying permission
NRW ratio before and after	51.2% → 7.1%	86.1% → 5.5%

b) Target of DMA construction

This plan set the targets of NRW reduction measures as following.

DMA set up schedule	1 Area (2-3DMA) / Year
Responsible Division/Section	NRW Management Section (Tentative)
Estimated DMA size	Approx.10 km 500 - 1,000 Connections per DMA

c) DMA construction model

When constructing DMA, following should be considered.

- Survey and make a topographical map, Planning/Design based on hydraulic analysis after pressure measurement.
- Pipe laying position: under the road, away from drainage ditch
- Position of Service line: under drainage ditch (avoid on-ground piping)
- Install enough numbers of valve for NRW/DMA management
- Install water meter where meter-readers can read easily
- Construction by using proper tools and equipment
- Easy to maintenance

4) Implementation schedule

DMA constructions will be implemented according to the model which was formulated through Yankin Pilot Project. Based on the experience of the Pilot project, the time required for each work process is assumed to be as follows.

Table 4-8:Required work period of DMA construction

Item	Required months
➢ Select target area	1
➢ Survey (create topographical map)	2
➢ Design (Hydraulic analysis)	3
➢ Grasp NRW status (before project)	1
➢ Construction	12
➢ Create As-built drawing	1

i. First year (2021)

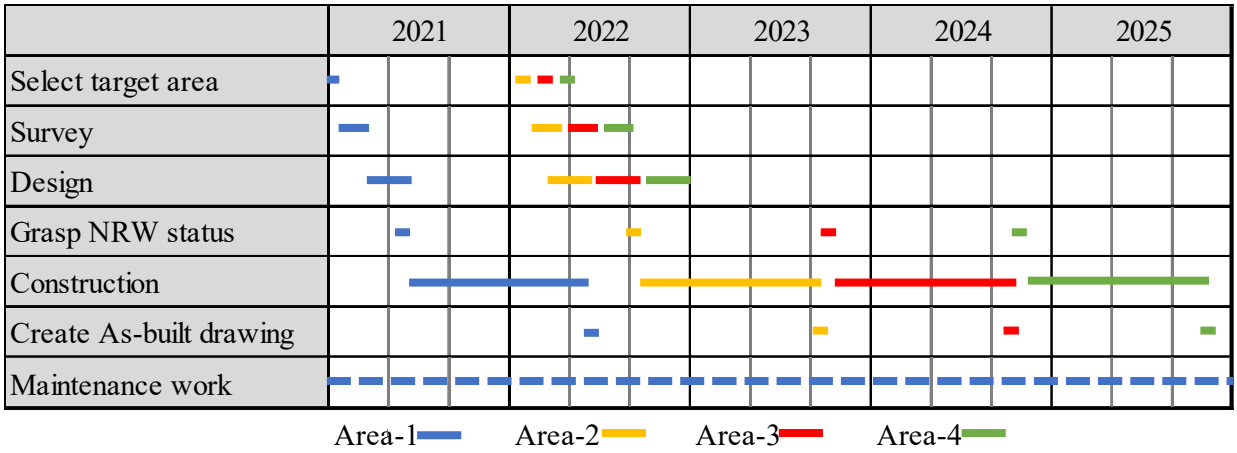
- ➢ As a pilot implementation, the project will be carried out from the selection of the area to the construction, while verifying SOPs, etc. which were formulated in TA project.

ii. 2022～2025

- ➢ Selection of area, survey and design for 2022-2025 will be carried out in 2022.
- ➢ Request a budget based on the design.
- ➢ Construction of 2nd year (2022) will start after rainy season.
- ➢ Grasping NRW status will be carried out just before the construction starts, and set initial NRW ratio.
- ➢ If any field changes will be found during the above work, reflect the changes in the design.

Based on the above conditions, a schedule for DMA constructions until 2025 is set as follows.

Table 4-9: DMA construction schedule until 2025



4.2.3. Maintenance work of pipe

(1) Proactive leakage prevention

To prevent leakage and to reduce factors of leakage, following activities are launched in construction

related section.

Table 4-10:activities and expected effects of proactive leakage prevention measures

Activity	Expected effects
Accurate representation of new pipelines and existing pipelines on the as-built drawings (offset of valve and bend pipe locations)	Enables accurate identification of buried locations of distribution pipelines for maintenance work.
Use of appropriate materials according to YCDC's material standards	The quality of pipe materials is secured and leakage due to poor quality is prevented.
Implement pressure test regularly	Prevent leakage due to jointing errors, etc.
Ensure use of saddle clamps for service pipe branch work	Prevent the most common sources of leakage

(2) Reactive leak repair

It is difficult to conduct leak survey by sound, because of water pressure is very low except part of Yangon so that, for the time being, measures for on-ground leakage will be carried out first. Leakage repairs are to be carried out promptly by T/S, and leakage record is to be prepared and submitted to NRW Management section. NRW Management Section will compile collected leakage record and reflect that in NRW management plan.

4.3. Commercial Loss Management Plan

4.3.1. Status of existing meters in Yangon City

NRW management section carried out damaged meter survey for all T/S in Yangon City in Sep 2020. The status of existing meters in Yangon City is shown in the table below. Totally 186,233 meters are defective meter which cannot read value appropriately.

This occupies 57% of the total number of customers.

Table 4-11:Estimated Status of Water maters as of September 2020

Item	Meter	Remarks
1. Broken	26,671	
2. Unreadable	34,576	
3. Bad position (meter-reader cannot read)	3,042	
4. Meter removed by customer	7,633	
5. No-meter (Flat rate)	35,246	
6. Existing meters suspected to be malfunctioning	78,446	Installed in religious facilities:2,229
7. Water supply equipment installed in government facilities, etc.	619	
Total (Defective mater)	**186,233**	57% of total customers
Total number of customer	**325,676**	

4.3.2. Meter installation plan

As analyzed in cost benefit of meter replacement measure, commercial loss measure is much efficient in the NRW measures. Commercial loss measure returns much return with less investment cost.

Therefore, WRAWSA will start at the commercial loss measure at the initial stage of NRW to reduce NRW quickly. A commercial loss reduction plan for NRW rate improvement from 2022 to 2030 has been developed in terms of improving customer meters, which is the main factor of commercial losses.

4.3.3. Meter replacement work

The NRW Management Section has been taking the lead in replacing damaged meters and will continue to work with T/S to replace damaged and defective meters. Meter replacement work will be carried out as follows.

- Implement according to under the instruction by NRW Management Section.
- Establish 3 teams (1 engineer and 3 workers for each team) in NRW Management Section, then carry out meter replacement work and instruct meter replacement team of T/S
- For T/Ss, establish working team (1 engineer and 3 workers) as well
- Pipe Section 1-4 will support replacement work if necessary.
- Send instruction letter for customer who use defective meter to replace meter to YCDC specified meter within 3 months. After T/S receives completion report, T/S will inspect the meter replacement work.
- For newly meter installation for flat rate customer, since consideration of meter installation location is required, a special team will be established to work systematically.
- Meter replacement work and newly installation will be implemented according to work plan above.

4.3.4. Meter installation annual target

The target of replacement of bad maters and installation of meter to flat customers are set as follows considering implementable numbers. 27,000 meters each year in average will be replaced/installed to improve commercial loss.

Table 4-12:Annual meter replacement/installation plan

Item	Replace / Install (no./year)
1. Replacement of defective meter	
a) Replace by NRW Management Section and T/S	1,000
b) Replace by Pipe-Section 1-4	20,000
c) Replace by customer	1,000
Sub total	22,000 (Average)
2. Meter installation for flat rate customer	5,000 (Average)
Total	27,000 (Average)

4.3.5. New meter installation by ODA project and WRAWSA own project

- In developing this long-term plan for commercial loss improvement, we estimated 22,000-25,000 (conns./year) for each year as the number of new water supply connections based on information such as the number of new water supply connections for each month of the year from Oct 2018 to Sep 2019.

- From 2022, water supply to Zone 7&8 from Lagunpyin WTP, which is currently under construction by ODA, is planned to start, and a total of 55,000 new water supply connections are expected to be added in the three years to 2024.
- Water supply for zone1 by Kokkowa project will start around 2025, and existing meters will be replaced. However, this is not reflected in this plan because reliable progress cannot be predicted.

4.3.6. NRW reduction plan up to 2030

Annual plan of NRW reduction is prepared based on the fowling conditions.

1) System input volume

The current flow data used collected by Flow Monitoring System as the system input volume. Besides, planned water supply volume of Lagunpyin WTP from 2022 is included in System Input Volume.

2) Connection (Customer) number

The defective meter number and the number of flat rate customer are got from "meter survey by business categories" and "Existing meter situation survey in Jan 2019".

The number of households for water supply in zone7 and 8 is also calculated for each year of the three-year period starting in 2022.

3) Consumption volume after meter improved

Average consumption volume before/after improvement by tariff categories is shown in the table below. However, for the categories, excluding Domestic and Commercial, the same amount of water was used for both before and after the improvement due to insufficient number of survey data. The amount of water used for new customer was set at 33.0 m3 based on the assumption of domestics.

Table 4-13:Average consumption volume before/after improvement

Category	Water consumption		Remarks
	Before improvement (m3)	After improvement (m3)	
Domestic	18.56	33.0	Before: Actual value After: Estimated value
Commercial	48.6	65.0	Before: Actual value After: Estimated value
Flat	21.0	33.0	After: Same value as Domestic
	Consumption before/after improvement		
Department Domestic	915		Based on actual values. (Not predictable after improvement)
Department Commercial	1,355		Based on actual value
FE(Foreigner) Domestic	1,018		Based on actual value
FE(Foreigner) Commercial	273		Based on actual value
FE(Foreigner) Flat	600		Based on actual value
Department Flat	86,810		Bulk water supply to industrial zone
Free of charge	434		Religious & VIP (unknown)

The following table shows the transition of reduction of NRW ratio by implementation of the plan starting in 2022.

Table 4-14:NRW reduction plan by commercial measures

Year	2020	2022	2023	2024	2025	2026	2027	2028	2029	2030
SIV (1000 m^3/year)	28,038	28,038	30,765	30,766	30,766	30,766	30,766	30,766	30,766	30,766
Revenue water (1000 m^3/year)	9,909	11,490	13,528	15,465	17,501	18,844	20,238	21,541	22,430	22,858
NRW (1000 m^3/year)	391,070	16,547	17,237	15,300	13,264	11,921	10,527	9,224	8,335	7,907
NRW ratio (%)	64.7%	59.0%	56.0%	49.7%	43.1%	38.7%	34.2%	30.0%	27.1%	25.7%
Connection number	325,676	347,698	388,198	429,198	473,198	498,198	523,198	548,198	573,198	598,198
Functioned meter	140,392	183,398	247,772	315,433	386,586	438,606	495,710	547,463	572,663	598,198
Defective meter	150,040	126,056	108,182	84,521	62,368	40,348	18,244	735	535	535
Flat rate	35,244	34,244	32,244	29,244	24,244	19,244	9,244	0	0	0

Note: The plan is expected to start from 2022 considering the political change in Feb 2021.

4.4. Training Plan

To achieve the NRW management plan, trainings for engineers or workers who are in charge of NRW management will be held in training center established at Yegu Pumping Station.

NRW Management Section and the Expert prepared training course for the training center as shown below.

Table 4-15:list of Lecture

No.	**Training Item**
LS-1	Water supply plan
LS-2	Hydraulic analysis
LS-3	Distribution pipe laying
LS-4	Water pressure test
LS-5	Design and Completion drawing
LS-6	Flow rate measurement
LS-7	Night Step Test
LS- 8	Leakage detection method
LS- 9	Leakage repair method
LS- 10	Water supply equipment
LS- 11	Issues caused by water meter
LS- 12	Management of Non-Revenue Water

Table 4-16:list of Practical training in the field

No.	**Training Item**
WS-1	Service pipe branch
WS-2	Function check of water meter
WS-3	Pipe cutting and jointing
WS-4	
WS-5	
WS-6	Water pressure test
WS-7	Branching method
WS-8	Flow measurement
WS-9	Night Step Test
WS-10	Leakage detection method

4.4.1. Mid- and long-term target

In 2019, the YCDC announced a policy to outsource the construction of new and replacement water pipes and distribution pipes for projects that exceed a certain budget amount, however, WRAWSA still directly manages construction. Except for pipeline construction works by ODA, WRAWSA has been implementing these works directly so that there is no environment for private contractors to enter the market. Therefore, the private companies with the technical capacities required for piping work have not been developed. It is quite difficult to manage water supply management of YCDC, where rapidly spread of water supply coverage is expected, only by YCDC engineers. To improve this present situation following measures are required.

1. Make an opportunity for private companies to acquire required technology and develop many engineers of waterworks.
2. Trainings for required technology or knowledge of waterworks by utilizing NRW training center. It is necessary to develop engineers by issuing licenses related to piping works to those who have completed a certain program of training and passed a certain technical examination. Moreover, an annual plan for developing engineers shall be formulated.
3. Develop and implement measures to qualify contractors with licensed engineers to receive orders for piping works of YCDC.

4.4.2. Short term training plan (2021~2024)

(1) Training in training yard

NRW training of YCDC is now at very first stage starting training in Training Center for NRW Management (Training Center). A training in NRW Training Center just launched with internal training in January 2020. The only C/Ps who were trained in Yankin pilot project including NRW Management Section staff can make a lesson and practical training in Training Center. Therefore, one of the most immediate tasks for WRAWSA is to develop more trainers. Presently, practical training in Training Center is suspended due to COVID-19 pandemic so that “on-line training” was prepared to continue NRW related training. The first on-line training was held in December 2020. This on-line training may be continued unless the CVID-19 pandemic is disappeared. After easing COVID-19 pandemic, practical training in Training Center will restart.

(2) OJT through NRW reduction project (DMA set up)

In addition to trainings in training yard, OJT will be carried out through DMA construction to spread technology in WRAWSA. Moreover, OJT participants are also expected to become trainers in training yards.

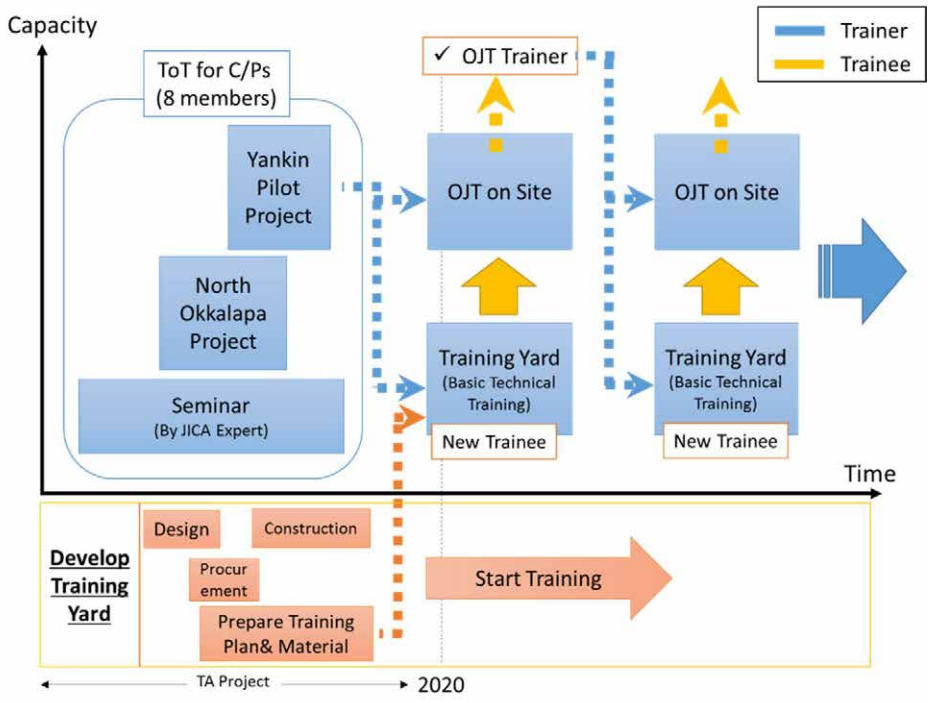


Figure 4-1: Image of training yard utilization

Items and target sections of OJT are shown below.

Table 4-17: Items and target sections of OJT

Item	OJT Target	OJT contents
Planning/Design	Design section Research section	Create topographical map (Survey) Site survey Hydraulic analysis Design drawing Material selection
Construction	T/S office engineer House connection section Pipe section 1-4	Material selection Proper construction according to SOP (Pipe jointing, tapping, etc.) Safety
Inspection	T/S office engineer House connection section Pipe section 1-4	Pressure test Create As-built drawing
Operation /Maintenance	T/S office engineer Meter readers	Appropriate meter-reading Grasp damaged meter situation Flow monitoring, maintenance of flowmeter Leak detection, repair

Annex-1 NRW Projects Implemented

1. NRW projects implemented as small scale

(1) Overall NRW projects

Projects to effectively reduce non-revenue water are listed below.

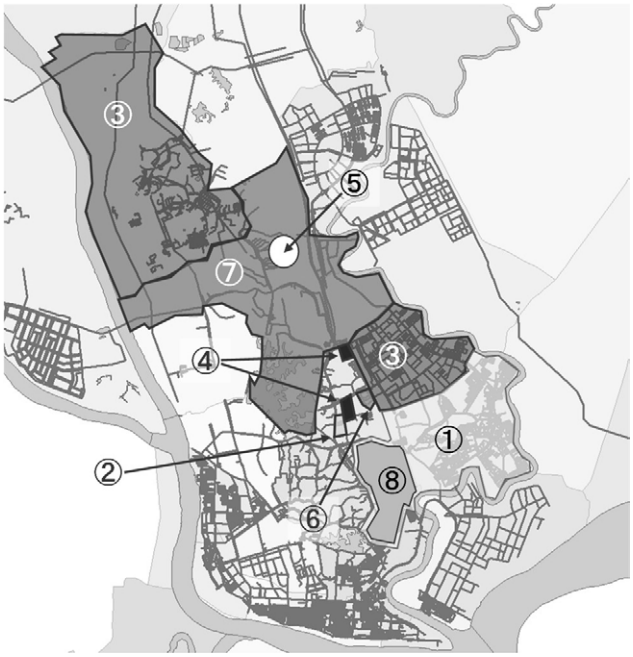


Figure-1 : Location of NRW projects by Donor

Table-1: NRW projects by Donors

No.	Project	Area (T/S)	Year	Player	Project cost	Construction	YCDC	Connections	Length of replaced pipe	NRW reduction
①	Pilot project consulting	Tarmwe & Thingangyun	—	EGIS,WMI	EUR 0.663 million	(Survey)	—	-	-	-
②	The Project for Urgent Improvement of Water Supply System in Yangon	Yankin	2016	JICA	JPY104 million	JICA (TODA)	U Moy Thein	1944	8	70→8.2
③	NRW reduction DMA pilot project in Yangon	Insein	2019	Manila Water- Mitsubishi	USD0.7 million	n.a	Daw Thawe Naing Oo	315	5.5	52→17.3
		South Okkalapa						496	5.6	56→12.3
④	Water supply and sanitation improvement advisor	Yankin	2014	JICA	USD0.16 million	YCDC	U Myint Oo	271	5.6	75→15
⑤	NRW reduction project in Mayangone township	Mayangone	2015	Japan Grassroots Grant Aid, Japan consortium (Tokyo Water, Toyo Engineering)	USD0.61 million	YCDC	U Myo Thein	292	5	76.6→32
⑥	PROJECT FOR IMPROVEMENT OF WATER SUPPLY MANAGEMENT OF YCDC	Yankin	2020	JICA	—	YCDC	NRW Management Section	311	2.1	86.1→5.5
⑦	the Project for Reduction of Non-Revenue Water in Mayangone Township in Yangon city	Mayangone	On going	JICS, Japan consortium (Tokyo Water, Toyo Engineering)	—	YCDC	U Myo Thein	9686	10.1	Half of initial NRW rate
⑧	NRW reduction pilot project	Tarmwe	—	AFD, France (EGIS)	—	—	U Myo Thein			

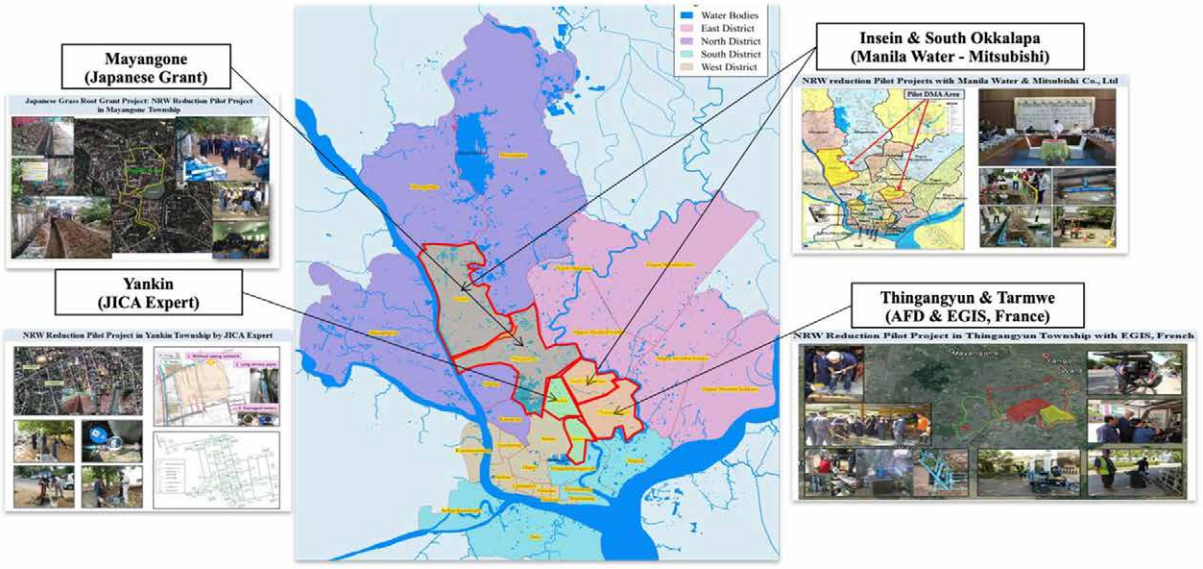


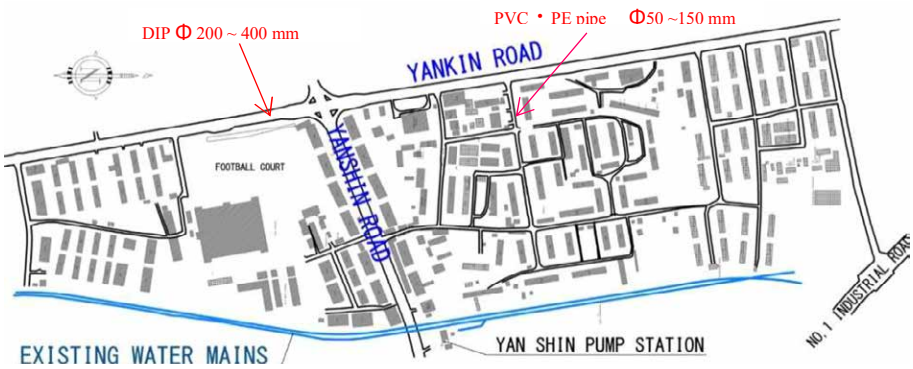
Figure-2: NRW Reduction Pilot Projects in Yangon City

(2) Individual Project Brief

1) **Grant Aid Project for Urgent Improvement of Water Supply**

- Replacement of 42"φ Transmission pipe
- Installation of DMA system in Ward No. 2,3 and 4, Yankin

This project which ended in 2016 includes construction of the Nyaungnapin Water Treatment Plant and installation of pumps, replacement of the existing 42" diameter pipe under the Gabar Aye Pagoda road with a 1000mm diameter DIP, and construction of a new DMA in the pilot area of the Yankin T/S. After the completion of the project, to control commercial losses in the DMA, regular meter readings are ensured, and water meter function tests and illegal use inspections are conducted.

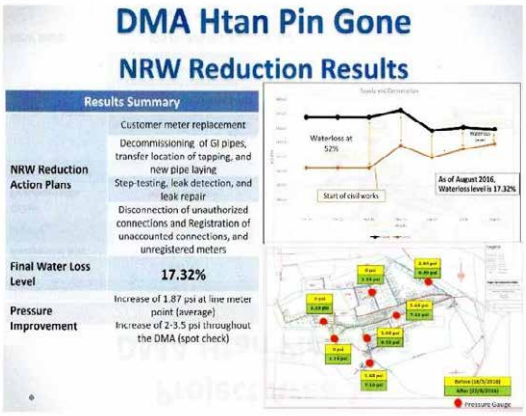


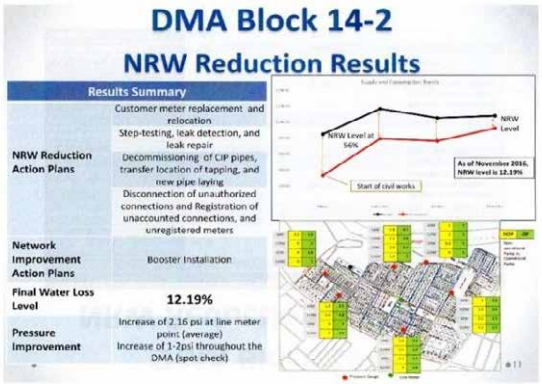
Project area of Grant Aid Project for Urgent Improvement of Water Supply

Pipe Length	8 km
Connections	1944 nos
Completed Year	2016
NRW Ratio	70% to 8.2%

2) **Pilot District Metered area project for NRW reduction in Yangon City**

From 2014-2016, NRW reduction projects were implemented in 14 wards of South Okkalap T/S and Htan Pin Gone ward of Insein T/S. As a result of the project implementation, South Okkalap T/S has been able to reduce the NRW rate from 55.97% before the project implementation to 12.19% after the project implementation. Also, Insein T/C was able to reduce the NRW rate from 52.6% before the project implementation to 17.32% after the project implementation.



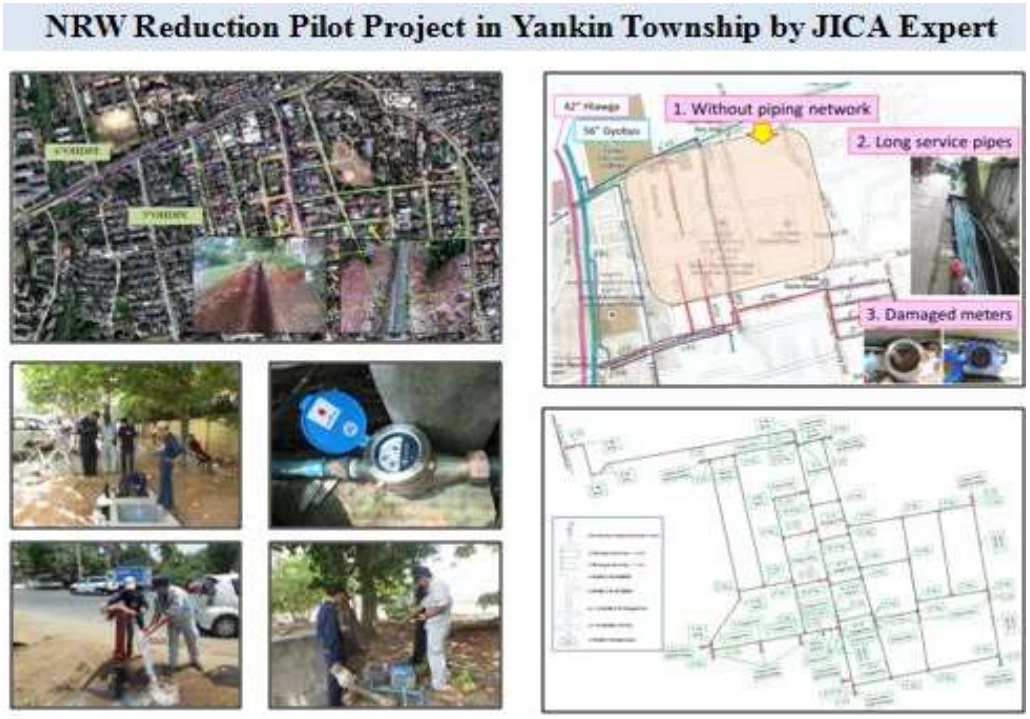


Insein T/C		South Okkalapa T/C	
Pipe Length	5.5 km	Pipe Length	5.6 km
Connections	315 nos	Connections	496 nos
Completed Year	2016y	Completed Year	2016y
NRW Ratio	52% to 17.32%	NRW Ratio	56% to 12.29%

3) **NRW DMA Pilot Project in Ward No.14 Ward, Yankin**

The project, which ended in 2014, implemented the DMA Pilot Project in 14 wards of Yankin Township. As a result, by monitoring the water consumption in the pipeline network area, it has become possible to grasp the situation of leakage occurrence and to supply water at a water pressure that does not cause

inconvenience to the customers. As a result of the improvement in NRW, the NRW rate was reduced from 75% before the project to 20%.



Pipe Length	5.651 km
Connections	271 nos
Completed Year	2015
NRW Ratio	75% to 20%

4) **Japanese Grass Root Project in Ward No. 5, Mayangone**

NRW Reduction Pilot Project was implemented in 5 wards of Mayangone T/S and the NRW rate was reduced from 72% before to 32% after the project which was completed in 2015.

Pipe Length	5 km
Connections	292 nos
Completed Year	2015
NRW Ratio	72% to 32%

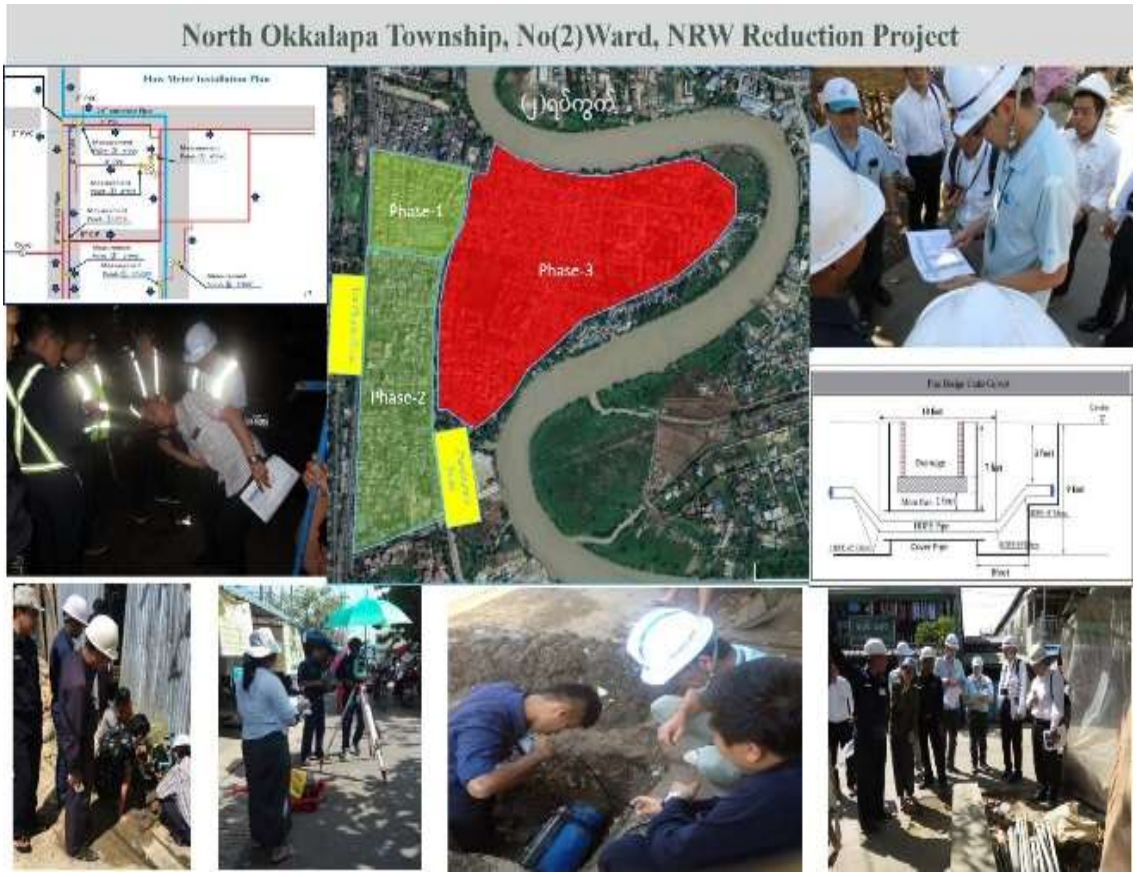
5) **Yankin T/C, No. (13) Ward, NRW Reduction Project**

The NRW Section has been implementing the NRW Reduction Pilot Project in Yankin T/S-13Ward with JICA Expert since the 2018-2019 budget year. The objective is to train NRW Reduction Instructors in EDWS through on-site training.

Project period	Jan,2019 – Jan,2020
Pipe length	2.13km
Connection nos.	311 (Households) *93 applying permission
NRW ratio	86.1% -> 5.5%

6) **North Okkalapa T/S No (2) Ward, NRW Reduction Project**

In the two wards of North Okkalapa T/S, we have implemented NRW projects during the 2017 and 2018 budget years. As a result, the NRW ratio was reduced from 51.17% to 7.12%

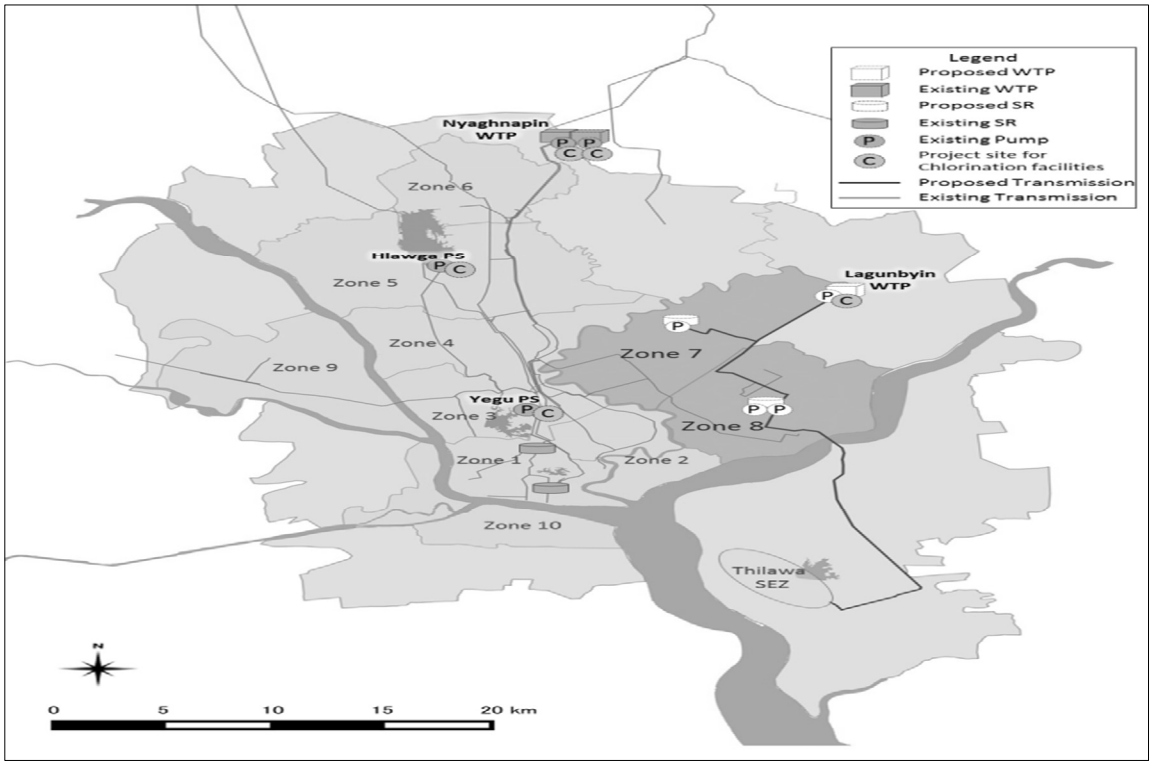


Pipe Length	67481 ft (20.57 km)
Connections	2,670 nos
Completed Year	2018
NRW Ratio	51.17% to 7.12%

2. On-going donor large projects

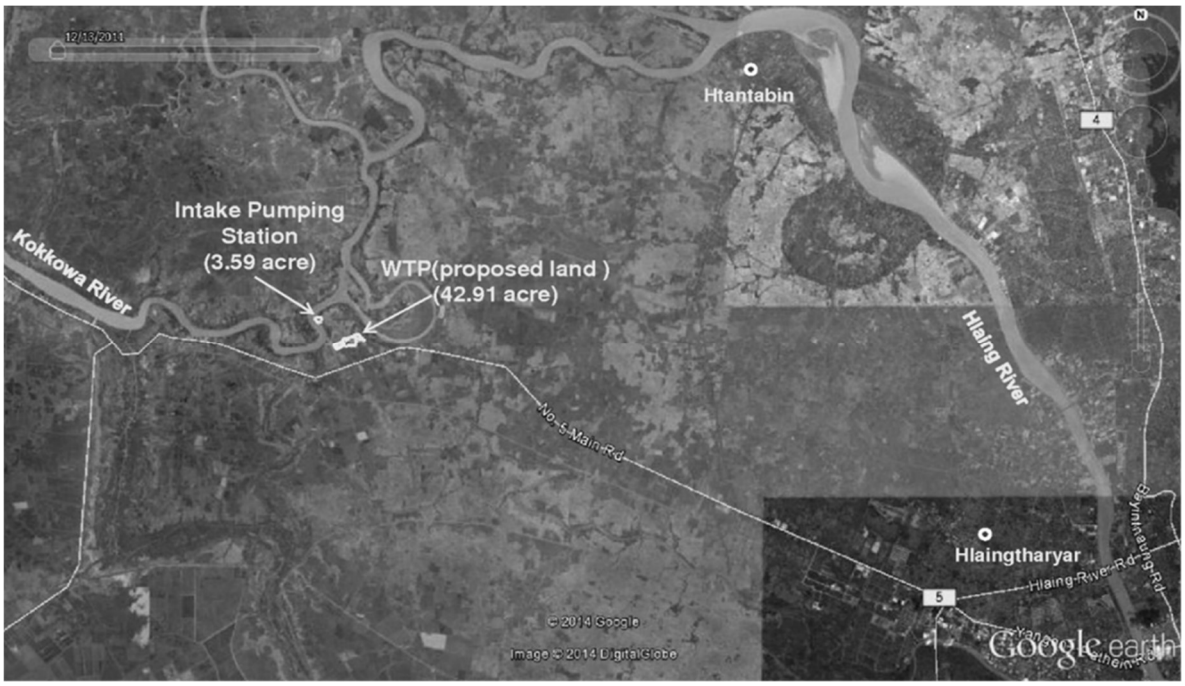
(1) Lagunbyin system (Yen Loan Phase 1) Zone

This project is a yen loan project. The objective of this project is to supply tap water from Lagubyin water treatment plant to phase (1) project zone, from Distribution Network Zone (7) to East Dagon and N/Dagon, and from Distribution Network Zone 8 to S/Dagon and Dagone Seikkan. Water distribution of 10 MGD to Thilawa SEZ is planned in 2019.



