添付資料 3.80

2017 年春期研修「O&M of Sewer and Storm Water Drainage」で作成された OJT 実施手順書

On the Job Training Implementation Plan

Sewerage and storm water Drainage

1. Sewer Pipe blockage repairing

No.	Items	Check
1.	Confirmation of the blockage occurrence date and time	
2.	Confirmation of the location/address of the blockage repairing site	
3.	Confirmation of the visible scale of blockage (Large/Moderate/Small)	
4.	Confirmation of the road condition (Spouting/Submergence/Subsidence)	
5.	Preparation of the pipeline map of the blockage site	
6.	Confirmation of the non-passage road area and detour (bypass) route	
7.	Confirmation of the blockage repair equipment, material and quantity	
8.	Confirmation of the blockage repair team member's role	
9.	Check of the traffic condition and the event near the blockage point	
10.	Preparation of the transportation	
11.	Confirmation of the departure time	
12.	Preparation of the working shoes, reflection vest and headlight	
13.	Information of the pipe (location, depth, material, diameter and lying age)	
14.	Information of the manhole(depth, material, diameter)	
15.	Confirmation of the O2 and H2S concentration in the manhole	
16.	Contact to the Police and relative traffic organization	
17.	Reporting of the repair work result	

2. Drainage Cleaning

No.	Items	Check
1.	Confirmation of the location/address of the dredging site	
2.	Confirmation of the amount of dredging	
3.	Confirmation of the road condition of dredging place	
4.	Preparation of the drainage of the dredging site	
5.	Confirmation of the non-passage road area and detour (bypass) route	
6.	Confirmation of the dredging equipment, material and quantity	
7.	Confirmation of the dredging repair team member’s role	
8.	Check of the traffic condition and the event near the dredging point	
9.	Preparation of the transportation	
10.	Confirmation of the departure time	
11.	Preparation of the working shoes, reflection vest and headlight	
12.	Information of the drainage (depth, lining material, width)	
13.	Contact to the Police and relative traffic organization	
14.	Reporting of the dredging work result	

3. Safety Control

No.	Items	Check
1.	Confirmation of the condition of safety gears and equipment	
2.	Confirmation of the quantities of safety gears and equipment	
3.	Confirmation of proper usage of safety gears for Sewer man	
4.	Confirmation of proper usage of safety equipment for manhole works	
5.	Confirmation of proper arrangement of traffic control	

添付資料 3.81

2017 年春期研修「O&M of Electrical Equipment」で作成された OJT 実施手順書

WASA: MULTAN Division: Disposal Station Sub Division: (North)

Approved by:

Prepared by: M Abbas WASA Multan

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Chungi No. 9	Shazad Muneer	Tariq	M. Abbas	Shafqat Raza	Daily Operation Record	15.5.17			
						SOP Check List				
						Device Inspection Sheet				
2.						Daily Operation Record				
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Chungi No. 9	Shazad Muneer	Tariq	M. Abbas	Shafqat Raza	1. O&M Manual	15.5.17			
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

WASA: Lahore Division: Nishtar Town Sub Division: Township

Approved by: ____________

Prepared by: M. Armughan Khan.

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge: XEN	SDO	Sub Engineer	Operator					
1.	Milad Park T/W	Sohail Cheema	Armughan Khan	Zaheer Ahmed		Daily Operation Record	1st may 2017			
						SOP Check List				
						Device Inspection Sheet				
2.	R-Block Near T/W	Sohail Cheema	Armughan Khan	Zaheer Ahmed		Daily Operation Record	1st may 2017			
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge: XEN	SDO	Sub Engineer	Operator					
1.	LMP Block	Sohail Cheema	Armughan Khan	Zaheer Ahmed.		1. O&M Manual	15th May 2017			
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

Approved by: ____________________

WASA: LAHORE *Division:* Electricity *Sub Division:* GULBERG

Prepared by: HASNAIN RAZA.

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	FCC Gulberg	Rafiq Ch	Hasnain Raza	Kashif	Ali	Daily Operation Record	28/04/17			
						SOP Check List				
						Device Inspection Sheet				
2.	G-Block GULBERG	Rafiq Ch.	Hasnain Raza	Kashif	Ahmed	Daily Operation Record	28/04/17			
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	FCC Gulberg	Rafiq Ch.	HASNAIN RAZA	KASHIF	Ali	1. O&M Manual	28/04/17			
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

WASA: RWP Division: Water Supply Sub Division: Filtration Plant

Approved by: ____________

Prepared by: Muhammad Ali

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Filtration Plant	Mr. Ahmed Manzoor	Shafaqat Mehmood	Muhammad Ali	Iqbal Mehmood	Daily Operation Record already implemented				
						SOP Check List	29-4-17			
						Device Inspection Sheet	10-5-17			
2.						Daily Operation Record				
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Filtration Plant	Ahmed Manzoor	Shafaqat Mehmood	Muhammad Ali	Yameen Nadeem	1. O&M Manual	10-5-17			
						2. Basic Specifications	15-5-17			
						3. Daily O&M Record already implemented				
						4. Preventive Maintenance Plan	20-5-17			

-Remarks-

WASA: Multan Division: DISPosal Sub Division: Central

Approved by: Sajid WASA Multan.

Prepared by:

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Sameejabad DISPosal.	Shahzad Munir	Sajid	Asif	Tufail	Daily Operation Record	14-5-17			
						SOP Check List				
						Device Inspection Sheet				
2.						Daily Operation Record				
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Samegabad DISPosal.	Shahzad Munir	Sajid	Asif	Tufail	1. O&M Manual	15-6-17			
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

WASA: WSSP Peshawar *Division:* ______________ *Sub Division:* ______________

Approved by: ____________________

Prepared by: Sub-engineer Jamal Biland

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge: XEN	SDO	Sub Engineer	Operator					
1.	Phase-6 Hayatabad	Tariq Aziz	Sohail	Jamal Biland	Izhar	Daily Operation Record	12/5/2017			
						SOP Check List				
						Device Inspection Sheet				
2.	Phase-2 Zahid Market	Tariq Aziz	Sohail	Jamal Biland	Usman	Daily Operation Record	14/5/2017			
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge: XEN	SDO	Sub Engineer	Operator					
1.						1. O&M Manual				
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

No Generator.

WASA: FAISALABAD Division: ~~EAST~~ WWM Sub Division: EAST

Approved by: ____________________

Prepared by: HASSAN MUSTAFA.

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	PS-31	MAKHDOOM BABAR	HASSAN MUSTAFA	TAHIR SHABBIR	LIAQAT	Daily Operation Record	MAY 2017			
						SOP Check List				
						Device Inspection Sheet				
2.						Daily Operation Record				
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	PS-31	MAKHDOOM BABAR	HASSAN MUSTAFA	TAHIR ShaBBIR	Hanif	1. O&M Manual	May 2017			
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

WASA: LAHORE Division: Gulshan-e-Ravi Sub Division: Gulshan-e-Ravi WASA

Approved by: ALi HAiDER NAQvi

Prepared by: SUB Engr WASA

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	P-S-31	Ejaz Nawaz	Rahil Ashraf	Ali HAiDER	Nawaz	Daily Operation Record	MAY 2017			
						SOP Check List				
						Device Inspection Sheet				
2.		Sohail Sindon				Daily Operation Record				
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.		Sohail Sindon	Rahil Ashraf	Ali HAiDER	Nawaz	1. O&M Manual	MAY 2017			
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

WASA: Lahore Division: Iqbal Town Sub Division: Samanabad

Approved by: ____________

Prepared by: M Faisal Salwal

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Zafar Colony	Babar Habib Khan	M Faisal Salwal	Umar Saleem		Daily Operation Record	1/5/17			
						SOP Check List				
						Device Inspection Sheet				
2.	LDA Colony	Babar Habib Khan	M. Faisal Salwal	Adeel		Daily Operation Record	1/5/17			
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Poonch Road Disposal	Babar Habib Khan	M Faisal Salwal	Adeel		1. O&M Manual	8/5/17			
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

WASA: ______ *Division:* ______ *Sub Division:* ______

Approved by: ______

Prepared by: ______

OJT Implementation Plan for Record Keeping, SOP & Device Inspection Activity of Electrical Panel

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.	Super Market Phase-1, Hayatabad	Tariq	Sohail	M.Rahman.	Pervez	Daily Operation Record	15-5-17			
						SOP Check List				
						Device Inspection Sheet				
2.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Daily Operation Record	[illegible]			
						SOP Check List				
						Device Inspection Sheet				

-Remarks-

OJT Implementation Procedure for O&M Manual, Record Keeping and Preventive Maintenance Activity of Diesel Generator

Administrative Information						Contents of Activity	Planning Date	Completed	Planning Date	Completed
Site No.	Site Name	Name of the Persons in Charge								
		XEN	SDO	Sub Engineer	Operator					
1.						1. O&M Manual				
						2. Basic Specifications				
						3. Daily O&M Record				
						4. Preventive Maintenance Plan				

-Remarks-

添付資料 3.82

「O&M of Sewer and Storm Water Drainage」におけるフォローアップ調査

Training Follow-up Checklist

O & M of Sewerage and Drainage System including Safety Precautions

Date of Visit	27 January, 2017	**WASA**	Lahore
Visitors Name (JICA/Al-Jazari Team)	Mr. Muhammad Irfan Ms. Ammara Asif Ms. Maryam Rabbani	**Sub Division**	Misri Shah
		Location	Gujjar Pura
Module No.	One (01)	**Name**	
Module Name	Safety Control and Measures for Sewer and Drainage Works	**Designation**	Sub Divisional Officer
		Contact No.	