(2) Kokkowa system (Yen Loan Phase 2) Zone 1 and Zone 9

For this project, a plan was formulated to treat a total of 240 MGD of purified water: 60 MGD from the Kokkowa River as the first step, 60 MGD as the second step, and 120 MGD as the third step. In the first step, water can be supplied to Zone-1 & Zone-9 Townships, in the second step to Zone-2 & Zone-3 Townships, and in the third step to Zone-3 & Zone-4 Townships. The goal is to build a water treatment plant with a capacity of 60 MGD to supply drinking water to Sanchaung Seikkan T/S, This project is scheduled to begin in 2017 and be completed in 2026.



(3) Mayangone

This project is a NRW reduction project to construct 10 districts and 20 DMAs in Mayangone T/S. Surveys were conducted in 2016 and construction began in 2018. Scheduled for completion in 2022, but extension is expected due to COVID-19. The construction is mainly done using materials imported from Japan.

Reduction target：Reduction by half (or less than 30)

Annex-2

Mid-term plan to reduce NRW by improving commercial loss

❒ Estimating to number of meters that need improvement in the future based on the survey of meter installation status and operating status.

Confirmed value of water consumption by meter status in pilot area

Average water usage (Domestic & Commercial) ϕ 20mm	Exiting Meter situation		
	Good	Damage	No Meter
214 house	47 house	112 house	55 house
	22%	52%	26%
27.2 ㎥/M	2,435.815㎥	2,804.600㎥	1,184.000㎥
	51.8㎥	25.0 ㎥	21.50 ㎥

26.0 ㎥/M

January-September 2020 Yangon city average monthly water consumption

→

33.0 ㎥/M

Average domestic violence water consumption estimated by YCDC

Amount water supplied of water resource

Water Source	NRW-Sec Flow Data Sep / 2020	Expected water distribution /2022~
Nyaughnapin WTP-1	11, 910, 065 ㎥/M	11, 910, 065 ㎥/M
Nyaughnapin WTP-2		
Gyoubyu	3, 117, 646 ㎥/M	3, 117, 646 ㎥/M
Phugyi		※Ragungpyin WTP 2, 727, 600 ㎥/M
Hlawga P-1	9, 287, 478 ㎥/M	9, 287, 478 ㎥/M
Hlawga P-2	1, 760, 665 ㎥/M	1, 760, 665 ㎥/M
Sub Total	**26, 075, 854 ㎥/M**	**28, 803, 454 ㎥/M**
Tub Well	1, 962, 508 ㎥/M	1, 962, 508 ㎥/M
TOTAL	**28, 038, 362 ㎥/M**	**30, 765, 962 ㎥/M**

Revenue Water	9, 909, 422 ㎥/M
Revenue Water-ratio	35. 30%

NRW-ratio	64. 70%

Number of uses and amount of water used by charge system

		Consumption Unit per month (Sep/2020)	Average consumption umit (Jan~Sep/2020)	
Domestic	Consumption Unit ㎥/M	5,976,690 ㎥/M	22.9 ㎥/M	26.0 ㎥/M
	Connection number	260,099		
Commercial	Consumption Unit ㎥/M	1,508,070 ㎥/M	55.9 ㎥/M	
	Connection number	26,979		
Department Domestic	Consumption Unit ㎥/M	1,329,450 ㎥/M		
	Connection number	1,453		
Department Commercial	Consumption Unit ㎥/M	153,120 ㎥/M		
	Connection number	113		
FE Domestic	Consumption Unit ㎥/M	125,220 ㎥/M		
	Connection number	123		
FE Commercial	Consumption Unit ㎥/M	81,060 ㎥/M		
	Connection number	297		
Flat	Consumption Unit ㎥/M	722,940 ㎥/M		
	Connection number	35,244		
Department Flat	Consumption Unit ㎥/M	12,272 ㎥/M	Revenue Water	
	Connection number	1		
FE Flat	Consumption Unit ㎥/M	600 ㎥/M	TOTAL	
	Connection number	1	9,909,422 ㎥/M	
FOC	Consumption Unit ㎥/M	356,970 ㎥/M		
	Connection number	822		
Other	Consumption Unit ㎥/M	32,480 ㎥/M	NRW	
	Connection number	544		
Water Tap	Consumption Unit ㎥/M	1,620 ㎥/M		
	Connection number			
TOTAL	Consumption Unit ㎥/M	10,300,492 ㎥/M		
	Connection number	**325,676**		

Estimated water supply connection status / SEP-2020

Meter status		Properly	Mulfunction	No meter
Zena's meter	73, 897	73, 897	—	—
Other exiting meter	112, 065	× 30% 33, 619	× 70% 76, 217	—
Added meter (New connection)	25, 875	25, 875	—	—
Replaced meter	6, 052	6, 052	—	—
Mulfunction	26,671		26,671	—
Dirt on the meter	34,576		34,576	—
Bad position	3,042		3,042	—
Removal by the owner	7, 633		—	7, 633
No meter	35, 246			35, 246
Other	554		—	554
Religious facility	Include in exiting		2,229	?
V. I. P	65		65	
TOTAL	325, 676	139, 443	142, 800	43, 433
	100%	42. 8%	43. 8%	13. 3%
Inappropriate rate of meter			➡ 57. 2%	

Number of cases to be improved	
Mulfunction Meter Total	⇨ 142, 800
Numbers of Meters required to be installed	⇨ 43, 433
Total number of targets	⇨ 186, 233

Sep / 2020	
Total connection number	
325, 676	
Improvement	Remain
0	
0	
0	325, 676
10,300,492㎥/M	
9,909,422	
28,038,362	
RW-ratio	35. 3%
NRW-ratio	64.7%

Customer Meter improvement work results for the purpose of Commercial Loss

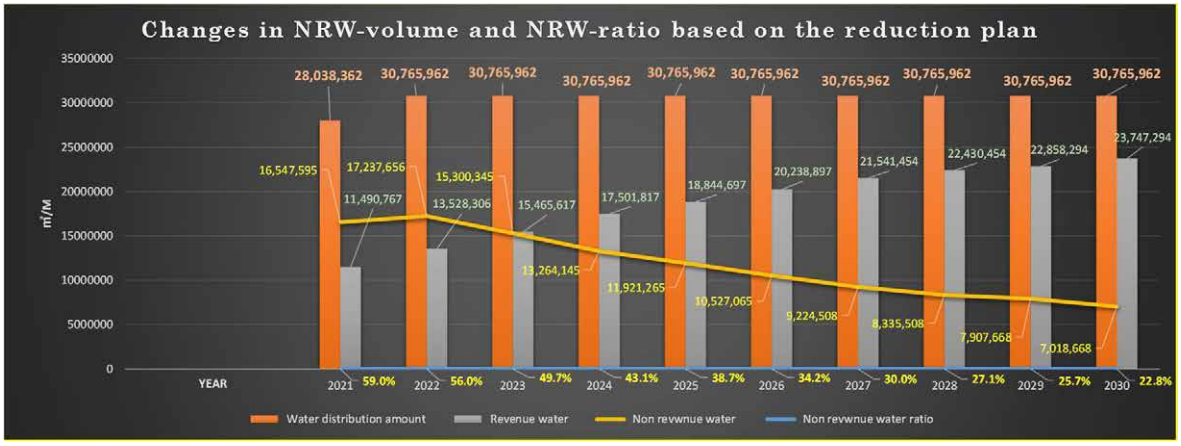
	2021		2022		2023		2024		2025	
	Total connection number		Total connection number		Total connection number		Total connection number		Total connection number	
	347, 698		388, 198		429, 198		473, 198		498, 198	
	Improvement	Remain	Improvement	Remain	Improvement	Remain	Improvement	Remain	Improvement	Remain
Target year	21, 006		23, 874		26, 661		27, 153		27, 020	
New & Exiting	162, 392		223, 898		288, 772		359, 433		411, 586	
Total	183, 398	164, 300	247, 772	140, 426	315, 433	113, 765	386, 586	86, 612	438, 606	59, 592
Amount of water	12,639,501㎥/M		14,368,526㎥/M		16,119,926㎥/M		17,979,256㎥/M		19,146,256㎥/M	
Revenue water	12,464,051		14,342,436		15,465,617		17,501,817		18,844,697	
Distribution amount	28,038,362		30,765,962		30,765,962		30,765,962		30,765,962	
	RW-ratio	44. 5%	RW-ratio	46. 6%	RW-ratio	50. 3%	RW-ratio	56. 9%	RW-ratio	61. 3%
	NRW-ratio	55.5%	NRW-ratio	53.4%	NRW-ratio	49.7%	NRW-ratio	43.1%	NRW-ratio	38.7%

Customer Meter improvement work results for the purpose of Commercial Loss

	2026		2027		2028		2029		2030	
	Total connection number		Total connection number		Total connection number		Total connection number		Total connection number	
	523, 198		548, 198		573, 198		598, 198		623, 198	
	Improvement	Remain	Improvement	Remain	Improvement	Remain	Improvement	Remain	Improvement	Remain
Target year	32, 000		26, 553		0		0		0	
New & Exiting	463, 710		520, 910		572, 663		597, 663		622, 663	
Total	495, 710	27, 488	547, 463	735	572, 663	535	597, 663	535	622, 663	535
Distribution amount	20,373,256㎥/M		21,545,274㎥/M		22,434,274㎥/M		22,323,274㎥/M		24,212,274㎥/M	
Revenue water	20,238,897		21,541,454		22,430,454		22,858,294		23,747,294	
	30,765,962		30,765,962		30,765,962		30,765,962		30,765,962	
	RW-ratio	65. 8%	RW-ratio	70. 0%	RW-ratio	72. 9%	RW-ratio	74. 3%	RW-ratio	77. 2%
	NRW-ratio	34.2%	NRW-ratio	30.0%	NRW-ratio	27.1%	NRW-ratio	25.7%	NRW-ratio	22.8%

Trends in NRW-volume from 2021 to 2030 due to commercial loss reduction plan

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Water distribution amount	28,038,362	30,765,962	30,765,962	30,765,962	30,765,962	30,765,962	30,765,962	30,765,962	30,765,962	30,765,962
Amount of water used	12,639,501	14,368,526	16,119,926	17,979,256	19,146,256	20,373,256	21,545,274	22,434,274	23,323,274	24,212,274
Revenue water	11,490,767	13,528,306	15,465,617	17,501,817	18,844,697	20,238,897	21,541,454	22,430,454	22,858,294	23,747,294
Revenee water ratio	41.0%	44.0%	50.3%	56.9%	61.3%	65.8%	70.0%	72.9%	74.3%	77.2%
Non revwnue water	16,547,595	17,237,656	15,300,345	13,264,145	11,921,265	10,527,065	9,224,508	8,335,508	7,907,668	7,018,668
Non revwnue water ratio	59.0%	56.0%	49.7%	43.1%	38.7%	34.2%	30.0%	27.1%	25.7%	22.8%
Connection number	347,698	388,198	429,198	473,198	498,198	523,198	548,198	573,198	598,198	623,198
Water supply population	1,808,030	2,018,630	2,231,830	2,460,630	2,590,630	2,720,630	2,850,630	2,980,630	3,110,630	3,240,630
Total Population	4,862,574	5,087,693	5,402,860	5,763,050	6,078,217	6,303,336	6,528,455	6,663,527	6,753,575	6,843,622



Forecast of increase in population and number of water supply connections over the next 10 years

2020		2021		2022		2023		2024		2025		
Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	
	4, 682, 498	108. 0%	4, 862, 574	113. 0%	5, 087, 693	120. 0%	5, 402, 860	128. 0%	5, 763, 050	135. 0%	6, 078, 217	
	914, 793	108. 0%	949, 978	112. 0%	985, 162	119. 0%	1, 046, 735	127. 0%	1, 117, 103	133. 0%	1, 169, 880	
	325, 676	115. 6%	**347, 698**	129. 0%	**388, 198**	142. 7%	**429, 198**	157. 3%	**473, 198**	165. 6%	**498, 198**	
—	1, 693, 515	—	1, 808, 030	—	2, 018, 630	—	2, 231, 830	—	2, 460, 630	—	2, 590, 630	
	+24, 839		+22, 022		+23, 000		+23, 500		+24, 000		+25, 000	(Conn
				⇨	+17, 500		+17, 500		+20, 000			

2026		2027		2028		2029		2030		
Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	
140. 0%	6, 303, 336	145. 0%	6, 528, 455	148. 0%	6, 663, 527	150. 0%	6, 753, 575	152. 0%	6, 843, 622	
140. 0%	1, 231, 453	145. 0%	1, 275, 433	148. 0%	1, 301, 821	150. 0%	1, 319, 414	152. 0%	1, 337, 006	
173. 9%	**523, 198**	182. 2%	**548, 198**		**573, 198**	190. 5%	**598, 198**	198. 8%	**623, 198**	
—	2, 720, 630	—	2, 850, 630	—	2, 980, 630	—	3, 110, 630	—	3, 240, 630	(Conn
	+25, 000		+25, 000		+25, 000		+25, 000		+25, 000	

Domestic exiting Meter ⇨ Number × 13.56㎥/M
Commercial exiting Meter ⇨ Number × 46.80㎥/M
Domestic properly Meter ⇨ Number × 33.0㎥/M (144.0%) ⟸ 22.9㎥/M
Commercial properly Meter ⇨ Number × 65.0㎥/M (116.0%) ⟸ 55.9㎥/M

		Consumption unit ㎥/M (Sep/2020)	Average	Sep-20 Meter operation situation number		2021 Improvement to properly Target year	2021 Improvement to properly Total	2021 Remain	2021 Consumption unit (㎥/M) Improvement	2021 Consumption unit (㎥/M) Exiting	2022 Improvement to properly Target year	2022 Improvement to properly Total	2022 Remain	2022 Consumption unit (㎥/M) Improvement	2022 Consumption unit (㎥/M) Exiting
Domestic	Unit ㎥/M	5,976,690													
	number	260,099	23.0	Properly	125,964	22,000	147,964		4,882,812		35,500	183,464		6,054,312	
				Damage		15,000	15,000		495,000		17,053	32,053		1,057,749	
				Remain	126,502			111,502		1,734,971			94,449		1,469,626
				Meter remove		2,000	2,000		66,000		2,000	4,000		132,000	
				Remain	7,633			5,633		87,649			3,633		56,529
Commercial	Unit ㎥/M	1,508,070													
	number	26,979	55.9	Properly	13,479	0	13,479		876,135		5,000	18,479		1,201,135	
				Damage		2,500	2,500		162,500		2,000	4,500		292,500	
				Remain	13,000			11,000		514,800			9,000		421,200
Department Domestic	Unit ㎥/M	1,329,450													
	number	1,453	915	Properly	949	0	949		868,335		0	949		868,335	
				Damage		0	0		0		0	0		0	
				Remain	504	0		504		461,160	0	0	504	0	461,160
Department Commercial	Unit ㎥/M	153,120	1,355												
	number	113			113	0	0	113	0	153,115	0	0	113	0	153,115
FE Domestic	Unit ㎥/M	125,220	1,018												
	number	123			123	0	0	123	0	125,214	0	0	123		125,214
FE Commercial	Unit ㎥/M	81,060	273												
	number	297			297	0	0	297	0	81,081	0	0	297		81,081
Flat	Unit ㎥/M	722,940													
	number	35,244	21	N0-Meter		1,000	1,000		33,000		2,000	3,000		99,000	
				Remain	35,244			34,244		719,124			32,244		677,124
Department Flat	Unit ㎥/M	36,810	36,810												
	number	1			1	0	0	1	0	12,270	0	0	1	0	12,270
FE Flat	Unit ㎥/M	600	600												
	number	1			1	0	0	1	0	600	0	0	1	0	600
FOC	Unit ㎥/M	356,970													
	number	822	434	Religious		500	500		217,000		257	757		328,538	
				Remain	757			257		111,688			0		0
				V.I.P		0	0				10	10		4,340	
				Remain	65			65		28,210			55		23,870
Other	Unit ㎥/M	32,480													
	number	544	60	Damage		0	0				544	544		32,477	
				Remain	544			544		32,482			0		0
Water Tap	Unit ㎥/M	1,620	1,620							1,620					1,620
	number														
Public Facility	Unit ㎥/M														
	number			Damage							8	8		800	
				Remain				10		1,000			2		200
				No-Meter		6	6		600		2	8		800	
				Remain				6		600			4		400
	TOTAL	10,325,030㎥/M				43,006	183,398	164,300	7,601,382	4,065,435	64,374	247,772	140,426	10,071,986	3,484,010
		325,676			325,676	21,006	TOTAL	347,698	TOTAL	11,666,817	23,874	TOTAL	388,198	TOTAL	13,555,996
								Revenue Water=		11,490,767				Revenue Water=	13,528,306

	2023 Improvement to properly Target year	2023 Improvement to properly Total	2023 Remain	2023 Consumption unit (㎥/M) Improvement	2023 Consumption unit (㎥/M) Exiting	2024 Improvement to properly Target year	2024 Improvement to properly Total	2024 Remain	2024 Consumption unit (㎥/M) Improvement	2024 Consumption unit (㎥/M) Exiting	2025 Improvement to properly Target year	2025 Improvement to properly Total	2025 Remain	2025 Consumption unit (㎥/M) Improvement	2025 Consumption unit (㎥/M) Exiting
Domestic	37,000	220,464		7,275,312		40,000	260,464		8,595,312		23,000	283,464		9,354,312	
	19,640	51,693		1,705,869		18,500	70,193		2,316,369		20,000	90,193		2,976,369	
			74,809		1,164,028			56,309		876,168			36,309		564,968
	2,000	6,000		198,000		1,633	7,633		251,889		0	7,633		251,889	
			1,633		25,409			0		0			0		0
Commercial	4,000	22,479		1,461,135		4,000	26,479		1,721,135		2,000	28,479		1,851,135	
	2,000	6,500		422,500		2,000	8,500		552,500		2,000	10,500		682,500	
			7,000		327,600			5,000		234,000			3,000		140,400
Department Domestic	0	949		868,335		0	949		868,335		0	949		868,335	
	0	0		0		0	0		0		0	0			
			504		461,160			504		461,160			504		461,160
Department Commercial	0	0	113	0	153,115	0	0	113	0	153,115	0	0	113		153,115
FE Domestic	0	0	123		125,214	0	0	123	0	125,214	0	0	123		125,214
FE Commercial	0	0	297		81,081	0	0	297	0	81,081	0	0	297		81,081
Flat	3,000	6,000		198,000		5,000	11,000		363,000		5,000	16,000		528,000	
			29,244		614,124			24,244		509,124			19,244		404,124
Department Flat	0	0	1	0	12,270	0	0	1	0	12,270	0	0	1	0	12,270
FE Flat	0	0	1	0	600	0	0	1	0	600	0	0	1		600
FOC	0	757		328,538		0	757		328,538		0	757		328,538	
			0		0			0		0			0		0
	15	25		10,850		20	45		19,530		20	65		28,210	
			40		17,360			20		8,680			0		0
Other	0	544		32,477		0	544		32,477		0	544		32,477	
			0		0			0		0			0		0
Water Tap					1,620					1,620					1,620
Public Facility	2	10		1,000		0	10		1,000		0	10		1,000	
			0		0			0		0			0		0
	4	12		1,200		0	12		1,200		0	12		1,200	
			0		0			0		0			0		0
	67,661	315,433	113,765	12,503,216	2,983,582	71,153	386,586	86,612	15,051,285	2,463,032	52,020	438,606	59,592	16,903,965	1,944,552
	26,661	TOTAL	429,198	TOTAL	15,486,797	27,153	TOTAL	473,198	TOTAL	17,514,317	27,020	TOTAL	498,198	TOTAL	18,848,517
				Revenue Water=	15,465,617				Revenue Water=	17,501,817				Revenue Water=	18,844,697

	2026					2027					2028				
	Improvement to properly		Remain	Consumption unit (㎥ / M)		Improvement to properly		Remain	Consumption unit (㎥ / M)		Improvement to properly		Remain	Consumption unit (㎥ / M)	
	Target year	Total		Improvement	Exiting	Target year	Total		Improvement	Exiting	Target year	Total		Improvement	Exiting
Domestic	23,000	306,464		10,113,312		23,000	329,464		10,872,312		23,000	352,464		11,631,312	
	20,000	110,193	16,309	3,636,369	253,768	16,309	126,502	0	4,174,566	0	0	126,502	0	4,174,566	0
	0	7,633	0	251,889	0	0	7,633	0	251,889	0	0	7,633	0	251,889	0
Commercial	2,000	30,479		1,981,135		2,000	32,479		2,111,135		2,000	34,479		2,241,135	
	2,000	12,500	1,000	812,500	46,800	1,000	13,500	0	877,500	0	0	13,500	0	877,500	0
Department	0	949		868,335		0	949		868,335		0	949		868,335	
Domestic	104	104	400	95,160	366,000	200	304	200	278,160	183,000	200	504	0	461,160	0
Department Commercial	0	0	113		153,115	0	0	113	0	153,115	0	0	113	0	153,115
FE Domestic	0	0	123		125,214	0	0	123	0	125,214	0	0	123	0	125,214
FE Commercial	0	0	297		81,081	0	0	297	0	81,081	0	0	297	0	81,081
Flat	10,000	26,000	9,244	858,000	194,124	9,244	35,244	0	1,163,052	0	0	35,244	0	1,163,052	0
Department Flat	0	0	1		12,270	0	0	1	0	12,270	0	0	1	0	12,270
FE Flat	0	0	1		600	0	0	1		600	0	0	1		600
FOC	0	757	0	328,538	0	0	757	0	328,538	0	0	757	0	328,538	0
	0	65	0	28,210	0	0	65	0	28,210	0	0	65	0	28,210	0
Other	0	544	0	32,477	0	0	544	0	32,477	0	0	544	0	32,477	0
Water Tap					1,620					1,620					1,620
Public	0	10	0	1,000	0	0	10	0	1,000	0	0	10	0	1,000	0
Facility	0	12	0	1,200	0	0	12	0	1,200	0	0	12	0	1,200	0
	57,104	495,710	27,488	19,008,125	1,234,592	51,753	547,463	735	20,988,374	556,900	25,200	572,663	535	22,060,374	373,900
	32,000	TOTAL	523,198	TOTAL	20,242,717	26,553	TOTAL	548,198	TOTAL	21,545,274	0	TOTAL	573,198	TOTAL	22,434,274
				Revenue Water=	20,238,897				Revenue Water=	21,541,454				Revenue Water=	22,430,454

	2029					2030				
	Improvement to properly		Remain	Consumption unit (㎥ / M)		Improvement to properly		Remain	Consumption unit (㎥ / M)	
	Target year	Total		Improvement	Exiting	Target year	Total		Improvement	Exiting
Domestic	23,000	375,464		12,390,312		23,000	398,464		13,149,312	
	0	126,502	0	4,174,566	0	0	126,502	0	4,174,566	0
	0	7,633	0	251,889	0	0	7,633	0	251,889	0
Commercial	2,000	36,479		2,371,135		2,000	38,479		2,501,135	
	0	13,500	0	877,500	0	0	13,500	0	877,500	0
Department	0	949		868,335		0	949		868,335	
Domestic	0	504	0	461,160	0	0	504	0	461,160	0
Department Commercial	0	0	113		153,115	0	0	113	0	153,115
FE Domestic	0	0	123		125,214	0	0	123	0	125,214
FE Commercial	0	0	297		81,081	0	0	297	0	81,081
Flat	0	35,244	0	1,163,052	0	0	35,244	0	1,163,052	0
Department Flat	0	0	1		12,270	0	0	1	0	12,270
FE Flat	0	0	1		600	0	0	1		600
FOC	0	757	0	328,538	0	0	757	0	328,538	0
	0	65	0	28,210	0	0	65	0	28,210	0
Other	0	544	0	32,477	0	0	544	0	32,477	0
Water Tap					1,620					1,620
Public	0	10	0	1,000	0	0	10	0	1,000	0
Facility	0	12	0	1,200	0	0	12	0	1,200	0
	25,000	597,663	535	22,949,374	373,900	25,000	622,663	535	23,838,374	373,900
	0	TOTAL	598,198	TOTAL	23,323,274	0	TOTAL	623,198	TOTAL	24,212,274
				Revenue Water=	22,858,294				Revenue Water=	23,747,294

Annex-5.D: Training Plan of Training Center for NRW Management

Training Plan of Training Center for NRW Management

NRW Management Section

2021

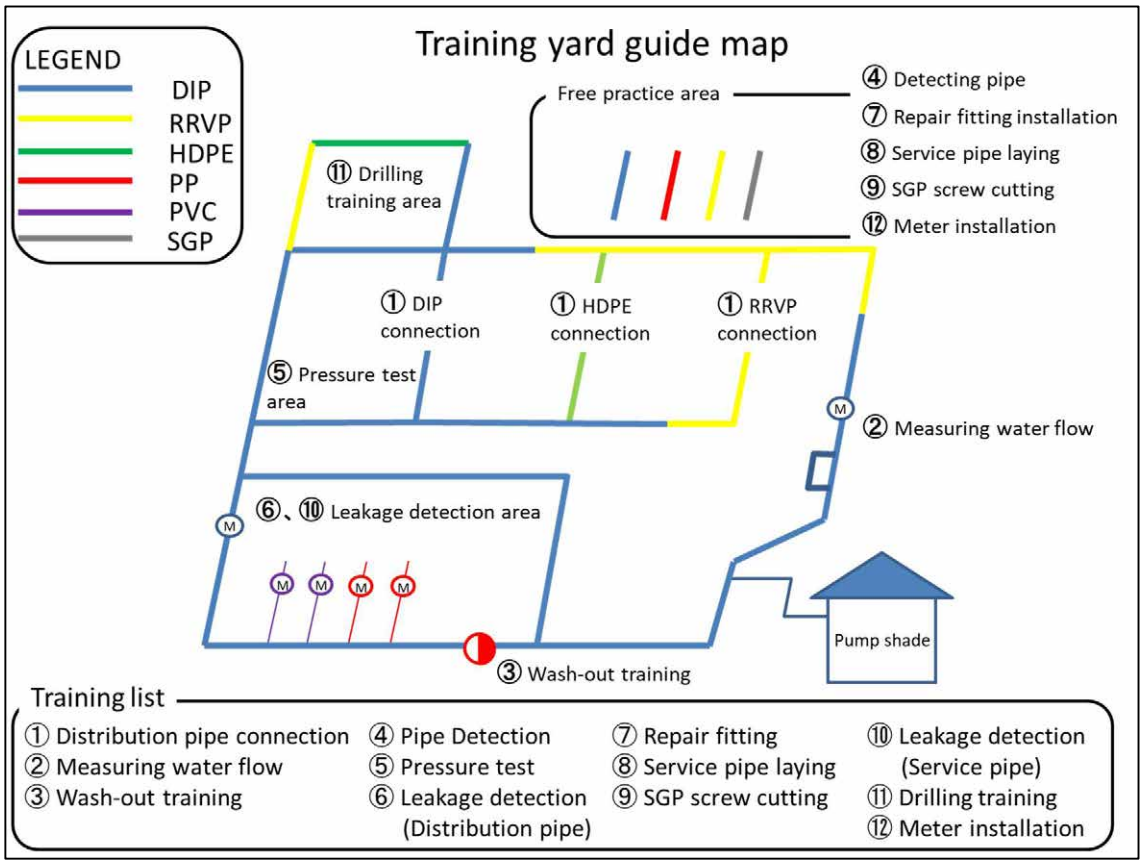
Table of Contents

1. Introduction

NRW Reduction Training Center was established in Jan 2019 with the aim to develop capacity related to NRW management. Engineers of WRAWSA could acquire basic skills and knowledge about NRW management through seminar or practical training in training center.
Trainees will be OJT trainer for the staffs and establish OJT system in their office.

2. Facilities in the NRW Reduction Training Center

The NRW Reduction Training Center consists of lecture house and training field and has facilities shown below. Trainee can learn not only reactive NRW reduction measures such as leak repair work but also prevention measures such as proper piping work or tapping under pressure in the Center.



3. Required Roles

Position	Roles
EE, AE, SAE	1. Plan NRW reduction activities and projects. 2. Monitor NRW rate and utilize it to make NRW reduction plan. 3. Manage the NRW reduction activities and projects. 4. Inspect and check documents of projects such as completion drawing. 5. To be a teacher or trainer of NRW training yard.
T/S Staff (any staffs relevant to NRW)	1. Carrying out NRW daily operation & maintenance properly. ✓ Leakage detection work ✓ Leakage repair work ✓ Flow measurement 2. Supervise constructions 3. Record and report every work properly such as daily report. 4. Implement OJT to new staffs or colleagues relating to NRW management as a trainer.
Engineers from private companies	1. Carrying out piping work or NRW reduction measures appropriately instead of WRAWSA 2. Well understanding of pipe jointing for every materials and joint those properly 3. Record and report construction work or leak detection/repair work in a fixed way.

4. Lecture/Training Program

Lecture

No.	Training Item
LS-1	Water supply plan
LS-2	Hydraulic analysis
LS-3	Distribution pipe laying
LS-4	Water pressure test
LS-5	Design and Completion drawing
LS-6	Flow rate measurement
LS-7	Night Step Test
LS-8	Leakage detection method
LS-9	Leakage repair method
LS-10	Water supply equipment
LS-11	Issues caused by water meter
LS-12	Management of Non-Revenue Water

Practical training in the field

No.	Training Item
WS-1	Service pipe branch
WS-2	Function check of water meter
WS-3	Pipe cutting and jointing
WS-4	
WS-5	
WS-6	Water pressure test
WS-7	Branching method
WS-8	Flow measurement
WS-9	Night Step Test
WS-10	Leakage detection method

5. List of Training Material

List SOPs and training text are shown in table below.

No.	Name of Standard Operating Procedures
SOP-01	Plane Table Survey
SOP-02	Pavement Cutting Line Marking
SOP-03	How to check digging depth and so on
SOP-04	Construction Signboard
SOP-05	Pipe laying
SOP-06	Pressure Test
SOP-07	Drilling for service connection
SOP-08	Back Fill
SOP-09	Material management
SOP-10	Equipment management
SOP-11	Pipe Line Drawing
SOP-12	Pressure Measurement
SOP-13	Flow Measurement
SOP-14	Leakage Volume Measurement
SOP-15	Leak Detection
SOP-16	Leak Correlator
SOP-17	Minimum Night Flow Measurement
SOP-18	Night Step Test
SOP-19	Customer Survey
SOP-20	DMA Monitoring
SOP-21	Meter Function Check
SOP-22	Survey of Damage Meters
SOP-23	Leakage Record
SOP-24	Daily Report
SOP-25	Tasks of NRW Section
SOP-26	Valve Box installation

No.	Training Item
LS-01	Water Supply Plan
LS-02	Hydraulic Analysis
LS-03	Distribution Pipe Laying
LS-04	Water Pressure Test
LS-05	Design and Completion Drawing
LS-06	Flow Rate Measurement
LS-07	Night Step Test
LS-08	Leakage Detection Method
LS-09	Leakage Repair Method
LS-10	Water Supply Equipment
LS-11	Issues Caused by Water Meter
LS-12	Management of Non-Revenue Water
WS-01	Tapping Under Pressure (For Distribution pipe)
WS-02	Branching Method for DIP
WS-03	Branching Method for VP
WS-04	Branching Method for HDPE

6. Training Course and curriculum

1) Five courses are provided for EE, AE and SAE level

2) Four courses are provided for T/S staff (any staffs relevant to NRW)

3) Two courses are provided for engineers from private companies

* Trainees from private companies must have an experience in water distribution pipe installation work.

** This is charged training course and aiming to get a license for plumbing.

Participant & Course			Carriculum by training course (e.g.)																				
			LS-1	LS-2	LS-3	LS-4	LS-5	LS-6	LS-7	LS-8	LS-9	LS-10	WS-1	WS-2	WS-3	WS-4	WS-5	WS-6	WS-7	WS-8	WS-9	WS-10	TOTAL
Group A	EE, AE, SAE	- Ⅰ	◎	◎																			
			2.0h	4.0h																			6.0h
		- Ⅱ			◎	◎	◎						◎					◎	◎				
					1.0h	1.0h	3.0h						2.0h					2.0h	2.0h				11.0h
		- Ⅲ						◎	◎											◎	◎		
								1.0h	3.0h											2.0h	3.0h		9.0h
		- Ⅳ								◎	◎	◎		○								◎	
										1.0h	1.0h	1.0h		1.0h								2.0h	7.0h
		- Ⅴ													○	○	○						
															4.0h	2.0h	2.0h						8.0h
Group B	T/S staff	- Ⅰ		○								◎		◎									
				4.0h								1.0h		1.0h									6.0h
		- Ⅱ			◎	◎	◎						◎		◎	◎	◎	◎	◎				
					1.0h	1.0h	3.0h						2.0h		4.0h	2.0h	2.0h	2.0h	2.0h				19.0h
		- Ⅲ						○	○											○	◎		
								1.0h	3.0h											2.0h	3.0h		9.0h
		- Ⅳ								◎	◎											◎	
										1.0h	1.0h											2.0h	4.0h
Group C	Private Engineer	- Ⅰ			◎	◎	◎						◎		◎	◎	◎	◎					
					1.0h	1.0h	3.0h						2.0h		4.0h	2.0h	2.0h	2.0h					17.0h
		- Ⅱ								○	○	◎										◎	
										1.0h	1.0h	1.0h										2.0h	5.0h

7. Contents of Lecture/Training

LS-01

Subject	Lecture: Water supply plan
Outline	Water supply plan is required to distribute water with enough pressure and volume to customers. Those who have responsible for planning will acquire necessary knowledge through this lecture.
Training Material	SOP-12 Pressure Measurement SOP-13 Flow Measurement SOP-19 Customer Survey Sop-20 DMA Monitoring LS-01 Water supply plan
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand what the water distribution plan is. ➢ How to calculate required water volume by business categories. ➢ How to make distribution plan.
Goals	➢ Become able to collect and compile water supply volume by business categories. ➢ Become able to make water distribution plan.

LS-02

Subject	Lecture: Hydraulic Analysis
Outline	Appropriate pipe diameter shall be selected to distribute water to customers with certain pressure. This lecture will show the basic knowledge of hydraulic analysis such as Hazen-Williams formula.
Training Material	SOP-12 Pressure Measurement SOP-13 Flow Measurement LS-02 Hydraulic Analysis
Contents	To understand what the water distribution plan is. How to make distribution plan.
Goals	➢ To become able to check distribution plan ➢ Understand the mechanism of head loss ➢ Understand how to use Hazen-Williams formula

LS-03

Subject	Lecture: Distribution Pipe Laying
Outline	Proper pipe jointing prevents leakage water. This lecture shows proper pipe jointing on 3 types of pipe ; D.I.P, RRPVC, HDPE.
Training Material	SOP-1 Plane Table Survey SOP-2 Pavement Cutting Line Marking SOP-3 How to check digging depth and so on SOP-4 Construction Signboard SOP-5 Pipe laying SOP-6 Pressure Test SOP-7 Drilling for service connection SOP-8 Back Fill SOP-9 Material management SOP-10 Equipment management SOP-11 Pipe Line Drawing LS-03 Distribution pipe laying
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand what the tools you need. ➢ Jointing rules for each type of pipe. ➢ Precautions when using materials.
Goals	➢ Become able to understand the necessary rules for jointing water distribution pipes. ➢ Become able to understand technology required for jointing water distribution pipes.

LS-04

Subject	Lecture: Water pressure test
Outline	Through this lecture, you will learn the importance of checking for water leaks before passing water to the newly constructed water distribution pipe.
Training Material	SOP-12 Pressure Measurement LS-04 Water Pressure Test
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand what the equipment required for water pressure test. ➢ To understand what the water pressure and pressurization time by pipe diameter and pipe length. ➢ How to check the water pressure gauge when a water leaks.
Goals	Become able to prevention of water leakage from new water distribution pipes.

LS-05

Subject	Lecture: Design and Completion Drawing
Outline	Understand the rules and procedures for creating design drawings, which are the basis for determining pipe materials and routes, and the purpose of creating completion drawings.
Training Material	SOP-11 Pipe Line Drawing LS-05 Design and Completion Drawing
Duration	3.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand what the design and completion drawing structure. ➢ To understand what the symbols displayed in the drawing. ➢ To understand what the importance of creating design drawing based on accurate topographic maps.
Goals	➢ Become able to create correct design drawings and competed drawings ➢ It will be possible to create a completed drawing that matches the topographic map pf the city and is useful for maintenance at a later date.

LS-06

Subject	Lecture: Flow rate measurement
Outline	Trainees will learn how to measure the flow rate in exiting water distribution pipes required for hydraulic analysis using an ultrasonic flow meter through this lecture.
Training Material	SOP-13 Flow Measurement LS-06 Flow Rate Measurement
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand settings when measuring ultrasonic flowmeter. ➢ How to attach the ultrasonic flowmeter to the measurement point. ➢ Analysis method of flow rate value after measurement.
Goals	➢ Become able to handle ultrasonic flowmeters. ➢ It will be possible to measure the flow rate in the exiting water distribution pipe.

LS-07

Subject	Lecture: Night step test
Outline	Understanding of exploration methods for each pipeline to identify leaks that occur in the pipelines in the DMA.
Training Material	SOP-14 Leakage Volume Measurement SOP-15 Leak Detection SOP-16 Leak Correlator SOP-17 Minimum Night Flow Measurement SOP-18 Night Step Test SOP-20 DMA Monitoring LS-07 Night Step Test
Duration	3.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Method of dividing pipelines according to valve installation position. ➢ Installation of a flow meter near the inlet of the DMA and prediction on the leak pipeline due to changes in the floe rate during measurement.
Goals	➢ Trainees can learn how to search for leaks by step test based on the completed drawing.

LS-08

Subject	Lecture: Leakage detection method
Outline	Introducing the procedure of leak exploration method using various leak exploration equipment.
Training Material	SOP-19 Customer Survey SOP-20 DMA Monitoring SOP-21 Meter Function Check SOP-22 Survey of Damage Meters SOP-23 Leakage Record SOP-24 Daily Report LS-08 Leakage Detection Method
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand the causes of water leaks. ➢ To understand the types of leak exploration and the principles of exploration. ➢ To understand the records of water leaks (location, cause, repair method).
Goals	➢ It will be possible to search for leaks using leak exploration. ➢ Become able to record the occurrence of water leaks and examine the causes of water leaks.

LS-09

Subject	Lecture: Leakage repair method
Outline	Understanding the selection of repair materials based on the correct understanding of the cause of water leakage, precautions for repair work, and items to be confirmed after repair .
Training Material	SOP-9 Material management SOP-15 Leak Detection SOP-16 Leak Correlator LS-09 Leakage Repair Method
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand of work procedures to prevent accidents such as muddy water that may occur during in repair work. ➢ Understanding of repair materials and usage.
Goals	➢ Become able to understand the precautions and procedures before, during, and after the work in the repair work when a water leak occurs.

LS-10

Subject	Lecture: Water supply equipment
Outline	Explains the understanding of the water supply equipment installed by the water supply user, the water supply method, and the calculation method of the water supply pipe diameter.
Training Material	SOP-10 Equipment management LS-10 Water Supply Equipment
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding of water supply equipment construction design standards set by EDWS. ➢ Understanding of friction loss in pipes that must be considered when calculating water supply pipe diameter. ➢ Understanding of meter installation in apposition where meter reading is easy. ➢ Understanding of water supply method to secure the required water supply pressure depending on the scale and floor height of the building.
Goals	➢ Deepen understanding of the concept of water supply equipment, water supply method and calculation method of water supply pipe diameter.

LS-11 running water events

Subject	Lecture: Issue caused by the meter
Outline	Learn the importance of installing a water meter and the appropriateness of the measuring function, which is a means of confirming the amount of water used, which is the basis for collecting water charges, which is the source of funds for funds for running water business.
Training Material	SOP-19 Customer Survey SOP-21 Meter Function Check SOP-22 Survey of Damage Meters LS-11 Issues Caused by Water Meter
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding the quality of customer-installed water meters, which is a major contributor to commercial loss. ➢ Understanding the number of years of use considering the aging deterioration of mechanical meters. ➢ Understanding the importance of proper water volume reading by meter reader.
Goals	➢ Understand the importance of installing a meter with normal function in the proper position and reading the correct amount of water with the correct meter reading.

LS-12

Subject	Lecture: Management of NRW
Outline	Lectures on NRW knowledge, factors that cause NRW, and basic methods to prevent NRW.
Training Material	SOP ALL LS-12 Management of Non-Revenue Water
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ To understand what the NRW is. ➢ Understanding why NRW occurs. ➢ Understanding of activities and rule formulation necessary to elimination NRW.
Goals	➢ Become able to understand the knowledge and work required to prevent the occurrence of NRW.

8. Contents of Practical Training in the Training Yard

WS-01

Subject	Training: Service pipe branch
Outline	Guidance is given using the equipment of the training yard on the construction technology of the service pipe, which is located on the most upstream side of the customer water supply equipment and is directly connected to the water distribution pipe.
Training Material	SOP-7 Drilling for service connection SOP-19 Customer Survey SOP-21 Meter Function Check SOP-22 Survey of Damage Meters
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding the pipe types used for service pipes. ➢ Understanding of joining technology between saddle clamps and service pipes used for branching from water distribution pipes.
Goals	➢ Become able to join service pipes.

WS-02

Subject	Training: Function check of water meter
Outline	Provide technical guidance on how to check the appropriateness of the function of the customer meter using an electronic test meter that is regularly calibrated.
Training Material	SOP-09 Material management SOP-21 Meter Function Check SOP-22 Survey of Damage Meters
Duration	1.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding how to measure flow rate using an electronic test meter. ➢ Understanding the confirmation of each flow measurement value of the electronic test meter and the customer meter. ➢ Understanding how to judge the appropriateness of the customer meter function based on the measured flow rate value.
Goals	➢ Become able to perform functional tests of customer meters using electronic test meters.

WS-03

Subject	Training: Pipe joining
Outline	Understanding of joining methods for each type of pipe and implementation of technical guidance on the operation of tools and equipment required for joining.
Training Material	SOP-05 Pipe laying
Duration	4.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding of joining methods by pipe type (D.I.P, RRPVC, HDPE). ➢ Understanding of tools and equipment required for joining pipe types. ➢ Understanding of confirmation of insertion depth after piping.
Goals	➢ Become able to acquire appropriate pipe joining technology for each pipe type.

WS-04

Subject	Training: Joining pipes with repair fittings.
Outline	Introduction of repair materials required for water leak repair work and guidance on installation technology.
Training Material	SOP-05 Pipe laying SOP-09 Material management SOP-15 Leak Detection SOP-20 DMA Monitoring
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding of leak repair materials. ➢ Understanding how to install leak repair materials.
Goals	➢ Become able to perform leak repair work using leak repair materials.

WS-05

Subject	Training: Joining pipes with flanges.
Outline	Guidance on tools required for joining and joining technology regarding the joining method of flanges, which are the materials for joining valves and air valves to pipes..
Training Material	SOP-05 Pipe laying SOP-09 Material management SOP-10 Equipment management SOP-26 Valve Box installation
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding flange types. ➢ Understanding of parts required for flange joining. ➢ Understanding of tightening torque with tools and bolts required for flange joining.
Goals	➢ Become able to learn the construction techniques required for flange joining.

WS-06

Subject	Training: Water pressure test.
Outline	Provide technical guidance on how to pressurize the water in the distribution pipe using a water pressure test pump and check for water leakage in the target pipe.
Training Material	SOP-06 Pressure Test SOP-12 Pressure Measurement
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding how to operate a pump for water pressure testing. ➢ Understanding the installation position of the test pump, the procedure for pressurizing the water distribution pipe, and the method for exhausting the air accumulated in the pipe.
Goals	➢ Become able to learn techniques related to water pressure testing that are effective as a means to check for water leaks immediately after laying water distribution pipes.

WS-07

Subject	Training: Branching method.
Outline	Teaching techniques for branching service pipes from water distribution pipes using saddle clamps and drilling machines prepared for each pipe type.
Training Material	SOP-07 Drilling for service connection SOP-21 Meter Function Check
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding the types of saddle clamps and how to install them. ➢ Understand how to operate a drilling machine. ➢ Understand how to connect the saddle clamp and water service pipe.
Goals	➢ Become able to possible to branch the water service pipe using a saddle clamp and a drilling machine.

WS-08

Subject	Training: Flow measurement.
Outline	An ultrasonic flow meter is installed on the pipeline installed in the training yard to teach the technique of measuring the flow rate in the pipelines.
Training Material	SOP-10 Equipment management SOP-13 Flow Measurement
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understand the mechanism of flow measurement using an ultrasonic flow meter. ➢ Understand how to install and operate an ultrasonic flow meter. ➢ Understand how to import the measured flow rate value into a PC as data.
Goals	➢ Become able to possible to measure the flow rate of water distribution pipes using an ultrasonic flow meter.

WS-09

Subject	Training: Night step test
Outline	Train step test procedures, which is one of the means to identify leak points, using equipment such as pipelines and valves installed in the training yard.
Training Material	SOP-17 Minimum Night Flow Measurement SOP-18 Night Step Test SOP-20 DMA Monitoring SOP-23 Leakage Record
Duration	3.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Understanding the location of valves on the pipeline. ➢ Understanding valve operating and closing operations. ➢ Understanding how to check the leaking section pipeline by monitoring the flow meter installed on the inlet side of the pipeline.
Goals	➢ Become able to learn the procedure of step test to confirm the pipeline where water leakage occurring from the pipelines laid over a wide area.

WS-010

Subject	Training: Leakage detection method.
Outline	Learn how to explore leaks using leak prove equipment in the training yard.
Training Material	SOP-14 Leakage Volume Measurement SOP-15 Leak Detection SOP-16 Leak Correlator SOP-23 Leakage Record
Duration	2.0 hours
Participants	Trainer: 2 persons Trainee: 18 persons
Contents	➢ Learn the technique of hoe to handle a acoustic bar that audibly captures the sound of water leakage. ➢ Learn how to operate a leak detector. ➢ Learn how to operate a correlated leak detector.
Goals	➢ Become able to leakage exploration using leak detector.

Annex-6 Water Quality Management

Annex-6.A: SOP for Water Quality Monitoring

Annex-6.B: SOP for Water Treatment Plants and Chlorination Facilities

Annex-6.C: Water Quality Management Plan (Provisional)

Annex-6.A: SOP for Water Quality Monitoring

Water quality monitoring SOPs

SOPs for Central laboratory and Mini laboratory (English version)

List of SOPs

Central laboratory

Title	SOP code
Admin SOPs	
Water Quality Monitoring	EDWS-LAB-OP1
Daily Duty	EDWS-LAB-OP1-W1
Weekly Duty	EDWS-LAB-OP1-W2
Monthly Duty	EDWS-LAB-OP1-W3
Sampling & Storage	EDWS-LAB-OP1-W4
Instruction for Laboratory (Dos & Don't)	EDWS-LAB-OP1-W5
Chemical Handling	EDWS-LAB-OP1-W6
Meter Operation	EDWS-LAB-OP1-W7
Safety	EDWS-LAB-OP1-W8
Analysis SOPs	
EC (Electrical Conductivity)	EDWS-CL-AP-W-2
TDS	EDWS-CL-AP-W-3
Salinity	EDWS-CL-AP-W-4
Color	EDWS-CL-AP-W-5
Turbidity (HANNA)	EDWS-CL-AP-W-6
Portable Turbidity (HANNA)	EDWS-CL-AP-W-6
Suspended Solid	EDWS-CL-AP-W-7
Jar Test	EDWS-CL-AP-W-8
Total Hardness	EDWS-CL-AP-W-9
Calcium	EDWS-CL-AP-W-10
Total Alkalinity	EDWS-CL-AP-W-11
Chloride	EDWS-CL-AP-W-12
Manganese	EDWS-CL-AP-W-13
Iron (Fe)	EDWS-CL-AP-W-14
Nitrate-Nitrogen (NO3-N)	EDWS-CL-AP-W-15
Nitrate-Nitrogen (NO2-N)	EDWS-CL-AP-W-16
Ammonia (NH3-N)	EDWS-CL-AP-W-17
Sulphate (SO42-)	EDWS-CL-AP-W-18
Phosphorous (PO43-)	EDWS-CL-AP-W19
Lead (Pb)	EDWS-CL-AP-W20
Zinc	EDWS-CL-AP-W21
Arsenic (Portable Test)	EDWS-CL-AP-W22
Phosphorous (Total LR)	EDWS-CL-AP-W23
Phosphorous (Total HR)	EDWS-CL-AP-W24
Nitrogen, Total LR (0.5 to 25 mg/L)	EDWS-CL-AP-W25
Nitrogen, Total LR (1 to 16 mg/L)	EDWS-CL-AP-W26
Nitrogen, Total LR (2 to 150 mg/L)	EDWS-CL-AP-W27
Residual Chlorine	EDWS-CL-AP-W28
Quanty Tray	EDWS-CL-AP-W29
Total Coliform & Fecal Coliform	EDWS-CL-AP-W30
Equipment SOPs	
pH Calibration for Mettler Toledo Brand	EDWS-SuD-EP-WI-1
EC Calibration for Mettler Toledo Brand	EDWS-SuD-EP-WI-2
Balance	EDWS-SuD-EP-WI-3
Oven	EDWS-SuD-EP-WI-4
Desiccator	EDWS-SuD-EP-WI-5
Measurement of Turbidity (HANNA)	EDWS-SuD-EP-WI-6
DO Meter	EDWS-SuD-EP-WI-7
U-50 Meter	EDWS-SuD-EP-WI-8
Jar Test (Laboratory Flocculator)	EDWS-SuD-EP-WI-9
DR-6000 (UV Spectrophotometer)	EDWS-SuD-EP-WI-10
Fume Hood	EDWS-SuD-EP-WI-11
DRB 200 Reactor (Digester)	EDWS-SuD-EP-WI-12
Burette	EDWS-SuD-EP-WI-13
Quanty-Tray Sealer Plus	EDWS-SuD-EP-WI-14
UV-Viewing Cabinet	EDWS-SuD-EP-WI-15
Incubator	EDWS-SuD-EP-WI-16
Auto Clave	EDWS-SuD-EP-WI-17

Mini laboratory

Title	SOP code
Mini Lab's SOP	EDWS-LAB-OP2
pH measurement instruction	EDWS-LAB-OP1-W1
EC measurement instruction	EDWS-LAB-OP1-W2
Salinity measurement instruction	EDWS-LAB-OP1-W3
Total Dissolved Solid measurement instruction	EDWS-LAB-OP1-W4
Jar Test measurement instruction	EDWS-LAB-OP1-W5
pH measurement instruction for mini lab	EDWS-LAB-OP2-W1
Turbidity measurement instruction for mini lab	EDWS-LAB-OP2-W2
Color measurement instruction for mini lab	EDWS-LAB-OP2-W3
Chlorine measurement instruction for mini lab	EDWS-LAB-OP2-W4
Daily activities instructions in the lab.	EDWS-LAB-OP2-W5
Instruction for taking water sample	EDWS-LAB-OP2-W6
Computer form	EDWS-LAB-OP2-F1

Central laboratory SOPs

1. **Water Quality Monitoring in Central Laboratory**

2. **Objective & Scope**

   (1) It's intended to get exact water quality data which can be used for clear water supply and to monitor the changing of water quality in the water resources.

   (2) It's intended to understand the staff in central laboratory & mini laboratories on the water quality monitoring procedures.

3. **Abbreviation & Definition**

   PI = Performance Indicator EC

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1.	Daily laboratory responsibilities	Staff in the laboratory	Central Laboratory
2.	Weekly laboratory responsibilities		
3.	Monthly laboratory responsibilities		
4.	Taking & keeping water samples.		
5.	Facts to follow in the laboratory.		
6.	Measurement activities/ tasks Reporting		
7.			

5. **Procedure**

   5.1 For daily activities in the laboratory, it's to follow **EDWS-LAB-OP1-W1.**

   5.2 Duties to do every week in the laboratory

For weekly activities in the laboratory, it's to follow **EDWS-LAB-OP1-W2.**

5.3 Duties to do every month in the laboratory

For monthly activities in the laboratory, it's to follow **EDWS-LAB-OP1-W3.**

5.4 Taking & Keeping the water samples

For taking & keeping the water samples, it's to follow **EDWS-LAB-OP1-W4.**

5.5 Facts to follow in the laboratory

(1) The instructions to follow in the laboratory, it's to follow as to the **EDWS-LAB-OP1-W5.**

(2) The facts to follow while using chemical materials, it's to follow as to EDWS-LAB-OP1-W6.

(3) While using equipment/ devices, it's to follow as to **EDWS-LAB-OP1-W7.**

(4) For safety work instructions, it's to follow as to **EDWS-LAB-OP1-W8.**

5.3 Measurement Activities

(1) For the measurement of pH meter, it's to follow **EDWS-LAB-OP2-W1** and in Nyaunghnahpin WTP mini laboratory, it's to follow **EDWS-LAB-OP1-W1.**

(2) For the measurement of Turbidity Meter, it's to follow **EDWS-LAB-OP2-W2.**

(3) For the measurement of Color Meter, it's to follow **EDWS-LAB-OP2-W3.**

(4) For the measurement of Chlorine Meter, it's to follow **EDWS-LAB-OP2-W4.**

(5) For the measurement of EC Meters, it's to follow as to **EDWS-LAB-OP1-W2** (Nyaunghnapin WTP Mini laboratory).

(6) For the measurement of Salinity, it's to follow as to **EDWS-LAB-OP1-W3** (Nyaunghnapin WTP mini laboratory).

(7) For the measurement of Total Dissolved Solid, it's to follow **EDWS-LAB-OP1-W4**.

(8) For the measurement of Jar Test, it's to follow as to **EDWS-LAB-OP1-W5** (Nyaunghnapin WTP mini laboratory).

5.6 Reporting

(1) The water quality monitoring results are to check every week & input it in computer.

(2) To check the soft copy & hard copy data from the mini laboratories and input the data in computer.

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		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

(3) To print out the sample water results from reservoirs every month and complained sample water results.

(4) If the results are in abnormal or the equipment malfunction, then inform it to top management level step by step in time.

6. Related documents

(1)	**EDWS-LAB-OP1-W1**	Daily laboratory responsibilities
(2)	**EDWS-LAB-OP1-W2**	Weekly laboratory responsibilities
(3)	**EDWS-LAB-OP1-W3**	Monthly laboratory responsibilities
(4)	**EDWS-LAB-OP1-W4**	Instruction for taking & keeping water samples
(5)	**EDWS-LAB-OP1-W5**	Instructions to follow in the laboratory
(6)	**EDWS-LAB-OP1-W6**	Instructions to follow for using chemical
(7)	**EDWS-LAB-OP1-W7**	Instructions to follow for handling equipment/ devices.
(8)	**EDWS-LAB-OP1-W8**	Safety Instructions

7. Related forms

1. Chemical Analysis record book
2. Bacteriological Analysis record book
3. Suspended Solid record book
4. Chemical Analysis record book
5. Bacteriological Analysis computer record
6. Monthly Results computer record
7. Minilab Results computer record

8. References

Standard Methods (For the Examination of Water and Wastewater-22nd Edition)

9. Appendix

- Nil

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု		
		SOP ကုဒ်အမှတ်	EDWS-LAB-OP1-W1
		ဗားရှင်းအမှတ်	
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		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

1. Instructions for daily responsibilities in the laboratory

2. Objective & Scope

(1) To follow the staff in the laboratory.

(2) It's only for the daily activities to do in the laboratory.

3. Abbreviation & Definition

- Nil

4. Duties, Responsibilities & Accountabilities

No.	Tasks	Person	Responsibility
1.	Daily activities/duties to do in the laboratory	Staff in the laboratory	Central Laboratory

5. Procedure

(1) Turn on the light and open the door to release the odor as soon as arrive to the laboratory.

(2) After cleaning the room, turn on the air-con and set the temperature at 25˚C.

(3) It's to measure the water samples based on the prioritize parameters and the parameters to measure at once are pH, EC, Turbidity, Salinity, Color, Ammonia-Nitrogen, Nitrate-Nitrogen, & Nitrite-Nitrogen.

(4) When measuring the parameters, the staffs are to wear Lab coat, tide the hair, keep the nails short, and wear the face mask & gloves. Threw the used masks & gloves into the dustbin systematically and wear the laboratory goggles when measuring Titration.

(5) Keep clean the glassware and select/choose the necessary glassware based on the measured parameters.

(6) When in measuring Turbidity, it's to calibrate the device and when in measuring Color, it's to measure both Raw & Filtration. It's not to open the lid

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		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

of Calibration Liquid of Color & Turbidity. It is to keep the calibration liquid systematically after using necessary amount.

6. Related documents

- Nil

7. Related forms

- Nil

8. References

- Central Laboratory

9. Appendix

- Nil

EDWS-LAB-OP1-W1 Daily Duty.docxအင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) 2021 ဧပြီ 20

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု …… ……	**SOP ကုဒ်အမှတ်**	EDWS-LAB-OP1-W2
		ဗားရှင်းအမှတ်	
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		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

1. **Instructions for weekly duties/responsibilities to do in the laboratory**

2. **Objective & Scope**
   (1) To follow the staff in the laboratory.

   (2) It's only for the weekly duties/ responsibilities to do in the laboratory.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1.	Weekly Duties/ responsibilities to do in the laboratory	Staff in the laboratory	Central Laboratory

5. **Procedure**
   (1) Checking the water quality monitoring results from mini laboratories & inputting the data in the computer (If the results are different, then ask the mini staff to give ledger book and check it again).
   (2) Checking the weekly water quality monitoring results in details and submits it to top management level.
   (3) For Titration, making the Chemical solution based on Standard Method (22nd Edition).
   (4) Cover the bacteria bottles with Aluminum Foil and disinfect in Auto clave and inform to the respective townships to monitor.
   (5) After measuring Bacteria, used trays are to disinfect in Auto Clave.
   (6) Clean the Auto clave & after cleaning, disinfect with distilled water.
   (7) Operate/run Distilled Water machine every week.
   (8) Measure Suspended Solid & after that clean the sample bottles & dishes.
   (9) If Silica in Desiccator changes the color, dry it on Oven.

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ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု

SOP ကုဒ်အမှတ်	EDWS-LAB-OP1-W2	
Version အမှတ်		
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စာမျက်နှာအမှတ်		

   (10) Throw away the used bottle systematically every week.
   (11) To calibrate pH meter & EC Meter every week.
   (12) Input PI data after measuring the samples every week.

6. **Related documents**
   - Nil

7. **Related forms**
   - Nil

8. **References**
   - Central Laboratory

9. **Appendix**
   - Nil

1. Instructions for Laboratory Monthly Duties

2. Objective & Scope

(1) To follow the staff in the laboratory.

(2) It's only for the monthly activities/duties to do in the laboratory.

3. Abbreviation & Definition

- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1.	Monthly activities/ duties to do in the laboratory	Staff in the laboratory	Central laboratory

5. Procedure

(1) Manage the weekly monitored data and prepare monthly report & submit it to the top management level & get instruction from them.

(2) Prepare monthly report using PI data and submit it to respective PI Section.

(3) Drawing Trend line using the data from central laboratory & mini laboratories.

(4) Checking & supervising every six months to mini laboratories whether there are any difficulties or necessary in the mini laboratories.

6. Related documents

- Nil

7. Related forms

- Nil

8. References

- Central laboratory

9. Appendix

- Nil

EDWS-LAB-OP1-W3 Monthly Duty.docx အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) 2021 ဧပြီ

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1. **Instructions for taking & keeping water samples**

2. **Objective & Scope**
   (1) To follow the staff in the laboratory.
   (2) It's duties to follow when taking & keeping water samples.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1.	Obligations to follow when taking & keeping samples	Staff in the laboratory	Central Laboratory

5. **Procedure**

5.1 Facts to follow when taking the samples On-site

(1) Keep clean the devices which are to use taking sample (e.g. Bucket, sampler, bottles)
(2) Before going On-Site Monitoring, calibrate the devices/equipment. (e.g. U50, pH meter, On-Site Turbidity meter, Thermometer)
(3) Take the Monitoring Data Sheet, bucket, water bottles, and robes to use in bucket, distilled water, mask, permanent pen, thermometer, gloves, electrical tape, packing tape & sticker.
(4) Clean the sample bottles and take the samples as to sampling point numbers.
(5) Based on the measured parameters, take/ select Sample Containers.
(6) Not to change water temperature, not to involve the outside air and not to get direct sunlight (e.g. Cover the sample bottle lid with tape firmly and carry with ice bucket)

(7) When inputting the On-site monitoring data and result correction is needed on the sheet, then it is not to use Correction pen, Correction tape but use only ballpoint pen and make a single line on the words.
(8) When measuring/monitoring On-site, it's to input the measurement time & sample taking times.
(9) When taking sample from well, lake, reservoir, river & stream, first clean the empty sample bottles & devices with that water.
(10) When the sample containers are chemical preservative, then don't wash the containers with water in advance.
(11) When taking sample from lake, reservoir, river & stream, take the water from at least 3 meters depth.

5.2 Taking Sample for Physical & Chemical analysis

(1) Before taking the sample, turn the water tap on.
(2) Then, filled the sample water (raw water) in the cleaned bottle fully.
(3) Tape the lid of the sample bottle and write the address and sample taking time on the lid.
(4) Take care not to get direct sunlight.

5.3 Taking Sample for Bacteriological Analysis

(1) Spay the cotton bud with Ethanol 70%. Clean in & out of pipe head which is used to take sample.
(2) After that, head the pipe head using lighter.
(3) After heating, open/run the water through the pipe for 2 minutes.
(4) After that, take the disinfected bottle & fill the water.
(5) While taking sample, don't touch the lid/top of the disinfected bottle. Don't fill the water fully.
(6) Put the tape on the lid of the bottle and write down address & sample taking time and put it in ice bucket.

5.4 Taking & keeping the water samples in the laboratory

(1) To accept & record the water sample sent from townships.
(2) The sample taker must be signed on the records.
(3) The received Sample must be checked by comparing with ID List and add ID number on the sample bottle.
(4) If the sample is from new well, then add new ID Number on the lists & ask the permission letter to analysis the water.
(5) The sample bottle will be sealed with tape & store it in fridge. If there isn't fridge, keep it in cold & dark place.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	**SOP ကုဒ်အမှတ်**	EDWS-LAB-OP1-W4
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

6. Related documents
- Nil

7. Related forms
- **Nil**

8. Reference
(Central Laboratory)

9. Appendix
- Nil

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု …… ……	**SOP ကုဒ်အမှတ်**	EDWS-LAB-OP1-W5
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

1. Topic
Instructions for Laboratory

2. Objective & Scope

(1) To follow the staff in the laboratory.

(2) It is the duties/ instructions to follow in the laboratory.

3. Abbreviation & Definition
- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1.	Duties to follow in the laboratory	Staff in laboratory	Central laboratory

5. Procedure
(1) Eating food in the laboratory is not allowed.
(2) Glassware in the laboratory is not to use for food.
(3) Wearing outside shoes are not allowed in the laboratory.
(4) Measure NH_3, Mn, Fe, Zn, TP, TN & Arsenic in Fume Hood.
(5) Not to use the reagent that color is changed.
(6) Clean Burette with distilled water and clean it again using related chemical solution.
(7) Put the chemical accurately & be careful/mine not to trap the air in the burette.
(8) When making Titration, it's to use only up to end point of Burette.
(9) When doing dilution, it's to add distilled water carefully and calculate the ratio of amount to use.
(10) Clean/wash the used Burette at the basin and wash it again with distilled water. Cover the top with Aluminum Foil.
(11) Before taking sample, shake the sample bottle well and wash the cup with sample water. When measuring water using measuring cylinder, don't put the extra sample back into the bottle.
(12) After using Pipette, wash it with tap water & also distilled water.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	**SOP ကုဒ်အမှတ်**	EDWS-LAB-OP1-W5
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

(13) Before making titration, read the Titration Flow Chart first.

(14) Add the exact amount of measured parameter chemical into the sample water for titration.

6. Related documents

- Nil

7. Related forms

-Nil

8. Reference

- (Central Laboratory)

9. Appendix

-Nil

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု …… ……	**SOP ကုဒ်အမှတ်**	EDWS-LAB-OP1-W6
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

1. Topic

Instruction for using/handling chemicals

2. Objective & Scope

(1) To follow the staff in the laboratory.

(2) It is the instructions to follow when using chemicals in the laboratory.

3. Abbreviation & Definition

- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	Responsibilities/duties to follow when handling chemicals	Staff in the laboratory	Central laboratory

5. Procedure

(1) To keep Acid & Base separately. (AgNO3 & HCL must be kept in separately)

(2) It is to cover AgNo3 bottle with Aluminium Foil not to get direct sunlight.

(3) It is to check the condition of Chemical Solution whether it's changed the color or not.
(If Phenolphthalein Solution turns to pink color, don't use it anymore)

(4) It is to study in advance the danger of Chemicals before handling/using it.

(5) Don't touch the chemicals (liquid & powder) with bared hands directly, tasting & smelling.

(6) It is needed to take great care when handling / using Acid. (Acid will be added into the water slowly)

(7) The flammable liquids are not used near the flame & heat.

(8) When using Chemical Solution, it's to take required amount and if take more amount, not to re put/add it in Chemical Solution.

(9) The used waste chemical solutions can harm the environment, so it's to do dilution till neutralization step and then dispose it.

(10) The used Chemical boxes will be kept & disposed systematically. (Don't throw it into the daily use dustbin)

(11) When taking out the reagent, it's to sign on bim card & on the materials (reagents), with the name of person & signature and date of issuing the reagents.

(12) It is to check the Expired date of Reagent before using it.

6. Related documents
- Nil

7. Related forms
- Nil

8. Reference
(Central Laboratory)

9. Appendix
- Nil

6A - 10

1. Topic
- Instruction for handling equipment

2. Objective & Scope

(1) To follow the staff in the laboratory

(2) It is the obligations to follow when using/handling equipment.

3. Abbreviation & Definition
- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	Obligations to follow when using equipment	Staff in the laboratory	Central Laboratory

5. **Procedure**

(1) Turn on Spectrometer after keeping it in Air-con room for 1 hour. After turning on the Spectrometer, take out cell-block and check whether measured parameter is selected or not on Spectrometer.

(2) Grab the lid of the cell and wipe it with tissue carefully.

(3) When measuring parameters, it's careful to measure the blank & sample.

(4) Measure/ analysis the parameters systematically according to the program.

(5) When measuring Parameters in Spectrometer and if the result is minutes (-), the result must be taken as less than (<) of range and if it shows Over Measure Range, and get the value in numbers and if it shows the value in '******, the result must be greater than (>) of the range.

(6) When measuring Total Nitrogen & Total Phosphate, it's to open/turn on Reactor in advance for digestion to get specific temperature.

(7) It's to open/turn on the Balance one hour in advance before using and the water is in center. If it isn't in center, then needs to adjust it.

(8) Open/turn on Oven & Incubator before using it to get sufficient temperature.

(9) It is to turn on the fridge for 24 hours where water sample & chemicals are kept/ stored.
(Don't use the electronic devices with wet hands)

6. Related documents
- Nil

7. Related forms
- Nil

8. Reference
(Central Laboratory)

9. Appendix
- Nil

6A - 11

1. Topic
Safety Instructions

2. Objective & Scope

(1) To follow the staff in the laboratory

(2) It is the obligations to follow for safety in workplace.

3. Abbreviation & Definition
- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1.	Things to follow for safety in work place	Staff in the laboratory	Central laboratory

5. Procedure

(1) While operating the equipment and accident happens, then turn off the power switch and related breaker.

(2) As a place where the flammable chemicals are stored or kept, it's always to check the expired date of fire extinguisher & keep it in accessible place.

(3) When using strong acids and some harmful things happen, it's to wash with water immediately and if needed, see the dermatologist.

(4) If chemical glassware is broken, it's to clean the mess using thick gloves.

6. Related documents
- Nil

7. Related forms
- Nil

8. Reference
(Central Laboratory)

9. Appendix

- Nil

5.1.2 EC (Electrical Conductivity)

Calibration forMettler Toledo Brand

(1) Firstly, press On/Off and set EC setting.

(2) Press Mode & Read. Then select/choose (12.88, 1413) each.

(3) Choose 12.88 and put Probe into 12.88 Calibration liquid & press Cal. (Add 10 ml Calibration liquid). If root appears on A, it is the end of Calibration and press Exit.

(4) Choose 1413 and put the Probe into 1413 Calibration liquid & press Cal. (Add 10 ml Calibration liquid). If root appears on A, it's the end of Calibration & press Exit.

Measurement of EC Read

(1) Put the Probe into sample water & press Read.

(2) If root appears on A, we can read the answer.

(Remark : The Unit must be µS/cm and if it's mS/cm, then needs to multiply by 1000)

5.1.3 Measurement of TDS Read

(1) Firstly, press On/Off on EC Meter and set TDS Setting.
Put the probe in sample water and press READ.

(2) If root appears on A, it can read the answer.
(Remark: The unit must be mg/L. If it's g/L, then multiply by 1000)

5.1.4 Measurement of Salinity Read

(1) Firstly, press On/Off button on EC Meter and set Salinity Setting.
Put the Probe into the sample water & press Read.

(2) If root appears on A, then can read the answer.
(Remark: Unit is PSU)

5.1.5 Color

(1) For Blank Preparation

- Firstly, make filtration the distilled water 50 ml with filter paper 0.7µ.
- Distill water after filtration is Blank.

(2) Take 50 ml water sample and filtrate it with filter paper 0.7µ.

(3) Select/choose program no: 124 on Spectrometer and put Blank (BC) and press Zero. Put SC in which Sample water is added and press Read.

(4) The result of sample water without using filter paper is PCU and the result using filter paper is TCU.

5.1.6 Turbidity (HANNA)

Calibration

1. It's to do calibration the turbidity meter before measuring sample water.
2. When in calibration, it's to do 5 points calibration.
3. When in calibration, firstly, press "CAL".
4. Point 1 will be appeared on Meter Screen. For Point 1, put 0.10 NTU Calibration liquid in the device and press READ.
5. Point 2 will be appeared on Meter Screen. For Point 2, put 15 NTU calibrations in the device and press READ.
6. Point 3 will be appeared on Meter screen. For Point 3, put 100 NUT Calibration in the device and press "READ".
7. Point 4 will be appeared on Meter screen. For Point 4, put 750 NTU Calibration in the device and press "READ".
8. Point 5 will be appeared on Meter screen. For Point 5, put 2000 NTU Calibration in the device and press "READ".
9. Store will be appeared.
10. Then, sample water can be measured on Turbidity meter by pressing READ button.

Measurement Method

Procedure

1. Firstly, press On/Off. When it's ready, (----) will be appeared on LCD. The current time will be shown on the left in display and on the right; range name will be appeared/shown.
2. Put sample water into clean & dry Cuvette (10 ml). It's to hole the top of the Cuvette.
3. Close the lid.
4. Before measuring, it's to clean the cell with dry cloth. Notice: If the turbidity valve is (<1 NTU), put Silicone Oil on Cuvette and rub the Cuvette with cloth.
5. Put Cuvette on Turbidity Meter.

6. Close the Turbidity Meter Cover.
7. Press Read.
8. ‘Read’ will be appeared on meter screen.
9. After that, get the result.

5.1.6 Turbidity (HANNA)

Measurement

1. Firstly, press On/Off button.
2. Then, “------”appears on the meter screen.
3. Put/add 10 ml sample into the cell.
4. Wait until bubble in the cell disappears.
5. Grab the lid of the cell.
6. Before measuring it, clean the cell bottle with the piece of clothes.
7. Put the cell into the meter. Add 10 ml sample water into the cell.
8. Close the lid of the cell and press Read.
9. “READ” appears on the meter and get result.

5.1.7 Suspended Solid (S.S)

Required items

1. Suction Vessel - 1
2. Filter Holder - 1
3. Filter Manbrare - 1
4. Air Vacuum Pump - 1
5. Tweezers - 1
6. Stirrer - 1
7. လေစုပ်ပိုက်ညို - 1
8. Dish - 2
9. Filter paper - 1
10. Beaker (500ml) - 1
11. Measuring Cylinder (1000ml) - 1
12. Measuring Cylinder (100ml) -1

Installation

(၁) S.S တိုင်းတာရန် Suction vessel, Filter holder နှင့်Vacuumed pumpကိုလေစုပ်ပိုက်ဖြင့်ဆက်ပေးပါ။

(1) To measure S.S, it's to connect Suction Vessel; Filter Holder & Vacuumed pump with (air pump)

(2) Place Breaker (500 ml) under Suction Vessel.

Preparation

(1) Prepare (2) Filter dishes when measuring a sample.

(2) Firstly, wash/clean glassware with distilled water. Take Filter paper using tweezers & put it on Filter membrane. Then install filter holder.

(၃) Distilled water (100ml) ကိုချိန်၍ filter အားလုံးကိုဖြတ်၍dishပေါ်တွင်ထည့်ရမည်။

(3) Measure distilled water (100) ml and pass through the entire filters and put it on the dish.

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(4) After (3) Steps, place Filter Dishes in the oven and heat it with (105℃) for (2) hours.

(5) After heating, put the dish into Desiccator and let it cold. Keep (1) hour after measuring sample.

(6) After the preparation of sample, take out filters from desiccator and measure it in balance. The balance level must be in center.

(7) Take 450 ml sample water and filtrate it with filter. The filtrated filter will be put in the dish. When putting the filtered paper, it's careful not to wrong dish.

(8) The dish after (7) steps will be heated in the oven (105℃) for 2 hours.

(9) After that, let it cold in Desiccator for an hour.

(10) After that, measure the filter in the balance and input the weight in the following formula and calculate S.S mg/L.

S.S Formula

$\frac{(A-B)x1000}{sample(ml)g/l}$X1000 mg/g =..... (mg/L)

A= After Filtration

B= Before Filtration

5.1.8 Jar Test

Required Items

1.	1 Lit Beakers	(6)
2.	Measuring Cylinder (1000 ml)	(1)
3.	Flocculation Tester	(1)
4.	100 ml Volumetric Flask	(1)
5.	Syringe	(1)
6.	pH meter	(1)
7.	Turbidity meter	(1)
8.	Color meter	(1)
9.	ACH	1 ml

Procedure

(1) Prepare 1 Litter Beakers (6 Cups)

(2) Wash/ clean Beakers with distilled water.

(3) Add sample raw water into Measuring Cylinder (1000 ml) slowly and put 1000 ml into each beaker (6 beakers).

(4) Measure pH, Turbidity & Color of Sample Raw Water.

(5) Place Beakers into Flocculation Tester.

(6) Making ACH Solution

- Put 1ml Original ACH solution into 100 ml Volumetric Flask and add 100 ml Distilled water and then get 1% ACH solution.

(7) Add 1% ACH solution into the beakers accordingly.
E.g., 5 ppm= 0.5 mi=l, 10 ppm= 1m, 25 ppm= 2.5 ml
Remark; it's to dose ACH Solution Dosage after mixing.

(8) Rpm – 120 & Time- 5 minutes
Rpm – 40 & Time – 15 minutes

(9) When time's up, lift up the mixer and wait 20 minutes for sedimentation time.

(10) After that, take out the water using Syringe and measure pH, turbidity & color.

Notice: Not to make any turbid.

ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-CL-AP-W-9*
	ဗားရှင်းအမှတ်	
	စတင်အသုံးပြုသည့်နေ့	
	စာမျက်နှာအမှတ်	
	ရေးသားသူ	
	အတည်ပြုသူ	
	ခွင့်ပြုသူ	

5.2.1 Measurement of Total Hardness (mg/L)

Required items

1.	Conical Flask (150 ml)	1
2.	Cylinder (50 ml)	1
3.	Buffer Solution (pH-10)	1 ml
4.	Hardness Tester	2 drops
5.	Burette	1
6.	0.01M, E.D.T.A	

Procedure

1. Wash conical flask (150 ml) & cylinder (50) with distilled water.
2. Then wash again the conical flask (150 ml) & cylinder (50 ml) with distilled water.
3. Add Sample Water (50 ml) into Cylinder.
4. Then, pour sample water (50 ml) in cylinder into conical flask.
5. Then, add buffer (1 ml) and hardness Tester (2 drops) in the water.
6. Then, shake conical flask slowly and it turns purple colour.
7. Firstly, wash the burette with distilled water.
8. Wash the burette with 0.01M, E.D.T.A.
9. To do titration, fill/ add 0.01 M, E.D.T.A into the burette.
10. Before titration, make a starting mark on the burette.
11. It's to titrate the sample water drop by drop till it turns to blue colour.
12. After the colour is changed, read the ending mark on the burette.
13. Calculate Total Hardness result (mg/L) using the start point & end points by calculation method.

အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	
	Version အမှတ်	
	စတင်အသုံးပြုသည့်နေ့	
	စာမျက်နှာအမှတ်	

Calculation

$$\text{Total Hardness (EDTA) as } CaCO_3 \text{ (mg/ lit)} = \frac{(A-B)\,x1000}{ml\ of\ SampleVolume}$$

Where; A= ml of titration for sample

B= ml titration for blank

5.2.2 Measurement of Calcium (mg/L)

Required items

1. Conical Flask (150 ml) 1
2. Cylinder (50 ml) 1
3. 1N NaOH Solution 2 ml
4. Calcon indicator 0.1 or0.2 g
5. Burette 1
6. 0.01M E.D.T.A Solution

Procedure

1. Firstly, wash conical flask (150 ml) & cylinder (50 ml) with distilled water.
2. Wash again conical flask (150 ml) & cylinder (50 ml) with sample water.
3. Then add sample water (50 ml) into Cylinder.
4. After that, pour the sample water (50 ml) in cylinder into Conical Flask.
5. Then add 1N, NaOH (2ml) & Calcon (0.1 or 0.2 g) into the water.
6. After shaking conical flask slowly, the water turns to pinkish colour.
7. Wash the burette with distilled water.
8. Wash the burette with 0.01 M, E.D.T.A for titration.
9. To do titration, fill E.D.T.A in the burette.
10. Before titration, make a mark on the burette.
11. Make titration the solution drop by drop in conical flask using 0.01M, E.D.T.A till it turns violet colour.
12. After the colour changes, read the top mark on the burette.
13. Calculate Calcium result (mg/L) using calculation method.

Calculation

$$\text{Ca /L (mg/ lit)} = \frac{(A-B)\ x400.8}{ml\ of\ SampleVolume}$$

Where; A= ml of titration for sample

B= ml titration for blank

5.2.3 Measurement of Total Alkalinity (mg/L)

Required items

1. Conical Flask (150 ml)	1
2. Cylinder (50 ml)	1
3. Methyl orange Indicator	2 drops
4. Phenolphthalein Indicator	2 drops
5. Burette	1
6. H_2SO_4Solution 0.02N	

Procedure

1. Wash conical flash (150 ml) & cylinder (50 ml) with distilled water.
2. Wash again conical flask (150 ml) & cylinder (50 ml) with sample water.
3. Add sample water (50 ml) into cylinder.
4. After that pour sample water (50 ml) in cylinder into conical flask.
5. Add Phenolphthalein (2 drops) into the water. If the colour doesn't change, then there isn't any carbonate in the water. If it changes to pinkish colour, there is carbonate and make titration using 0.02N, H_2SO_4.
6. If the colour doesn't change after adding phenolphthalein, then add methyl orange (2 drops).

The water will turn to yellow colour.

7. Wash the burette with distilled water.
8. Wash the burette with 0.02N, H_2SO4 for titration.
9. To do titration, add 0.02N, H_2SO_4 into burette.
10. Before titration, make a starting mark on the burette.
11. After that, make titration the solution in conical flask drop by drop till it turns pink colour using 0.02N, H_2SO_4.

12. After the colours change, read the result on the burette.
13. Calculate Total Alkalinity result (mg/L) using start point and end point by calculation method.

Calculation

Alkalinity, mg CaCO3/L (mg/ lit) = $\frac{AxNx50000}{ml\ of\ SampleVolume}$

Where; A= ml of titration for sample

B= ml titration for blank, and

N= Normality of H2SO4(0.02N)

ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-CL-AP-W-12*
	ဗားရှင်းအမှတ်	
	စတင်အသုံးပြုသည့်နေ့	
	စာမျက်နှာအမှတ်	
	ရေးသားသူ	
	အတည်ပြုသူ	
	ခွင့်ပြုသူ	

5.2.4 Measurement of (mg/l)

Required items

1. Conical Flask (150 ml) 1
2. Cylinder (50 ml) 1
3. K_2CrO_4 Indicator 2 drops
4. 0.01N, $AgNO_3$ Solution
5. Burette 1

Procedure

1. Firstly, wash conical flask (150 ml) & cylinder (50 ml) with distilled water.
2. Wash again conical flask (150 ml) & cylinder (50 ml) with sample water.
3. Add sample water (50 ml) into cylinder.
4. After that, pour sample water (50 ml) in cylinder to conical flask.
5. Then add K_2CrO_4 (2 drops) into the water.
6. Then shake the conical flask slowly, and the solution turns to yellow colour.
7. Wash the burette with distilled water.
8. Wash the burette with 0.01N, $AgNO_3$ for titration.
9. To do titration, add 0.01 N, $AgNO_3$ into burette.
10. Before doing titration, make a starting mark on the burette.
11. Then using 0.01 N, $AgNO_3$, titrate the solution in conical flask till it turns (pinkish yellow) colour.
12. After the colour changes, read the result on burette.
13. Calculate Chloride result using the starting mark and ending mark by calculation method.

Calculation

$$CL^- /L\ (mg/lit) = \frac{(A-B)xNx35450}{ml\ of\ SampleVolume}$$

Where; A= ml of titration for sample

B= ml titration for blank, and

N= Normality of $AgNO_3$ (0.014N)

5.2.5 Measurement of Maganese (Mn)

(1-(2-Pyridylazo)-2-Naphthol PAN Method[1]LR (0.006 to 0.700 mg/L)

Required items

1.	1 inch cell	2
2.	Sample cell stopper	2
3.	Timer	1
4.	Ascorbic acid Powder	2 packages
5.	Pan Indicator Solution	12x2 drop
6.	Alkaline Cyanide Solution	12x2 drop

Procedure

1. Select/choose 290, Manganese (Mn) in Store Program on Spectrometer.
2. Wash the sample cells with distilled water. Then wash again the cells with sample water.
3. Prepare for Blank (BC)
   - Add/put 10 ml distilled water into sample cell.
4. Prepare for Sample (SC)
   - Add/put 10 ml sample water into another Sample cell.
5. Put Ascorbic Acid power into each cell and close the cells with stoppers and then put the cells upside down to dissolve the power and then shake it.
6. When the power dissolved, put/add Alkaline Cyanide reagent solution (12 drops) into each cell and then shake it in circle.
7. Put 0.1% Pan Indicator solution (12 drops) into each cell and then shake it in circle. If orange colour appears, then manganese involves in it.
8. Wait for 2 minutes in timer.

9. When the time's up, wipe the BC cell/cup with tissue and put the cell into Spectrometer and press Zero. '0.000 mg/L Mn' will show on Screen.
10. Then wipe the SC cell/cup according to Step 9 and press READ on Spectrometer. The result will be shown in ….mg/L Mn on the screen. It's Manganese (Mn) result.

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-CL-AP-W-14*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

<u>5.2.6 Measurement of Iron (Fe)</u>

FerroMo Method [1] (0.01 to 1.80 mg/L)

<u>Required items</u>

1. Cylinder, graduated mixing (50ml) 2
2. FerroMo Reagent I 1pack
3. FerroMo Reagent II 1pack
4. Timer 1 pack
5. 1 inch cell 2 cups

<u>Procedure</u>

1. Select/choose 275, FerroMo (Fe) in stored program on Spectrometer.
2. Wash the sample cells with distilled water. Then, wash again the cells with sample water.
3. Put/add sample water (50 ml) into Mixing Cylinder (50 ml).
4. Then, put a pack of FerroMo Reagent IPower into Mixing Cylinder.
5. Put/keep the mixing cylinder upside down to dissolve the reagent and then shake it.
6. Put/pour the solution (from step 5) into new Cylinder for 25 ml.
7. Put a pack of FerroMo Reagent **II** Powder power into 25 ml Cylinder. Put/keep the Cylinder upside down to dissolve the power and then shake it. If the solution turns blue color, then iron dissolved in the water.
8. Set the timer for 3 minutes and wait it.
9. When the time's up, put the solution from Step-5 into sample cell for blank.
10. For sample water, put/pour the solution from step 7 into sample cell.
11. Then put the BC in the Spectrometer and set zero setting. '0.00 mg/L Fe' will be shown on display.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

12. Then, put SC from Step 10 into Spectrometer and press Read. The result will be shown in '….. mg/L'.

5.2.7 Measurement of Nitrate-Nitrogen (NO_3-N)

Cadmium Reduction Method (0.01 to 0.5 mg/L NO_3^-N) (LR)

Required items

1. 1 inch cell — 2 cups
2. Sample cell with stopper — 2
3. Mixing Cylinder — 1
4. NitraVer-6 — 1 package
5. NitriVer-3 — 1 package
6. Timer — 1

Procedures

1. Select/choose 351, Nitrate (NO_3-N) in stored program on Spectrometer.
2. Wash the sample cell with distilled water and again wash it with sample water.
3. Add/put 15 ml sample water into mixing cylinder.
4. After that, add a pack of Nitra Ver-6 Reagent into the cylinder and close it.
5. Set the timer for 3 minutes.
6. When the time's up, shake the cylinder in upside down position.
   Note: Some powder won't be dissolved in.
7. Set the timer for 2 minutes.
8. When the time's up, pour/add 10 ml sample water, which is from step 6, into the sample cell slowly (Be careful not to mix the cadmium powder)
9. Add a pack of Nitri Ver-3 Reagent Power into the solution in the sample cell.
10. Set the timer for 30 seconds.
11. Close the sample cell and shake it upside down for 30 seconds.

Note: If there is pinkish colour in the sample cell, then there is Nitrate in it.

12. Set 15 minutes in the timer.
13. Add 10 ml Original Sample water into new sample cell.
14. Wipe BC with tissues and place it in Spectrometer.
15. Press 'Zero' in spectrometer and '0.00 mg/L NO_3-N' will be shown on display.
16. Then, wipe SC with tissues and place it in spectrometer.
17. Press Read and the result '….mg/L NO_3-N' will be shown on Screen.

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-SuD-AP-WI-16*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.2.8 Measurement of Nitrite-Nitrogen (NO_2-N)

USEPA Diezotization Method 0.002 to 0.300 mg/L NO_2^--N

Required items

1. 1 inch cell — 2 cups
2. Timer — 1
3. NitriVer-3 — 1 pack

Procedure

1. Choose/select 371, Nitrite (NO_2-N) in stored program on Spectrometer.
2. Wash the sample cells with distilled water. And then wash again the cells with sample water.
3. Add 10 ml sample water into a sample cell.
4. Add a pack of Nitri Ver-3 Reagent Power.
5. Then to dissolve in powder, shake it in circle.
   Note: If the colour in Sample cell is pink, then there is Nitrite.
6. Set the timer for 20 minutes.
7. When preparing blank, add/ put 10 ml Original Sample water into new sample cell.
8. Wipe BC with tissues and place in Spectrometer. Press 'Zero' on Spectrometer. '0.000 mg/L NO_2-N' will be shown on Display.
9. Wipe SC with tissues and place in Spectrometer.
10. Press 'READ' and the result '…. Mg/L NO_2-N' will be shown on screen.

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-CL-AP-W-17*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.2.9 Measurement of Ammonia (NH_3-N)

Salicylate Method (0.01 to 0.50 mg/L NH_3-N)

Required items

1. 1 inch cell — 2 cups
2. Timer — 1
3. Ammonia Salicylate — 2 packages
4. Ammonia Cyanurate — 2 packages

Procedure

1. Choose 385, Ammonia (NH_3) on stored program in Spectrometer.
2. Wash the sample cell with distilled water. And again wash the cell with sample water.
3. Put/ add Deionized Water 10 ml into the BC cup.
4. Put/add Sample water 10 ml into SC cup.
5. Put Ammonia Salicylate Reagent into each cell cup. And then shake it and wait for 3 minutes.
6. Then add/put Ammonia Cyanurate Reagent into each cell cup. And then shake it and wait for 15 minutes.
7. Put/place the BC cup with deionized water into Spectrometer and set zero setting.
8. Put/place the SC cup with sample water into Spectrometer and press READ.
9. The result can be shown on display. The result is Nitrogen, Ammonia (… mg/L NH_3-N).

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု …………………………………… ……………………………………	SOP ကုဒ်အမှတ်	*EDWS-CL-AP-W-18*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.2.10 Measurement of Sulphate (SO_4^{2-})

SulfaVer 4 Method (2 to 70 mg/L)

Required items

1. 1 inch cell — 2 cups
2. Timer — 1
3. SulfaVer-6 — 1 pack

Procedure

1. Select/choose 680, Sulphate (SO_4^{2-}) in stored program on Spectrometer.
2. Wash the sample cells with distilled water. Then wash again with sample water.
3. Add sample water (10 ml) into SC to measure (SO_4^{2-}).
4. Add a pack of Sulfa Ver-6 into SC (which has 10 ml sample water) and then shake it.
5. Wait for 5 minutes.
6. Add 10 ml sample water into BC to set Zero Setting.
7. Put/place the BC (which has sample water) into Spectrometer and set Zero Setting.
8. Put/place the SC with solution into Spectrometer and press READ.
9. The result can be seen on display. The result of Sulphate (SO_4^{2-}) will be shown in (…..mg/L SO_4^{2-}).

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု …………………………………… ……………………………………	SOP ကုဒ်အမှတ်	*EDWS-CL-AP-W-19*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.2.11 Measurement of Phosphorus (PO_4^{3-}) (Orthophosphate)

USEPA[1]PhosVer 3[R] (Ascorbic Acid) Method[2]0.02 to 2.50 mg/L PO_4^{3-}

Required items

1. 1 inch cell — 2 cups
2. PhosVer-3 Phosphate reagent powder pillow — 1 package
3. Timer — 1

Procedure

1. Select/choose 490, P React PP in stored program on Spectrometer.
2. Wash the sample cells with distilled water and then wash again with sample water.
3. Add 10 ml sample water into a sample cell.
4. Add a pack of Phos Ver-3 Phosphate reagent power into sample cell.
5. Close the sample cell immediately and shake it upside down quickly within 20 seconds or 30 seconds.
6. Then, set the timer for 2 minutes.
   Note: If it's to use AcidperSulfate digestion, it's necessary to wait 10 minutes.
7. When preparing blank, add 10 ml Original Sample Water into new sample cell.
8. Wipe BC with tissues and place it in Spectrometer.
9. Press Zero on Spectrometer. '0.00 mg/L OP_4^{3-}'will show on Display.
10. Then, wipe SC with tissue and place it in Spectrometer.
11. Press Read and the result '….mg/L PO_4^{3-}' will show on Screen.

<u>**5.2.12 Measurement of Lead (Pb)**</u>

Fast Column Extraction Method (5 to 150 μg/L)

<u>**Required items**</u>

1.	Lead Trak Ragent Set	1
2.	Beaker, Polypropylene, 150 ml	2
3.	Beaker, Polypropylene, 250 ml	1
4.	Clamp, 2-prong extension, with Clamp holder	1
5.	Cylinder, graduated polypropylene, 25 ml	1
6.	Cylinder, graduated polypropylene, 100 ml	1
7.	Dropper, 0.5 and 1.0 ml marks	1
8.	1 inch cell	1
9.	Support for Ring Stand	1

<u>**Procedure**</u>

1. Select/choose 283 Lead Number in Stored program on Spectrometer.
2. Measure the sample water with 100 ml measuring cylinder and put it into 250 ml beaker.
3. Take Pb-1 solution (1ml) with 1ml Plastic dropper and put it into the sample water in 250 ml beaker and stir it and wait for 2 minutes.
4. After that, take Pb-2 9 (2ml) with another (1 ml) Plastic dropper and put it in the sample and stir it.
5. Install the Column Extractor on Ring Stand. 150 ml Plastic beaker must be kept under Extractor.

6. To stick the Cotton plug in the extractor, it is to press down by plunger by adding deionized water. If the cotton plug isn't stick, then press again by plunger. The cotton plug must be stick in the inside of column.
7. Then pour/add the prepared sample water into column extractor slowly. Wait until the sample water flows to the bottom. The flow of the sample water must be 2 drops per second.
8. If the sample flow stops in extractor, press Absorbent Pad by plunger and then pull out the plunger slowly.
   (When pulling out the plunger, the absorbent pad must be stick under extractor. Throw away the liquid in the beaker which is under extractor)
9. Then place the dry 150 ml beaker under extractor. Measure Pb-3 Eluant solution (25 ml) in 25 ml cylinder and put/add in extractor.
10. The Pb-3 solutions will flow down to beaker slowly through extractor. If the flow stops, press the Absorbent Pad by plunger.
11. Take Pb-4 solution (1 ml) with 1 ml plastic dropper and put it in Beaker (which is prepared in Step 10) and then stir it.
12. Then put/add a pack of Pb-5 power into the beaker and stir it. The solution turns to brown colour.
13. Put/add 10 ml into the sample cell and wait for 2 minutes. When time's up, set the Zero setting in Spectrometer.
14. After setting Zero Setting, put/add Pb-6 solution (3 drops) into sample cell and stir it.
15. Put the cell into Spectrometer and press READ and get Lead Result (μg/L).

5.2.13 Measurement of Zinc (Zn)

Zincon Method (0.01 to 3.00 mg/L)

Required items

1. 1 inch cell — 2 cups
2. Cylinder (25ml) — 2
3. Cyclohexanone — 0.5 ml
4. Zinco Ver 5 Reagent Powder Pillow — 2 packages

Procedure

1. Select/choose 7580 Zinc in Stored Program on Spectrometer.
2. Wash the sample cells with distilled water. Then wash again the cells with sample water.
3. Add 20 ml sample water into 25 ml Cylinder.
4. Add a pack of Zinco Ver 5 Reagent into Cylinder and close the stopper.
5. Shake the Cylinder in upside down. If the reagent powder doesn't dissolve, the result will be low level. The sample colour turns to orange colour. If the sample turns to blue (or) brown colour, there is high concentration of Zinc. If the colour changes, it's necessary to dilute the sample.
6. After step (5), add sample (10 ml) into Sample cell and get Blank.
7. To measure Zinc, add 0.5 ml cyclohexanone into the remaining solution using plastic dropper.
8. After step (7), shake the cylinder for 30 seconds. The colour of the sample will change to dark orange, brown or blue colour based on the concentration of Zinc.
9. Add the solution into second sample cell and wait for 3 minutes.
10. When the time's up, wipe the blank solution sample cell with tissue and put it in spectrometer and set Zero Setting.

11. Wipe the second sample cell with tissue and put it in spectrometer and press READ and get Zinc result (mg/L).

5.2.14 Measurement of Arsenic (Potable Test)

0.005 to 0.5 mg/L $As^{3+/5+}$

Required items

1. Test Bottle & Caps 2
2. Timer 1
3. Spoon 2
4. Detector 1
5. First Reagent Quick (As-I) 2 drops
6. Second Reagent (As-II) 1spoon
7. Third Reagent (As-III) 1spoon
8. Test strip 1
9. Color scale 1

Procedure

1. Wash the test bottle with distilled water and wash again the bottles with sample water.
2. Put/add sample water (100 ml) into test bottle 100 ml.
3. Add First reagent quick (As-I) 2 drops.
4. Shake it for 2 seconds in circle.
5. Take a spoon of Second Reagent (As-II) power using white spoon and put it in Test bottle.
6. As per step 4, shake it for 2 seconds.
7. Take a spoon of As-III powders using red spoon and put it in test bottle.
8. As per step 4, shake it for 2 seconds.

9. Close/cover the test bottle with screw cap.
10. Lift the stick up in the test strip on Screw cap.
11. Put the test strip into test bottle through screw cap.
12. The mark on the screw cap and the mark on test strip must be face to face.
13. When putting the test strip into screw cap, mind not to put fully into screw cap. The test strip must be 2 cm out of the screw cap.
14. Then, close screw cap and leave it for 15 minutes.
15. When the time's up, take the test strip out of the screw cap.
16. Put the test strip into the breaker which has distilled water for 2 seconds. Then, take out the test strip and shake it.
17. Read the result by comparing with colour scale.

Note: It's to measure the arsenic in Fume hood.

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		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.2.15 Measurement of Phosphorus, Total LR

PhosVer3 with Acid Persulphate Digestion Method LR (0.06 to 1.10 mg/LP)

Required items

1. Timer 1
2. Funnel 1
3. Pipette
4. Potassium Persulphate Powder Pillow 1 package
5. Total and acid Hydrolyzable Vial 1
6. 1.54 N Sodium Hydroxide Standard Solution 2ml
7. Phos Ver3 powder Pillow 1

Procedure

1. Firstly, turn on DRB 200 Reactor and heat it up to **150°C.**
   (EDWS-SuD-EP-W1-12)
2. Select/choose 536 P total/ AH PV TNT on Spectrometer.
3. Add/pour sample water 5 ml into Total and acid Hydrolyzable vial using Ten settee pipet.
4. Add a pack of Potassium Persulfate Powder Pillow into Vial using funnel.
5. Close the lid/cover firmly and turn the bottle into 45°**C** and shake it up and down to dissolve the powder.
6. After that, add vial into DRB 2800 and then close the lid/cover.
7. Heat it for 30 minutes.
8. When the time's up, take the vial out of reactor and put it in Test Tube rack and keep it cold in the room temperature.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) .... ဌာနခွဲ .... ဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

9. Pud/add 1.54 N Sodium Hydroxide Standard Solution 2 ml into vial using Ten Sette Pipet and close the lid and shake it.
10. Wipe the outer part of vial with wet clothes and wipe again with dry clothes.
11. Put vial into 16 ml cell holder.
12. To set Zero setting, press ZERO. 0.00mg/L PO_4^{3-} will be shown on display.
13. Add a pack of Phos Ver 3 Powder Pillow into vial using funnel.
14. Close the lid/cover immediately and shake it for 20-30 seconds to mix/ dissolve the reagent. The powder won't dissolve completely.
15. Set the timer for 2 minutes. When the time's up, read the sample within 2-8 minutes.
16. When the time's up, wipe the outer part of vial with wet clothes and again wipe with dry clothes. Put the vial in 16mm cell holder and press READ to read the result. The result will be shown in **----mg/L PO_4^{3-}** .

5.2.16 Measurement of Phosphorus, Total HR

PhosVer3 with Acid Persulphate Digestion Method HR (1 to 100 mg/LP)

Required items

1.	Timer	1
2.	(Funnel)	1
3.	Pipette	3
4.	Potassium Persulphate Powder Pillow	1 pack
5.	Total and acid Hydrolyzable Vial	1
6.	1.54 N Sodium Hydroxide Standard Solution	2ml
7.	Phos Ver3 powder Pillow	1
8.	Molybdovanadata Reagent	0.5ml
9.	Deionized water (Total Phosphorous Test N Tube Vial)	5ml

Procedure

1. Firstly, turn on DRB 200 reactor and heat it to get the 150˚C temperature. (SOP Code …)
2. Select Spectro 542 P Total HR TNT.
3. For Blank preparation
   - Add Deionized Water 5 ml into N Tube Vial using Ten sette pipet.
4. For Sample preparation
   - Add Sample Water 5 ml into N Tube Vial using Ten Sette pipet.
5. Add the packets of Potassium Persulfate Powder Pillow into blank & sample using fennel. Then close the lid/cover firmly and shake it to dissolve the powder.
6. Add vials into DRB 200 Reactor. Close the lid/cover of Reactor.
7. Heat it for 30 minutes.

8. When the time's up, take out the vials from reactor and put in Test Tube rack and keep it cold in room temperature (18°C- 25°C).
9. Add 1.54 N Sodium Hydroxide solutions into each vial for 2 ml using ten sette pipet. And then shake it upside down.
10. Put/ add Molybdovanadate Reagent into each vial for 0.5 ml using Polyethylene Dropper. Close the lid/cover and shake it upside down.
11. Set the timer for 7 minutes.
12. When the time's up, wipe the vial with dry clothes.
13. Add blank in vial (16 ml cell holder) on Spectrometer and adjust Zero Setting and press Zero.**0.0mg/L PO_4^{3-}** will be shown on Display.
14. Put sample vial in the 16mm cell holder and press READ to read the result. The result will be shown in **---mg/L PO_4^{3-}**.
    Note: The result must be read within (7-9) mins.

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) .... ဌာနခွဲ .... ဌာနစု	SOP ကုဒ်အမှတ်	***EDWS-CL-AP-W-25***
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.2.17 Nitrogen, Total LR

Persulfate Digestion Method LR (0.5 to 25.0 mg/L N)

Required items

1. Total Nitrogen Persulfate - 2
2. Total Nitrogen Hydroxide Digestion Reagent vials - 2
3. Deionized water in the kit - 2ml
4. Total Nitrogen A Powder - 2
5. Total Nitrogen B Powder - 2
6. Total Nitron Reagent C Vials - 2

Procedures

1. Turn on DRB 200 Reactor and set the temperature at 105℃.
2. Add/put Total Nitrogen Persulfate Reagent Power into total Nitrogen Hydroxide Digestion Reagent vial using Funnel.

   Note: Wipe the reagent powder on the lid of the tube.
3. Prepared Sample

   - Add 2 ml sample water into Vial (tube).

   Blank Preparation

   - Add 2 ml deionized water into Vial (tube).

   Note: The water without Nitrogen can be used as deionized water.
4. Cover SC & BC vials (Tube) and shake it upside down for 30 seconds quickly.

   If reagent didn't dissolve, there is no effect in solution.
5. Put Vials (SC & BC) into reactor and heat it for 30 minutes.
6. Move the heated Vials (SC & BC) to finger cots immediately. Keep it cool in room temperature.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) .... ဌာနခွဲ .... ဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

Note: Keep the vials completely cool.

7. Choose 350 N Spectrometer.
8. Open Digested vials (SC & BC) cover and add Total Nitrogen (TN) Reagent A Powder.
9. Close vials cover and shake it upside down for 15 seconds.
10. Wait for 3 minutes.
11. When the time's up, open SC & BC Vials cover and adds TN Reagent B Powder.
12. Close Vials cover/lid and shake it upside down for 15 seconds. If the reagent doesn't dissolve, there isn't effect in the solution. The solution changes to yellow colour.
13. Wait for 2 minutes.

Note: When closing vials lid/cover, the lid liner & the cover liner must be fixed.

14. When the time's up, open TN Reagent C Vials cover and put 1st vial sample 2 ml into TN Reagent vial 2 and put 2nd vial blank into TN Reagent vial 2.
15. Close the Vials lip/cover and shake it upside shown for 10 times. The tube becomes hot.
16. Wait for 5 minutes and the colour turns to solid yellow colour.
17. Wipe Reagent Blank with tissue and put into cell holder.
18. Press Zero (0.0 mg/L N)
19. Wipe Reagent Vial 2 with tissue and put into cell holder
20. Press Read (… mg/LN)

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ် ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-CL -AP-W-26*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

Nitrogen, Total

Persulfate Digestion Method LR (1 to 16 mg/L N)

Procedure

1. Turn on DRB 200 Reactor and heat it till 100℃
2. Add 1.3 ml sample water & 1.3 ml Solution A into dried 20-mm reaction tube. Then add 1 Reagent B tablet and close the tube immediately. Don't keep it upside down.
3. Add/put reaction tubes into reactor and heat it for 1 hour.
4. Take out the tubes from reactor and keep it cool in the room temperature (15-20˚C).
5. After cooling the reaction tube, open the lid and put Micro Cap C (white solid) into the tube.
6. After closing the lid, keep the lid of the reaction tube in horizontal and shake it up & down for 2 or 3 times and after that can see reaction tube solution.
7. Take digested sample 0.5 ml (500μl) in Reaction Tube by using Pipet and put it in the test vial.
8. Take 0.2 ml (200μl) from solution D by using Pipet and put it in test vial.
9. Close test vial lid immediately. Keep the lid of the test vial in horizontal and shake it up & down.
10. Wait for 15 minutes.
11. When the time's up, wipe the vial with the clothes and put it into cell holder. Press Barcode and read the result. The result will be shown in (mg/ LN).

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ် ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-CL -AP-W-27*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

Nitrogen, Total

Persulfate Digestion Method HR (2 to 150 mg/L N)

Required items

1. Total Nitrogen Persulfate - 2
2. Total Nitrogen Hydroxide Digestion Reagent vials - 2
3. Deionized water in the kit - 2ml
4. Total Nitrogen A Powder - 2
5. Total Nitrogen B Powder - 2
6. Total Nitron Reagent C Vials - 2

Procedure

1. Open/turn on DRB 200 Reactor and set the temperature 105℃.
2. Put Total Nitrogen Persulfate Reagent Powder into HR Total Nitrogen Hydroxide Digestion Reagent Vial using funnel.
   Note: Wipe the reagent on the lid of the tube.
3. Prepared Sample - add 0.5 ml sample water into Vial Tube.
   Blank Preparation- add 0.5 ml deionized water in total Nitrogen Set into Vial (tube).
   Note: The water without Nitrogen can be used as Deionized water.
4. Close SC & BC vials (tube) lids and shake it upside down for 30 seconds quickly. If the reagent won't dissolve, we can't know the measurement result.
5. Add vials (SC & BC) into Reactor and head it for 30 minutes exactly.
6. Move Vials (SC & BC) to finger cots. And keep it cold in room temperature.
   Note: Vials will be kept cold to room temperature.
7. Select Spectrometer (394 N).

8. Open Digested vials (SC & BC) cover/lid and add Total Nitrogen (TN) Reagent A Powder.
9. Close Vials and shake it upside down for 15 seconds.
10. Wait 3 minutes.
11. When the time's up, open SC & BC vials and adds TN Reagent B Powder.
12. Close vials lid and shake it upside down for 15 seconds. If the reagent doesn't dissolve, then there is no effect on the measurement result. The solution will turn to yellow color.
13. Wait 2 minutes.

    Note: When closing the vials lid the line of the lid must be fixed.
14. When the time's up, open TN Reagent C Vials lid/cover and add 1st vial sample 2 ml into TN Reagent Vial 1 and 2nd vial Blank into TN Reagent vial 2.
15. Close vials lid/cover and shake it upside down for 10 times. The tubes become hot.
16. Wait for 5 minutes and the yellow color may become strong.
17. Wipe the Reagent Blank with tissue and put it into Cell Holder.
18. Press ZERO (0.0 mg/L N).
19. Wipe the Reagent Vial 2 with tissue and put it into Cell Holder.
20. Press READ (… mg/L N).

5.2.15 easurement of Chlorine Concentration

- Firstly, it—s to dilute to know Cl2% of NaClO device and measure it.
- To dilute Cl_2 of NaClO device, it—s to know the estimate value of concentration of NaClO device.

  (Example- NaClO device Cl_2% = 5000 ppm)
- If Cl2% of NaClO is 5000 ppm, it—s to do 5000 times dilution.
- It—s to adjust dilution as the result of the sample on Cl_2 meter is based on the range of Chlorine meter.

  (For example, if the meter is 0-2 mg/L range, the result must be half of the result of the range.)

  Meter Range " 0 " 2 mg/L

  Answer (nearly) " 1 mg/L

Dilution လုပ်နည်း / Dilution method

For 50 times dilution : 2 ml of Conc: NaClO + 100 ml of No Cl_2 water

For 5000 times Dilution : 1 ml of 50 times NaClO Solution + 100 ml of No Cl_2 water

Read Cl_2 meter with DPD powder

(Answer: A)

တွက်နည်း။။သိလိုသော NaClO Concentration = x ppm

x ppm = A × (Dilution times)

= …….ppm

% ဖြင့်ပြောင်းလျှင် ppm ကို 1000 ဖြင့်စားရမည်။(……..ppm × 10^{-3} =…….%)

Measuring Residual Chlorine in Laboratory

- It—s to know Cl2 concentration of NaClO device. (x ppm)
- Set the Cl2 dosage amount. (Example; 0.1 ppm, 2 ppm…)

- Must know Sample water volume.

Example: NaCLO Cl_2= 5800 ppm
We want to dose= 1ppm
Sample water vol:^{n}=200ml =0.2L
Dosage Cl_2vol:^{n} = ?

$$1\ ppm = \frac{5800\ ppm \times ?}{0.2L}$$

$$\text{Dosage } Cl_2\text{Vol:}^n = 1\ ppm \times \frac{0.2\ L}{5800\ ppm}$$

$=3.4 \times 10^{-5} \times 10^3$ ml/l
$=3.4 \times 10^{-2}$ ml
= 0.034 ml

- Dosage Cl_2vol:^{n} amount 0.034 ml is difficult to take by pipette.
- Dosage Cl_2vol:^{n} isn–t easy to take with pipette, so it–s to dilute the original NaCLOsols:^{n} for 100 times.
- If add 100 times NaCLO into 200 ml sample water, then get 1ppm chlorinated water.
- Chlorinated water must be kept in Incubator with temperature 30˚C.
- To measure Residual Cl_2 , it–s to set Time Schedule to measure Chlorinated Water using Cl_2 meter & DPD. (Eg; 0hr, 1 hr, 2 hr, 3 hr,…., 24 hr)
- The obtained Cl_2 data result will be kept by drawing Cl_2 graph.

Measurement of Cl_2 Abs using Spectrometer

Wavelength Scan ဖတ်နည်း/ Wavelength Scanning Method

- To get Wavelength Scan 510nm-552nm in Spectrometer, it–s to scan Cl_2 sol:^{n}.
- To measure Cl2, choose the wave length 400 nm to 800 nm.
- The wavelength can change based on the water conditions.
- To scan Wavelength; it–s necessary to scan (2) types; Distilled Water + DPD sol:^{n} + Buffer sol:^{n}နှင့်sample water + DPD sol:^{n} + Buffer sol:^{n}.
- If the peak point of wave length is 552 nm, then it can be used.

Spectrometer မှData Store နည်း/ Data Storing method in Spectrometer

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ် ဆေးရေးဌာနစု	SOP ကဒ့ဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

- If we get the wavelength, press Data store box in Option, choose scan number and then press store.

Data ကို stick ထဲပို့နည်း/ Transfer the data into stick

- Copy the Wavelength Scan from Recall Data and select Scan No. and press Send data on Option.

Measurement of Cl_2 Abs

- Enter Single Wavelength and choose 552 nm.
- To set Zero Setting, it–s to use distilled water.
- Put the sample and press READ.
- And get Abs result.
- It–s to read the sample Abs at least 3 times.

Measurement of Chlorine in Spectrometer by using DPD Solution

- N - N Diethyl - p " phenylene diamine (DPD) solution for 100ml solution

Anhydrous DPD sulfate - 2 g
1+3 H_2SO_4- 0.2 ml
(ထိုဆုကြောင့် 1+3 $H_2SO_4$1 ml concentrateH_2SO_4 + 3 ml $NOCL_2$Water)
EDTA - 0.02 g
Distilled Water - 100 ml

- It–s to measure chemical amount on balance.
- Add/fill 0.2 g DPD sulfate + 0.02 g EDTA + 0.2 ml $H_2SO_4$and DW into Volumetric Flask 100 ml.
- Put DPD solution into brownish color bottle and keep it in cold place.

Phosphate Buffer Solution for 100 ml

Na_2HPO_4 - 2.4 g
Anhydrous KH_2PO_4- 4.6 g
EDTA - 80 mg (0.08) g

ဖဒိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)
ထုတ်ဝေသည့်ရက်စွဲ

Distilled Water - 100 ml
$HgCl_2$ - 2 mg
(HgCl2 is used to prevent from fungus in the solution. Not necessary to add if the solution amount is small)

- The amount of chemical will be measured in balance.
- Put Na_2HPO_4 & KH_2PO_4 into Volumetric Flask 100 ml and make the solution using distilled water.
- Make EDTA & DW 10 ml solution and add into Flask. Then add DW up to 100 ml.
- Put Phosphate Buffer Solution into brown bottle and keep it in cold place.

CL_2 Calibration Chart ပြုလုပ်နည်း

$KMnO_4$ - 0.891 g
Distilled Water - 1 L (1000 ml)

- $KMnO_4$ - 0.891 g အား balance တွင်ချိန်ပါ။
- Measure $KMnO_4$ -0.891 g in balance.
- Add $KMnO_4$ into volumetric flask and add D.W 1000 ml and shake it with mixer.
- $KMnO_4$sol:^{n} will be kept in Reagent Bottle.

$KMnO_4$ Standard Sol:^{n}

Take 0.891 g $KMnO_4$sol:^{n} 10 ml and put it in 100 ml volumetric Flask and add distilled water up to 100 ml.

- 1 ml of $KMnO_4$sol:^{n} + 100 ml Distilled Water
  ($KMnO_4$ amount is equal to 1mg/l, of Cl_2)

That–s why it–s to make 0.05 mg/l, 0.1 mg/l , 0.5 mg/l ,1mg/l, 1.5 mg/l, 2 mg/l , 2.5 mg/l , 3 mg/l, 4 mg/l amount solution using $KMnO_4$sol:^{n}.
(Eg: 0.05 ml $KMnO_4$sol:^{n} + 100 ml $NoCl_2$water) = 0.05 mg/l of Cl_2
(0.1 ml$KMnO_4$sol:^{n} + 100 ml $NoCl_2$water) = 0.1mg/l of Cl_2
(3ml$KMnO_4$sol:^{n} + 100 ml $NoCl_2$water) = 3mg/l of Cl

- After getting 0.05 mg/l, 0.1 mg/l,0.5 mg/l ,1mg/l, 1.5 mg/l, 2 mg/l , 2.5 mg/l , 3 mg/l, 4 mg/l solution, it–s to make DPD & Phoshpate Buffer solution to read Abs in Spectrometer.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ် ဆေးရေးဌာနစု	SOP ကဒုတ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

- Firstly, put 1 ml of DPD solution & 1 ml of Phosphate Buffer solution into the tube and shake it.
- Add standard solution 20 ml into the tube and the solution turns to pink color.
  (Based on the amount of $KMnO_4$ solution, the color will be different. If the solution amount is less, the color will be pinkish)
- Put standard solution in the tube into 1' cell cup to 10 ml. Set the Zero Setting in Spectrometer by single wavelength 552 nm Distilled water and put standard solution cell cup and press read and get Abs value.
  (Measure this way for 3 times)
- By using Abs data and drawing graph, get the calibration chart.