Observations				
Sr.No.	**Parameters**	**Yes**	**No**	**Remarks**
1	Risk & Hazard Assessment regarding Job		-	-
2	Availability of PPE at Site	-		No PPE was present
3	Use of PPE during O&M job	-		No staff members worn PPE
4	Confined Space Entry Permit		-	WASA has no such permit system
5	Availability of Gas Monitor & Use	-		Not available
6	Traffic Control Management during de-silting operation	-		There was no traffic control. Safety cones were not present around the heavy machine in streets.
7	First Aid Box		-	They don't have safety box with them at site.

Bottlenecks

1. Workers are not ready to wear PPE during operation
2. They don't have gas monitor to check hazardous gases before entrance into manhole
3. Financial constraints in WASA department
4. Approval from higher authorities

Proposals/Recommendations

Responsible Authority

Al- Jazari	**WASA**
1. Team should re-visit WASA facility for follow up 2. Gas monitor should be provided to WASA facility 3. WASA professionals should be motivated or encouraged to change their mindset regarding implementation of HSE rules & regulations	1. Budget should be allocated for HSE related items 2. HSE training should be conducted for lower staff 3. There should be awareness campaign for public through various means

Signature Al-Jazari Team Lead **Signature WASA (SDO/Sub Engineer)**

Training Follow-up Checklist

O & M of Sewerage and Drainage System including Safety Precautions

Date of Visit	27 January, 2017	**WASA**	Lahore
Visitors Name (JICA / Al-Jazari Team)	Muhammad Irfan Ms. Ammara Asif Ms. Maryam Rabbani	**Sub Division**	Misri Shah
		Location	Gujjar Pura
Module No.	Three (03)	**Name**	
Module Name	Operation and Maintenance of Sewer System	**Designation**	SDO
		Contact No.	

Observations

Sr. No.	Parameter	Yes	No	Remarks
1	Inspection	-		Visual inspection was done
2	Testing		-	NA
3	Maintenance of Cleaning Machinery	-		Proper maintenance of machinery
4	Repair / Rehabilitation Method / Technique		-	
5	Maintenance of Disposal Station		-	NA
6	Emergency Response Plan	-		WASA have ERP for monsoon season

Bottlenecks

Proposals/Recommendations

Responsible Authorities

WASA	Al-Jazari
1. Training should be conducted for lower staff regarding proper operations of sucker and jetter	1. Revisit 2. Proper follow-up of the activities and SOPs

Signature Al-Jazari Team Lead

SDO Signature

Training Follow-up Visit Report

O & M of Sewerage and Drainage System including Safety Precautions

Date of Visit	15-16 March, 2017	**WASA**	Faisalabad
Visitors Name (JICA/Al-Jazari Team)	Mr. Yusuki Ando Mr. Muhammad Irfan Mr. Rizwan Qazi	**Sub Division**	AIC Sub Division
		Location	1 Ps- 31 (Disposal Station) 2 Main Bazar Waris Pura
Module No.	Three (03)	**Name**	Mr. Hassan Mustafa Mr. Ahmad Raza
Module Name	O&M of Sewerage System	**Designation**	Assistant Director
		Contact No	+92-336-8880483 +92-336-8880483

Observations				
Sr. No.	**Parameters**	**Yes**	**No**	**Remarks**
1	Site Preparation	√		
2	O&M Planning	√		
3	Traffic Control	√		
4	Safety Control	√		
5	T&P and Machinery Status / Condition	√		
6	Operation Standards / Methodology	√		Need improvement
7	Sludge handling / Disposal	√		By FWMC after 24 HRS

Bottlenecks	
1.	Lengthy procedure of the approval of the cases
2.	Shortness of the PPEs (Lack of Gas Monitor)
3.	Lack of awareness of general public
4.	Difficulties in traffic control
5.	No availability of dumping site for sludge disposal
6.	Corrosive environment at disposal
7.	Improvement of the infrastructure
8.	Lights issues in the disposal
9.	Proper ventilation in the building
10.	

Proposals / Recommendations			
Al- Jazari / JICA		**WASA Officer**	
1.	Provision of more PPEs to staff	**1.**	Need training of supervisory staff
2.	Traffic control must be more effective	**2.**	Training to use PPEs
3.	Repaired of infrastructure/Disposal Station	**3.**	Provision of complete set of PPEs
4.	Desilting material from manhole must be removed as early as possible	**4.**	
5.		**5.**	

Suggested (Proposed) Action Plan for Improvement	
Responsible Authority	
1.	Prevention maintenance of disposal machinery before Monsoon
2.	Routine desilting of sewer lines before Monsoon
3.	Rectification of the public complaints received at the earliest
4.	Repair & maintenance of dewatering sets
5.	Infrastructure of the disposal station e.g. LED lights, paint, repair of structure etc.

Date: 15- March 23, 2017

Signature Al-Jazari Team Lead

Name: (i) Yusuke Ando

(ii) Muhammad Irfan

Signature WASA (SDO/Sub-Engineer)

Name: (i) Hassan Mustafa

(ii) Ahmed Raza

Training Follow-up Visit Report

O & M of Sewerage and Drainage System including Safety Precautions

Date of Visit	21 & 22 March, 2017	**WASA**	Multan
Visitors Name (JICA/Al-Jazari Team)	Mr. Yusuki Ando Mr. Muhammad Irfan Mr. Rizwan Qazi	**Sub Division**	Hassan Parwana
		Location	Kalmah Chowk
Module No.	Three (03)	**Name**	Mr. Irfan Ali Mr. Muhammad Adeel
Module Name	O&M of Sewerage System	**Designation**	(Assistant Director) (Sub- Engineer)
		Contact No	+92-3077996996 +92-301-7475731

Observations				
Sr. No.	**Parameters**	**Yes**	**No**	**Remarks**
1	Site Preparation			Partially done
2	O&M Planning	√		Good
3	Traffic Control	√		Good
4	Safety Control		√	No policy
5	T&P and Machinery Status / Condition	√		Used policy
6	Operation Standards / Methodology	√		Cones were placed
7	Sludge handling / Disposal			

Bottlenecks	
1.	Shortage of PPEs & safety control devices
2.	Lower staff must be trained
3.	Careless behavior & ignorance regarding the solid waste
4.	Pair of Sucker & Jetter lacking in number
5.	
6.	
7.	
8.	
9.	
10.	

Proposals / Recommendations			
Al- Jazari / JICA		**WASA Officer**	
1.	More training must be conducted	**1.**	Awareness should be done regarding disposal of solid waste to the citizens
2.	SOPs must be provided	**2.**	Training of lower staff should be conducted at early as possible
3.	PPEs & Equipment must be provided	**3.**	More O&M machinery and equipment must be provided
4.		**4.**	
5.		**5.**	

Suggested (Proposed) Action Plan for Improvement	
Responsible Authority	
1.	Raising of buried manhole by using metal detector
2.	Desilting of trunk line in the Hassan Parwana Sub- Division before Monsson season
3.	Using of Gas Monitor during the desilting of manhole
4.	Use of PPEs during O&M works
5.	Cover all the uncovered manhole (if any)

Date: March 22, 2017

Signature Al-Jazari Team Lead

Name: (i) Yusuke Ando

(ii) Muhammad Irfan

Signature WASA (SDO/Sub-Engineer)

Name: Irfan Ali

Training Follow-up Visit Report

O & M of Sewerage and Drainage System including Safety Precautions

Date of Visit	17 March, 2017	**WASA**	Rawalpindi
Visitors Name (JICA/Al-Jazari Team)	Mr. Yusuki Ando Mr. Muhammad Irfan Mr. Rizwan Qazi	**Sub Division**	Satellite Town
		Location	Commercial Market RWL
Module No.	Three (03)	**Name**	Mr. Hammad Fazal Mr. Tariq Malik
Module Name	O&M of Sewerage System	**Designation**	Director (S & D)
		Contact No	0343-4400992

Observations				
Sr. No.	**Parameters**	**Yes**	**No**	**Remarks**
1	Site Preparation	√		
2	O&M Planning	√		
3	Traffic Control	√		Partially adopted
4	Safety Control	√		Gas Monitor missing
5	T&P and Machinery Status / Condition	√		
6	Operation Standards / Methodology	√		
7	Sludge handling / Disposal	√		Removal after 8 Hrs.

Bottlenecks	
1.	Comprehensive training required for lower staff
2.	More PPEs required (Helmets, ladder etc.)
3.	Gas Monitor missing & now required
4.	Under size sewerage system in old areas
5.	
6.	
7.	
8.	
9.	
10.	

Proposals / Recommendations			
Al- Jazari / JICA		**WASA Officer**	
1.	Purchase and supply PPEs to WASA	**1.**	Gas Monitor urgently required
2.	Training of Power Rodder	**2.**	Compact /light SCBA required
3.	SCBA must be provided	**3.**	Air line system required
4.	Provision of Sucker and Jetter	**4.**	
5.		**5.**	

Suggested (Proposed) Action Plan for Improvement	
Responsible Authority	
1.	Desilting/ proper sewer cleaning ranging from 9" dia to 36" dia.
2.	Desilting and maintenance operation at drain (Nullah Lai) till June (before Monsoon)
3.	Regular checking & over hauling / maintenance of equipment (e.g. power rodder, Jetting/Sucker machinery)
4.	Awareness of staff regarding use of PPEs
5.	

Date: March 17, 2017

Signature Al-Jazari Team Lead

Name: (i) Yusuke Ando

(ii) Muhammad Irfan

Signature WASA (SDO/Sub-Engineer)

Name: (i) Hammad Afzal

Dir (S& D)

(ii) Muhammad Tariq Malik

Sub Engineer

添付資料 4.1

本邦研修の研修員リスト（第 3 年次）

Specialized in water supply

No	Name	Sex	Organization	Position
1	Zainab Abbas	F	Lahore WASA	Chief Chemist
2	Rashid Chaudhry	M	Lahore WASA	SDO
3	Muhammad Tahir Rehman	M	Lahore WASA	Sub Engineer
4	Hassan Mustefa	M	Faisalabad WASA	Assitant Director (Tech)
5	Muhammad Khurram Nabeel	M	Gujranwala WASA	Assistant Director (S&D)
6	Shafqat Mehmood	M	Rawalpindi WASA	Assistant Director (Water Supply)
7	Muhammad Khalil Akbar	M	Water & Sanitation Services Company, Mardan	Manager Municipal Services
8	Mubasher Ahmad Cheema	M	Al-Jazari Academy	Technical Skills Based Training Specialist
9	Nizam ud din	M	Urban Unit	GIS Manager

Specialized in sewerage

No	Name	Sex	Organization	Position
1	Fiza Anjum	F	Lahore WASA	Assistant Director
2	Amir Tufail	M	Lahore WASA	Sub Engineer
3	Muhammad Umer Farooq	M	Lahore WASA	Sub Engineer
4	Mohsin Ali Asghar	M	Faisalabad WASA	Sub Engineer
5	Sohail Akhtar	M	Multan WASA	Sub Engineer
6	Mirza Waseem Iqbal	M	Gujranwala WASA	Sub Engineer
7	Muhammad Ishfaq	M	Rawalpindi WASA	Sub Engineer
8	Farrukh Zeb	M	Water & Sanitation Services, Peshawar	Assistant Manager (Operations)
9	Ihsan ul haque Javed	M	Al-Jazari Academy	Sr. Instructor (Health & Safety)
10	Ammara Asif	F	Al-Jazari Academy	Young Professional (Sewerage & Storm Water Drainage 2)

添付資料 4.2

研修ガイドライン

Aug. 30, 2017 (Ver. 1)

Training Guideline

0 Introduction

This document is a training guideline for constructing a training system to be implemented for WASA (Water and Sanitation Agency) in Punjab Province.

1 Basic Policy

1.1 Understanding of current status and background of water supply

WASA in each city provides water supply and sewerage services within the area in charge. WASA has the following problems;

Insufficient O&M (Operation and Maintenance) and financial constraints
Deficit operation by low water cost
Lack of working capital and facility renewal cost
Inefficient water supply facilities operation such as direct water distribution from the well to the water distribution pipe
Irregular water quality inspection
Defects resulting from insufficient equipment inspection
Old water pipe
Low operation and maintenance ability

For these reasons, the Punjab provincial government recognized that it is indispensable for improving the water supply and sewerage service in the province, strengthening the operation and maintenance capacity and management capacity of each WASA.

1.2 Setting of basic policy

Under these circumstances, improvement of the water supply and sewer system in WASA in 5 cities is an urgent task. For each WASA, the needs for training items on the following modules were found. As initial setting, the following was required.

Development of below training modules
Improvement of the capacity of WASA staff through know-how and skills that gained through training
Improvement of systematic WASA's water supply and sewer system through OJT

(1) Leakage detection (as part of measures against Non-Revenue Water)
(2) Operation and maintenance management of water supply facilities
(3) Operation and maintenance of machine equipment
(4) Operation and maintenance of electric facilities
(5) Operation and maintenance of rainwater drainage / sewerage facilities
(6) Business plan
(7) Asset management

1.3 Setting of training purpose

Through the above training modules, the purpose is to confirm the degree of comprehension of knowledge of WASA staff, to learn the missing knowledge through training and to further improve it.

It also aims to grasp and extract problems and tasks at each WASA and to reflect the know-how and skills acquired through training in the daily work of each staff member and organization.

2 Setting of Goals

2.1 Setting of goals for training implementation

2.1.1 Leakage detection

Develop basic knowledge of leakage detection in water supply system
Understand the use and operation of various leak detection equipment for onward application in Field at respective WASAs
Develop Leakage Prevention Action Plan at respective WASAs
Identify the buried leakages and to implement control measures in Field for leakage prevention
Undertake preventive maintenance of water supply pipe lines with reference to leakage control
Understand different Pipe Repair Techniques

2.1.2 Operation and maintenance management of water supply facilities

Build operation and maintenance knowledge regarding water distribution system
Undertake Improvement in efficiency of WASA Operations regarding water supply sector
Achieve Effective O&M of Pipelines and Appurtenances through implementation of Water Supply Action Plan at respective WASAs
Assess water quality concerns from Source up to Distribution System
Undertake Preventive Maintenance Activities at respective WASAs
Making Inspection, Repair and Maintenance of Water Supply Network

2.1.3 Operation and maintenance of machine equipment

Standard Operating Procedure (SOPs) for Pumps, Valves, Heavy Machines (Backhoe, Jetting and Suction Machines etc.), Ultra filtration and Chlorination system
Ability to inspect and evaluate mechanical equipment current conditions
Selection, testing and installation of different equipment for diagnostic analysis
Ability to perform preventative maintenance according to owner's manual
Implementation of work place organization and Operational Excellence Tool (5S)
Implementation of Health, Safety and Environment (HSE)

2.1.4 Operation and maintenance of electric facilities

Ability to read basic engineering drawings and different measuring gauges
Basic design and selection criteria for different components within a control panel and generator
Selection, testing and installation of different equipment within an electrical control panel

Ability to plan and execute periodic and preventative maintenance while referring to owner's manual
Implementation of quality workplace organization (5S) and safety (HSE) based work environment

2.1.5 Operation and maintenance of rainwater drainage / sewerage facilities
Improved awareness regarding various risks and hazards at O&M worksite
Enhancement in workers' "safe working" capacity, during their O&M jobs in confined spaces, like deep manholes and wet wells of disposal stations
Development of assessment and evaluation capacity regarding the current status of infrastructures viz. disposal station/lift stations and tube wells
Exercising and use of multi gas monitor to assess the poisonous and other hazardous gases present in manholes and wet wells
Exercising and use of manhole cover locator, to search the lost manholes structures
Improved capacity of manhole cleaning and removal of sewer line blockages
Estimation of deposited sludge volume in storm water drains, to achieve the de-silting job effectively and with minimum resources
Development of action plans to enhance the overall capacity in respective fields
Improvement in acquaintance related to preventive and corrective maintenance mechanism

2.1.6 Business plan
Enhance capacity of trainees to better understand the Vision and Mission of WASA/ WSSC and make long term and short term objectives.
Identify and measure various gaps including operational gaps, financial gaps, human resource gaps and communication gaps.
Development of Performance Improvement Plans for Energy Management, Water Supply System and Sewerage System.
Make strategies to improve Revenue Management, Human Resource Management, Communications and arrear recovery (through the use of GIS).
Development of capacity to build financial models and conduct financial appraisals including NPV, IRR and Benefit Cost Ratios.
Development and presentation of Business plans.

2.1.7 Asset management
Enhance capacity of trainees in understanding of assets, asset condition, asset risk and asset life cycle management
Introducing knowledge of Asset Management Information System (AMIS) and Arc GIS for water supply and sewerage pipelines for provision of accurate record in decision making.
Ability to determine and document asset conditions in field on international standards.
Asset Database Analysis through the use of simple MS Excel tools.
Apply asset replacement planning techniques for formulation of short, medium, long term plan with costs
Development Asset Management Plans.

2.2 Setting of the overall goal when the above goal is achieved

In the current situation of each WASA, their goals of water supply business are different. If it is judged that training has improved the quality of staff, WASA has to set a slightly impossible goal to aim for next. If it becomes possible to grasp the current situation of the water supply business by training, the goal is to set numerical targets and aim for improvement.