Method to measure Residual Chlorine using Wavelength in Spectrometer

- Add desired Cl_2 dosage in the sample.
- Store the chlorinated water in Incubator at temperature 30 degree Celsius. To measure Residual chlorine, it–s to set time schedule for chlorinated water and measure Abs.
  (Eg " 0 hr, 1 hr, 2 hr,……., 22 hr , 24 hr)

Measurement

- Add/put (1 ml) Phosphate Buffer & 1 ml of DPD sol: into test tube and shake it.
- Add Chlorinated sample (20) ml into tube and then shake it again.
- The sol:^{n} in tube will be poured into 1' cell for 10 ml.
- Set the Zero Setting using distilled water on single wavelength 552 nm and put sample cell and press READ and get Abs value.
  (Abs must be measured 3 times per sample)
- Calculate Cl_2 (mg/l) using Cl_2 Calibration Chart and Avg value from Abs data.

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)
ထုတ်ဝေသည့်ရက်စွဲ

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	*EDWS-CL-AP-W-29*
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

<u>5.3.1 Measurement of E Coli, Total Coliform by QUanty Tray (Idexx Reagent)</u>

Items

- Idexx Sample Bottle
- Colilert Reagent
- 97 Tray (or) 51 Tray
- Colilert (Presence/Absence Comparator)
- 97 Tray mold (or) 51 Tray mold
- Quanti-Tray Sealer Plus (Idexx)
- UV Viewing Cabinet
- Ethanol

Before measuring Bacteria, it–s to open/ turn on Incubator in advance. Incubator can be used when the temperature reaches to 35 degree Celsius.

Procedure

- Firstly, disinfect the area with Ethanol.
- Bacteria တိုင်းတာမည့်ရေအား Idexx Sample Bottle 100 ml
- Put a pill of Colilert Reagent into the bottle.
- Then shake the bottle. Don–t shake it to form bubbles.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

- Keep (30 seconds or 1 minute) after the power are dissolved in.
- Then, pour the sample water into 97 tray (or) 51 tray.

  Notice: If the sample water is dirty, use Tray 97 and if it–s assumed the water is clean, use Tray 51.
- When in pouring, press the top of the tray with right hand fingers and press the middle of the tray with left hand and pull out the piece and pour sample water.
- Put Tray into tray mold card and keep in Quanti-tray sealer plus (Idexx) and write down the measured sample water name, date & time on the back of it and place it in Incubator. It–s to set the temperature about 35'C for 24 hours in Incubator. After 24 hours, the sample water color will turn to yellow. The result of the water sample can be compared with Colilert Comparator and read the changing of color.
- The obtained result can be seen on 97 trays MPN Table (or) 51 trays MPN Table.
- For instance, in trays 97 for total coliform, Large well = 49, Small well = 48 and the result table of the two points is > 2419.6. The E-coli result can be read by putting in UV Viewing Cabinet. When the trays turn to blue in UV Viewing Cabinet, the E-coli result can be read. For E-coli result, Large well=49, Small well= 48 and the result of the table in two points is >2419.6.
- For example, in trays 51 for total coliform, Large well = 51 and the result table is > 200.5. The E-coli result can be read by putting into UV Viewing Cabinet. When the trays turn to yellow color in UV Viewing Cabinet, the E-coli result can be read. For E-coli result, Large well= 51and the answer in result table is > 200.5.

- If the colors are not clear in the UV Viewing Cabinet, put the trays in Incubator for 3 hours and then read the result again.
- After reading the result, the result of Coliform & Ecoli must be rewritten down on the back of the trays. The answer/result must be input in Data Sheet.
- Then disinfect the areas with Ethanol. Put the Trays into Autoclavable Disposal bag and disinfect by setting Autoclave Time 10 mins, Temp 121 C. Throw the disinfected trays to the dustbin and then clean the autoclave

5.3.2 Measurement of Total Coliform & Fecal Coliform by MPN Method (Multiple Tube Fermentation Method)

Required Reagents

၁. Ammonium Chloride
၂. Minerals Modified Glutamate Medium Base
၃. Sodium Glutamate
၄. Brilliant Green Lactose Bile Broth 2 %
၅. Membrane Lauryl Sulphate Agar
၆. Ethanol

Required accessories

၁. (100 ml) Reagent Bottle
၂. (30 ml) Reagent Bottle
၃. Test Tube
၄. Burner
၅. Inoculation loop
၆. Agar Plate
၇. AluminiumFoil
၈. Distilled (Sterilized Distilled Water)
၉. Tissue, Mask, Glove
၁၀. (250 ml) Reagent Bottle
၁၁. Distilled Water
၁၂. Sticker
၁၃. Thermometer

Taking Sample water for Bacteriological

(1) Clean the pipe with sprayed Ethanol cotton.
(2) Disinfect the pipe with gas.

(Notice: Don–t do it to plastic pipe)

(3) After disinfection, let the tap run.

(4) Put into Sterilized Sample Bottle (250 ml) after waiting for 2 minutes.

Procedure

When checking/monitoring the water sample, it–s to monitor/check Low, Medium, High level based on the water condition.

Low condition	(100 ml) Reagent Bottle	1 bottle
	(30 ml) Reagent Bottle	5 bottles
Medium condition	(100 ml) Reagent Bottle	1 bottle
	(30 ml) Reagent Bottle	10 bottles
High condition	(100 ml) Reagent Bottle	1 bottle
	(30 ml) Reagent Bottle	15 bottles

For One Sample (Medium Level)

- Firstly, it–s to make (Double Strength, Single Strength) solution.

When making MMGM (Double Strength) Solution

Ammonium Chloride	-5g
Minerals Modified Glutamate Medium Base	-22.7g
Sodium Glutamate	-12.7gတစ်လုံးကို

Distilled water 1000ml တွင်ဖျော်ပါ။

When making MMGM (Single Strength) Solution

Ammonium Chloride	- 2.5g
Minerals Modified Glutamate Medium Base	-11.4g
Sodium Glutamate	-6.4gတစ်လုံးကို

Distilled water 1000mlတွင်ဖျော်ပါ။

It–s to measure pH of the solution (D.S, S.S0

- Before disinfection, pH result must be 6.9±0.2. If pH level is low, it–s to increase/raise pH level using NaoH (1N) and if pH level is high, it–s to decrease the level using HCI (3 N).
- If the pH level reaches to 6.9 levels, add solution 50 ml into Reagent Bottle 100 ml for D.S.

	အင်ဂျင်နီယာဌာန (ရေနှုင့်သန့်ရှင်းမှု) အထေောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

- For D.S, it–s to add 10 ml (5) bottles each using micro pipette into 30 ml Reagent Bottle.
- For S.S, it–s to add 5 ml (5) bottles each using micro pipette into 30 ml Reagent Bottle.
- Disinfect the Reagent Bottles in Autocalve by setting Temperature 115°C for 10 min.
- After the disinfection process, measure/monitor the pH level again. pH results will be kept in data sheet.
- Before adding Sample water, it–s to put the stickers on the cover/lid of solution bottle.

Example : Name of Sample 50ml ⟶ (100ml) Reagent Bottle

Name of Sample 10ml (1,2,3,4,5) ⟶ (30ml) Reagent Bottle (5) bottles

Name of Sample 1ml (1,2,3,4,5) ⟶ (30ml) Reagent Bottle (5) bottles

Name of Sample 0.1ml (1,2,3,4,5) ⟶ (30ml) Reagent Bottle (5) bottles Blank (30ml) ⟶ Reagent Bottle (1) bottle

+ Control ⟶ (30ml) Reagent Bottle (1) bottle

- Add Sample water into solution bottles.
- When adding sample water, firstly heat the sample bottle in the burner.

In low condition

Sample water	(100 ml) Reagent Bottle	1 bottle
(30 ml) Reagent Bottle		5 bottles

In medium condition

Sample water	(100 ml) Reagent Bottle	1 bottle
	(30 ml) Reagent Bottle	10 bottles

In high condition

Sample water	(100 ml) Reagent Bottle	1 bottle
	(30 ml) Reagent Bottle	15 bottles

How to add Sample Water

How to add sample water in each bottle

ဖိုလုပ်အမည် အင်ဂျင်နီယာဌာန (ရေနှုင့်သန့်ရှင်းမှု)
ထုတ်ဝေသည့်ရက်စွဲ

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထွေထွေအကျပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

	100ml Reagent Bottle		30ml Reagent Bottle		30ml Reagent Bottle		30ml Reagent Bottle	
	MMGM (D.S)	Sample	MMGM (D.S)	Sample	MMGM (S.S)	Sample	MMGM (S.S)	Sample
Low	50ml	50ml	10ml	10ml	-	-	-	-
Medium	50ml	50ml	10ml	10ml	5ml	1ml	-	-
High	50ml	50ml	10ml	10ml	5ml	1ml	5ml	0.1ml

(Note : D.S= Double Strength, S.S= Single Strength)

- MMGM (D.S) solutionတွင်+ control ကိုထည့်ရာတွင်ပိုးမွေးထားသော Agar plateကိုယူပါ။ Loop ကို burner ဖြင့်မီးရှို့၍ပိုးသတ်ပါ။ပြီးလျှင် Agar plate ထဲမှပိုးကို Loopဖြင့်ယူ၍ MMGM (D.S) တွင်ထည့်ပါ။ပြီးလျှင် Loop ကို burner ဖြင့်မီးရှို့၍ပိုးပြန်သတ်ပါ။
- When putting + control in MMGM (D.S) solution, take Agar plate which incubate the cells. Disinfect the loop using burner. Take the cells in Agar plate using loop and put it in MMGM (D.S). Then disinfect the loop using burner.
- For Blank, put (10) ml Sterilized Distilled Water into MMGM (D.S).
- After that, put 50 ml into 100 ml bottle. Then, put/add 10 ml into 30 ml bottle using micro pipette.
- S.S အတွက် 30 ml ပုလင်းထဲသို့ 1 ml ထည့်ပါ။ထို့နောက် Incubator ထဲသို့ Temperature37℃တွင် 48 hrထား၍ပိုးမွေးရပါမည်။
- For S.S, put 1 ml into 30 ml bottle. Then keep it in Incubator at Temperature37℃ for 48 hours to incubate.
- Put sample bottles, + control and blank bottles together.
- For Blank, put/ add 10 ml distilled water into D.S bottle.
- ၄၈နာရီပြည့်လျှင်ပိုးမွေးထားသောပုလင်းများကို ထုတ်၍အရောင်ပြောင်းလဲခြင်းရှိ/ မရှိကြည့်ရမည်။ပုလင်းတွင်အဝါရောင်ပြောင်းပါကပိုးရှိ၍ခရမ်းရောင်အတိုင်းကျန်ရှိနေပါကပိုးမပေါက်ခြင်းမရှိပါဟုယူဆရမည်။ ထို့နောက် MPN method ဇယားတွင် result ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထွေထွေအကျပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

ဖတ်ပါ။အရောင်ပြောင်းသောပုလင်းများအား BGLB solution Tube အတွင်းထည့်၍ Fecal Coliform မွေးရန်ပြင်ဆင်ရပါမည်။

- After 48 hours, check the incubated bottles whether the color has changed or not. If there is yellow color in the bottle, there are bacteria and if the color is still purple, there aren–t any bacteria. Then read the result on MPN method table. The color changing bottles will be kept in BGLP solution tube and prepare to incubate Fecal Coliform.

BGLB ဖျော်ရန်တွက်နည်း:For1 Sample

e.g Sample အရေအတွက်၁၁ပုလင်း+ Plus Control + Blank
Total ၁၃ပုလင်း×၂ (For 37℃ and 44℃)
စုစုပေါင်း ၂၆ပုလင်း

Distilled Water ……………………………BGLB
1000 ml …………………………….. 40g
လိုချင်တဲ့ ml …………………………….. ?

Making BGLB Solution

Make the solution (BGLB 40g) in Distilled Water 1000 ml.

Before Sterilized

- If pH level is low, increase the level using NaOH and if pH level is high, decrease the level using HCI.
- Fill 5 ml each into Test tube using Micro Pipette.
- Disinfect in Auto Clave with the Temperature12° C and Time 15 minutes. And then measure pH.

BGLB Solution Sticker ကပ်နည်း

Name of Sample 50 ml → 37 °C, 44 °C
Name of Sample 10 ml (1,2,3,4,5) → 37 °C, 44 °C
Name of Sample 1 ml (1,2,3,4,5) → 37 °C, 44 °C
Name of Sample 0.1ml (1,2,3,4,5) → 37 °C, 44 °C
+ Control → 37 °C

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

Blank → 37°C → 44°C

- ပိုးသတ်ထားသော BGLB Solutionထဲသို့MMGMSolutionဖြင့်၄၈နာရီကြာ 37° C Incubator ထဲတွင်ပိုးမွေးထားထားသောအရည်ကို Inoculation Loop ဖြင့်ထည့်ပါ။
- Put the incubated solution which is in 37° C Incubator for 48 hours into disinfected BGLP solution using Inoculation Loop.
- When putting/adding into BGLB Test tube by using Inoculation Loop, disinfect the Inoculation Loop by using burner.
- It—s to mark Temperature37°C & 44°C separately on BGLB Test Tube.
- The two solutions will be kept in Incubator under Temperature37°C & 44°C respectively.
- When the time—s up, if there are bubbles in Durham Tube in BGLB Solution Tube, it means there is coliform. The result can be read on Quantification MPN table. (The result got on 37°C is Total Coliform and the result on 44°C is Fecal Coliform)
- အထားလုံးပြီးပါကပိုးမွေးထားသောMMGMနှင့်BGLBပုလင်းမျာားကို Auto Calve တွင်Temperature 121 ° C, Time 30 min ဖြင့်ပိုးသတ်ရပါမည်။
- After that, all the incubated MMGM & BGLB bottles will be kept in Auto Calve and disinfect at Temperature 121°C, Time 30 min.
- After disinfection, wash it and keep it dry in Oven.

(Note: Before & after the process, disinfect with Ethanol)

Making Agar

- Dilute Agar 86.2 g with distilled water 1 g (1000ml).
- Measure pH. pH level must be at 7.7 ± 0.1.
- To adjust pH level, it—s to do according to BGLB, MMGM methods.
- Then add/put the solution into Conical Flask and cover with Alumimium Foil and disinfect in Auto Clave at the Temperature of 121C for 15 minutes.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ် ဆေးရေးဌာနစု	SOP ကဒုခ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

After disinfection, measure pH level again.

- Before Agar are getting cold, head the conical flask with burner and put in Agar Plate to keep cool. If the Agar becomes solid in Agar Plate, cover with Aluminium Foil and keep it in the fridge.

+ Control ပြုလုပ်ပုံ

- Disinfect Inoculation Loop with Burner.
- Take sample water using disinfected Loop and draw on Agar Plate.
- Put the Plate in Incubator for 48 hours under 44°C temperature.
- After 48 hours, there will be bacteria on Agar.
- Cover Agar Plate with Aluminium Foil and keep it back in the fridge.
- It—s incubation on Agar to check the result using Plus Control.
- When putting/placing the sample bottles in Incubator, it—s necessary to write down the Incubator Device Name, Display Temperature, Thermometer Temperature, Date, Time & name of analysed person.
- Thermometers are kept in Incubator.

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)
ထုတ်ဝေသည့်ရက်စွဲ

5.1.1 pH Calibration For Mettler Toledo Brand

Maintenance

Meter

1. Never pull out the Probe Stand from Meter Box.
2. Don't wipe the meter with wet cloth if it isn't necessary.
3. If Organic Solvents (toluene, xylene and methyl ethyl ketone) spill over meter, wipe with wet cloth immediately.
4. While in measuring, it's to shake the sample water beaker slowly.

Electrode

1. Keep the Electrode in Electrolyte Solution and not to make it dry.
2. If the electrolyte solution accuracy is high, then remove the probe from electrolyte bottle and wash the sensor with deionized water.

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု..... ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေး ဌာနစု	SOP ကုဒ်အမှတ်	EDWS-SuD-EP-WI 2
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.1.2 EC Calibration For Mettler Toledo Brand

Maintenance

Meter

1. Never pull out the Probe Stand from Meter Box.
2. Don't wipe the meter with wet cloth unless necessary.
3. If Organic Solvents (toluene, xylene & methyl ketone) spill over the meter, wipe it with wet cloth immediately.
4. While in measuring, it's to shake the sample water beaker slowly.

Electrode

1. While in measuring, don't touch the probe with hands. Press the Blue button in the probe stand and move up & down position slowly.
2. After measuring, wash the probe with deionized water & keep it dry.

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

5.1.3 Balance

Procedure

1. To use balance, it's to turn the power on 1 hour in advance.
2. If it's to use the device, put the first empty dish on weighing pan. And a value will be appeared.
3. Press → O/T ← button and set Zero Setting. If '0.00g' appears, then put the measured material in the dish and press O/T to weight.
4. If '0' appears on screen, it's needed to wait to get value. If '0' symbol disappear, then can read the weight of material.
   - Notice : After using the device, it's to take out the dish on weighing pan. Then negative value will be appeared on screen. Then press → O/T ← button and turn off the power.

Maintenance

1. When placing/keeping balance, the bottom must be stable & in horizontal position.
2. Don't keep the balance in vary/unstable temperature.
3. Don't keep it in direct sunlight.
4. Don't place it in direct air pressure. (E.g., fan, air con)
5. It's always to check the level indicator on balance. The air bubble in level indicator always must be in center.
6. If Air bubble shows 12, it's necessary to adjust by turning the wheels under device in clock wise position simultaneously.

7. If Air bubble shows 3, it is to turn the wheel in left to clock wise position & wheel in right to anti-clock wish position simultaneously.
8. If Air bubble shows 6, it's to turn both wheels in anti-clock wise position simultaneously.
9. If Air bubble shows 9, it's to turn the wheel in left to anti-clock wise position & wheel in right to clock wise position simultaneously.

Remark: If it's to move the balance from one place to another, it's to adjust Air bubble to center at once and then can use it.

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

5.1.4 Oven

Turn on the switch on the oven. Wait until Signal becomes stable on the screen.

Choosing Program on Oven

1. Press Menu. Choose Program. And edit the temperature on each program. (E.g. For S.S, Temperature – 105°C) and save it.
2. If it's to use oven, press Menu and Run. After pressing run, choose the program and immediately.
3. After pressing Run and warning sign appears on Screen, then it's necessary to check the whole process again.
4. After using Oven and want to turn off, press Stand By Mode. And then turn off the switch on the oven.

Caution

When drying the items/ things in the oven, it's to mind not to hit the temperature sensor in the oven.

5.1.5 Desiccator

1. If it's to use desiccator, it's to place the filter papers close to silica gel.
2. After putting Filter Paper, it's to close the door immediately.
3. When measuring Filter papers, it's to measure the filter one by one. It's to close the door after taking each paper.

Maintenance

1. It's always to check the color of silica gel in desiccator.
2. If the color of silica gel (blue color) in desiccator turns to light blue, it's to heat it in the oven.
3. After using, it's to close the door carefully.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ..... ဌာနခွဲ ..... ဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြု..... ဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေး ဌာနစု	SOP ကုဒ်အမှတ်	EDWS-SuD-EP-WI 6
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

5.1.6 Measurement of Turbidity (HANNA)

Maintenance

1. It's to do calibration the turbidity meter before measuring sample water.
2. When doing calibration, it's to do 5 points calibration.
3. When doing calibration, firstly press 'CAL'.
4. Point 1 will be appeared on meter screen. For Point 1, put/add 0.1 NTU Calibration liquid into the device and press READ.
5. Point 2 will be appeared on meter screen. For point 2, put/add 15 NTU Calibration liquid into the device & press READ.
6. Point 3 will be appeared on meter screen. For point 3, put/add 100 NTU Calibration liquid into the device & press READ.
7. Point 4 will be appeared on meter screen. For point 4, put/add 750 NTU Calibration liquid into the device & press READ.
8. Point 5 will be appeared on meter screen. For point 5, put/add 2000 NTU Calibration liquid into the device & press READ.
9. After the calibration process/step, Store will be appeared.
10. It can start to measure the sample water turbidity.

Caution

1. Before putting in the meter, rub/wipe with tissue.
2. When rubbing with tissue, it's careful not to make any stripe on the cell bottle.

5.1.7 DO Meter

It's to do calibration in the air before measuring DO Meter.

Calibration

1. Before calibration, it's to connect Sensor & the device for at least 6 hours.
2. It's to check the membrane condition before calibration and contamination. If it's dirty, clean with wet & soft cloth.

1- Point Calibration

ရေ Sample ထည့်ထားသော ပုလင်းထဲသို့ Probe အား ၁ မီတာခွါ၍ လေဟာနယ်ထဲတွင်ထားပါ။

1. Place the Probe in sample water bottle 1 meter above vacuum.
2. Press Cal button. If it's reached to End point, press Read. Wait for few seconds and press End.
3. The value/ digit will be appeared on Display.
4. Then press Save. If you don't want to save, press Cancel.

Operation

1. Put DO Probe into sample water.
2. Press 'READ'.
3. The DO value will be shown in (mg/l).

Maintenance

Meter

1. Never pull out the Probe stand from meter box.
2. Don't wipe the meter with wet cloth unnecessarily.
3. If Organic Solvents (toluene, xylene & methyl ethyl ketone) spills over the meter, wipe/rub with wet cloth immediately.
4. When in measuring, it is to shake the beaker slowly.

Electrode

1. When in measuring, don't touch the probe with hand. It's to move up & down slowly by pressing blue button on Probe stand.
2. After measuring, wash/clean the probe with Deionized water and keep it dry.

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ..... ဌာနခွဲ ..... ဌာနစု	SOP ကုဒ်အမှတ်	
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		စာမျက်နှာအမှတ်	

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

5.1.8 U-50 Meter

Procedure

Choosing/ selecting GPS

(When choosing GPS location, it's to choose space area. GPS can't be chose in the building)

1. Select/choose using Right Key in the Setting.
2. Move the cursor to system using Down Key and press Enter.
3. Press down key and select 'GPS Locate' and press Enter.
4. If 'Press ENT Key to start position measurement' appears on LCD, press ENTER & select/choose Yes.
5. 'Warming up. Please wait' will be appeared. Warming up time will take 10 seconds. After warming up time is over, the location point will move automatically for about 40 times. If location point gets, Longitude & Latitude will be shown in LCD.
6. If location point can't be shown, it's to avoid/ remove the barriers when choosing location (E.g., avoid to measuring in the building)

Choosing correct GPS Location

1. Choose GPS location accuracy and can find 3 levels. (Low, Middle, High) and can choose either one by selecting Black Circle.
2. Satellite sign will be shown on LCD which means GPS is on in the meter.

Calibration

In U 50, there is Auto Calibration & Manual Calibration.

1. Before doing calibration, it's to turn on DO sensor for 30 minutes.
2. Put Standard solution 200 into Calibration Cup to do calibration.
3. When doing calibration for pH, Cond, Turbidity, DO and depth, the temperature must be 25 degree Celsius.
4. If the air temperature change, the result will be vary/ not stable. Thus, the environment temperature & Standard Solution Temperature must be equal/ the same.
5. While in calibration, don't touch the probe with hands.

Auto Calibration

1. Before Calibration, uncap the Probe and wash with deionized water for (2) or (3) times.
2. Take clear Calibration cup. Put/ add pH4 Standard solution up to the limited line on the cup.
3. Choose/select Auto Calibration on Calibration Setting and then press ENTER.
4. Put Sensor in Calibration liquid. When putting the Probe into Calibration cup, the DO probe must be removed & inserted/put carefully. There mustn't be bubble in pH solution.
5. Then, put the clear cup to black cup.
6. Wait for 3 minutes to get/show Sensor value. And then press ENTER.
7. After the Calibration process, the message 'Cal completes. MEAS to measure' will be appeared. At that time, press MEAS and can do measurement.

Measurement procedure of U50

1. Press Power Button for 1 second. Then after ten seconds, MEASUREMENT will be appeared.
   Notice: Don't use the sharp items to turn on the device..
2. Press 'Right' button and Setting will be shown.
3. Press 'Down' button, select 'MEASUREMENT' and press 'Enter'.
4. Press 'Down' button, select 'Single Measurement' and press 'Enter'.
5. If Interval Measurement is selected, Time can be measured. Press Up & Down to set the measurement time.
6. Back to 'Setting' screen and choose 'Select Site' and can set the location name on the device.
7. Back to 'Setting' on the screen and choose 'Unit for report' and can choose the Unit for each parameter.
8. Back to 'Setting' on the screen and can choose 'Sensor Selection'.
9. Back to 'Setting' on the screen and choose 'Compensation' and then can set Max; Or Min; Range of each parameter.
10. Back to 'Setting' on the screen and choose 'System' and can change 'Language'.
11. Back to 'Setting' on the screen and choose 'System' and can change 'Date & Time'.
12. Back to 'Setting' on the screen, choose 'System' and can change the brightness on 'Display & Contract'. Back to 'Setting' on screen and choose 'System' and can change Initialize.
13. After changing the above steps, then press Enter.

Manual Calibration

It's to do Manual Calibration for the first time to use the device and if there is error.

Caution for measurement of U50

1. Put the Sensor Probes into sample slowly.
2. If Probe falls down from 1 meter above, it can break.
3. Don't put the probe into the water lower than 30 meter depth.

4. After turning on Power and reading DO, it's to check the stability. (It will take 30 minutes)

Procedure

1. It's to check whether Sensor is fixed in Sensor Guard or not.
2. Select Single Measurement.
3. Put the Sensor Probe in the water and shake it a little. (To remove the bubble in the sensor)
4. When the digit/number become stable on LCD, and then presses MEAS.
5. If the data is stable, press Enter.
6. If you want to erase the measurement, press ESC.

5.1.9 Jar Test (Laboratory Flocculator)

1. Adjust by turning the bolt on the device.
2. Place the beakers.
3. Put the mixer on the beakers. (Caution: the bottom of the beakers and mixer must not be touched)
4. Turn on the power.
5. Press Key 5 and select LED 2. To define/set speed parameters, press Key 4 and choose speed with key 5 & 6. After choosing the speed, it will show on Digital display.
6. Press Key 6 and choose LED 3. Press Key 4 to set the time and choose the time by Key 5 & 6. After choosing Time, it will show on Digital display.
7. To start the process, press Key7 (Start/Stop). If you want to turn off, press Key7 (Start/Stop) again. If time's up, turn off it again.
8. If necessary, turn on the Light switch.

Maintenance

1. Wash the mixer with Ethanol.
2. Don't spray plastic coating with ethanol directly. Use cotton bud and clean it.

Reference

1. Key 1 indicates the numbers of Speed & time.
2. Key 2- LED light indicates Speed.
3. Key 3- LED light indicates Time.
4. Key 4- To select Speed & Time.
5. Key 5- To press when you want to increase Parameter value.
6. Key 6- To press when you want to decrease Parameter value.
7. Key 7- Press Start/Stop.

5.2.1 DR-6000 (UV Spectrophotometer)

Procedure

1. Turn on the Power.
2. Wait for 45 seconds. Self-check box will be appeared.
   ထို Self-Check Box တွေင် 100% ပြည့်သည်အထိခေတ္တစောင့်ပါ။
3. Wait until Self-check box gets to 100%.
4. And then, Main Menu Box will be appeared on Screen.
5. Choose & press Stored Program.
6. Box will be shown to choose the Code.
7. Choose the measured parameter Code Number and press OK.
8. For Zero Setting, put the first blank cell and press Zero.
9. And put measured cell and press READ and get result.
10. If you want to check the past measured result, press Recall Data on Main Menu Box.
11. Recall data box will be appeared. Press Data log on Recall Data box.
12. Then, can check the data result on Recall Data Box.
13. After the measurement, press Back button to exit to Main Menu.

Caution

- Before placing/putting the cell into Spectrophotometer, clean the cell using dry tissue. (Mind not to get strips)
- The diameter of the cell & lamp must be in fix/horizontal.
- Don't put the cell in the device.
- After using the device, it's to remove the plug.
- The Lamp must be cool.

5.2.2 Fume Hood

1. Turn on the Switch.
2. Turn on Exhaust Fan switch. (making acid solution, chemical solution, making high concentration solution)
3. After using it, spray with distilled water and clean with tissue.

5.2.3 DRB 200 Reactor (Digester)

Procedure

1. Turn on the Power Switch on the device.
2. Press the button in the middle of the device.
3. Select Block will be appeared. Both 'Right' & 'Left' will be appeared. Select the side you want to use.
4. Select program will be appeared. Select the temperature you want.
5. Digestion Period will be appeared on Screen. Select the time you want to use. And press 'OK'.

Maintenance

1. Turn off the power after using. Keep the device cool.
2. Can clean the device using soft & wet cloth.

Caution

If the Liquids in Vital Tube overflow or broke or spilt a little, it's to do as to the following procedure.

1. Turn off the device and get/let the device cool.
2. The spilled liquid will be taken by Pipette. While doing so, it's to be careful not to touch with body skin.

5.2.4 Burette

1. Install the Burette in the Burette Stand. (The mark should be on the side of person)
2. Firstly, put the funnel on the burette and fill the tap water and open burette valve and wash it.
3. Then clean/wash using Distilled water as to above procedure.
4. Clean/wash using chemical solution as to above procedure.
5. Then, close Burette valve.
6. After closing, fill the chemical solution using funnel.
7. To read the chemical solution point, it's to take the point which indicates the bottom of the line.
8. After using Burette, wash it in the basin and cover with Aluminium Foil and place it in the Stand.

5.3.1 Quanti-Tray Sealer Plus (IDEXX)

Procedure

1. Press Power button in the back of device/equipment. Then, yellow light will be appeared.
2. After the device is getting warm, it turns to green light. (If it isn't turned to green light, it can't be used. It's because it hasn't reached to specific temperature.)
3. If the light turns to green, the prepared Sample trays will be placed in Mold and Sealer and seal/close it. (Before placing the trays in Sealer, don't used Label Tape. It can damage Sealer. The Label tape can be used after Sealer)
4. After 10 seconds, the tray will be out and if it isn't ok press reverse button.
5. After using Sealer, first turn off the power button and plug.

Maintenance

1. Clean/ wash Rubber Tray using mild soap.
2. Rub the outside of Sealer using dry & delicate cloth.
3. While placing Tray in the Sealer and it becomes unfit or spill the sample water, don't take out the try and wait until the device stops.
4. If there is some error, it's to contact the company and do maintenance works.

5.3.2 UV-Viewing Cabinet (WL-160)

Procedure

1. Press Power Button.
2. UV Lamp will be lighted.
3. Put the Tray and can read E-Coli Result.

Notice / Caution

After turning off the power button, it's to pull the plug. Don't check/look UV Lamp by eyes directly.

Maintenance

1. If the light of UV Lamp becomes weak, it's to replace.

5.3.3 Incubator (Selecta

Procedure

1. Press Main Switch. (Two green lights will be appeared)
2. Turn the Blue Button to get the certain/desirable Temperature into clockwise position.
3. After adjusting desirable Temperature, press Blockage Device.
4. When the temperature reaches to desirable temperature, the Operation Indicator Lampe (Yellow light) will be appeared.

Maintenance

1. Wash with Ethanol.
2. Don't spray Plastic Coating with Ethanol directly. Put Ethanol on cotton ball and clean.

5.3.4 Auto Clave

Procedure

1. Close Drain Valve in Autoclave.
2. Put/Add distilled water up to Heater Protection Cover.
3. The disinfected items will be put in the bucket and put that bucket in Autoclave.
4. Close the Chamber and turn it into clockwise position tidily.
5. Close the air valve by turning clockwise position.
6. Install the Circuit Breaker.
7. Press the Power button which is on the left side of the device/equipment. The Current Temperature Light will be appeared. Change/adjust the desirable temperature.

Changing/ adjusting the temperature

a. Press Mode button.
b. 'Temperature' will be appeared.
c. Press△ and move it to desirable place/location.
d. Using the arrow in the device, choose 0 to 9 values.
e. The maximum temperature is 121'C and not to exceed 121'C.

Changing Time

a. Press Mode button.
b. 'Time' will be appeared.
c. Press△ and move it to desirable place/location.
d. Using the arrow in the device, choose 0 to 9 values.
e. The maximum minutes are 59 minutes 59 seconds. The factory default time value is 20 minutes.

f. Setting Temperature & Time and press Mode button.
g. After choosing Temperature & time, press Start button to start operation.

Notice

1. Don't open the lid of the device while disinfection process.

2. If Ventilation shows on SV LED during disinfection process, then turn on the air valve slowly.
3. If the temperature reaches to 95·C and END appears on SV CLED, then press STOP button.
4. Wait till the pressure becomes low and then open the lid.
5. Not to open the lid of the device just after the disinfection process.

Maintenance

1. It's to clean the Spill in Autoclave when it's getting cold.
2. If the glassware in Autoclave is broken, it's to take the pieces with tweezers.
3. To protect from smell & contamination, it's to replace the distilled water after using the device for (5) times.

Mini laboratory SOPs

	ရန်ကုန်မြို့တော်ရေနှင့်သန့်ရှင်းမှုဦးစီးဌာန ENGINEERING DEPARTMENT (WATER & SANITATION) **ရန်ကုန်မြို့တော်ရေနှင့်သန့်ရှင်းမှုဦးစီးဌာန** **ယာယီရေးကရေတွင်းစည်းပင်သာယာ** **အင်ဂျင်နီယာဌာန** (ရေနှင့်သန့်ရှင်းမှုဦးစီးမှူး) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ် ဆေးရေးဌာနစု …… ……	**SOP ကဒ်အမှတ်**	EDWS-LAB-OP2
		ဗဟိုရှင်းအမှတ်	01
		စတင်အသုံးပြုသည့်နေ့	April 20, 2021
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		အတည်ပြုသူ	DYCE-1
		ခွင့်ပြုသူ	CE

1. **Topic**
   - Water Quality Monitoring in Mini Laboratories

2. **Objective & Scope**
   - To understand the staff working in mini laboratories.
   - It's only for mini laboratories.

3. **Abbreviation & Definition**
   EC = Electrical Conductivity

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1 2 3 4	- Daily activities to do in the laboratory - Taking water sample - Water Quality Monitoring - Making report	Staff in the mini laboratories	Central Laboratory

5. **Procedure**

5.1 Daily Activities to do in the laboratory
- It's to follow according to **EDWS-LAB-OP2-W5.**

5.2 Taking Sample
- For taking sample, it's to follow according to **EDWS-LAB-OP2-W6.**

5.3 Water Quality Monitoring

(1) When in using pH meters, it's to follow according to **EDWS-LAB-OP2-W1** and in the mini lab of Nyaunghnapin WTP, it's to follow as to **EDWS-LAB-OP1-W1.**

(2) When in using Turbidity meters, it's to follow according to **EDWS-LAB-OP2-W2.**

(3) When in using Color meters, it's to follow according to **EDWS-LAB-OP2-W3.**

(4) When in using Chlorine meters, it's to follow according to **EDWS-LAB-OP2-W4.**

(5) When in using EC Meters, it's to follow according to **EDWS-LAB-OP1-W2. (Nyaunghnapin WTP mini laboratory)**

(6) When in measuring Salinity, it's to follow the instruction **EDWS-LAB-OP1-W3. (Nyaunghnapin WTP mini laboratory)**

(7) When in measuring Total Dissolved Solid, it's to follow the instruction **EDWS-LAB-OP1-W4. (Nyaunghnapin WTP mini laboratory)**

(8) When in measuring Jar Test, it's to follow the instruction **EDWS-LAB-OP1-W5. (Nyaunghnapin WTP mini laboratory)**

5.4 Reporting

(1) Water Quality Monitoring results are to submit to Central Laboratory in every week & every month in both soft & hard copy files.

(2) If monitoring equipment have error or abnormal conditions, it's to inform to central laboratory at once by mobile phone or in person. (If equipment is needed to repair or maintain, the central laboratory staff will take care of it and need to replace the equipment, the central laboratory staff will submit the information to top level step by step and get instruction)

6. Related documents

(1)	**EDWS-LAB-OP1-W1**	pH measurement instruction
(2)	**EDWS-LAB-OP2-W1**	pH measurement instruction (mini laboratories)
(3)	**EDWS-LAB-OP2-W2**	Turbidity measurement instruction (mini laboratories)
(4)	**EDWS-LAB-OP2-W3**	Color measurement instruction (mini laboratories)
(5)	**EDWS-LAB-OP2-W4**	Chlorine measurement instruction (mini laboratories)
(6)	**EDWS-LAB-OP1-W2**	EC measurement instruction
(7)	**EDWS-LAB-OP1-W3**	Salinity measurement instruction
(8)	**EDWS-LAB-OP1-W4**	Total dissolved Solid measurement instruction
(9)	**EDWS-LAB-OP1-W5**	Jar Test measurement instruction
(10)	**EDWS-LAB-OP2-W5**	Instruction for daily activities in the laboratory.
(11)	**EDWS-LAB-OP2-W6**	Instruction for taking sample

7. Related forms

(1) Daily record book (mini laboratories)

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	**SOP ကဒ်အမှတ်**	EDWS-LAB-OP2
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8. Reference

- Manual Books of Central Lab (central laboratory)

9. Appendix

- Nil

EDWS-LAB-OP2 Minilab SOP.docx အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)
2021 ဖေဖော်ဝါရီ 20

1. **Topic**
   - Measurement of pH

2. **Objective & Scope**

   - To follow/use the staff in Central Lab & mini lab in Nyaunghnapin WTP.

   - It's only for Mettler Toledo Brand pH Meter.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1 2	pH meter Calibration Measurement of pH Read	Staff in the laboratory	Central Laboratory

5. **Procedure**

5.1 Calibration for Mettler Toledo Brand

(1) Firstly, press On/Off and set pH setting.

(2) Press Mode and press Read for 2 times. Then select (4.01, 7.00, 9.21).

(3) After choosing 4.01 and then, put Probe in 4.01 Calibration liquid and press Cal. (Add 10 ml Calibration liquid). If root appears on A, then Calibration process is finished and then press Exit button.

(4) After choosing 7.00, then put Probe in 7.00 Calibraion liquid and press Cal. (Add 10 ml Calibration liquid). If root appears on A, then Calibration process is finished and press Exit button.

(5) After choosing 9.21, then put Probe in 9.21 Calibration liquid and press Cal. (Add 10 ml Calibration liquid). If root appears on A, then Calibration process is finished and press Exit button.

5.2 Measurement of pH Read

(1) Put the Probe in Sample water and press Read.