Regarding the indicators; water supply rate, sewer connection rate, revenue / non-revenue water rate, water supply / sewer equipment inspection rate, sewerage manhole visual inspection implementation rate, leakage repair rate, sewer pipe/culvert repair rate, water / sewer fee collection rate, employee training rate, others, regarding the Performance Indicators (PIs), the evaluation of numerical improvement will be made from the year trend change.

3 Attendance Qualification

3.1 Eligibility for trainees

Entry qualifications for training should be decided by each training module and it is desirable not to create unification standards. The basic qualification requirements shall include the age of the applicant, the minimum number of years of employment as a WASA staff member, and the boss's recommendation. If it is assumed that there are a large number of applicants, it is possible to adjust the number of people by limiting this age and years of experience.

Before the applicant fills in the application form with the name of the application, it is necessary for the applicant to understand the conditions of the application, so it must be stated at the earliest stage with the purpose of the training.

3.2 Difficulty of training level

WASA staffs participating in the training have various backgrounds, job types, work environment and knowledge comprehension level. Since the level of each trainee is not the same, since the trainees have their own vectors and scalars, it is difficult to ask all the trainees for the same outcome at the same training course. Therefore, at the time of application, it should indicate the lecture content of the training and the degree of difficulty, and should provide materials that can be considered by applicants whether to apply. Applicants who seem to be unable to come up with the level of training might be adopted. Therefore, it is desirable to prepare basic teaching materials in advance and notify the trainees.

3.3 Confirmation of the level of participants

Regardless of the level of the trainees, training textbooks are constructed with wide difficulty levels from basic to applied level. Normally, textbooks are created based on a higher degree of difficulty, and explanations are made in lecture by lecturer to raise trainees understanding.

It is important for lecturers to grasp the level of comprehension of trainees for promoting lectures. In the training course, a pre-test is carried out before the training begins, and the lecturers grasp the understanding degree of the trainees and make lectures.

While checking the understanding degree of the trainees as a whole, the lecture is a two-way lecture that draws answers and comments from participants, not one-way lecture.

4 Training Method

4.1 Training method

4.1.1 Lecture

The lecture is the basic part of the training, and it is a form to receive the lecture on the desk. It is expected that trainees learn or re-learn the basics of training modules in this lecture.

The teaching materials used are mainly textbooks and lecture slides. Lecture slide is supplementary teaching material that visually replaces the contents of sentences in textbooks with presentation slide that is superior in information storage entering from the sight. The lecture slide that extracted important parts of textbooks, by explaining the points, the trainees can grasp the contents of the textbook in a short time. By using video materials as auxiliary teaching materials, the understanding of trainee increases. Since images are not suitable for printing, it is necessary to capture scenes that become topics and include them in handouts.

Since textbooks and slides have the same contents, attaching the section number and page number of the textbook to the slide increases the efficiency of the trainees' learning.

4.1.2 Exercise

The exercise is what the trainees think and solve by referring to the examples used in the lectures. The exercise mainly includes calculation on desk, problem solving with existing cases, checklist creation, etc. This exercise consists of individual answering, group answering, or group discussions on individual answering.

4.1.3 Practical training

The practical training is to learn while actually doing work by using real machine or practicing machine, with reference to the example handled in the lecture. It actually touches the real thing with hands and performs operations and work. In textbooks, only two-dimensional information on photographs can be obtained. However, in practical training, trainees can grasp the real thing in three-dimensions, and also feel the surrounding circumstances that do not appear in the photograph, and sounds, vibrations and odors can be felt if they are driving. The practical training can complement the textbook information for the trainees.

4.1.4 Discussion

The training tends to be a one-way lecture from lecturers to trainees. However, by providing opportunities for trainees to express opinions in the lecture, trainees can grasp different perspectives and ideas of other trainees. In addition, questions from participants are not answered by lecturers but are opportunities for trainees to discuss and resolve themselves.

4.1.5 Test

The test is conducted at the beginning and the end of the lecture, and it is judged whether or not the trainees gained knowledge by taking the training. In the test, 10~20 basic questions are asked and content that can be answered with about 70% correct answer rate in about 15~20 minutes shall be taken. The difficulty level should be constructed as follows.

Easy questions that can be answered without looking at textbooks: 20%
Normal questions that can be answered by general technical terms (knowledge) appearing in textbooks: 70%
High level of difficulty applying textbooks: 10%

By preparing questions of similar degree of difficulty and comparing before and after the training, it is possible to evaluate the degree of growth.

It is possible to evaluate the degree of growth by comparing the tests before and after the training by preparing many questions with high difficulty and conducting the test by the same question.

The answer can be easily scored by the selection formula rather than the description formula. This eliminates the need to judge the correctness or incorrectness to the answer of an obscure description.

4.2 Assembling of the training

In order to improve the knowledge level of trainees using the above training method, training is composed by combining each element. Depending on the module, there are lectures to introduce a lot of practice including fieldwork. Although it does not indicate the reference proportion, it is requested that Academy policy adopt more exercises and practical training than lecture.

4.3 Creation of lecture scenario

The combination of lectures is decided by the Academy that plans the lecture. It is desirable to incorporate the requests of trainees as much as possible. When applying for application, the questionnaire will be taken from the applicant, and the Academy should listen to the field of interest and requests for option selection of the applicant. When incorporating options, notification can be made to the trainees before the start of training.

4.4 Lecture composition

The order of the lecture should be in accordance with the textbook in the original schedule. However, in the course of training, if the order goes back and forth, lecturer may explain and change to the trainees, or, lecture may be delimited on the way and carried over the next day.

4.5 Preparation of training materials

Human information analysis accounts for more than half of the information coming from the eyes, and it is over 90% when combined with information entered from ears. In order to convey the information entered from the lecture slide and information from the ears by the lecturer's words to the trainees, the slide of the lecture is not a long sentence but keywords, charts, simple tables, and images (illustrations) that are easy to memorize. Illustrations are not forced to fill the spaces, but only when they match truly lecture content.

In exercises and practical training, it is desirable to confirm the content that is conscious of practice, and it is content suitable for actual work.

In the discussion, topics to be discussed on slides are included in advance. The lecturer provides opportunities for all the trainees to discuss when there is content that lecture wants to dig deeper further as the lecture progresses and questions are given from the trainees.

4.6 Understanding of training effect

At the end of the training, lecturer must conduct the post-test for confirmation and evaluate the level of comprehension of the trainees through the all training. The evaluation of trainees decides pass/fail by adding not only this test but also attendance and contribution degree. Therefore, the lecturer must instruct the trainee so that they can pass.

5 Responding to Trainees

5.1 Response at the time of training

The lecture that the lecturer just talks to the trainees endlessly feels that everyone is boring. However, it is true that there are many lecturers who make such lectures. The interactive lecture gives a sense that lecturer and trainees are doing together in the training. The motivation of trainees to participate in training is enhanced.

Lectures do not have to do so, forcibly. However, it can be said that it is a good lecture to provide an environment that trainees can easily ask questions and send comments.

5.2 Responding of question from trainee

As you continue to lecture, questions from participants will be gathered. Lecturer answers its question not only to the questioner but also to the whole trainees. The question from one of the trainees probably may be wondering by other trainees.

Depending on the remaining time of the lecture, the lecturer may not immediately answer the questions from the trainees, and the trainees may discuss about its question.

5.3 Equality treatment for trainees

Response to trainees whose abilities are remarkably low can respond especially individually. Although this will gain understanding from other trainees, long-term response will be disadvantageous for other trainees, so pay attention to the response time.

5.4 Adjustment of aggressiveness of trainees

Some of the trainees often speak or some do not speak at all. In order to balance in the lecture, comments and answers from trainees should be averaged. For trainees with few speak, a daily conversation that is not relevant to the lecture may be good, it is important to try conversation.

For trainees with low understanding, the instructor makes simple questions like YES / NO, and asks for additional comments on the answers of other trainees and try to equalize the speak.

5.5 Attention advice to mobile phone (Leaving midway by private telephone)

Although it is the principle of training that not answering the telephone during training, telephone response here is unavoidable. However, while answering the phone, the lecture will proceed and its trainee may be missing important parts. The lecturer must inform trainees that the telephone response will be done during rest time. Also, since the ringing tone interferes with the lecture, lecturer informs the switching to the silent mode of phone. When the ringing tone sounds, lecturer must pay attention to switching to the trainee.

6 Fieldwork

6.1 Safety attention in outdoor activities

A fieldwork is equivalent to the aforementioned practice training. Unlike lectures in the classroom, since it is an outdoor activity, there are many points to keep in mind.

Lecturers and support members must pay attention to the safety of trainees to the utmost. Therefore, lecturers and support members should consult in advance about the safety of the transportation and the worksite, and conduct preliminary inspection of the site, also confirm whether there is a dangerous place. When doing the fieldwork in the same place, the lecturer leaves a record of safety management, and the other lecturers are reference when doing it in another place.

6.2 Cooperation request to WASA

In the fieldwork, in order to conduct training using actual equipment and facilities, lecturers must request cooperation from WASA (Lahore mainly) for training implementation. In advance, the lecturer must inform the training purpose to WASA and discuss the details to be implemented.

In case of implementation at OJT, it must be carried out according to the maintenance schedule of WASA. Therefore, the lecturer must adjust the schedule so as not to interfere with WASA's OJT.

6.3 Correspondence at stormy weather

In outdoor work, training may be difficult depending on the weather. It is necessary to prepare measures for stormy weather beforehand without panic in sudden stormy weather. When going to preliminary survey, the lecturer needs to take photograph of the facility and to compile it on a slide, and takes measures to be able to explain the equipment by slides in the classroom in stormy weather.

7 Creation of Report

7.1 Prompt creation of evaluation report

After the training, based on the evaluation from the trainees and lecturer, a training evaluation report is prepared within about one week and confirmed within the lecturer's team. After that, the lecturer's team receives the approval of the top position and registers teaching materials, reports, etc. in the training database system.

7.2 Comparison with past implementation situation

The evaluation report compares not only this evaluation of the training but also the previous evaluation. In the evaluation report, it is possible to know the tendency of the evaluation so far and set future target values. The lecturer's team compares whether the result of this time is in a bad direction or a good tendency. Since the tendency is hard to see in the table data, it is necessary to prepare materials that can be judged by graphing.

8 Implementation of improvement

8.1 Implementation of PDCA cycle

After completing the training course for a certain number of times, Academy will hold an evaluation meeting of the training about once or twice a year. At the evaluation meeting, the improvement points indicated in each report are listed up, the improvement measures are summarized and reflected in the next training course. If improvement in the medium-long term is necessary, Academy will consider it as continuing agenda for the evaluation meeting and seek for improvement points.

8.2 Problems that have not been improved before

If improvements do not progress in the medium-long term, it is desirable to establish a specialized Review Committee. The Review Committee invites stakeholders and experts from the outside (If necessary) to examine fundamental improvement points. The review committee should be implemented in conjunction with the above evaluation meeting.

8.3 Pursuit of effectiveness and efficiency

As lecturer concentrates on lecturing, sometimes lecture time is exceeded. From the lecture experience, the lecturer reviews the appropriate lecture time and break time and builds an appropriate training environment.

Since multiple lecturers serve as lecturers in the same module, it is indispensable to share information among lecturers so that differences in lecture levels do not occur. It is necessary to adjust the content among lecturers so that the content of lectures will not be duplicated or missing.

9 Summary

WASA has a major purpose to improve the living level of citizens by improving WASA's water supply business by improving the capacity of WASA staff. The Al-Jazari

Academy is responsible for this training. The Academy is required to have knowledge and skills on water supply and sewer at higher level than the WASA organization. In addition, the Academy lecturers must teach the trainees their know-how and skills in an easy-to-understand manner. Academy lecturers will give training lectures with the same concepts and it will be possible to construct a training system with unity and continuity.

添付資料 4.3

更新されたコースおよび講師への評価に関する質問票

Al-Jazari Water & Sanitation Academy
Course Evaluation Form (Confidential)

Training Title: ______________ ___ **Date of training:** _________________

Trainer Name: _________________

Please provide your honest evaluation of the training course that you have just undertaken. Your evaluation will help us to improve the future delivery of trainings by Al-Jazari Academy.

Sr. No.	How satisfied are you with…	Not Satisfied 1	Somewhat Satisfied 2	Satisfied 3	Very Satisfied 4
1	Class Lectures				
2	Class Exercises				
3	Field Activities/Exercises during site visits				
4	Quality of training materials (PPT Slides, Handouts, Lecture Notes, Models, SOP formats etc.)				
5	Schedule and Length of the trainings				
6	Technical Knowledge of the trainer				
7	Presentation Skills of the trainer				
8	Training relevant to your job duties				
9	Logistical Arrangements (classroom, vehicles, food, hostels, communications etc.)				

Comments / Suggestions (English/Urdu): *(if you need extra space, please write on the back of this page)*

____

____

ALJAZARI
ACADEMY

Training Coordinator

Note: *The information contained in this form will be used for evaluation and analysis. We may also use your comments in certain publications or reports.*

添付資料 4.4

Young Professional の研修プログラム

Young Professionals Presentation Schedule

Presentation Time: 11:00 A.M, Fridays*

Presentation Duration: 30-45 Minute

Sr. No.	Training Title	Resource Person	Day & Date
1.	**Wastewater Treatment Plant KOSKI, KONYA, TURKEY**	Mr. Tanveer Shahzad	FRIDAY February 16, 2018
2.	**Wastewater Characterization**	Ms. Ammara Siddiqui	FRIDAY February 23, 2018
3.	**Wastewater Treatment**	Ms. Maryam Rabbani	FRIDAY March 02, 2018
4.	**LAN Network Infra-structure and Security**	Mr. Sibtain Athar	FRIDAY March 09, 2018
5.	**Rain Water Harvesting**	Ms. Ramisha Taseer	FRIDAY March 16, 2018
6.	**Municipal Solid Waste Management**	Mr. Syed Fahad Hussain	FRIDAY March 30, 2018
7.	**Agricultural Issues in Pakistan**	Mr. Rizwan Jabbar	FRIDAY April 20, 2018
8.	**Human Resource Management**	Mr. Rehan Khalid	FRIDAY April 27, 2018
9.	**Participatory Rural Appraisal**	Mr. Muhammad Faisal	FRIDAY May 04, 2018

**Any missed presentation due to unforeseen circumstances will be held on the following Saturday.*

添付資料 4.5

Young Professional の発表への評価表（案）

ALJAZARI
ACADEMY

presentation skills [Assessment Form]

Presenter's Name	
Presentation Title	
Day / Date	

Please evaluate this presentation in below listed fields:

Sr. No.	Parameters	Min. →				Max.
		1	2	3	4	5
1.	Choice of Topic					
2.	Opening / Kickoff Style					
3.	Eye Contact					
4.	Confidence					
5.	Voice Modulation					
6.	Clarity in Speaking					
7.	Gestures & Postures					
8.	Effective Use of Audio / Visual Aids					
9.	Pace of Presentation					
10.	Quality of Contents					
11.	Command on Subject					
12.	Inspiring for Audience					
13.	Interaction with Audience					
14.	Encouraged Participants					
15.	Replies to the Audience					
16.	Closing Style					

	Obtained Marks / Total Marks	**...... / 80**
	▪ What changes would make the presentation more effective?	
	▪ Any other comments or suggestion:	

Name of Evaluator	
Designation	

添付資料 4.6

2017 年秋期研修「O&M of Tube Well and Pump Facility」のスケジュール

ALJAZARI
ACADEMY

Operation and Maintenance (O&M) of Tube Well and Pump Facility Course
Training Schedule (December 04 to December 07 , 2017)
Course Code: W1221

Sr.No	Day and Date	Themes	Session 1			Tea 11:00-11:15am	Session 2		Lunch 1:15-2:00pm	Session 3
			1st Lecture 9:00-10:00am		2nd Lecture 10:00-11:00am		3rd Lecture 11:15am-12:15 pm	4th Lecture 12:15-1:15pm		Assignment 2:00-4:00pm
			9:00-9:10	9:10-10:00						
1	Monday (December 04, 2017)	• Key Issues in Water Distribution System • Operation & Maintenance of Water Supply Pipelines & Valves	• Introduction of Course Participants • Training Expectations	• Key Issues in Water Distribution System	• Key Issues in Water Distribution System • Components of Water Supply Facility		• Components of Water Supply Facility • Arrangement of Water Distribution System	• Pipe Material • Appurtenances		• Critical Report on Major Issues of Five WASA`s (Group Assignment) • Reflection and Review
2	Tuesday (December 05, 2017)	• Operation & Maintenance of Water Supply Pipelines • Water Safety Plan (WSP)	Review of Previous Lecture	• Water Distribution Operational Plan • Water Distribution Maintenance Plan			• Water Distribution Maintenance Plan • Water Distribution System Mapping • Overhead Reservoirs	• Water Safety Plan Linked with Distribution Pipelines and Reservoirs		• Group Assignment (Preparation of WSP Plan) • Reflection and Review
3	Wednesday (December 06, 2017)	EPANET Analysis for Water Distribution System	Review of Previous Lecture	Pipeline Network Analysis Exercise of Supply Area of One Tube Well						
5	Thursday (December 07, 2017)	Operation and Maintenance of Water Distribution System	Review of previous Lecture	OJT at Green Town WASA Sub Division , Lahore • Checking of Valves, Hydrants and pipeline crossing river as per Drawing • Checking of Pressure and Residual Chlorine • Checking of Water Level at Tubewell				• Individual Assignment on Preparation of Operational and Maintenance Action Plan		• Individual Assignment on Preparation of Operational and Maintenance Action Plan • Course Evaluation • Training Closure Evaluation