(2) If root appears on A, then can read the answer. (Noted: there isn't unit)

6. **Related documents**
   - Nil

7. **Related Forms**
   - Nil

8. **Reference**
   Manual Books of Central Lab

9. **Appendix**
   - Nil

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) အထောက်အကူပြုဌာနခွဲ ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု …… ……	**SOP ကုဒ်အမှတ်**	EDWS-LAB-OP1-W2
		ဗားရှင်းအမှတ်	01
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		အတည်ပြုသူ	DYCE-1
		ခွင့်ပြုသူ	CE

1. **Topic**
   - Measurement of EC

2. **Objective & Scope**

   - It's to use the staff in Central Laboratory & mini laboratory in Nyaunghnapin WTP.

   - It's only for Mettler Toledo Brand EC meter.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	pH meter Calibration	Laboratory staff	Central Laboratory
2	Measurement of pH		

5. **Procedure**

5.1 Calibration for Mettler Toledo Brand

(1) Firstly, press On / Off button. Set in EC Setting.

(2) Press Mode & Read. Then select (12.88, 1413) in each.

(3) After choosing 12.88, put Probe in 12.88 Calibration liquid & press Cal. (10 ml Calibration liquid). If root appears on A, the calibration process is finished. Then press Exit button.

(4) After choosing 1413, put Probe in 1413 Calibration liquid & press Cal. (10 ml Calibration liquid). If root appears on A, the calibration process is finished. Then press Exit button.

5.2 Measurement of EC Read

(1) Put Probe in Sample water and press Read.

(2) If root appears on A, then can read the answer. (Noted: The unit must be µS/cm. If the unit is mS/cm, then multiply by 1000)

6. **Related documents**

- Nil

7. **Related Forms**
   - Nil

8. **Reference**
   Manual Books of Central Lab

9. **Appendix**
   - Nil

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ	SOP ကုဒ်အမှတ်	EDWS-LAB-OP1-W3
		ဗားရှင်းအမှတ်	01
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	ရေအရည်အသွေးကြီးကြပ်စစ်ဆေးရေးဌာနစု	ရေးသားသူ	AE
		အတည်ပြုသူ	DYCE-1
	.....	ခွင့်ပြုသူ	CE
	.....		

1. **Topic**
   - Measurement of Salinity

2. **Objective & Scope**

   - To follow/use the staff in Central Laboratory & mini laboratory in Nyaunghnapin WTP.

   - It's only for Mettler Toledo Brand Meter.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	Measurement of Salinity	Laboratory staff	Central Laboratory

5. **Procedure**

   5.1 Calibration for Mettler Toledo Brand

   (1) Firstly, press EC Meter On/Off button. Set in Salinity setting. Put Probe in sample water and then press Read.

   (2) If root appears on A, then can read the answer. (Noted: The unit is PSU)

6. **Related documents**
   - Nil

7. **Related Forms**
   - Nil

8. **References**
   - Manual Books of Central Laboratory

9. **Appendix**
   - Nil

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ	SOP ကုဒ်အမှတ်	EDWS-LAB-OP1-W4
		ဗားရှင်းအမှတ်	01
	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)	စတင်အသုံးပြုသည့်နေ့	April 20, 2021
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		အတည်ပြုသူ	DYCE-1
	.....	ခွင့်ပြုသူ	CE
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1. **Topic**
   - Measurement of TDS

2. **Objective & Scope**

   (1) To use/follow the staff in Central laboratory & Nyaunghnapin Mini Laboratory.

   (2) It's only for Mettler Toledo Brand meter.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	Measurement of TDS	Laboratory Staff	Central Laboratory

5. **Procedure**

   5.1 Measurement of TDS

   (1) Firstly, press EC Meter On/Off button. Set in TDS Setting. Put the Probe in Sample Water and press Read.

   (2) If root appears on A, then can read the answer. (Noted: The unit must be mg/L. If unit is g/L, then multiply by 1000).

6. **Related documents**
   - Nil

7. **Related forms**
   - Nil

8. **Reference**
   - Manual Books of Central Laboratory

9. **Appendix**
   - Nil

1. **Topic**
   - Measurement of Jar Test

2. **Objective & Scope**
   - To follow/use the staff in Central Laboratory & Nyaunghnapin Mini Laboratory.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	Measurement of Jar Test	Laboratory Staff	Central Laboratory

5. **Procedure**

Necessary Items

1. 1 Lit Beakers — 6 nos
2. Measuring Cylinder (1000 ml) — 1
3. Flocculation Tester — 1
4. 100 ml Volumetric Flask — 1
5. Syringe — 1
6. pH meter — 1
7. Turbidity meter — 1
8. Color meter — 1
9. ACH — 1 ml

1. Prepare 1 litter Beakers (6) cups.
2. Wash these beakers with distilled water thoroughly.
3. Pour Sample raw water into measuring cylinder (1000 ml) slowly and then fill up 1000 ml each in 6 beakers.
4. Measure pH, Turbidity, & Color for Sample raw water.
5. Places the beakers in the Flocculation Tester.
6. Dilute ACH Solution. Put/ add 1ml original ACH solution to 100 ml volumetric flask and add distilled water up to the mark on 100 ml volumetric flask. And then get 1% ACH solution.
7. Add diluted ACH solution to prepared Beakers accordingly.

Eg : 5ppm=0.5 ml, 10ppm=1ml, 25ppm= 2.5 ml
Noted: To dose ACH solution after mixing.

8. Rpm – 120 & Time- 5 minutes
   Rpm – 40 & Time – 15 minutes
9. If time's up, lift the missing propeller out of beakers and wait 20 minutes for sedimentation time.
10. After that, take the water in beakers using Syringe and measure pH, turbidity and color.
    Noted: While taking out the water in beakers, not to make sediment

6. **Related Documents**
   - Nil
7. **Related Forms**
   - Nil
8. **References**
   - Manual Books of Central Laboratory
9. **Appendix**
   - Nil

1. **Topic**
   - To measure pH in the mini laboratories.
2. **Objective & Scope**
   (1) To follow the staff in the mini laboratories.
   (2) It's only for pH Bench Top Meter (AE-150).
3. **Abbreviation & Definition**
   - No
4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	pH meter Calibration	Staff in mini laboratories	Central Laboratory
2	pH measurement		

(၄) pH 7ကိုBeakerခွက်အတွင်း Probe မြုတ်မည့်ပမာဏလောက်ထည့်ပါ။

5. **Procedure**

5.1 Calibration for pH Bench Top Meter (AE-150)

(1) Press On/ Off on pH meter.
(2) If pH meter is on, then MEAS appears on Screen.
(3) Before calibration, shake the pH Calibration bottle.
(4) Add pH7 in the beaker enough amount to mute the probe.
(5) Press Cal/MEAS. If Ready appears, press Enter and get 7:00.
(6) Put pH 4.01 solution and calibrate. If Ready appears, press Enter & get 4.01.
(7) Put pH 10.01 solution and calibrate. If Ready appears, press Enter & get 10.01. (Noted: If it's to calibrate, first put pH7 liquid and measure it. Then calibrate pH 4.01 and pH 10.01. Don't rub Probe which is used to measure pH meter with tissue. It's only to clean using Distilled water. If ERROR appears on screen, then press Exit to press Cal/MEAS.

5.2 pH Read measurement

(1) Press On/Off on meter.

(2) Put the sample in the beaker and put pH Probe in it.

(3) If Ready appears on screen, then get the result/answer.

(4) Press MODE and change pH, mV.

6. Related Documents

- Nil

7. Related Forms

- Nil

8. References

Manual Books of Central Lab

9. Appendix

- Nil

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1. Topic

- To measure the Turbidity in the mini laboratories.

2. Objective & Scope

(1) To follow/use the staff in the mini laboratories.

(2) It's only for Turbidity Meter (HANNA).

3. Abbreviation & Definition

- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	Turbidity Meter (HANNA)	Staff in mini laboratories	Central Laboratory
2	Turbidity Meter (HANNA) Calibration Turbidity Measurement		

5. Procedure

5.1 Turbidity Meter (HANNA) Calibration

(1) Put Distilled H20 10 ml in the cell.

(2) Rub the Cell bottle in Turbidity meter with a piece of cloth.

(3) Then press "Calibration".

(4) If "-------" appears, it's the end of calibration procedure.

5.2 Turbidity measurement

(1) Firstly, press On/Off button.

(2) Then "-------" will be appeared on meter screen.

(3) Then put/add 10 ml sample into the cell.

(4) Wait till the bubbles in the cell disappear.

(5) Put the cell in the meter.

(6) The mark on the lid of the cell and the mark on the meter must be fit.

(7) Press Read. Then "SIP" appears on the screen and after 25 seconds, Turbidity value/result will be out. (Noted: Take the battery off in the meter in weekends.)

6. Related documents
- Nil

7. Related forms
- Nil

8. References
- Manual Books of Central Lab

9. Appendix
- Nil

1. Topic
- To measure Color in the mini laboratories

2. Objective & Scope

(1) To follow/ use the staff in mini laboratories.

(2) It's only for Color Meter (HI 96727) (HANNA)

3. Abbreviation & Definition
- Nil

4. Duties, Responsibility & Accountability

No	Tasks	Person	Responsibility
1	Color Meter Calibration	Staff in mini laboratories	Central Laboratory
2	Color meter Validation		
3	Color Measurement		

5. Procedure

5.1 **Calibration for Color Meter (HI 96727) (HANNA)**

(1) Firstly, press On/ Off button.
(2) If the sound on, the color meter is ready to use.
(3) Press CAL CHECK for 3 seconds and while in calibration, CAL will be appeared on screen and then ZERO will be appeared.
(4) Put CAL CHECK™ standard HI96727-11 bottle A in the meter. The lid on the bottle must be fit in the meter.
(5) Press ZERO/CFM.
(6) After few seconds, zero 0:0 will be appeared on screen. And READ appears.
(7) Remove the bottle (A).

(8) Put CAL CHECK™ standard HI96727-11 bottle B in the meter. The lid on the bottle must be fit in the meter.
(9) Press READ.
(10) After 3 seconds, the value will be shown on screen.
(11) The previous calibration date can be seen on screen.
(12) Set the year making calibration by pressing GLP.
(13) After selecting the year, set ZERO/CFM (or) READ
(14) Set the month making calibration by pressing GLP.
(15) After selecting the month, set ZERO/CFM (or) READ.
(16) Set the date making calibration by pressing GLP. After selecting the month, set ZERO/CFM (or) READ.
(17) Press ZERO/CFM and save.
(18) After 1 second, Stor appears and save Calibration.

5.2 Validation Procedure

(1) Put CAL CHECKTM standard HI96727-11 bottle A in the meter. The lid on the bottle must be fit in the meter.

(2) Press ZERO/CFM.

(3) After few seconds, zero 0:0 appears on the screen. Read appears on the screen.

(4) Put CAL CHECK™ standard HI96727-11 bottle B in the meter. The lid on the bottle must be fit in the meter.

(5) Press CAL Check.

(6) After 3 seconds, 250 appears on screen. If it isn't, rub the bottle with tissue and measure it again.

(7) After that, can measure it normally.

(8) After the end of calibration, press On/Off to switch off the meter. (Noted: Don't open the Calibration Solution bottle. If accidentally open it or the bottle is broken, don't touch the solution/liquid with hands. Clean the solution/liquid with clear water and use it. Use the gloves.)

5.3 Color Measurement
(1) Press On/Off button on meter.

(2) If the sound is on in LCD, the color meter is ready to use. If ZERO appears on the screen, it's to set zero setting.
(3) To set Zero Setting, put deionized water (100 ml) into 1st sample cell (100 ml level). It must be Blank water.
(4) The water which is 100 ml level in 2nd sample Cell is unfiltered water (Apparent color).
(5) Put the 50 ml sample water to a beaker. Filtrate 50 ml water using Membrane filter and get True color water.
(6) Put 1st sample cell in the meter. The lid on the cell must be fit in meter.
(7) Press Zero/CFM.
(9) After few seconds, Zero 0:0 appears. If Zero appears on meter, then can remove 1st Sample Cell.
(9) Put 2nd Sample cell in the meter. The lid on the cell must be fit in meter.Press READ. Apparent color value is shown on the meter.
(10) Then put filtrated water sample into the Sample Cell and put Sample Cell into the meter. The lid on the cell must be fit in the meter. Press READ. The True color value is shown on the meter.
(Noted: take the battery out of the meter in weekends)

5.4 How to use Filter Paper in color meter

(1) Let the Filter Paper Dry.

(2) If it's to use Filter Paper, use it with tweezers. Don't touch with hands.

(3) Put Aspirator, which has Filter paper, on the top of the pipe.

(4) The Filter Paper must be on the sieve of Aspirator.

(5) If Filter Paper changes the color and replace it with new ones.

(6) Firstly, filtrate clear water and then filtrate colored water.

6. Related documents
- Nil

7. **Related forms**
   - Nil
8. **Reference**
   - Manual Books of Central Lab
9. **Appendix**
   - Nil

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1. **Topic**
   - Instruction for measurement of Residual Chlorine in the mini laboratories.

2. **Objective & Scope**

   (1) To follow/use the staff in mini laboratories.

   (2) It's only for Chlorine Meter.

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	Residual Chlorine Measurement	Staff in mini laboratories	Central Laboratory

5. **Procedure**

5.1 Measurement of Residual Chlorine

1. First Press Power button on Cl_2 Meter.
2. Put the distilled water into the Sample Cell and press Zero button to set Zero Setting.
3. 0:00 will appears on Display.
4. Then put sample water into the sample cell.
5. Then add DPD free Chorine reagent into the cell & shake it.
6. Then press READ and get result.
7. The result is Residual Chlorine result.
8. The unit of Residual Chlorine is mg/L. (Noted: take the battery out of the meter in weekends)

6. **Related Documents**

- Nil

7. Related Forms
- Nil

8. Reference
- Manual Books of Central Lab

9. Appendix
- Nil

1. Topic
- Instruction for daily activities in the laboratory.

2. Objective & Scope

(1) To follow/ use the staff in the laboratory.

(2) It's only for the daily work to do in the laboratory.

3. Abbreviation & Definition
- Nil

4. Duties, Responsibilities & Accountabilities

NO	Tasks	Person	Responsibility
1	Daily works in the laboratory	Staff in laboratory	Central laboratory

5. Procedure

(1) As soon as arrived to the laboratory, open the door and turn the light on.

(2) After cleaning the room, turn on the Air-con and set the room temperature at 25-degree Celsius.

(3) After washing the glassware, place it in order. Based on the measured parameters, it's to choose suitable glassware.

(4) When in monitoring Turbidity, it's to calibrate. When in monitoring Color, it's to measure both Raw and Filtration. Don't open the cover of Calibration Liquid of Color & Turbidity. After using Calibration liquid in required amount, please keep it back systematically.

(5) When in measuring /monitoring Residual Chlorine, it's to check Meter and DPD power whether it changes color or not. It's only to touch the top of the Sample Cell with hands.

(6) Put the monitoring data in the records books every day.

(7) The data/information on daily water quality monitoring are kept in the table **EDWS-LAB-OP2-F1 in computer every time.**

6. Related documents

- EDWS-LAB-OP2-F1 (Daily Water Quality monitoring table)

7. Related forms

- Nil

8. Reference

- Central laboratory

9. Appendix

- Nil

1. Topic

- Instruction for taking sample

2. Objective & Scope

(1) In order to follow/use the staff in the laboratory.

(2) It's only for taking samples.

3. Abbreviation & Definition

- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	Taking sample	Staff in laboratory	Central Laboratory

5. Procedure

(1) The bucket/bottle or cup to take sample must be clean.
(2) Before filling the bottle with sample water, make it sure whether it's clean or not.
(3) When taking the water in lake, ponds, reservoir, river and stream in which are not chlorinated, before taking sample from these, it's to clean the bottle with those water.
(4) When taking the sample for Chemical Analysis, there must be any vancant in the bottle.
(5) When taking the sample for Bacteriology Analysis, the water level must be at the neck of the sample bottle. Make sure to write down the sampling point on the bottle. Close the bottle with tape and bring it the black plastic bag.
(6) When taking the sample from lake, reservoir, river & stream, then take the sample from at least 3 meters depth.
(7) The sample water will be poured into 1-liter bottle without any vacant.
(8) It's to make sure not to make mistake while recording on sample bottle and sampling points.

6. Related documents

- Nil

7. Related Forms
- Nil

8. Reference
(Central Laboratory)

9. Appendix
- Nil

နေ့စဉ်ရေအရည်အသွေးရလဒ်ဇယား

Daily Water Quality Result Table

Daily Results of ..... Mini Laboratory

Sampling point:

Year / Month:

Parameter	Unit	Day																													AVG	STDEV	CV	Max	Mini
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
Time	AM/ PM																																				
Water temperature	Deg. C																																				
pH																																				
Turbidity	(NTU)																																				
Color	(PCU)																																				
	(TCU)																																				
Residual Chlorine	mg/L																																				

Annex-6.B: SOP for Water Treatment Plants and Chlorination Facilities

SOP for Water Treatment Plants and Chlorination Facilities

List of SOPs

No	Facility	SOP Name	SOP Code	Nos
	NWTP (Nyaunghnapin/Ngamoeyeik)			
1		Duties of Ngamoeyeik Water Treatment Plant	EDWS-NWTP-OP1	**20**
2		Daily maintenance work in Ngamoeyeik WTP	EDWS-NWTP-MP1	
3		Lowlift pump operation	EDWS-NWTP-OP1-W1	
4		ACH Dosing Pump Operation Instruction	EDWS-NWTP-OP1-W2	
5		Instruction for Pre-sedimentation pond	EDWS-NWTP-OP1-W3	
6		Instruction for Sedimentation basin	EDWS-NWTP-OP1-W4	
7		Instruction for Rapid Sand Filter	EDWS-NWTP-OP1-W5	
8		Instruction for backwashing process in Rapid Sand Filter	EDWS-NWTP-OP1-W6	
9		Operation of Booster pumps	EDWS-NWTP-OP1-W3	
10		Activities to carry out when in power failure	EDWS-NWTP-OP1-W4	
11		Activities to carry out when the power is recovered	EDWS-NWTP-OP1-W5	
12		Dosing rate adjusting table	EDWS-NWTP-OP1-A1	
13		Lowlift pump operation record	EDWS-NWTP-OP1-F1	
14		Dosing pump operation record	EDWS-NWTP-OP1-F2	
15		Aluminum Chlorohydrate (ACH Ledger book)	EDWS-NWTP-OP1-F3	
16		Booster pump operation point (1st Phase)	EDWS-NWTP-OP1-F4	
17		Booster pump operation point (2nd Phase)	EDWS-NWTP-OP1-F5	
18		Power failure/recovery (times, duration & frequency)	EDWS-NWTP-OP1-F6	
19		Water Quality in NWTP (1st Phase)	EDWS-NWTP-OP5-F1	
20		PI Data record		
	Yegu pumping station (Cl_2 Plant)			**9**
1		Duties of Yegu Pumping Station	EDWS-YPS-OP	
2		Operation of Electro chlorinator	EDWS-YPS-OP3	
3		Maintenance of Electro chlorinator	EDWS-YPS-MP3	
4		Operation of Electro chlorinator	EDWS-YS-OP3-W1	
5		Maintenance of Electro chlorinator	EDWS-YPS-MP3-W1	
6		Dosing pump control chart	EDWS-YPS-OP3-A1	
7		Daily Check Sheet (Electro chlorination Plant)	EDWS-YPS-MP3-F1	
8		Monthly check sheet (Electro chlorination Plant)	EDWS-YPS-MP3-F2	
9		Annual Check sheet (Electro chlorination Plant)	EDWS-YPS-MP3-F3	

1. Topic

Duties of Ngamoeyiek Water Treatment Plant

2. Objective & Scope

1. It's intended to understand the staff working in Ngamoeyeik Water Treatment Plant (Nyaunghnapin).
2. It's only for Ngamoeyeik Water Treatment Plant.

3. Abbreviation & Definition

ACH	Aluminium Chlorohydrate
BP	Booster Pump
BWP	Backwash Pump
HR	Head Regulator (ရေထိန်းတံခါး)
LLP	Low Lift Pump (အနိမ့်ရေတင်စက်)
NWTP	Ngamoeyeik Water Treatment Plant
PI Data	Performance Indicator Data
RSF	Rapid Sand Filter
WP	Working Procedure
YCDC	Yangon City Development Committee

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1.	Activities/duties of Ngamoeyeik Water Treatment Plant	Respective Engineers, & Team leaders	Plant Manager, Deputy Plant Manager

5. Procedure

(1) To get the information of Head Regulator condition to take 90 MGD water from Ngamoeyeik main channel. If necessary, it's to contact with main channel in charge of Ngamoeyeik reservoir.

(2) To check/inspect along the YCDC channel not to do swimming, throwing litters, fishing, etc., and to get information regularly about water seeping along channel, water overflow and the condition of siphon and to get proper water flow, it's to clean the flooding particles.

(3) To supervise the cleaning of flooding particles in the water and be the water level of pre-sedimentation pond between 12.5'to 15.5'. (If the water level reaches less than 12.5', then not to operate Low Lift Pumps. If the water is more than 15.5', it can happen the water overflow & damage in open channel.

(4) To operate Low Lift Pumps, it's to operate according to the water demands of BP & BWP as to low lift pump operation instruction **EDWS-NWTP-OP1-W1. (The amount of using ACH & the cost of raw water will be calculated based on the Low Lift Pumps Operation Time)**

(5) When dosing ACH at outlet of Water tower, it's to use **EDWS-NWTP-OP1-A1** to adjust ACH Dosing Pump and operate ACH dosing pump using **EDWS-NWTP-OP1-W2** and ACH dosing Pump Operation will be recorded in **EDWS-NWTP-OP1-F2.** For checking ACH solution in store, ACH used ledger will be recorded in **EDWS-NWTP-OP1-F3.**

1. EDWS-NWTP_OP1_1.docx ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ၁. ၁. ၂၀၁၉

(6) It is to supervise the Flocculator's functions as to EDWS-NWTP-OP2.

(7) It is to supervise the Sedimentation basin's functions and if necessary, it's to do sludge removing/ draining out the sludge as to EDWS-NWTP-OP3.

(8) It's to supervise the Rapid Sand Filter's functions, and if necessary, it's to do backwashing activities as to EDWS-NWTP-OP4-W1.

(9) It's to take water sample twice a day at specific/designated places and monitor the water quality in NWTP mini laboratory using EDWS-NWTP-OP5 and record it in EDWS-NWTP-OP5-F1.

(10) The water in Clear Water Reservoir must be in specific level. If the water reaches to maximum level, then can't operate the Booster pumps. (Water Level Sensors are installed in Control Panel). If the water reaches to specific level, the treated water will overflow and be wasted).

(11) When operating Booster pumps, it's to adjust the outlet valves to get desirable water amount pressure (6.5 bars to 7.2 bars) using EDWS-NWTP-OP1-W3. For the operation record of Phase 1, it's to input in EDWS-NWTP-OP1-F4 and for phase 2, it's to input it in EDWS-NWTP-OP1-F5.

(12) If power failure happens, it's to contact with respective in charge of YESC and try to get power as quickly as possible. To do so, it's to follow EDWS-NWTP-OP1-W4. If power recovers, it's to do as to EDWS-NWTP-OP1-W5. After that, for the operation of pumps will be done according to the operation procedure (OP) mentioned above. The power failure record will be inputted in EDWS-NWTP-OP1-F6 and submitted that record & weekly report to Deputy Plant Manager, Plant Manager & top level of the department.

6. Related documents

(1) EDWS-NWTP-OP1-W1 Low Lift Pump Operation Instruction

(2) EDWS-NWTP-OP1-W2 ACH Dosing Pump Operation Instruction

(3) Low Lift Pump Operation Record (Daily) Phase 1 & 2

(4) ACH using ledger books (Phase 1 & 2)

(5) Booster Pump Operation Record (Daily) Phase 1 & 2

(6) Water Quality Monitoring Form & records

(7) Monthly PI Data records

(8) Monthly pump operation records & raw water uses record

(9) Related SOPs

(10) Assigned duties records

(11) Raw Water Jar Test Record

(12) Monthly report

(13) Unusual cases records & reports

7. Related forms

(1) EDWS-NWTP-OP1-F1 Low Lift Pumps Operation Record

(2) EDWS-NWTP-OP1-F2 ACH Dosing Pumps Operation Record

(3) EDWS-NWTP-OP1-F3

(4) EDWS-NWTP-OP1-F4

(5) EDWS-NWTP-OP1-F5

(6) EDWS-NWTP-OP1-F6

(7) EDWS-NWTP-OP5-F1

(8) PI Data Record

8. Reference

- Nil

9. Appendix

(2) EDWS-NWTP-OP1-A1 Table of controlling Dosing Pumps

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ..... ဌာနခွဲ ..... ဌာနစု	SOP ကုဒ်အမှတ်	
		ဗားရှင်းအမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

1. Topic

Daily maintenance works in Ngamoeyeik Water Treatment Plant.

2. Objective & Scope

From Ngamoeyiek Water Treatment Plant, we can supply water (45) MDG from Phase 1 & (45) MDG from Phase 2, in total approximately (90) million gallons per day.

It's intended to know the maintenance of earthen open channel which is used to carry the raw water from Ngamoeyeik reservoir to water treatment plant every day, daily maintenance of water treatment system & water quality monitoring system, ACH Dosing System, daily maintenance of Low Lift Pumps & Booster Pumps & Electrical works.

It's only for the staff including plant manager, deputy-plant manager, respective engineers & team leaders working at Ngamoeyeik Water Treatment Plant.

3. Abbreviation & Definition

ACH – Aluminum Chlorohydrate
B.P – Booster Pump
EDWS – Engineering Department Water and Sanitation
H.R – Head Regulator (ရေထိန်းတံခါး)
L.L.P – Low Lift Pump
NWTP _ Ngamoeyeik Water Treatment Plant
PI Data – Performance Indicator Data
R.S.F – Rapid Sand Filter

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ..... ဌာနခွဲ ..... ဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

4. Duties, Responsibilities & Accountabilities

Tasks	Person	Responsibility
To be able to operate the booster pump 24/7 to get enough water amount and pressure supply to downtown areas.	Respective in charge (Engineers) & team leaders	Plant Manager, Deputy-plant manager

5. Procedure

(1) To get the information of closing/opening of Head Regulator condition to take (90) MDG daily from Ngamoeyeik Reservoir. It's to supervise not to do swimming, fishing, taking bath, throwing the rubbish in the YCDC main channel, to inspect the seepage condition, water overflow, Siphon conditions every day and cleaning the flooding particles.

(2) To supervise the cleaning of solid particles/flooding particles in the pre-sedimentation pond & the water level in pre-sedimentation pond must be between 15.5'to 15.5'. (The Low Lift Pump can't operate if the water level decreases to less than 12.5'and if the water levels reaches to above 15.5', the seepage or damage in open channel might happen. (The officer needs to contact Regulator in charge and conduct open/close of head regulator accordingly.)

It's to check the pre-sedimentation pond condition and if some unusual happens, inform at once to officer and it's to clean flooding particles every day.

6. Related documents

- Nil

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ..... ဌာနခွဲ ..... ဌာနစု	SOP ကုဒ်အမှတ်	
		Version အမှတ်	
		စတင်အသုံးပြုသည့်နေ့	
		စာမျက်နှာအမှတ်	

7. Related forms

- Nil

8. Reference

- Nil

9. Appendix

- Nil

ဖိုင်အမည် အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ထုတ်ဝေသည့်ရက်စွဲ

1. Topic

- Low Lift Pump Operation Instruction

2. Objective & Scope

It's intended to know the systematic operation of Low Lift Pump 110 KW-440 V (15 MGD) in Ngamoeyeik WTP.

It's only for the operation of Low Lift Pump 110 KW-440 V (15 MGD) pumps & motors.

3. **Abbreviation & Definition**

LLP : Low Lift Pump

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	Operation of Low Lift Pump	In charge of Electrical & Mechanical team & respective staff	Plant Manager, Deputy Plant Manager

5. Procedure

5.1 Things to check before operation

(1) Firstly, it's to check the water level of pre-sedimentation pond whether the water level is between 12.5'to 14.5' or not and record it in low lift operation ledger book (**EDWS-NWTP-OP1-F1).**

(2) Check the inlet valve in the pump whether it's 100% fully open or not.

(3) It is to check the electricity voltage whether it's within 380-440 or not and record it in low lift operation ledger book (**EDWS-NWTP-OP1-F1)**

(Remark: If voltage is lower than 380 V or higher than 420 V, then it's to check Motor Ampere (between 175 A & 208 A) and operates carefully.)

(4) Check the strength of Coupling in Bolt & Nuts which is join to pumps & motors.

(5) Turn the pump & motor's coupling to 360 degree by force and check motor & Pump.

(၆) ရေတင်စက်များနှင့် မော်တာများ၏ အထိုင် Bolt & Nuts များ တင်းရင်းမှု ရှိမရှိ စစ်ဆေးရမည်။

(6) Check the strength of bolts & Nuts of pumps & motors.

5.2 Operation

(1) Press Start Button on Control Panel.

(2) After waiting for few seconds, green color pilot lamp will be appeared and check the current in Ampere Meter on Control Panel and record it in **EDWS-NWTP-OP1-F1.**

(၁) အနိမ့်ရေတင်စက်များအား ပုံမှန်ဝန်အားဖြင့် လည်ပတ်နေခြင်း ရှိမရှိ Ampere Meter တွင် စစ်ဆေးရမည်။ (175A နှင့် 208A အတွင်းရှိနေရမည်။)

5.3 Things to be check while in operation

(1) It is to check whether low lift pumps are operating in normal condition/ weight, on ampere meter. (It must be between 157 A & 208 A)

(2) It is to check the sound, vibration, smell & temperature of low lift pumps so frequently.

(3) It is to record the operation condition of low lift pumps every hour in **EDWS-NWTP-OP1-F1.**

6. Related documents

- Nil

7. Related forms

(1) **EDWS-NWTP-OP1-F1 (Record of Low lift pump)**

8. Reference

- Nil

9. Appendix

-Nil

1. **Topic**

   - ACH Dosing Pump Operation Instruction

2. **Objective & Scope**

   It's intended to understand the supervisor & staff working in ACH Dosing Pump operation at Ngamoeyeik Water Treatment Plant (Nyaunghnapin).

   It's only for the supervisor & staff for operation of Aluminium Chlorohydrate 15%-17% at WTP.

3. **Abbreviation & Definition**

   ACH - Aluminum Chlrohydrate

   LLP - Low Lift Pump

4. **Tasks, Duties & Responsibilities**

N	Tasks	Person	Responsibility
1.	Operation Of Ach Dosing Pump	In charge of ACH Dosing House & assigned staff	Plant Manager, Deputy Plant Manager

5. **Procedure**

   (1) Keep (250) gallons (2) Suction Tanks at each dosing house and fill (500) gallons of ACH.

(2) The average use of ACH per day in Phase 1 is 400 gallons and in Phase 2 also 400 gallons. So, it's to fill ACH from Storage tank to 1m^3 Suction tank every day.

(3) Each dosing house keeps (2) ACH dosing pumps (1 operate 1 stand by) and operate one pump every two days.

(4) According to the Jar Test result & dosing rate, it is to operate the dosing pump using **EDWS-NWTP-OP1-A1.**

(5) Operation of ACH Dosing Pumps

(1) Open the outlet valve of 1m^3 Suction Tank fully.

(2) Open the inlet valve of Dosing Pump fully.

(3) Turn on Main Switch on Power board of Dosing pump.

(4) After turning on Manual on Dosing Frequency board, the pump will start to operate.

(၅) လိုအပ်သော ဆေးခပ်နှုန်းနှင့် ကိုက်ညီသည့် frequency နှင့် Pump stoke ကို ဇယားချပ်တွင် ကြည့်ပြီး ချိန်ညှိမောင်းနှင်ရမည်။

(5) It is to operate the dosing pump by checking & adjusting dosing rate, frequency & pump stroke.

(၆) မောင်းနှင်ထားသည့် LLP အရေအတွက်ပေါ်မူတည်၍ ဆေးခပ်ရမည့်ပမာဏအား frequency အတိုး/ အလျှော့ဖြင့် လိုအပ်သလို ချိန်ညှိပေးရမည်။

(6) Based on the operated LLP numbers, it's to adjust the dosing frequency accordingly.

(၇) 1m^3 Suction Tank အတွင်း၌ ဆေးရည်လက်ကျန် ဂါလံ ၅၀ သို့ရောက်ရှိပါက နောက် ၁ ပုံး ပြောင်းသုံးပြီး ဆေးရည်ပြန်ဖြည့်ထားရမည်။

(7) If the ACH solution left 50 gallons in 1m^3 Suction tanks, then change another tank and refill the ACH solution.

(၈) လျှပ်စစ်ဓါတ်အားပြတ်တောက်ပါက Dosing frequency board မှ Manual ခလုတ် အလို အလျှောက်ပိတ်ပြီး ဓါတ်အားပြန်လည်ရရှိပါက Manualခလုတ်ကို ပြန်ဖွင့်ပြီးမောင်းနှင်ရမည်။

(8) If power failure happens, Manual Switch on Dosing Frequency board will turn off automatically and when it recovers, turn on the Manual Switch and operate it again.

(6) Checking ACH Dosing Rate & Recording

(1) The assigned staff at pump house has to check the frequency & pump stoke condition in Dosing Pump regularly. (Every hour)

(2) Based on the operated LLP numbers, it's to check the amount of coagulant by checking the level on Suction Tank. (Every hour)

(3) Based on the results checking in mini laboratory, it's to do Jar Test Activity to know the dosing rate, and adjusting Dosing rate accordingly, record keeping & reporting.

6. Related documents

(1) Jar Test Records (Ngamoeyeik Water Treatment Plant Mini Laboratory

7. Related forms

- Nil

8. Reference

- Nil

9. Appendix

(1) EDWS-NWTP-OP1-A1 ACH Dosing Pump record

1. **Topic**
   - Instruction for pre-sedimentation pond

2. **Objective & Scope**
   - It's intended for the supervisor & staff who take responsibility for pre-sedimentation pond.
   - It's only for the staff working in pre-sedimentation pond at Nyaunghnapin WTP.
   -

3. **Abbreviation & Definition**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1. 1	The operation of pre-sedimentation pond	Supervisor & Staff	Plant Manager, Deputy Plant Manager

5. **Procedure**

(1) It's to check the condition of pre-sedimentation pond every two hours.

(2) It's to check whether the water in baffle wall are over flow or not and if there is, then inform it to respective officers.

(3) It's to check the water flow through water gate are properly/ equally flow to pre-sedimentation pond or not and if not, inform it to respective supervisor and adjust the opening/closing condition of water gate.

6. **Related documents**

- Nil

7. **Related forms**
   - Nil

8. **Reference**
   - Nil

9. **Appendix**
   - Nil

#	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ရေလှောင်ကန်ကြီးများဌာနခွဲ ငမိုးရိပ်ရေသန့်စင်စက်ရုံ (ညောင်နှစ်ပင်)	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-W4
		ဗားရှင်းအမှတ်#	Trial#
		စတင်အသုံးပြုသည့်နေ့#	1/ 1/2019#
		စာမျက်နှာအမှတ်#	Page 1 of 2#
		ရေးသားသူ#	#
		အတည်ပြုသူ#	#
		ခွင့်ပြုသူ#	#

1. **Topic**

   - Sedimentation Basin Instruction

2. **Objective & Scope**

   - It's intended to know the systematic operation of the sedimentation basin.
   - It's only for the staff working sedimentation basin at Nyaunghnapin WTP.

3. **Abbreviation & Definition**

   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	Removing the sludge in sedimentation basin systematically	Assigned staff & Supervisor	Plant Manager, Deputy Plant Manager

5. **Procedure**

   1. To open the desludging valve every two days.
   2. To check the sledge piling up condition upon the sedimentation basin position.
   3. To check the sludge level every week and allowable level 1st step is 2 meters and in 2nd step 2.7 meters and if exceed, inform it to respective officer.

#	ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ရေလှောင်ကန်ကြီးများဌာနခွဲ ငမိုးရိပ်ရေသန့်စင်စက်ရုံ (ညောင်နှစ်ပင်)	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-W4
		ဗားရှင်းအမှတ်#	Trial#
		စတင်အသုံးပြုသည့်နေ့#	1/ 1/ 2019#
		စာမျက်နှာအမှတ်#	Page 2 of 2#

4. If the sludge level is exceeded more than standard level, it's to remove the sludge using desludging valve and removing the sludge using engine pump according to sledge removing schedule.

6. **Related documents**

   - Nil

7. **Related forms**

   - Nil

8. **Reference**

   - Nil

9. **Appendix**

   - Nil

1. **Topic**
   - Instruction of Rapid Sand Filter

2. **Objective & Scope**
   - It's intended to understand the process of Rapid Sand Filter.
   - It's only for the supervisor & assigned staff working in Rapid Sand Filters at Ngamoeyeik Water Treatment Plant.

3. **Objective & Scope**
   - Nil

4. **Duties, Responsibilities & Accountabilities**

No	Tasks	Person	Responsibility
1	Rapid Sand Filter Activities	Rapid Sand Filter assigned staff & Supervisor	Plant Manager, Deputy Plant Manager

5. **Procedure**

(1) Open the inlet valve of Rapid Sand Filter 100% fully.

(2) Open the Clear Water Outlet valve of Rapid Sand Filter 100% fully.

(3) Close the 12" Drain valve 100% fully.

(4) Check carefully whether filtration rate is appropriate/ good or not.

(5) If the sand filter can't filtrate the water properly, then backwashing process can be done using **EDWS-NWTP-OP4-W1**

6. **Related documents**
   - Nil

7. **Related forms**
   - Nil

8. **Reference**
   - Nil

9. **Appendix**
   - Nil

#	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ရေလှောင်ကန်ကြီးများဌာနခွဲ ငမိုးရိပ်ရေသန့်စင်စက်ရုံ (ညောင်နှစ်ပင်)	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-W6
		ဗားရှင်းအမှတ်#	Trial#
		စတင်အသုံးပြုသည့်နေ့#	1/ 1/2019#
		စာမျက်နှာအမှတ်#	Page 1 of 3#
		ရေးသားသူ#	#
		အတည်ပြုသူ#	#
		ခွင့်ပြုသူ#	#

1. Topic

Instructions for Backwashing process in Rapid Sand Filter

2. Objective & Scope

It's intended to know the supervisor & assigned staff working for backwashing activities in Rapid Sand Filter.

It's only for the Rapid Sand Filter (28) nos in Phase 1 & (32) nos in Phase (2).