添付資料 4.7

2017 年秋期研修「Leakage Detection」のスケジュール

Leakage Detection and Repair

Course Code - W 7231

Training Schedule (16th October to 20th October, 2017)

Sr. No.	Day & Date	Themes	Session 1		Tea	Session 2		Lunch 1:15pm-2:00pm	Session 3
			1st Lecture 9:00am - 10:00am	2nd Lecture 10:00am - 11:00am	11:00am - 11:15am	3rd Lecture 11:15am - 12:15pm	4th Lecture 12:15pm - 1:15pm		2:00pm-4:00pm
1	Monday (October 16, 2017)	• Basic Knowledge of Leakage Detection • Repairing of Leakage and Burst Pipelines	• Introduction of Course Participants & Trainer • Training Expectations from Participants • Current Scenario of Leakage Detection at WASAs	• Countermeasures for Leakage		•Countermeasures for Leakage • Leakage Survey Equipment	• Leakage Survey Equipment • Repairing of Leakage and Burst Pipeline		**.Case Study** **.Group Presentation** . Current practices for leakage prevention and pipe reparing from each Water Utility . Q&As
2	Tuesday (October 17 2017)	• On Site Leakage Detection	• Review of Previous Lectures • Visit Briefing • Sharing of OJT Plan & Checksheets	**OJT at Green Town Sub Division, Lahore** • Leak Detection by Leak Detector and Acoustic bar •Leakage Reparing Site • Installation and Operation of Non-Metal Pipe Locator					• Discussion on Site Visit • Site Visit Reflection
3	Wednesday (October 18, 2017)	• On Site Installation and Operation of Leakage Detection Equipment	• Review of Previous Site Visit • Visit Briefing	**OJT at Green Town Sub Division, Lahore** • Installation and Operation of Metal Pipe Locator • Flow Measurement and Pressure Recording by Ultrasonic Flowmeter and Pressure Recorder					• Discussion on Site Visit • Site Visit Reflection
4	Thursday (October 19, 2017)	Visit to BBJ Pipe Factory, Lahore							
5	Friday (October 20, 2017)	• Leakage Prevention Action Plan	• Review of Previous Lecture & Site Visit • Briefing on Leakage Prevention Action Plan	• Preparation of Action Plan of Leakage Prevention by Training Participants		• Preparation of Action Plan for Leakage Prevention by Training Participants . Group Presentation .Training Evaluation . Training Closure			

添付資料 4.8

2017 年秋期研修「O&M of Sewer and Storm Water Drainage」のスケジュール

ALJAZARI ACADEMY

Operation & Maintenance (O&M) of Sewerage and Storm Water Drainage System including Safety Precautions
Training Schedule (02 - 06 October, 2017)

Sr. No.	Day and Date	Module	Session 1			Tea 11:00 am-11:15 am	Session 2			Lunch 1:15 pm-2:00 pm	Session 3	
			1st Lecture 9:00 am-10:00 am		2nd Lecture 10:00 am-11:00 am		3rd Lecture 11:15 am - 12:15 pm		4th Lecture 12:15 am - 1:15 pm		5th Lecture 2:00 pm - 3:00 pm	6th Lecture 3:00 pm -4:00 pm
			09:00 am-9:15 am	9:15 am-10:00 am			11:15 am-11:45 am	11:45 am-12:15 pm				
1	Monday October 02, 2017	**Module 01** Safety Control and Measures for Sewerage and Drainage Works	• Welcoming Remarks • Participant Introduction • Course Overview • Training Expectations	• Hazards & Risks • Control Measures • Current Safety Practices in WASA	• Working in Confined Space • Introduction to PPE • First Aid in Emergency Situations	**TEA BREAK**	• Traffic Control Practices during O&M Works	• Demonstration on PPE	• Demonstration on Cardiopulmonary Resuscitation (CPR)	**LUNCH BREAK**	• Exercise - Traffic Routing during O&M Works	• Quick Win Measures (QWMs) • Conclusion on Day's Activities
2	Tuesday October 03, 2017	**Module 02** O&M of Storm Water Drainage System	• Module Overview • Expected Learning Outcomes	• Need for O&M of Drains • Drain Dredging Equipment	• Estimation of Sludge in Drains • Sludge Disposal Techniques		**(Field Work)** • Observation of Drain Dredging Equipment (WASA Office, Drainage Division South) • Observation of Storm Water Darin Mangement Model (Drainage Central Division)				• Estimation of Sludge in Sattu-Katla Drain	• QWMs • Conclusion on Day's Activities
3	Wednesday October 04, 2017	**Module 03** O&M of Sewerage System	• Module Overview • Expected Learning Outcomes	• Inspection of Manholes & Sewers • Testing Techniques	• Machinery & Equipment • Cleaning Techniques		**(Field Work)** • Manhole / Sewer Line Inspection • Use of Gas Monitor (-both activities around academy)				• Use of Metal Locator (-inside academy)	• QWMs • Conclusion on Day's Activities
4	Thursday October 05, 2017		• Recap of Previous Day Activities	• Introduction of ERP • Measures taken by WASAs during Monsoon	• Disposal Station -Introduction -O&M		**(Field Visit / Field Work)** • Observation of O&M Works & Faciliy Assessment at... 1. Disposal Station - Sattu Katla 2. Disposal Station - Gulshan-e-Ravi				**LUNCH BREAK**	• QWMs • Conclusion on Day's Activities
5	Friday October 06, 2017	**Action Plan**	• Finalisation of QWMs & Action Plan				• Finalisation of QWMs & Action Plan			**LUNCH BREAK**	• Conclusion & Closing Remarks	

ALJAZARI ACADEMY

添付資料 4.9

2017 年秋期研修「O&M of Electrical Equipment」のスケジュール

Operations and Maintenance (O&M) of Electrical Equipment
Training Schedule (December 11th - December 15th, 2017)
Course Code: WSD 5231
Module-1, 2 Electrical Control Panels & Generators

Sr. No.	Day and Date	Themes	Session 1		Tea	Session 2		Lunch	Session 3	
			1st Lecture 9:00-10:00am	**2nd Lecture 10:00-11:00am**	**11:00-11:15am**	**3rd Lecture 11:15am-12:15 pm**	**4th Lecture 12:15-1:15pm**	**1:15-2:00pm**	**5th Lecture 2:00-3:00pm**	**6th Lecture 3:00-4:00pm**
1	Monday (December 11, 2017)	**Electrical Control Panel** •Usage of electrical control panel •Control panel assembly	• Introduction of course participants and module expectations •Benefit and purpose of electrical control panels •Electrical units and components	• Introduction to main electrical units, design and its components **Exercise P1**: Wiring diagram of different components of MCU		• Motor Starters • Introduction to Motors (Working Principle of motor) • Power factor correction **Exercise P2.1**: Troubleshooting of MCU using Flow Chart **Exercise P2.2:** Troubleshooting of MCU using O&M manual	• Record Keeping • SOP **Exercise P3**: SOP check on demo panel, Modification of Operation Record		**Exercise P4**: Device Inspection on demo panel, Continuity check by Clamp multi-meter ・Day's wrap-up and Review ・Discussion and Queries	
2	Tuesday (December 12, 2017)	**Electrical Control Panel** •Standard operating procedures (SOP) •Problem solving techniques •Preventive maintenance	•Preventative Maintenance •Introduction to testing equipment •Applicable PPE	Demonstration at WASA tube well at Green Town (10:00-12:30) ・PPE Preparation •Record keeping •SOP Checklist ・Device Inspection ・Demostration of Preventive maintenance (・Practice on Insulation resistance tester) Review of results in filled templates at Academy					・5S Implementation **Exercise P5:** 5S activity in house •Label alll essential equipment on control panel •Post standard fault reporting or maintence request procedure •Post emergency contact list (including site operations and maintenance team contacts)	
3	Wednesday (December 13, 2017)	**Generator** •Generator assembly •Standard operating procedures (SOP) •Preventive maintenance •Applicable PPE	• Introduction to Diesel Generator	• Assembly parts of a generators **Exercise G1:** Label exploded diagram of a diesel generator		•SOP •Daily operation and maintenance Record ·Preventive Maintenance	Demonstration on Generator at Academy ・Queries about components and their flow ・Daily operation and maintenance record		Demonstration on Generator at Academy Demonstration of Preventative Maintenance ・Day's wrap-up and Review ・Discussion and Queries	
4	Thursday (December 14, 2017)	**Generator and HSE** ・Preventive Maintenance Plan ・Troubleshooting with the manufaturer's manual	• Importance of the Manufacturer's Manual	**Exercise G2**: Develop preventive maintenance plan		Demonstration **Exercise G3:** Refer to operations manual and perform troubleshooting on generator	**Health Safety and Enviroment** Introduction to HSE with respect to Electrical Equipment		**Health Safety and Enviroment** Deomonstration HSE related to electrical equipment operations	
5	Friday (December 15, 2017)	・Output Challenge • Action plan • Course evaluation	**Exercise A1**: ・Output Challenge of Electrical Panel and Generator	·Action plan -List up possible actions -Develop OJT implentation procedure		•Presentation of gained knowledge and action plan (Each WASA) •Course and trainer evaluation				

添付資料 4.10

2017 年秋期研修「O&M of Mechanical Equipment」のスケジュール

ALJAZARI ACADEMY

Operations and Maintenance (O&M) of Mechanical Equipment
Training Schedule (Jan 1st - Jan 3rd, 2018)
Course Code: WSD 5231
Module-1 Pumps and Valves; Module-2 Filtration and Chlorination Systems

Sr. No.	Day and Date	Themes	Session 1		Tea	Session 2		Lunch	Session 3	
			1st Lecture 9:00-10:00am	2nd Lecture 10:00-11:00am	11:00-11:15am	3rd Lecture 11:15am-12:15 pm	4th Lecture 12:15-1:15pm	1:15-2:00pm	5th Lecture 2:00-3:00pm	6th Lecture 3:00-4:00pm
1	Monday (Jan 1, 2018)	•Pumps •Valves	•Introduction of course participants •Training expectations •Introduction to pumps and valves	•Assembly components of pumps and valves •Selection criteria for pumps •Preventive maintenance plan		**Exercise1:** •Pump selection criteria •Calculate total head for pumps	**Exercise2:** Find and identify appropriate manual section and develop a monthly maintenance plan		Demonstration visit to Green Town tube well: Observe standard operating procedure of centrifugal pumps • SOP of Pump start/Off (especially lubrication of shaft bearings before start) •Pump lubrication before start •Pressure checks •Leakage inspection •Valve functions •Gland seal replacement procedure •UF plant	
2	Tuesday (Jan 2, 2018)	•Preventive maintenance •Common faults and trouble shooting •**Chlorination and Filtration Systems** **(Start of module 2)**	•Record keeping •SOPs	Pumps and Valves: •Major faults and root causes •Current maintenance issues at WASAs		•WHO water safety guidelines • Introduction to filtration system at WASA tube well filtration plants	• Introduction to filtration system at WASA tube well filtration plants		**Exercise1:** Filtration system components and specific function identification	
3	Wednesday (Jan 3, 2018)	•Chlorinators **(Start of module 3)** •Introduction to heavy machines (Suction, Jetting and Backhoe)	•Chlorinator pump operating principle •Chlorinator pump parts and maintenance	•Adjustment of chlorinator (pump) for required treatment levels •Use of MS Excel tool to calculate the correct knob setting for the chlorinator pump		**Exercise 2 :** •Identify various parts and features of the chlorinator pump	•Importance of heavy machines in WASA capacity enhancement (operational efficiency) •Assembly components and operations of Suction and Jetting Machines		•Assembly components and operations of Backhoes	

ALJAZARI ACADEMY

ALJAZARI ACADEMY

Operations and Maintenance (O&M) of Mechanical Equipment
Training Schedule (Jan 4th - Jan 5th, 2018)
Course Code: WSD 5231
Module-3 Heavy Machines, HSE & 5S; Module-4 Water Meters

Sr. No.	Day and Date	Themes	Session 1		Tea	Session 2		Lunch	Session 3	
			1st Lecture 9:00-10:00am	2nd Lecture 10:00-11:00am	11:00-11:15am	3rd Lecture 11:15am-12:15 pm	4th Lecture 12:15-1:15pm	1:15-2:00pm	5th Lecture 2:00-3:00pm	6th Lecture 3:00-4:00pm
1	Thursday (Jan 4, 2018)	•SOPs •Preventive maintenance for heavy machines •HSE •Work place standardization and process optimization (5S)	•SOP of Jetting unit •SOP of Suction unit •SOP of Backhoe •Preventive maintenance for heavy machines •Videos of demonstration of suction, jetting and backhoe machine operations	**Exercise 1:** Jetting and Suction machine components and machine purpose **Exercise 2**:Truck Severe Condition Maintenance Plan Items		• Facility and Process Standardization and Optimization (5S) •HSE related to mechanical equipment and facility	•Demonstration of HSE and 5S implementation		•Demonstration of suction, jetting and backhoe machine operations •HSE aspects of heavy machine operations	
2	Friday (Jan 5, 2018)	•Water meters •Participant reflections and site action plan •Module evaluations	•Importance of water meters •Water meter types •Common maintenance issues •Water meter accuracy check demonstration	**Exercise 1:** water and flow meter types and functions		•Participant reflections and site action plan	•Module evaluations			

ALJAZARI ACADEMY

添付資料 4.11

2017 年秋期研修「Asset Management」のスケジュール

ALJAZARI ACADEMY

Asset Management Course

Training Schedule (October 30, 2017 to November 04, 2017)

Sr.No	Day and Date	Themes	Session 1		Tea 11:00-11:15am	Session 2		Lunch 1:15-2:00pm	Session 3	
			9:00-10:00am	10:00-11:00am		11:15am-12:15 pm	12:15-1:15pm		2:00-3:00pm	3:00-4:00pm
1	**Monday (October 30, 2017)**	Introduction to Asset Management Asset Inventory & Asset Management Information System	Definition of Assets Assets of WASAs Fixed Asset Register.	Financial Appraisals of Projects.		Introduction of Asset Management Information System (AMIS) Registration of Users Addition of Assets into AMIS Searching and Editing of Assets			Assignment 1- Practical exercise on AMIS (Asset Management Information System) in WASAs with respect your organzation/sub-division and prepare a brief report of 300 words. Output: Participant Specific Asset Inventory. (10 Marks)	
			Asif Iqbal	**Asif Iqbal**		**Asif Iqbal & Waseem Hussain**			**Waseem Hussain**	
2	**Tuesday (October 31, 2017)**	Asset Condition Assessment and Visit Field	Asset Condition Assessment & scale to determine Asset conditions.			Field Visit to a tubewell to conduct condition assessment (with Faculty)			Assignment 2- Group Activity to conduct Asset Condition Assessment of Tubewell.	
			Ali Raza & Ali Qumain			**Ali Raza & Ali Qumain**			**Ali Raza & Ali Qumain**	
3	**Wednesday (November 1, 2017)**	Definition of Risk Risk Management of Assets of WASAs	Risk Types of Risks Business Risk of WASAs	Risk Management Strategies for WASAs.		Asset Management Plan based on Risk Categorization Introduction to IDAMP			Assignment 3- Asset Condition & Risk Assessment & asset management plan of assets extracted in assignment 1.	
			Asif Iqbal & Shahbaz			**Ali Raza, Ali Qumain & Asif**			**Asif, Ali Raza & Ali Qumain**	
4	**Thursday (November 2, 2017)**	GIS	Introduction to ArcGIS software Asset data browsing classification Editing the assest data			GIS based Pipe Replacement Palnning: Applying query functions Making Water and sewerage project Map of subdivision/zone of WASA.			Assignment 4 - Prepare and present Project Map of Subdivision. Output: Project map of actual subdivision (10 Marks)	
			Aneeqa Azeem & Nizam			**Aneeqa Azeem & Nizam**			**Aneeqa Azeem & Nizam**	
5	**Friday (November 03, 2017)**	Asset database Analysis & Asset Replacement Planning	Data Description Definition & application of pivot table. Asset Condition Analysis. Cost calculation and priortization for replacement planning. Demonstration. Practical exercises on analysis and observation.			1) Pipeline replacement plan: formulating pipeline replacement plan in a WASA, short, medium, and long-term plan, with its cost 2) Replacement with its cost (assignment 3): Exercises of imputing a cost table to calculate the short, medium, and long-term plan.			Assignment 5- Conduct Asset Data Analysis and prepare Pivot Tables showing condition analysis. Output: Asset Replacement Plan with Cost. (10 Marks)	
			Aneeqa Azeem & Asif			**Mr. Kuroda & Asif**			**Aneeqa, Kuroda & Asif**	
6	**Saturday (November 04, 2017)**	Preparation and presentation of Asset Mangement Plan	Preparation and Presentation of Asset Management Plan and Asset Replacement Plan. (35 Marks)							
			Asif, Kuroda, Aneeqa, Ali Raza, Ali Qumain and Shahbaz							