3. Abbreviation & Definition

- Nil

4. Duties, Responsibilities, & Accountabilities

No	Tasks	Person	Responsibility
	The water can be filtrated without clogging in Sand, Anthracite, & gravel.	The assigned staff & supervisor	Plant Manager, Deputy-plant manager

5. Procedure

(1) Close the inlet valve of rapid sand filter 100% fully.

(2) Reduce the water up to 1' above of anthracite and close Clear Water Outlet valve.

(3) Open 12"Drain Valve.

(4) Open 6"surface wash valves slowly up to 100%.

(5) After opening 6"surface wash valve for 2 minutes, open 12"backwash valve (right 15% and left 30%).

(6) Adjust the back wash valve pressure accordingly not to overflow the sand & anthracite.

(7) If the water is getting clear, then close 6"surface wash valve slowly.

(8) Then close 12" back wash valve slowly.

(9) After that close the outlet valve & open inlet valve.

(10) After opening Clear Water Outlet Valve, the rapid san filter can be used again.

6. Related documents

- Nil

7. Related forms

- Nil

8. Reference

- Nil

9. Appendix

- Nil

8. EDWS-NWTP-OP1-W6_1.docx ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ၁. ၁.
၂၀၁၉

1. Topic

- Operation of Booster Pumps

2. Objective & Scope

- It's intended to know well the staff working for the operation of Booster Pumps which are used to supply the treated water to the city.
- It's only for the supervisors & staffs who are working for the operation of Booster Pumps in both phase at Ngamoeyeik Water Treatment Plant.

3. Abbreviation & Definition

B.P – Booster Pump

4. Duties, Responsibilities & Accountabilities

Tasks	Person	Responsibility
It's to operate booster pump to pump up the treated water to the pipeline.	Supervisor & operators for booster pumps	Plant Manager, Deputy-plant manager

5. Procedure

5.1 Things to check before operating

5.1.1 The water level in Clear Water Tank must be at least 12 feet above.

5.1.2 It is to open the suction valves 100% fully. (There are 2 suction valves in each pump. One valve in clear water tank & another one is in the pump house.)

5.1.3 The electricity voltage in Control Panel must be between 6000 voltage & 6800 voltage.

5.1.4 It is to check the Coupling Bolt & Nut conditions.

5.1.5 It is to turn the Coupling to 360· Fully & check it. The operation must be gentle.

5.1.6 It is to check that the foundation bolt & Nut of the pumps are tightened enough.

5.2 Start operation

5.2.1 Press Start Button on Control Panel.

5.2.2 After waiting for few seconds, Green Color Pilot Lamp will be appeared and check the current and if the current is in normal, press Valve Open Button on Control Panel to open Discharge Valve.

5.2.3 When opening Discharge Valve, the pump's pressure must be between 6.00 bars to 9.00 bars.

5.3 Things to check while operating the pumps

5.3.1 It is to check whether the pumps are operating in normal or not by checking Ampere meter on Control Panel. (It must be between First step 88-A & Second step 59-A).

5.3.2 The temperature of ball bearing of the pumps, motor coil temperature, pressure of the pump, water pressure & amount of the main pipe will be checked on HMI & Computer and record it.

5.3.3 It is to check the pump's sound, vibration & smell.

5.3.4 It is to input the condition of the pumps in the record hourly.

Things to record

(a) Water level in pre-sedimentation pond

(b) Voltage, Current (Ampere)

(c) Operating Pump No. & number

(d) The temperature, pressure of each pump & outlet valve position

(e) Record of transmission pipe pressure & amount

(f) Pump operation records

(g) Power failure & recover records

6. Related documents

(1) Daily operation record (BP-Phase 1)

(2) Daily operation record (BP-Phase 2)

7. Related forms

- Nil

8. Reference

- Nil

9. Appendix

- Nil

1. Topic

- Operation of Booster Pumps

2. Objective & Scope

- It's intended to know well the staff working for the operation of Booster Pumps which are used to supply the treated water to the city.
- It's only for the supervisors & staffs who are working for the operation of Booster Pumps in both phase at Ngamoeyeik Water Treatment Plant.

3. Abbreviation & Definition

B.P – Booster Pump

4. Duties, Responsibilities & Accountabilities

Tasks	Person	Responsibility
It's to operate booster pump to pump up the treated water to the pipeline.	Supervisor & operators for booster pumps	Plant Manager, Deputy-plant manager

5. Procedure

5.1 Things to check before operating

5.1.1 The water level in Clear Water Tank must be at least 12 feet above.

5.1.2 It is to open the suction valves 100% fully. (There are 2 suction valves in each pump. One valve in clear water tank & another one is in the pump house.)

5.1.3 The electricity voltage in Control Panel must be between 6000 voltage & 6800 voltage.

5.1.4 It is to check the Coupling Bolt & Nut conditions.

5.1.5 It is to turn the Coupling to 360· Fully & check it. The operation must be gentle.

5.1.6 It is to check that the foundation bolt & Nut of the pumps are tightened enough.

5.2 Start operation

5.2.1 Press Start Button on Control Panel.

5.2.2 After waiting for few seconds, Green Color Pilot Lamp will be appeared and check the current and if the current is in normal, press Valve Open Button on Control Panel to open Discharge Valve.

5.2.3 When opening Discharge Valve, the pump's pressure must be between 6.00 bars to 9.00 bars.

5.3 Things to check while operating the pumps

5.3.1 It is to check whether the pumps are operating in normal or not by checking Ampere meter on Control Panel. (It must be between First step 88-A & Second step 59-A).

5.3.2 The temperature of ball bearing of the pumps, motor coil temperature, pressure of the pump, water pressure & amount of the main pipe will be checked on HMI & Computer and record it.

5.3.3 It is to check the pump's sound, vibration & smell.

5.3.4 It is to input the condition of the pumps in the record hourly.

Things to record

(a) Water level in pre-sedimentation pond

(b) Voltage, Current (Ampere)

(c) Operating Pump No. & number

(d) The temperature, pressure of each pump & outlet valve position

(e) Record of transmission pipe pressure & amount

(f) Pump operation records

(g) Power failure & recover records

6. Related documents

(1) Daily operation record (BP-Phase 1)

(2) Daily operation record (BP-Phase 2)

7. Related forms

- Nil

8. Reference

- Nil

9. Appendix

- Nil

1. **Topic**

   - Things to be carried when the power recovers

2. **Objective & Scope**

   - It's intended to know what to be carried out when the power recovers.

3. **Abbreviation & Definition**

   B.P- Booster Pump

   GCE- Gas Circuit Breaker

   L.L.P- Low Lift Pump

   VCB- Vacuum Circuit Breaker

4. **Duties, Responsibilities & Accountabilities**

Tasks	Person	Responsibility
Things to be carried out when the power recovers	In charge & assigned staff in dividing plant	Plant Manager, Deputy Plant Manager

5. **Procedure**

၅.၁ လျှပ်စစ်မီးပြန်လည်ရရှိပါက 33 KV Line Control Panel မှ Volt Meter ၏ R, Y, B Line များ တွင် Voltage ပြည့်/မပြည့်နှင့် (30KV-34KV) အတွင်း ရှိ/မရှိ အား Selector Switch လှည့်ပြီး စစ်ဆေးရမည်။

5.1 When the power recovers, it's to check whether R, Y, B line on 33 KV Line Control Panel is enough voltage (30KV-34KV) or not by turning Selector Switch.

5.2 Turn ON the 110 V DC Output Breaker on Battery Charger Panel.

5.3 Turn On the Main GCB in Outdoor Switch Yard. (If GCG on Transformer (1) & (2) are off, then turn it ON again.)

၅.၄ 33/6.6KV Transformer (၂) လုံးမှအထွက် 6600V အား Incomer Panel No(1) နှင့် No(2) Volt Meter များ၏ R, Y, B Line များတွင် Voltage ပြည့်/မပြည့်နှင့် (6.0KV-6.8KV) အတွင်းရှိ/မရှိ အား Selector Switch လှည့်ပြီး စစ်ဆေးရမည်။

5.4 It's to check whether R, Y, B Lines on Incomer Panel No (1) & No. (2) Volt Meter are enough voltage (6.0 KV-6.8 KV) or not by turning Selector Switch.

5.5 It's to record the power failure & recover condition & unusual conditions in record book and report it to officers.

5.6 When the power recovers and voltage becomes stable, it's to operate LLP & BP as follows;

(1) Start to operate 1 Booster pump each in both phases 1 &2.

(2) It is to operate LLP one by one (every five minutes) up to 3 pumps in each Phase (1&2).

(3) The operation of LLP & ACH Dosing Pumps will be done simultaneously.

(4) Then, after checking the water level in pre-sedimentation pond, it's to operate the booster pumps every 15 minutes.

(5) The operation of LLP & BP will be recorded in the book.

5.7 After operating the booster pumps, the operator needs to inform it to officers of Water Treatment Plant.

6. **Related documents**

(1) Power failure/ recover records

(2) LLP operation record

(3) BP operation record (Phase 1)

(4) BP operation record (Phase 2)

7. Related forms

- Nil

8. Reference

- Nil

9. Appendix

- Nil

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ရေလှောင်ကန်ကြီးများဌာနခွဲ ငမိုးရိပ်ရေသန့်စင်စက်ရုံ (ညောင်နှစ်ပင်)	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-A1
		ဗားရှင်းအမှတ်	Trial
		စတင်အသုံးပြုသည့်နေ့	1/ 1/2019
		စာမျက်နှာအမှတ်	Page 1 of 1
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

Stoke Opening 60%

ဆေးဓာတ်ထည့်မည့်အချိုး (ppm)	အဝင်ရေယူပမာဏ											
	ပန့်အကြီး(၁)လုံး		ပန့်အကြီး(၁)လုံးနှင့် အသေး(၁)လုံး		ပန့်အကြီး(၂)လုံး		ပန့်အကြီး(၂)လုံးနှင့် အသေး(၁)လုံး		ပန့်အကြီး(၃)လုံး		ပန့်အကြီး(၃)လုံးနှင့် အသေး(၁)လုံး	
	၁၅ သန်းဂါလံ / နေ့		၂၀ သန်းဂါလံ / နေ့		၃၀ သန်းဂါလံ / နေ့		၃၅ သန်းဂါလံ / နေ့		၄၅ သန်းဂါလံ / နေ့		၅၀ သန်းဂါလံ / နေ့	
	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း
၁	၀.၅	၂.၄	၀.၆	၃	၁	၄.၇	၁.၁	၅.၄	၁.၅	၇.၁	၁.၆	၇.၈
၂	၁.၀	၄.၇	၁.၃	၆.၁	၂	၉.၅	၂.၃	၁၀.၈	၃	၁၄.၂	၃.၃	၁၅.၅
၃	၁.၅	၇.၁	၁.၉	၉.၂	၂.၉	၁၄.၂	၃.၄	၁၆.၃	၄.၅	၂၁.၃	၄.၉	၂၃.၃
၄	၂.၀	၉.၅	၂.၆	၁၂.၃	၄	၁၈.၉	၄.၆	၂၁.၇	၆	၂၈.၃	၆.၆	၃၁.၁
၅	၂.၅	၁၁.၈	၃.၂	၁၅.၃	၅	၂၃.၅	၅.၇	၂၇.၁	၇.၅	၃၅.၄	၈.၂	၃၈.၉
၆	၃.၀	၁၄.၂	၃.၉	၁၈.၃	၆	၂၈.၃	၆.၉	၃၂.၅	၉	၄၂.၅	၉.၉	၄၆.၇
၇	၃.၅	၁၆.၅	၄.၅	၂၁.၅	၇	၃၃	၈	၃၇.၉	၁၀.၄	၄၉.၅	၁၁.၅	၅၄.၅
၈	၄.၀	၁၈.၇	၅.၂	၂၄.၅	၈	၃၇.၇	၉.၂	၄၃.၃	၁၁.၉	၅၆.၆	၁၃.၂	၆၂.၃
၉	၄.၅	၂၁.၃	၅.၈	၂၇.၅	၉	၄၂.၅	၁၀.၃	၄၈.၈	၁၃.၄	၆၃.၆	၁၄.၈	၇၀
၁၀	၅.၀	၂၃.၅	၆.၅	၃၀.၆	၁၀	၄၇.၅	၁၁.၄	၅၄.၂	၁၄.၉	၇၀.၇	၁၆.၄	၇၇.၈
၁၁	၅.၅	၂၅.၉	၇.၁	၃၃.၆	၁၁	၅၁.၉	၁၂.၆	၅၉.၇	၁၆.၄	၇၇.၈	၁၈.၁	၈၅.၆
၁၂	၆.၀	၂၈.၃	၇.၈	၃၆.၈	၁၁.၉	၅၆.၆	၁၃.၇	၆၅.၁	၁၇.၉	၈၄.၉	၁၉.၇	၉၃.၃
၁၃	၆.၅	၃၀.၆	၈.၄	၃၉.၈	၁၃	၆၁.၄	၁၄.၉	၇၀.၅	၁၉.၄	၉၂	၂၁.၄	၁၀၁.၁
၁၄	၇.၀	၃၃	၉	၄၂.၈	၁၃.၉	၆၆	၁၆	၇၅.၉	၂၀.၉	၉၉.၁	၂၃	၁၀၉
၁၅	၇.၅	၃၅.၄	၉.၇	၄၅.၉	၁၄.၉	၇၀.၇	၁၇.၂	၈၁.၄	၂၂.၄	၁၀၆.၁	၂၄.၆	၁၁၆.၇

Stoke Opening 40%

ဆေးဓာတ်ထည့်မည့်အချိုး (ppm)	အဝင်ရေယူပမာဏ											
	ပန့်အကြီး(၁)လုံး		ပန့်အကြီး(၁)လုံးနှင့် အသေး(၁)လုံး		ပန့်အကြီး(၂)လုံး		ပန့်အကြီး(၂)လုံးနှင့် အသေး(၁)လုံး		ပန့်အကြီး(၃)လုံး		ပန့်အကြီး(၃)လုံးနှင့် အသေး(၁)လုံး	
	၁၅ သန်းဂါလံ / နေ့		၂၀ သန်းဂါလံ / နေ့		၃၀ သန်းဂါလံ / နေ့		၃၅ သန်းဂါလံ / နေ့		၄၅ သန်းဂါလံ / နေ့		၅၀ သန်းဂါလံ / နေ့	
	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း	ဂါလံ/နာရီ	ကြိမ်နှုန်း
၁	၀.၅	၂.၄	၀.၆	၃	၁	၄.၇	၁.၁	၅.၄	၁.၅	၇.၁	၁.၆	၇.၈
၂	၁.၀	၄.၇	၁.၃	၆.၁	၂	၉.၅	၂.၃	၁၀.၈	၃	၁၄.၂	၃.၃	၁၅.၅
၃	၁.၅	၇.၁	၁.၉	၉.၂	၂.၉	၁၄.၂	၃.၄	၁၆.၃	၄.၅	၂၁.၃	၄.၉	၂၃.၃
၄	၂.၀	၉.၅	၂.၆	၁၂.၃	၄	၁၈.၉	၄.၆	၂၁.၇	၆	၂၈.၃	၆.၆	၃၁.၁
၅	၂.၅	၁၁.၈	၃.၂	၁၅.၃	၅	၂၃.၅	၅.၇	၂၇.၁	၇.၅	၃၅.၄	၈.၂	၃၈.၉
၆	၃.၀	၁၄.၂	၃.၉	၁၈.၃	၆	၂၈.၃	၆.၉	၃၂.၅	၉	၄၂.၅	၉.၉	၄၆.၇
၇	၃.၅	၁၆.၅	၄.၅	၂၁.၅	၇	၃၃	၈	၃၇.၉	၁၀.၄	၄၉.၅	၁၁.၅	၅၄.၅
၈	၄.၀	၁၈.၇	၅.၂	၂၄.၅	၈	၃၇.၇	၉.၂	၄၃.၃	၁၁.၉	၅၆.၆	၁၃.၂	၆၂.၃
၉	၄.၅	၂၁.၃	၅.၈	၂၇.၅	၉	၄၂.၅	၁၀.၃	၄၈.၈	၁၃.၄	၆၃.၆	၁၄.၈	၇၀
၁၀	၅.၀	၂၃.၅	၆.၅	၃၀.၆	၁၀	၄၇.၅	၁၁.၄	၅၄.၂	၁၄.၉	၇၀.၇	၁၆.၄	၇၇.၈
၁၁	၅.၅	၂၅.၉	၇.၁	၃၃.၆	၁၁	၅၁.၉	၁၂.၆	၅၉.၇	၁၆.၄	၇၇.၈	၁၈.၁	၈၅.၆
၁၂	၆.၀	၂၈.၃	၇.၈	၃၆.၈	၁၁.၉	၅၆.၆	၁၃.၇	၆၅.၁	၁၇.၉	၈၄.၉	၁၉.၇	၉၃.၃
၁၃	၆.၅	၃၀.၆	၈.၄	၃၉.၈	၁၃	၆၁.၄	၁၄.၉	၇၀.၅	၁၉.၄	၉၂	၂၁.၄	၁၀၁.၁
၁၄	၇.၀	၃၃	၉	၄၂.၈	၁၃.၉	၆၆	၁၆	၇၅.၉	၂၀.၉	၉၉.၁	၂၃	၁၀၉
၁၅	၇.၅	၃၅.၄	၉.၇	၄၅.၉	၁၄.၉	၇၀.၇	၁၇.၂	၈၁.၄	၂၂.၄	၁၀၆.၁	၂၄.၆	၁၁၆.၇

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ရေလှောင်ကန်ကြီးများဌာနခွဲ ငမိုးရိပ်ရေသန့်စင်စက်ရုံ (ညောင်နှစ်ပင်)	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-F1
		ဗားရှင်းအမှတ်	Trial
		စတင်အသုံးပြုသည့်နေ့	23/8/2018
		စာမျက်နှာအမှတ်	Page 1 of 2
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

<u>Low Lift Pumps Operation Record</u>

Phase(　　)　　　　　　　　Date-

Time	Voltage	Current (A)					110 KW				75 KW	Pumps Nos	Pre-Clear Well W-L	Remark
		1	2	3	4	5	1	2	3	4	5			

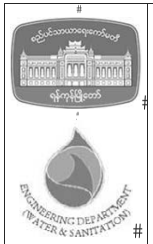
	ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ .... ဌာနခွဲ .... ဌာနစု	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-W1
		ဗားရှင်းအမှတ်	00
		စတင်အသုံးပြုသည့်နေ့	5/31/2021
		စာမျက်နှာအမှတ်	Page 2 of 2

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ ရေလျှောင်ကန်ကြီးများဌာနခွဲ ငမိုးရိပ်ရေသန့်စင်စက်ရုံ (ညောင်နှစ်ပင်) #####	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-F2
		ဗားရှင်းအမှတ်	Trial
		စတင်အသုံးပြုသည့်နေ့	1/ 1/ 2019
		စာမျက်နှာအမှတ်	Page 1 of 2
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

Ngamoeyeik Water Treatment Plant (Nyanghnapin)…….. Phase

Dosing Pump Operation Record

Date	Time	အကြို	Temperature (˚C)	ACH Tank No.	ACH gallon	Freq	LLP No.				B.W	Remark
							1	2	3	4	5	
	6:00											
	7:00											
	8:00											
	9:00											
	10:00											
	11:00											
	12:00											
	13:00											
	14:00											
	15:00											
	16:00											
	17:00											
	18:00											
	19:00											
	20:00											
	21:00											
	22:00											
	23:00											
	0:00											
	1:00											
	2:00											
	3:00											
	4:00											
	5:00											
	6:00											
		Total (ACH)										

	**ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ** **ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့** **ရေလှောင်ကန်ကြီးများဌာနခွဲ** **ငမိုးရိပ်ရေသန့်စင်စက်ရုံ (ညောင်နှစ်ပင်)**	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-F3
		ဗားရှင်းအမှတ်#	Trial
		စတင်အသုံးပြုသည့်နေ့#	1/ 1/ 2019
		စာမျက်နှာအမှတ်#	Page 1 of 2
		ရေးသားသူ#	
		အတည်ပြုသူ#	
		ခွင့်ပြုသူ#	

Aluminium Chlorohydrate (ACH) Use of ACH ledger book

No.	Date	Phase 1 (gallon)	Phase 2 (gallon)	Total (gallon)	In stock (gallon)	Remark

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-F4
		ဗားရှင်းအမှတ်	*00*
	ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့	စတင်အသုံးပြုသည့်နေ့	*23/8/2018*
		စာမျက်နှာအမှတ်	*Page 1 of 2*
	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)	ရေးသားသူ	
	..... ဌာနခွဲ	အတည်ပြုသူ	
	..... ဌာနစု	ခွင့်ပြုသူ	
	.....		

Monitoring Sheet For Booster Pump Operation Point (First Phase)

Date	Time	Current (A)				Running Pump Nos	Pump Discharge	Pipeline Pressure	Flow Rate	DN600 Valve Opening(%)				DN1400 Valve Opening (%)	Voltage (kv)	Remark
		1	2	3	4		Mpa	Mpa	m3/min	1	2	3	4			
	7:00															
	8:00															
	9:00															
	10:00															
	11:00															
	12:00															
	13:00															
	14:00															
	15:00															
	16:00															
	17:00															
	18:00															
	19:00															
	20:00															
	21:00															
	22:00															
	23:00															
	0:00															
	1:00															
	2:00															
	3:00															
	4:00															
	5:00															
	6:00															

	**ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ** ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ..... ဌာနခွဲ ..... ဌာနစု	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-F5
		ဗားရှင်းအမှတ်	*00*
		စတင်အသုံးပြုသည့်နေ့	*23/8/2018*
		စာမျက်နှာအမှတ်	*Page 1 of 2*
		ရေးသားသူ	
		အတည်ပြုသူ	
		ခွင့်ပြုသူ	

Monitoring Sheet for Booster Pump Operation Point (Second Phase)

Date-

Date	Time	Current (A)						Running Pump Nos	Pump Discharge	Pipeline Pressure	Flow Rate	DN600 Valve Opening(%)						DN1400 Valve Opening	Voltage	Remark
		1	2	3	4	5	6		Mpa	Mpa	m3/min	1	2	3	4	5	6	(%)		

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP1-F6
		ဗားရှင်းအမှတ်	*00*
	ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့	စတင်အသုံးပြုသည့်နေ့	*23/8/2018*
		စာမျက်နှာအမှတ်	*Page 1 of 2*
	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)	ရေးသားသူ	
	..... ဌာနခွဲ	အတည်ပြုသူ	
	..... ဌာနစု	ခွင့်ပြုသူ	
	.....		

Ngamoeyeik Water Treatment Plant (Nyaunghnapin)

Power failure times/duration & frequency record

No	Date	Power failure time	Power Recover time	Power failure (Duration)	Power failure time in a day	Total	Remark

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ	SOP ကုဒ်အမှတ်	EDWS-NWTP-OP5-F1
	ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့	ဗားရှင်းအမှတ်	*00*
		စတင်အသုံးပြုသည့်နေ့	*23/8/2018*
	အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု)	စာမျက်နှာအမှတ်	*Page 1 of 1*
	..... ဌာနခွဲ	ရေးသားသူ	
	..... ဌာနစု	အတည်ပြုသူ	
	.....	ခွင့်ပြုသူ	

* **Water Quality in the Ngamoeyeik Water Treatment Plant (Nyaunghnapin) Phase (1)**

Date	Unit																						
		Mon			Tue			Wed			Thu			Fri			Sat			Sun			
Water		Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	
Time																							
W.T																							
P.H																							
Tur																							
Col																							
E.C																							
TDS																							
SAL																							
TA																							
Water		Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	
Time																							
W.T																							
P.H																							
Tur																							
Col																							
E.C																							
TDS																							
SAL																							
TA																							

* **Water Quality in the Ngamoeyeik Water Treatment Plant (Nyaunghnapin) Phase (2)**

Date	Unit																						
		Mon			Tue			Wed			Thu			Fri			Sat			Sun			
Water		Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	
Time																							
W.T																							
P.H																							
Tur																							
Col																							
E.C																							
TDS																							
SAL																							
TA																							
Water		Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	Raw	Sed;	C.W	
Time																							
W.T																							
P.H																							
Tur																							
Col																							
E.C																							
TDS																							
SAL																							
TA																							

2. Production (Reservoir, WTP, underground water) 2018 - PI

Reservoir Division, Electrical and Mechanical Division

KPI	N		Performance Indicators (PIs)	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Average	Definition
					31	28	31	30	31	30	31	31	30	31	30	31	365		
	A	Data																	
	P1	Reservoir																	
	P1-1	Gyobyu Reservoir																	
		Design (fixed)																	
		1	Design high water level (Spill way)	m															
		2	Design low water level	m															
		3	Design storage capacity (full)	m^3															
		Monitoring data																	
		4	Average monthly water level	m															
		5	Minimum water level	m															
		6	Maximum water level	m															
		7	Water level at the end of month	m															
		8	Average storage volume	m^3															
		9	Storage volume at the end of month	m^3															
		10	Monthly precipitation	mm															
	P1-2	Phugyi Reservoir																	
		Design (fixed)																	
		1	Design high water level (Spill way)	m															
		2	Design low water level	m															
		3	Design storage capacity (full)	m^3															
		Monitoring data																	
		4	Average monthly water level	m															
		5	Minimum water level	m															
		6	Maximum water level	m															
		7	Water level at the end of month	m															
		8	Average storage volume	m^3															
		9	Storage volume at the end of month	m^3															
		10	Monthly precipitation	mm															
	P1-3	Ngamoeyeik Reservoir																	
		Design (fixed)																	
		1	Design high water level (Spril way)	m															
		2	Design low water level	m															
		3	Design storage capacity (full)	m^3															
		Monitoring data																	
		4	Average monthly water level	m															
		5	Minimum water level	m															
		6	Maximum water level	m															
		7	Water level at the end of month	m															
		8	Average storage volume	m^3															
		9	Storage volume at the end of month	m^3															
		10	Monthly precipitation	mm															
	P1-4	Hlawga Reservoir																	
		Design (fixed)																	
		1	Design high water level (Spril way)	m															
		2	Design low water level	m															
		3	Design storage capacity (full)	m^3															
		Monitoring data																	
		4	Average monthly water level	m															
		5	Minimum water level	m															
		6	Maximum water level	m															
		7	Water level at the end of month	m															
		8	Average storage volume	m^3															
		9	Storage volume at the end of month	m^3															
		10	Monthly precipitation	mm															
	P2	WTP (Production)																	
	P2-1	Nyaughnapin WTP																	
		Design capacity																	
		1	Plant design capacity	m^3/day															
		2	Capacity of clear water tank	m^3															
		3	Electrical power design capacity	kW															
		4	The number of flow meters in WTP	Nb.															
		Monitoring data																	
		5	Operating number of flow meters for treated water	Nb.															
		6	Monthly raw water volume (~~metered~~/estimated)	m^3/month															
		7	Daily average raw water volume (~~metered~~/estimated)	m^3/day															
		8	Monthly water production volume (~~metered~~/estimated)	m^3/month															
		9	Daily average water production volume (~~metered~~/estimated)	m^3/day															
		10	Plant average operating hours	h/day															
		11	Backwash water volume	m^3/month															
		12	Overflow water volume	m^3/month															
		13	Power consumption for production	kWh/month															
		14	Electrical breakdown records	hrs															
		15	Coagulant consumption	kg/month															
		16	Chlorine consumption	kg/month															
		17	The number of malfunctioned major equipment and facility in a year	number/month															
		18	The number of recovered major equipment and facility within the registered time	number/month															
	B	Ratio																	
	P4	Nyaughnapin WTP																	
P4-1		1	Achievement ratio of WTP water production of the planned production	%															Actual water production divided by planned water production of WTP
P4-2		2	Production efficiency (balance between inflow and outflow)	%															Treated water volume divided by raw water volume
P4-3		3	Transmission efficiency (transmitted water / produced water)	%															Transmitted water volume divided by treated water volume
P4-4		4	Overall production-transmission efficiency (transmitted water / raw water volume)	%															Transmitted water volume divided by raw water volume
		5	Power consumption for production	Kwh/m^3															
P4-6		6	Alum sulfate consumption per unit treated water volume (m^3)	g/m^3															
		7	Chlorine consumption per unit treated water volume (m^3)	g/m^3															
		8	Recovery ratio of key equipment and facility from major malfunction within relevant registered time	%															No. of recovered major equipment and facility within the registered time per No. of malfunctioned major equipment and facility in a year
		9	Achievement ratio of routine (daily, weekly, monthly) check	%															No. of executed routine check per planed No. of routine check
	P5	Power consumtion																	
		1	Transmission pumping stations	kWh/month															
		2	WTP for production	kWh/month															
		3	Tube wells	kWh/month															
		4	Booster pumping stations in distribution network	kWh/month															
		5	Others	kWh/month															
		6	Total	kWh/month															

Prepared by:
(Name)

Checked by:
(Name)

Received by (Division ACE)
Date:

2. Transmission System **2018 - PI**

Reservoir Division Responsible for: [Water Quality Monitoring Sec.]

KPI	N		Performance Indicators (PIs)	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Average	Definition
					31	28	31	30	31	30	31	31	30	31	30	31	365		
	A	**Data**																	
	T1	**Transmission pumping station**																	
	T1-1	**Nyaughnapin Ph1**																	
		Design (fixed)																	
		1	Total capacity	m^3/hr															
		2	Total number of pumps	Nb.															
		Monitoring data																	
		3	Total pump operation hours	hr/month															
		4	Electricity breakdown hours	hr/month															
		5	Average pressure (outflow)	Mpa															
		6	Electrical power consumption	kWh/month															
		7	The number of pumps operated	Nb.															
		8	Monthly flow volume (Outlet total)	m^3/month															
		9	Daily average flow volume (Outlet total)	m^3/day															
	T1-2	**Nyaughnapin Ph2**																	
		Design (fixed)																	
		1	Total capacity	m^3/hr															
		2	Total number of pumps	Nb.															
		Monitoring data																	
		3	Total pump operation hours	hr/month															
		4	Electricity breakdown hours	hr/month															
		5	Average pressure (outflow)	MPa															
		6	Electrical power consumption	kWh/month															
		7	The number of pumps operated	Nb.															
		8	Monthly flow volume (Outlet total)	m^3/month															
		9	Daily average flow volume (Outlet total)	m^3/day															

Prepared by:
Date:
Received by (Division ACE)
Date:

Checked by:
Date:

1. Topic

- The duties of Yegu Pumping Station.

2. Objective & Scope

(1) To understand the staff working in Yegu Pumping Station.

(2) It's only for Yegu Pumping Station.

3. Abbreviation & Definition

- Nil

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	Operation & Maintenance of Pumps	SAE, pump operators	Pump Station Manager
2	Operation & maintenance of Electro Chlorinator	SAE, Deputy Supervisor, operators	Pump Station Manager
3	Water Quality Monitoring	Deputy Supervisor, Office staff	Pump Station Manager
4	Collecting the data from SCADA System	Deputy Supervisor, Office staff	Pump Station Manager
5	Office works	Deputy Supervisor	Pump Station Manager

5. Procedure

(1) To operate No.1 Pump, it's to follow according to EDWS-YPS-OP1.

(2) To operate No.2 Pump, it's to follow according to EDWS-YPS-OP2.

(3) To operate Electro Chlorinator, it's to follow EDWS-YPS-OP3.

(4) To monitor the water quality, it's to follow EDWS-LAB-OP2.

(5) To get data from SCADA System, it's to follow EDWS-YPS-OP4.

(6) To maintain No.1 Pump, it's to follow EDWS-YPS-MP1.

(7) To maintain No.2 Pump, it's to follow EDWS-YPS-MP2.

(8) To maintain Electro Chlorinator, it's to follow EDWS-YPS-MP3.

(9) To maintain SCADA System, it's to follow EDWS-YPS-MP4.

(10) To do office works in Yegu Pumping Station, it's to follow EDWS-YPS-OP-W2.

6. Related documents

- Nil

7. Related forms

- Nil

8. References

- Nil

9. Appendix

- Nil

1. Topic

- Operation of Electro Chlorinator which is used to produce Sodium Hypochlorite Solution from salt

2. Objective & Scope

(1) To understand the production step of Sodium Hypochlorite solution from Electro Chlorinator.

(2) It's only to operate 10 KG/hr Electro Chlorinator (Shanghai) in Yegu Pumping Station.

3. Abbreviation & Definition

(၁)	H_2	:	Hydrogen
(၂)	MCC	:	Main Control Centre
(၃)	NaOCL	:	Sodium hypochlorite solution
(၄)	PLC	:	Programme Logic Control System

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	To produce Sodium Hypochlorite Solution	Staff in Electro Chlorination Plant	Pump station manager, SAE, Deputy Supervisor
2	Operation of Electro Chlorinator	〃	〃

5. Procedure

5.1 For safety work, it's to follow according to safety instruction EDWS-YPS-OP-W1.

5.2 The operation works (operation, steps to operate the pump, things to be checked while in operation, things to do after operation, power failure and recover conditions) are followed according to operation instruction EDWS-YPS-OP3-W1.

5.3 Record Keeping

(1) The operation time of Electrolyzer & Dosing Pumps, stopping conditions, power failure, maintenance conditions are kept in Electro Chlorinator operation record every day.

(2) The maintenance conditions are kept in Electro Chlorinator log book every day.

(3) The use of salt, chemicals are kept in the ledger book, Sodium Hydroxide ledger book, Sodium Carbonate ledger book every day.

5.4 Reporting

(1) The use of salt & chemicals in Electro Chlorination Plant, operation and maintenance works are reported every week.

(2) If emergency case happens, then report it step by step to top management level and get instructions.

6. Related documents

(1) Monthly report (Yegu Pumping Station)
(2) EDWS-YPS-OP-W1 (Safety Instruction)
(3) EDWS-YPS-OP3-W1 (Work Instruction of Electro Chlorinator)
(4) Operation Record (Yegu Pumping Station- Elector Chlorinator)
(5) Use of salt- ledger book (Yegu Pumping Station Office)
(6) Ledger book for Sodium Hydroxide (Yepu Pumping Station Office)
(7) Ledger book for Sodium Carbonate (Yegu Pumping Station Office)
(8) Electro Chlorinator Operation Record (Yegu Pumping Station Office)
(9) Electro Chlorinator Maintenance Record (log book) Yegu Pumping Station Office

7. Related Forms

(1) EDWS-YPS-MP3-F_1 Daily Checking Form (Yegu Pumping Station Electro Chlorination Plant)

(2) EDWS-YPS- OP1-F1 Performance Indicators

(3) EDWS-YPS- OP3-A1 Dosing Pump Control Chart

8. Reference

Work Instruction of ELECTRO CHLORINATOR of HAN SEIN THANT Co.,Ltd

9. Appendix

- Nil

1. Topic

- Maintenance of Electro Chlorinator which is used to produce Sodium Hypochlorite Solution from salt.

2. Objective & Scope

(1) It's to understand the staff how to main the Electro Chlorinator.

(2) It's only for the maintenance of 10KG/hr Electro Chlorinator (Shanghai) in Yegu Pumping Station.

3. Abbreviation & Definition

- HCL : Hydrochloric

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	To produce Sodium Hypochlorite Solution	Staff in Electro Chlorination Plant	Pump Station Manager, SAE, Deputy Supervisor
2	Maintenance of Electro Chlorinator	〃 Staff in Electro Chlorination Plant	〃

5. Procedure

5.1 For safety works, it's to follow according to EDWS-YPS-OP-W1.

5.2 For daily maintenance work, it's to follow according to EDWS-YPS-MP3-W1 and it's to use daily check sheet/form EDWS-YPS-MP3-F1 and submit it to pump station manager through assigned engineer.

5.3 For weekly maintenance work, it's to follow according to EDWS-YPS-MP3-W1 and it's to use monthly check sheet/form EDWS-YPS-MP3-F2 and submit it to pump station manager through assigned engineer.

5.4 For yearly maintenance works, it's to follow according to EDWS-YPS-MP3-W1 and it's to use EDWS-YPS-MP3-F3 yearly check sheet and submit it to pump station manager through assigned engineer.

5.5 For emergency maintenance works, it's to follow according to EDWS-YPS-MP3-W1 and submit it to pump station manager through assigned engineer.

5.6 Recording

(1) Power failure, repair & maintenance of the equipment are to be recorded every day in Electro Chlorinator operation record.

(2) The maintenance of the equipment is to be kept every day in Electro Chlorinator maintenance log book.

5.7 Reporting

(1) The equipment (pump & motor) and pipes maintenance & repaired activities are recorded and submitted every week.

(2) If emergency case happens, then submit the condition to the top-level step by step and get instructions.

6. Related documents

(1) Weekly report (Yegu Pumping Station Office)

(2) EDWS-YPS-OP-W1 Safety instructions

(3) EDWS-YPS-MP3-W1 Work instruction of Electro Chlorinator

(4) Operation Record (Yegu Pumping Station Electro Chlorination Plant)

(5) Ledger book for the use of salt (Yegu Pumping Station Office)

(6) Ledger book for the use of Sodium Hydroxide (Yegu Pumping Station Office)

(7) Ledger book for the use of Sodium Carbonate (Yegu Pumping Station Office)

(8) Electro Chlorinator Operation Record (Yegu Pumping Station Office)

(9) Electro Chlorinator Maintenance Record (log book) (Yegu Pumping Station Office)

7. Related Forms

(1) EDWS-YPS-MP3-F1 (Daily Check Sheet)

(2) EDWS-YPS-MP3-F2 (Monthly Check Sheet)

(3) EDWS-YPS-MP3-F3 (Yearly Check Sheet)

(4) EDWS-YPS-OP1-F1 (Performance Indicator)

8. Reference

Work Instruction of ELECTRO CHLORINATOR of HAN SEIN THANT Co., Ltd

9. Appendix

- Nil

1. Topic

- The operation of Electro Chlorinator which is to produce Sodium Hypochlorite Solution from Salt.

2. Objective & Scope

(1) It's to understand the production step of Sodium Hypochlorite Solution.
(2) It's only to operate 10 KG/hr Electro Chlorinator (Shanghai) in Yegu Pumping Station.

3. Abbreviation & Definition

(၁) H_2 : **Hydrogen**

(၂) MCC : Main Control Centre

(၃) NaOCL : Sodium hypochlorite solution

(၄) PLC : Programme Logic Control System

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	To produce Sodium Hypochlorite Solution	Staff in Electro Chlorination Plant	Plant Station Manager, SAE, Deputy Supervisor
2	To operate Electro Chlorinator	〃	〃

5. Procedure

5.2 Operation steps

(1) Firstly, it's to do backwash the Softener Tank every day.
(2) Put/ add 1212 kilogram (50 viss per bag (15 bags) into Raw Salt Dissolving Tank by using Screw Conveyor.
(3) Open Softener Water Inlet Valve to add water.

(4) Open Inlet valve which is connected to Raw Salt Dissolving Tank to Raw Salt Water Tank. Adjust 250 L/h flow rate.
(5) Open (2) Raw Salt Outlet valves.
(6) Before operating Raw Salt Water Pump, it's to select/choose Reaction Agiator Tank (1) or (2) on Membrane System Control Screen and open Inlet Valve.
(7) Open (2) Outlet valves in Sodium Hydroxide Pump & Sodium Carbonate Pump to Reaction Agiator Tank and operate it on Membrane Touch Screen. While operating Sodium Hydroxide (10 kg) Dosing Pump & Sodium Carbonate (25 kg) Dosing Pump, it's to adjust 100 L/h Flow Rate.
(8) After settling Mixing Salt Water in Reaction Agiator Tank for 8 hours, open drain valve slowly. If the sediment flow out through Transparent Pipe and if it's clear, then close drain valve. Release/discharge the sediment by opening drain valve for 5 or 6 times.
(9) Membrane Filtering Device Touch Screen- Login- Name-ADMIN >>>Password-ADMIN and press Enter. Then choose Generator System Flow on Membrane Filtering Device Touch Screen. Then operate 2 Chemical Pumps in Manual Mode by clicking/pressing Start and operate one by one.
(10) Login on Membrane Filtering Device Touch Screen. Name-ADMIN >>> Password- ADMIN and press Enter. Then enter to Generator System Flow >>> Precipitation System on the Membrane Device Touch Screen. Before operating Membrane Filter Pump, it's to choose Sedimentation Tank (1) or Sedimentation Tank (2) on the Membrane Filtering Touch Screen.
(11) Then open chosen Reaction Agitator Tank Outlet Valve on the Membrane Filtering Device Touch Screen. Then open Refined Brine Tank Inlet Valve.
(12) If Tube is filled with salt water, then press STOP on Membrane Filtering Device Touch Screen to stop the pump. After that check by eyes whether salt water in tube is getting clear or not. If it isn't clear, open the drain pipe from Reaction Agitator Tank to drain out. Then open Drain Valve in the tube. By opening Drain Valve, it's also cleaning Membrane Pipe in the tube and can check the salt water by eyes.
(15) While operating Generator, adjust the valves in NaOCL Electrolyzer; Brine Flow Rate – 165 L/hr, Soft Water Flow Rate – 1.25 m^3/hr & cooling flow rate – 2.5m^3/hr respectively.

Noted: It's to check Generator System Flow Tap Water whether it's exceeded 35° C or not in hot season. If it's exceeded 35° C, the generator will be shut down. If the temperature is high (above 35° C), not to operate the Generator. The Conductivity in

Generator System Flow Screen must be between 45-49 ms/cm. The outlet temperature must not exceed 50° C.

(16) If the Electrolyzer is in normal condition, Voltage must be 90 V and Ampere is 560 A. If Ampere is under 560 A, then turn Output Knob on Rectifier Panel to clock wise direction slowly.

(17) If Rectifier starts to run, then check H_2 Removing Blower whether it's running fully or not. Before operating Generator, Main Voltage must be (380-400 V). If the voltage is higher than limited, then it is not to operate the Generator.
While in operating Generator, if Alarm sound appears on PLC Control Panel Touch Screen, it can know the Fault (why does the alarm sound appear). While operating the generator, it's to check water level in Softened Water Tank not to reach Low level. If the water reaches to low level in Softened Water Tank, the Generator will be automatically shut down. Noted: If the water nearly reaches to low level in Softened Water Tank, stop Generator by Auto Step on PLC Control Panel Screen.

(18) PLC Control Panel Touch Screen>> Generator System Flow >>> Storage System. Press START to operate NaOCl Dosing Pumps.

(19) When operating NaOCl Dosing pumps, choose NaOCl Storage Tank (1) or (2) in Storage System on PLC Control Panel Touch Screen.

6. Related documents

- Nil

7. Related Forms

- Nil

8. Reference

- Work Instruction of ELECTRO CHLORINATOR of HAN SEIN THANT Co., Ltd.

9. Appendix

- Nil

	ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ရေလှောင်ကန်ကြီးများဌာနခွဲ ရေကူးရေတွန်းစက်ရုံ	SOP ကုဒ်အမှတ်	EDWS-YPS-OP3-W1
		Version အမှတ်	01
		စတင်အသုံးပြုသည့်နေ့	May 31, 2021
		စာမျက်နှာအမှတ်	Page 4 of 4

4. EDWS-YPS-OP3-W1_1.docx အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) May 31, 2021

1. Topic

- Maintenance of Electro Chlorinator which is used to produce Sodium Hypochlorite Solution from salt.

2. Objective & Scope

(1) To understand maintenance of Electro Chlorinator.

(2) It's only for the maintenance of 10 KG/hr Electro Chlorinator (Shanghai) in Yegu Pumping Station.

3. Abbreviation & Definition

- HCL : Hydrochloric

4. Duties, Responsibilities & Accountabilities

No	Tasks	Person	Responsibility
1	To produce Sodium Hypochlorite Solution	Staff in Electro Chlorination Plant	Pump Station Manager, SAE, Deputy Supervisor
2	Maintenance of Electro Chlorinator	〃 Staff in Electro Chlorination Plant	Pump Station Manager, SAE, Deputy Supervisor

5. Procedure

5.1 Daily Maintenance

(1) It's to clean the inside/out of the pump house and equipment.
(2) To backwash Softener every day.
(3) It's to check Storage Tanks, Sensors in Electrolyzer and Level Switch whether it's functioned or not.
(4) It's to check the meters every day.
(5) It's to check the purifier whether it functions or not and clean/wash the filter media in the tube.
(6) It's to check the storage tank.

(7) It's to check dosing pumps and motors whether it's functioned or not and check Gear oil.
(8) It's to check the pipe and pipe joints whether it's leak or not.

5.2 Monthly Maintenance

(1) Filter rod in Softener must be replaced.
(2) It's to clean Electrolyzer using HCL Acid or water every month.
(3) It's to clean Membrane Filtering Device with HCL Acid or water every month.
(4) Put the Gear Oil into Dosing Pump every month.
(5) Cleaning Storage tank every month.
(6) It's to add/put the oil in the motors every month.

5.3 Yearly maintenance

(1) It's to replace the filter media in every year.
(2) It's to do servicing every year for MCC Panel, PLC Panel, Rectifier, Membrane Filtering Device Panel which are used to operate Electrolyzer.
(3) It's to do servicing every year for Electrolyzer.
(4) It's to replace Electrolytic Cell Seal in Eletrolyzer every year.

5.4 Emergency Maintenance

(1) If pipe break or leak happen, it's to replace and repair it at once.
(2) If motor is malfunctioned, it's to replace & install it at once.
(3) If Sensor & level switch are malfunctioned or damaged, it's to replace it at once.

6. Related documents

- Nil

7. Related forms

- Nil

8. Reference

- Work Instruction of ELECTRO CHLORINATOR of HAN SEIN THANT Co.,Ltd

9. Appendix

- Nil

Dosing Pump Control Chart

Dosage Chlorine (mg/l)	Residual chlorine (mg/L)											
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.5	2.0
Flow Rate: 20MGD (3,805,175L/hr)												
4000	95.13	190.26	285.39	380.52	475.65	570.78	665.91	761.04	856.16	951.29	1426.94	1902.59
4500	84.56	169.12	253.68	338.24	422.80	507.36	591.92	676.48	761.04	845.59	1268.39	1691.19
5000	76.10	152.21	228.31	304.41	380.52	456.62	532.72	608.83	684.93	761.04	1141.55	1522.07
5500	69.19	138.37	207.56	276.74	345.93	415.11	484.30	553.48	622.67	691.85	1037.78	1383.70
6000	63.42	126.84	190.26	253.68	317.10	380.52	443.94	507.36	570.78	634.20	951.29	1268.39
6500	58.54	117.08	175.62	234.16	292.71	351.25	409.79	468.33	526.87	585.41	878.12	1170.82
7000	54.36	108.72	163.08	217.44	271.80	326.16	380.52	434.88	489.24	543.60	815.39	1087.19
Flow Rate: 30MGD (5,707,763L/hr)												
4000	142.69	285.39	428.08	570.78	713.47	856.16	998.86	1141.55	1284.25	1426.94	2140.41	2853.88
4500	126.84	253.68	380.52	507.36	634.20	761.04	887.87	1014.71	1141.55	1268.39	1902.59	2536.78
5000	114.16	228.31	342.47	456.62	570.78	684.93	799.09	913.24	1027.40	1141.55	1712.33	2283.11
5500	103.78	207.56	311.33	415.11	518.89	622.67	726.44	830.22	934.00	1037.78	1556.66	2075.55
6000	95.13	190.26	285.39	380.52	475.65	570.78	665.91	761.04	856.16	951.29	1426.94	1902.59
6500	87.81	175.62	263.44	351.25	439.06	526.87	614.68	702.49	790.31	878.12	1317.18	1756.23
7000	81.54	163.08	244.62	326.16	407.70	489.24	570.78	652.32	733.86	815.39	1223.09	1630.79
Flow Rate: 40MGD (7,610,350L/hr)												
4000	190.26	380.52	570.78	761.04	951.29	1141.55	1331.81	1522.07	1712.33	1902.59	2853.88	3805.18
4500	169.12	338.24	507.36	676.48	845.59	1014.71	1183.83	1352.95	1522.07	1691.19	2536.78	3382.38
5000	152.21	304.41	456.62	608.83	761.04	913.24	1065.45	1217.66	1369.86	1522.07	2283.11	3044.14
5500	138.37	276.74	415.11	553.48	691.85	830.22	968.59	1106.96	1245.33	1383.70	2075.55	2767.40
6000	126.84	253.68	380.52	507.36	634.20	761.04	887.87	1014.71	1141.55	1268.39	1902.59	2536.78
6500	117.08	234.16	351.25	468.33	585.41	702.49	819.58	936.66	1053.74	1170.82	1756.23	2341.65
7000	108.72	217.44	326.16	434.88	543.60	652.32	761.04	869.75	978.47	1087.19	1630.79	2174.39

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ရေလျှောင်ကန်ကြီးများဌာနခွဲ ရေကူးရေတွင်းစက်ရုံ	**SOP ကုဒ်အမှတ်**	**EDWS-YPS-MP3-F1**
		ဗားရှင်းအမှတ်	**01**
		စတင်အသုံးပြုသည့်နေ့	**May 31, 2021**
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		ရေးသားသူ	**AE**
		အတည်ပြုသူ	**DYCE**
		ခွင့်ပြုသူ	**CE**

Check Sheet for Daily (Electro Chlorination Plant)

Room Temp; (°C)		Date (/ /)			Time (:) hr		Remark
MEASUREMENT	Equipment	Rectifier	MCC	Softener	Dosing Pump	Electrolyzer	Special mention matters
	Current (A)						
	Voltage (V)						
	Frequency (Hz)						
	Pressure (Bar)						
	Conductivity					ms/cm	
	Temperature(°C)						
CHEMICAL PUMPS	Pump & Motor	NaOH	Na_2Co_3	Acid Cleaning	Dosing	Brine	Special mention matters Sensors
	Noise						
	Vibration						
	Grease						
	Smell						
	Oil Level						
	Leakage						
OTHER PUMPS	Pump & Motor	Agitator	Raw Salt Water	Soft Water	H_2 Remov;	Membrane	Special mention matters Sensors
	Noise						
	Vibration						
	Grease						
	Smell						
	Oil Level						
	Leakage						
Signs for judgment		✓ : Good	Δ : Caution		⋆ : Need to repair		

တာဝန်ခံမှူး ပြင်/ထိန်း တာဝန်ကျအင်ဂျင်/ယာ စက်ရုံမှူး

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ရေလှောင်ကန်ကြီးများဌာနခွဲ ရေကူးရေတွင်းစက်ရုံ	**SOP ကုဒ်အမှတ်**	**EDWS-YPS-MP3-F2**
		ဗားရှင်းအမှတ်	**01**
		စတင်အသုံးပြုသည့်နေ့	**May 31, 2021**
		စာမျက်နှာအမှတ်	**Page 1 of 1**
		ရေးသားသူ	**AE**
		အတည်ပြုသူ	**DYCE**
		ခွင့်ပြုသူ	**CE**

Check Sheet for Monthly (Electro Chlorination Plant)

Room Temp; (˚C)		Date (/ /)		Time (:) hr			Remark
TREMENT	Equipment	Storage Tanks		Softener	Membrane	Electrolyzer	Special mention matters Sensors
		Water	Brine				
	Filter rods						
	HCl Acid(Dilute)						
	Cleaning						
	Conductivity					ms/cm	
CHEMICAL PUMPS	Pump & Motor	NaOH	Na_2Co_3	Acid Cleaning	Dosing Pump	Brine	Special mention matters Sensors
	Noise						
	Vibration						
	Grease						
	Smell						
	Oil Level						
	Leakage						
OTHER PUMPS	Pump & Motor	Agitator	Raw Salt Water	Soft Water	H_2 Remov;	Membrane	Special mention matters Sensors
	Noise						
	Vibration						
	Grease						
	Smell						
	Oil Level						
	Leakage						
Signs for judgment		✓ : Good		Δ : Caution		* : Need to repair	

တာဝန်များ ပြင်/ထိန်း တာဝန်ကျ အင်/ယာ စက်ရုံများ

	ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ ရေရရှိရေးနှင့်ရေပေးဝေရေးလုပ်ငန်းတာဝန်ခံအဖွဲ့ အင်ဂျင်နီယာဌာန (ရေနှင့်သန့်ရှင်းမှု) ရေလျှောင်ကန်ကြီးများဌာနခွဲ ရေကူးရေတွင်းစက်ရုံ	**SOP ကုဒ်အမှတ်**	**EDWS-YPS-MP3-F3**
		ဗားရှင်းအမှတ်	**01**
		စတင်အသုံးပြုသည့်နေ့	**May 31, 2021**
		စာမျက်နှာအမှတ်	**Page 1 of 1**
		ရေးသားသူ	**AE**
		အတည်ပြုသူ	**DYCE**
		ခွင့်ပြုသူ	**CE**

Annual Check Sheet (Electro Chlorination Plant)

Year;		Date (/ /)				Time (:) hr			Remark
SERVICE	Equipment	Panels				Softener	Membrane	Electrolyzer	Special mention matters Sensors
		MCC	PLC	Rectifier	Memb				
	Filter Media								
	Electrolytic Cell Seal								
	Servicing								
CHEMICAL PUMPS	Pump & Motor	NaOH		Na_2Co_3		Acid Cleanig	Dosing	Brine	Special mention matters Sensors
	Noise								
	Vibration								
	Grease								
	Smell								
	Oil Level								
	Leakage								
OTHER PUMPS	Pump & Motor	Agitator		Raw Salt Water		Soft Water	H_2 Remov;	Membrane	Special mention matters Sensors
	Noise								
	Vibration								
	Grease								
	Smell								
	Oil Level								
	Leakage								
Signs for judgment		✓ : Good		Δ : Caution			* : Need to repair		
တာဝန်များ		ပြင်/ထိန်း		တာဝန်ကျ အင်/ယာ			စက်ရုံများ		

Annex-6.C: Water Quality Management Plan (Provisional)

Water Quality Management Plan

(Provisional)

Part1: Water Quality Monitoring

Part2: Water Treatment Facility

WRAWSA

YCDC

Part 1

Water Quality Monitoring

WRAWSA

YCDC

Water quality management plan (Individual detailed plan)

N0. 1

Objective

- Establishment of water quality monitoring organization for urban tap water monitoring

Issues to be improve

- Current water quality monitoring organization should be enhanced for the monitoring of tap water in urban area. Especially, residual chlorine monitoring plan should also be established to control the appropriate residual chlorine management in tap water.

Strategic approach

- Establishment of water quality monitoring organization for urban tap water and tube well water monitoring.
- Capacity development of township or district office for tap water monitoring.

Improvement target

- Cooperation with central laboratory and township or district office.
- Capacity development for water quality monitoring of township or district office personnel.

Initiation

Cooperation with central laboratory and township or district office

- Institutionalization of tap water quality monitoring, including township or district office.
- Development of residual chlorine monitoring plan.
- Decide tap water monitoring item, monitoring point and monitoring frequency.
- Procurement of additional water quality monitoring equipment for tap water quality monitoring.

Capacity development of township or district office for tap water monitoring

- Preparation training materials and training plans for township or district office personnel.
- Development SOPs of monitoring and sampling to be used for training materials.
- Decide curriculum including schooling and OJT.
- Decide training schedule.
- OJT and technical follow up.

Expected effect

- Establishment of tap water quality monitoring system in collaboration with TS or District office will allow for more extensive and frequent monitoring of tap water quality. This initiative will enable more effective tap water quality control.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from Year 1.

Scheduled duration

Year 1 to Mid of Year 2.

After mid of Year 2: OJT and technical follow up

Water quality management plan (Individual detailed plan)

N0. 2

Objective

- Enhancement of water quality management capacity in water source area

Issues to be improve

- Reservoir water without treatment is still distributed. SS and turbidity in these untreated water causes not only water quality problems but also malfunction of water meter. Thus, water quality management including environmental management of water source area (surround area of reservoir) should be considered. For this issue, capacity enhancement of mini laboratory is necessary.

Strategic approach

- Capacity enhancement of mini laboratory.
- Capacity enhancement of environmental protection of water catchment area of reservoir.
- Continuing implementation of technical assistance to mini laboratory.

Improvement target

- Capacity of mini laboratory is improved.
- Training material and training plan for mini laboratory are improved.

Initiation

Capacity of mini laboratory is improved

- Training and trip guidance for mini laboratories are continued

Training material and training plan for mini laboratory are improved

- Development of training materials and training plans for mini laboratory
- Revise current mini laboratory SOPs for training materials.
- Prepare training material including revised SOPs, additional curriculum for water catchment area protection.

Expected effect

- Water quality and environment in water source area will be protected by the enhancement of capacity of mini laboratory.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from Year 2.

Scheduled duration

Year 2 to Mid of Year 3.

Water quality management plan (Individual detailed plan)

N0. 3

Objective

- Capacity enhancement of central laboratory

Issues to be improve

- The leadership role of central laboratory will increase in future. Therefore, there is a need to continue to improve the technical capacity of the central laboratory.

Strategic approach

- Measurement items and methods should be improved in accordance with the Myanmar National Drinking Water Quality Standard (MNDWQS).
- Enhancement of data analysis capacity and consulting ability to encourage an ability as leading laboratory.

Improvement target

- Improve water quality monitoring capacity through the introduction of new technologies and increase a technical consultation capacity for water quality improvement. In addition, improve a capacity for environmental protection of water sources.

Initiation

Improve water quality monitoring capacity

- Introduce MNDWQS decided method or other standard method.
- Introduce AAS for heavy metal monitoring.
- Increase monitoring item to meet MNDWQS decided items.

Increase a technical consultation capacity for water quality improvement

- Improve a capacity of water quality data analysis
- Increase knowledge of water resource management and water purification technology.
- Enhancement of capacity of information dissemination.

Capacity enhancement of water source protection

- Capacity enhancement of reservoir water quality management.
- Establish catchment area environment protection system including waste management, wastewater discharge and soli runoff.
- Capacity enhancement of river water quality management.
- Establish river water quality monitoring system including collaboration with pertinent agencies and institutions.

- Capacity enhancement of groundwater source quality management.

Expected effect

- Water quality and environment in water source area will be protected by the enhancement of capacity of mini laboratory.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from Year 1.

Scheduled duration

Year 1 to Mid of Year 5.

Water quality management plan (Individual detailed plan)

N0. 4

Objective

- Support of new WTP laboratory operation

Issues to be improve

- Operation of new WTP will start (Lagunbin: 2020- and Kokkowa: 2025-). To ensure the effective operation of new laboratory, training of new water quality monitoring personnel and implementation of technical support to new laboratory is necessary.

Strategic approach

- Technical training of new WTP laboratory staff (Lagunbin and Kokkowa) and continuum technical consultation

Improvement target

- Technical training of new laboratory personnel.
- Technical support and consultation of new laboratory operation.
- Establishing the roll-sharing of central laboratory and new WTP laboratory

Initiation

Technical training of new laboratory personnel

- Prepare syllabus, training material and schedule of new laboratory staff.

Technical support and consultation of new laboratory operation

- Implement weekly meetings with new WTP laboratory staff.
- Implement trip guidance to new WTP laboratory.

Establishing the roll-sharing of central laboratory and new WTP laboratory

- Decide scope of responsibility of water quality monitoring among central laboratory and new WTP laboratories.
- Decide water quality monitoring area and monitoring point of WTP laboratory

Expected effect

- This activity will ensure a smooth start-up of the new water treatment plant. In addition, the technical support provided by the central laboratory will establish a working relationship with central laboratory and new WTP laboratory.

Priority

Low or Medium or High

Scheduled time

- For Lagunbyin WTP: To start improvement work from Year 1.
- For Kokkowa WTP: to start improvement work from Year 4.

Scheduled duration

2 years from the start of activity

Water quality management plan (Individual detailed plan)

Objective

- Continue the activities initiated in the medium-term plan

Issues to improve

- Continue the activities initiated in the mid-term plan and enhance capacity.
- Establish the PDCA cycle by monitoring the results of activities and reflecting the results in the improvement of activities.

Strategic approach

- Periodical monitoring of each activity
- Modification of activities to reflect monitoring results.

Initiatives

Urban tap water monitoring

- Continue tap water monitoring.
- Continue training of township or district personnel.
- Reflect monitoring results to improvement water quality management activity.

Enhancement of water quality management capacity in water source area

- Continue technical training to mini laboratory personnel.
- Reflect monitoring results to improvement environmental management of water source area.

Capacity enhancement of central laboratory

- Improvement in the ability to analyze water quality measurement data
- Continue of development of periodical water quality reports
- Improve the contents of water quality report.
- Strengthen cooperation with public relation section and strengthen the dissemination of information.
- Dissemination of information and recommendations for improving water quality through seminar and academic meeting.

Support of new WTP laboratory operation

- Continue technical training and guidance to new WTP laboratory

- Reflect monitoring results to improvement WTP O&M

Priority

Low or Medium or High

Scheduled time

After the completion of the activities of each medium-term plan, the contents of the long-term plans are implemented as a follow-up.

Scheduled duration

Until year 10 or more

Schedule of the Water quality management plan: Water quality monitoring

No.	Improvement water quality monitoring and water quality management capacity	Year 1	Year 2	Year3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Water quality monitoring organization for urban tap water monuitoring										
1	Establish residual chlorine monitoring organization										
2	Prepare residual chlorine monitoring plan										
3	Deveropment traing material, training plan										
4	Training of new monitoring organization staffs (TS office or District office)										
5	OJT and technical followup										
	Enhancement of water quality management capacity in water source area										
6	Development training materials and training plan										
7	Implement mini laboratory training and trip guidance										
	Capacity enhancement of central laboratory										
8	Improve existing measurement method										
9	Introduce new measurement item to satisfy MNDWS monitoring item										
10	Prepare new SOP										
11	Capacity enhancement of technical consultation										
	Support of new WTP laboratory operation										
12	Establish and training of Lagunbyin WTP laboratory and follow up										
13	Establish and training of Kokkowa WTP laboratory and follow up										

Part 2

Water Treatment Facility

WRAWSA

YCDC

Water quality management plan (Individual detailed plan)

N0. 1

Objective

- Improvement of clear water quality in Nyaunghnapin-WTP.

Issues to improve

- Nyaunghnapin WTP has been designed to make water of which quality would be met the Myanmar National Drinking Water Quality Standards, so it has the treatment flow which is capable to produce less than 1 NTU water. However, the present clear water turbidity is often high, and it exceeds the standards, occasionally.

Strategic approach

- Recovery of sand filtration function.

Improvement target

- Replacement of existing filter media with an appropriate quality, quantity and size of filter media.

Initiatives,

- All 60 filters, 28 filters of Phase 1 and 32 filters of Phase 2, are improved.
- Existing filter media, which are anthracite and sand, are removed from a filter.
- Sieved sand of which the effective diameter is between 0.40 mm ~ 0.60 mm, and uniformity coefficient is 1.4 ~ 1.7, is refilled.
- Purchased anthracite of which size and quality are predesignated, is refilled. The effective diameter of it is 0.80 mm ~ 1.2 mm, and uniformity coefficient is 1.4 ~ 1.7, is refilled.

Expected effect

- An enhancement of removing efficiency of flocs and turbid matters included filter influent is expected. It will make filtrate turbidity low so that clear water quality is improved.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 1.

Scheduled duration

- Year 1 ~ year 5

Note

- This work shall be done together with another filter improvement plan (Raise of outflow side weir height, Replacement of valves, etc.). This will reduce the number of work procedure and minimizes the total cost of them.

Reference

- Research Report of Filter Improvement Task Force Team, October 2019

Water quality management plan (Individual detailed plan)

N0. 2

Objective

- Improvement of clear water quality in Nyaunghnapin-WTP.

Issues to improve

- Nyaunghnapin WTP has been designed to make water of which quality would be met the Myanmar Water Quality Standards, so it has the treatment flow which is capable to produce less than 1 NTU water. However, the present clear water turbidity is often high, and it exceeds the standards, occasionally.

Strategic approach

- Recovery of sand filtration function.

Improvement target

- Optimization of filter washing method

Initiatives,

- To find out the reason that filter wash water includes air
- Then take measures so that water do not include air.
- To set appropriate backwash rate which makes filter wash efficiently.

Expected effect

- Maintaining cleanliness of filter media. It will make filtrate turbidity low so that clear water quality is improved.
- Changing the suction pipe of back-wash pumps to the deeper position (or) Changing the back-wash pumps to the deeper position
- Construction of new back-wash pumping station at lower elevation together with the new clear water reservoir
- Research together with analysis should be done before implementation

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 1.

Scheduled duration

・ Year 1 ~ year 5

Note

・ This work shall be done for the filters after improvement of the “No.1 Individual detailed plan”.

Reference

・ Seminars for the Task Force Team

No.	Date	Outline of Contents
1st	27th, Aug, 2016	• Basic Design Parameters on Design Standard • Functions Required to Filters • Rapid Sand Filtration
2nd	6th, Sep, 2016	• How to get yield, minimum and maximum diameter of a filter media from a sieve analysis
3rd	26th, Oct, 2016	• Review of the last TFT mini seminar • Exercise • Requirements to be considered in the filter improvement plan

・

Water quality management plan (Individual detailed plan)

N0. 3

Objective

- Improvement of clear water quality in Nyaunghnapin-WTP.

Issues to improve

- Nyaunghnapin WTP has been designed to make water of which quality would be met the Myanmar Water Quality Standards, so it has the treatment flow which is capable to produce less than 1 NTU water. However, the present clear water turbidity is often high, and it exceeds the standards, occasionally.

Strategic approach

- Recovery of sedimentation function

Improvement target

- Enhancement of sludge discharge function

Initiatives,

- New construction of sludge discharge system
- Sludge can be removed in shorter time than now.

Expected effect

- Lowering turbidity of settled water

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 3.

Scheduled duration

- Year 3 ~ year 8

Note

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Reference

- "Planning for sludge management", Thit Lwin, (Sub Assistant Engineer), 7th Half Monthly Meeting (23rd, May 2018)

Water quality management plan (Individual detailed plan)

N0. 4

Objective

- Improvement of clear water quality in Nyaunghnapin-WTP.

Issues to improve

- Nyaunghnapin water treatment plant is designed with the same amount of water intake and water supply. The miscellaneous water used for wash of filters during the water purification process etc. is not considered. In order to obtain the amount of miscellaneous water, the operation of taking excess amount of raw water more than the design water volume is performed. This makes the water quality of clear water is getting worse.

Strategic approach

- To reduce the amount of excess water intake as much as possible.

Improvement target

- Increase the capacity of the clear water tanks,
- To store clear water in a clear water tank when the amount of supply water decreases at night. Clear water stored in a night used as miscellaneous water in daytime.

Initiatives,

- Expansion of volume of phase 1 and phase 2 clear water tanks
- Construction of new clear water tanks.

Expected effect

- Making clear water quality better and keep its quality constant.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 7.

Scheduled duration

- Year 7 ~ year 8

Note

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Reference

・ Seminars specialized in individual themes

5th	17th, Oct, 2018	Relation between Amount of Water Supply, Amount of Raw Water Intake and WTP Capacity (JICA Expert) ➢ Basic Parameter of Flocculation Basin ➢ Basic Parameter of Sedimentation Basin ➢ Basic Parameter of Filter

Water quality management plan (Individual detailed plan)

N0. 5

Objective

- Improvement of clear water quality in Nyaunghnapin-WTP.

Issues to improve

- Turbid matters and sludges have settled at the bottom of each clear water tank, deteriorating water quality.
- Clear water tanks in Nyaunghnapin water treatment plant have not been able to clean since there is only one clear water tank in phase 1 and phase 2 respectively.

Strategic approach

- To establish a system or introduce a new structure of clear water tanks, so that they can suspend the operation of the tanks for their cleaning while keeping supplying water to the city.

Improvement target

- To improve clear water supply system, so that clear water can be supplied without going through the tanks.
- To improve clear water tank structure, so that they can drain water and emptying tanks.

Initiatives,

- Build a new clear water tank.
- Connecting pipes will be installed between the existing clear water tanks and the newly constructed clear water tank.
- Modify the existing clear water tanks so that the stored water can be drained in a short time.
- Study an effectiveness of a bypass pipe so that water can supply without going through a clear water tank.

Expected effect

- Prevention of water quality deterioration.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 9.

Scheduled duration

- Year 9 (Scheduled duration is one year)

Note

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Reference

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Water quality management plan (Individual detailed plan)

N0. 6

Objective

- Securing the processing capacity margin in Nyaunghnapin water treatment plant, so that to prevent worsen water quality in a case of maintenance.

Issues to improve

- Nyaunghnapin water treatment plant is designed having not enough margin of sedimentation facilities in phase 1 and phase2. When operation of flocculation basin or sedimentation basin is stopped, rest of the other operated basins are required to treat about 20 % more water than the design capacity. This makes treated water worse.

Strategic approach

- To prevent treating of excess water than capacity.

Improvement target

- Increase of water treatment plant capacity of the process of flocculation and sedimentation.

Initiatives,

- Construction of new flocculation and sedimentation basins.
- Increase of flocculation basin capacity by a renovation of facilities.
- Decreasing treatment amount of water when a flocculation or sedimentation basins are under maintenance work.
- Add necessary treatment capacity to compensate a decrease of existing capacity when a construction of new Nyaunghnapin treatment facility.

Expected effect

- Stable operation of existing facilities of Nyaunghnapin water treatment plant.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 9.

Scheduled duration

- Year 9 ~ year 12

Scheduled time

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Scheduled duration

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Note

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Reference

・ Seminars specialized in individual themes

5th	17th, Oct, 2018	Relation between Amount of Water Supply, Amount of Raw Water Intake and WTP Capacity (JICA Expert) ➢ Basic Parameter of Flocculation Basin ➢ Basic Parameter of Sedimentation Basin ➢ Basic Parameter of Filter

Water quality management plan (Individual detailed plan)

N0. 7

Objective

- Improvement of quality of water supplying from reservoirs.

Issues to improve

- Almost half of the water has supplied from 3 Reservoirs, supplying water from Hlawga and Phugyi haven't been done any water treatment.
- Gyophyu has a water treatment facility, though the facility in Gyophyu constructed in 1940 and its treatment ability is not enough to produce clear water.

Strategic approach

- To treat water and to make water quality better, reliable and constant by rational treatment method.
- Establishment of optimum water treatment method for reservoir water.

Improvement target

- To study about suitable water treatment method for reservoir water.
- To confirm the treatment method cost-effective and produced water quality good.

Initiatives,

- Installation of water treatment research equipment and investigation using it.
- Installation of water treatment research equipment at the site each reservoir.
- To get basic design parameters for the designing of a plan for the facility.
- To get operational parameters.

Expected effect

- Improved quality of water supplying from reservoirs is supplied to vast city area constantly.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 4.

Scheduled duration

- Year 4 ~ year 10

Note

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Reference

・ RESEARCH REPORT OF DIRECT FILTRATION, February 2020

Water quality management plan (Individual detailed plan)

N0. 8

Objective

- Improvement of water quality supplying from reservoirs.

Issues to improve

- The reservoir used as a tap water source is designated as a protected area. It has not been confirmed whether the regulated contents designated as protected areas are appropriate and effective.

Strategic approach

- Verify whether the regulated contents designated as a protected area is valid in the future.

Improvement target

- Improvement of regulated contents designated as protected areas and enhancement of protection measures.
- Introduction of highly effective water quality conservation measures.

Initiatives,

- Confirmation of the regulated contents of conservation measures to prevent deterioration of reservoir water quality.
- Confirmation of the actual operation status and the effectiveness of the contents of conservation measures.
- Verification and understanding of long-term water quality trends.
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Expected effect

- Maintaining good reservoir water quality in future.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 2.

Scheduled duration

- Year 2 ~ year 4

Note

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Water quality management plan (Individual detailed plan)

N0. 9

Objective

- Reliable execution of disinfection treatment.

Issues to improve

- Multiple chlorination facilities have started operation at the same time. This is the first operation of a chlorine disinfection facility using sodium hypochlorite solution at EDWS. Appropriate operation and maintenance methods for these facilities have not been established at all facilities.

Strategic approach

- Establishing optimal operation methods for chlorination facilities.
- Appropriate maintenance methods for these facilities are established and applied at all facilities.

Improvement target

- All the disinfection facilities are operated and maintained in a same manner by all the site workers in a different facility in the future.

Initiatives,

- The disinfection facilities are operated and maintained using SOPs.
- Monitoring of operation and maintenance status at each facility is done.
- Verification of operation and maintenance status at each facility is done.
- The verification results of the operation and maintenance status of each facility are shared by all facilities, and the SOPs of all facilities are updated in the same manner.

Expected effect

- Ensuring inactivation of pathogenic bacteria in tap water, so that tap water become safer.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 1.

Scheduled duration

- Year 1 ~ year 3

Note

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Reference

・ Report for Improvement Plan on Management of Water Treatment and Water Quality Based on the Third Country Research Study in PPWSA, Cambodia, May 2019

・ Seminars specialized in individual themes

4th	17th, Oct, 2018	Chlorine dosing house (JICA Expert) ➢ Chlorine Dosing House ➢ Plain Drawing of Chlorine Dosing Facility ➢ Dosing Room and Dosing pumps ➢ Example of dike in dosing house Basic Policy of chlorination in Japan (JICA Expert) ➢ Basic Policy of chlorination in Japan. Water Supply Act of Japan ✧ Water Supply Act of Japan ✧ Enforcement Regulations of the Water Supply Act ✧ Drinking Water Quality Standards in Japan ✧ MHLW Ordnance of Water Supply Facility Standards based on the Water Supply Act ✧ Notice of the director of the Water Supply Division, Health Service Bureau, MHLW (No. & place of sampling points for water quality test)

Water quality management plan (Individual detailed plan)

N0. 10

Objective

- Establishment and execution of standard O&M work procedures at water purification plants, etc. and succession of technical information in EDWS

Issues to improve

- SOPs are in place throughout the organization, but there is no system in place to maintain them in the future.
- The improvement of SOPs is done in a non-centralized way.

Strategic approach

- Establishment of standard operating procedure (SOPs) system.
- To ensure that SOPs are applied in all sections.
- To establish a centralized operation and improvement system for all SOPs.

Improvement target

- To ensure that officers and site workers do not work, do not operate or do not maintain facilities in an arbitrary manner.

Initiatives,

- "Review" method for confirming the operational status of SOPs is established and introduced into the SOPs system.
- "Internal Audit" method to confirm the operational status of SOPs is established and introduced in the SOPs system.

Expected effect

- Making work procedures appropriately, confirmation of technical base, prevention of work errors and ensuring traceability

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 3.

Scheduled duration

- Year 3 ~ year 6

Note

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Reference

・ Report for Improvement Plan on Management of Water Treatment and Water Quality Based on the Third Country Research Study in PPWSA, Cambodia, May 2019

Water quality management plan (Individual detailed plan)

N0. 11

Objective

- Prevention of water quality deterioration at distribution tanks in the city area.

Issues to improve

- Turbid matters and sludges have settled at the bottom of each distribution water tank, deteriorating water quality.
- Maintenance and cleaning method are not established for distribution tanks in the city area.

Strategic approach

- Remove turbid matters and sludges settled at the bottom of distribution water tanks regularly.

Improvement target

- The distribution water tanks will be renovated and introduce a new structure, so that it can be easily cleaned while supplying water to the city.

Initiatives,

- The existing tank is partitioned so that the other tank can be cleaned while supplying water to the city area.
- To introduce drainage equipment to tanks, so that water can drain for cleaning of tanks in a short time.
- Build a new tank.

Expected effect

- Water quality is not deteriorated while it is stored in a distribution tanks in the city area.

Priority

Low or Medium or High

Scheduled time

- To start improvement work from year 7.

Scheduled duration

- Year 7 ~ year 12

Note

Reference

Schedule of Water quality management plan: Water treatment facility

No.	Facility to improve and target to improve	Year 1	Year 2	Year3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
	Nyaunghnapin Water Treatment Plant												
1	Replacement of existing filter media with an appropriate quality, quantity and size of filter media												
2	Optimization of filter washing method												
3	Enhancement of sludge discharge function												
4	Increase the capacity of the clear water tanks												
5	To improve clear water supply system, so that clear water can be supplied without going through the tanks. To improve clear water tank structure, so that they can drain water and emptying tanks												
6	Increase of water treatment plant capacity of the process of flocculation and sedimentation												
	Gyophyu, Hlawga and Phugyi reservoirs												
7	Establishment of optimum water treatment method for reservoir water Construction of new treatment facilities												
8	Improvement of regulated contents designated as protected areas for reservoir water quality protection Introduction of highly effective water quality conservation measures												
	Chlorination facilities												
9	Establishing optimal operation methods for chlorination facilities Appropriate maintenance methods for these facilities are established and applied at all facilities												
	Main facilities for supplying water												
10	Establishment of standard operating procedure (SOPs) system To establish a centralized operation and improvement system for all SOPs												
	Water distribution facilities												
11	Partitioning and introduction of drainage system to distribution tanks Construction of new water distribution tanks												