添付資料 4.12

2017 年秋期研修「Business Planning」のスケジュール

Training Plan

B1131 - Business Planning Course

DAY & DATE	MODULE	Session 1		Tea	Session 2		Lunch & Prayer	Session 3	
		9:00-10:00	10:00-11:00	11:00-11:15	11:15-12:30	12:30-1:15	1:15:2:00	2:00pm-3:00pm	3:15pm-4:00pm
Monday, November 13, 2017	Module 1: Business Planning and GAP Anlysis	**LECTURE & GROUP ACTIVITY** **Course Introduction, Benchmarking * SWOT Analysis**	**LECTURE & GROUP ACTIVITY** **Business Planning Practise - International**		**GROUP ACTIVITY** **GAP Analysis through SWOT technique of FIVE WASAs**	**LECTURE & GROUP ACTIVITY** **Energy Management Plan**		**GROUP ACTIVITY** **GAP Analysis and Target Setting** **Energy Management (Including Simple SOP)**	
		Mr M Kashif	Mr Kuroda		Mr Asif & Mr M Samie	Mr Ali Rao		Mr Ali Rao and Mr Ali Qumain	
Tuesday, November 14, 2017	Module 2: Strategies for Service Delivery Improvements	**LECTURE** **Best Practices on Benchmarking in Phnom Penn**	**GROUP ACTIVITY** **GAP Analysis and Target Setting** **Financial Management**		**GROUP ACTIVITY** **GAP Analysis and Target Setting** **Integrated Development and Assets Management Plan (Above and Below Ground Assets)**			**LECTURE** **IDAMP Framework and Project Prioritation**	**LECTURE & GROUP ACTIVITY** **Performance Improvement Plan (PIP)** **Operational Business Plan (OBP) and IDAMP**
		Mr Kuroda	Mr Asif & Mr M Samie		Ali Rao, Ms Aneeqa and Mr Ali Qumain			Mr Asif	Mr Ali
Wednesday, November 15, 2017		**LECTURE & GROUP ACTIVITY** **Performance Improvement Plan (PIP)** **Operational Business Plan (OBP) and IDAMP** **- Water Supply System**			**LECTURE & GROUP ACTIVITY** **Performance Improvement Plan (PIP)** **Operational Business Plan (OBP) and IDAMP** **- Water Supply System**	**LECTURE & GROUP ACTIVITY** **Performance Improvement Plan (PIP)** **Operational Business Plan (OBP) and IDAMP** **- Sewerage and drainage system**		**LECTURE & GROUP ACTIVITY** **Performance Improvement Plan (PIP)** **Operational Business Plan (OBP) and IDAMP** **- Sewerage and drainage system**	
		Ali Rao, Ms Aneeqa and Mr Ali Qumain			Ali Rao, Ms Aneeqa and Mr Ali Qumain			Ali Rao, Ms Aneeqa and Mr Ali Qumain	
ursday, November 16, 2017		**GROUP ACTIVITY** **Role Play** **Project Prioritization and Approval**			**LECTURE & GROUP ACTIVITY** **Communication Strategy** **Communication Plan of Next Three Years**			**GROUP ACTIVITY** **Preparation of Business Plan including SWOT Analysis, PIPs, Communication Plan, Energy Management Plan**	

Training Plan

B1131 - Business Planning Course

DAY & DATE	MODULE	Session 1		Tea	Session 2		Lunch & Prayer	Session 3	
		9:00-10:00	10:00-11:00	11:00-11:15	11:15-12:30	12:30-1:15	1:15:2:00	2:00pm-3:00pm	3:15pm-4:00pm
Th		Mr Asif and Mr Kuroda			Ms Memoona and Ms Madiha			Mr Asif, Mr Shahbaz & Mr Ali Qumain	
Friday, November 17, 2017	Module 3: Strategies for Human Resource Development	**LECTURE Human Resource Development INDIVIDUAL ACTIVITY Job Role Analysis**	**LECTURE AND INDIVIDUAL ACTIVITY Knowledge Skill Attitude (KSA)**		**LECTURE AND INDIVIDUAL ACTIVITY Training Prioritization**	**LECTURE Workforce Database Analysis**		**GROUP Activity Training Plan**	
Monday, November 20, 2017	Module 4: Strategies for Financial Management System	**LECTURE AND GROUP ACTIVITY Strategies for Improvement in Financial Management System**			**LECTURE AND GROUP ACTIVITY Strategies for Improvement in Financial Management System**	**GROUP ACTIVITY (Aging of Arrears and Development of Arrears Recovery Strategy)**		**GROUP ACTIVITY (Aging of Arrears and Development of Arrears Recovery Strategy)**	**GROUP ACTIVITY Action Plan - Financial Management**
		Mr Asif & Mr Samie			**Mr Asif & Mr Samie**			**Mr Asif & Mr Samie**	
Tuesday, November 21, 2017		**LECTURE AND GROUP EXERCISE Investment Appraisal (Four exercises including a case of bottling company)**			**LECTURE AND GROUP EXERCISE Investment Appraisal (Four exercises including a case of bottling company)**	**LECTURE Tariff Revision Practise in Sudan**		**GROUP ACTIVITY Preparation of Business Plan including Training Plan, Financial Management Plan**	
		Mr Asif & Mr Samie			**Mr Asif & Mr Samie**	**Mr Kuroda**		**Mr Asif & Mr Samie**	

Training Plan

B1131 - Business Planning Course

DAY & DATE	MODULE	Session 1		Tea	Session 2		Lunch & Prayer	Session 3	
		9:00-10:00	10:00-11:00	11:00-11:15	11:15-12:30	12:30-1:15	1:15:2:00	2:00pm-3:00pm	3:15pm-4:00pm
Wednesday, November 22, 2017	Module 5: Business plan formulation and implementation	**GROUP PRESENTATION** **3 Year Sub-division-wise Business Plan**		**Group Photo**	**GROUP PRESENTATION** **3 Year Sub-division-wise Business Plan**			**GROUP PRESENTATION** **3 Year Sub-division-wise Business Plan**	

添付資料 4.13

2017 年秋期研修「O&M of Tube Well and Pump Facility」の教材

JICA

ALJAZARI ACADEMY

Urban Sector Planning & Management Services Unit (Pvt.) Ltd
A Public Sector Company Government of the Punjab

O&M of Tube Well and Pump Facility (W1221)

O&M of Water Distribution System (Module1)

Key Issues in Water Distribution System

Zia Mustafa (Water Specialist)
Ramisha Taseer (Research Associate)

December 2017

3

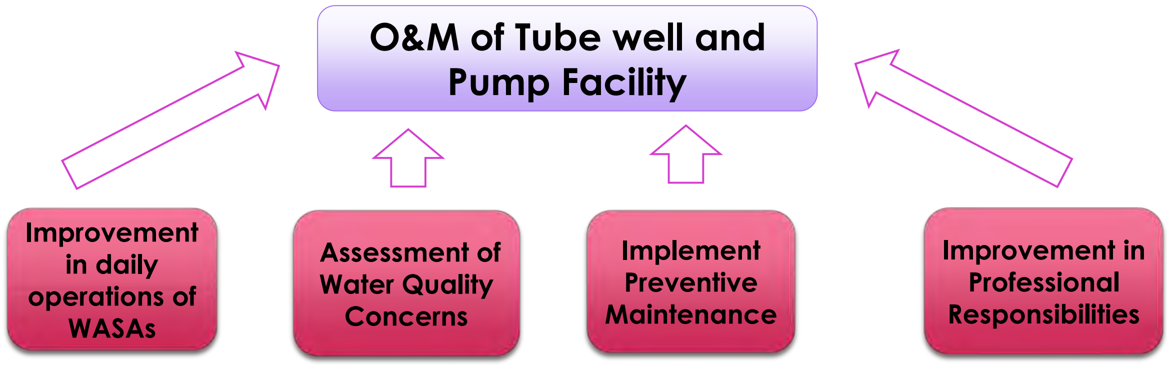
Outline of the Presentation

- Trainee's Expectations
- Learning Outcomes
- Existing Water Distribution System in Five WASA`s
- Key Issues in Water Distribution System

4

What are Your Training Expectations??

Course Outcomes



Existing Water Distribution System in Five WASA`s

WASA Lahore

7

- Water source Groundwater
- Direct Pumping System
- No. of Tube well 528
  (Supply hours 14-18hr/day)
- Total length of water distribution pipelines 5,444km
- No Overhead Reservoir in operational state Except Lange Mandi OHR (Capacity 1MG)

WASA Faisalabad

8

- 60% of population provided with piped water supply
- Water source Combination of ground water and surface water
- 15MGD of water being augmented in system by French Project
- Present Water Demand 145MGD
- Supplied Water to Consumers 93.5 MGD

WASA Multan

9

- 65% of population provided with piped water supply
- Water source — Ground water
- Depth of WT — 70-80ft
- No. of Tube wells — 102
- No. of Reservoirs — 18 Nos.
- Water supplied to consumers — 221MGD
- Water supply pipelines — 3” to 24”
  - Main lines — 231 km
  - Distribution lines — 1,049km
- No. of Filtration Plants (Cap. 1000 gallons/hr. Each) — 32

Lecture 1: Key Issues in Water Distribution System

WASA Rawalpindi

10

- 90% of population provided with water supply facility
- Two Surface water sources with treatment plants
  - Rawal Water Treatment Plant — 23MGD
  - Sanjani Water Treatment Plant — 6MGD
- No. of Tube wells (0.25 cusecs capacity each) — 362
  (39 MGD water supplying to consumers)
- Transmission and Distribution pipelines length — 1,250km (3”to 54”)

Lecture 1: Key Issues in Water Distribution System

WASA Gujranwala

11

- 40% of population provided with piped water supply
- 10 reservoirs (8 operational & 2 abandoned)
- 67 Tube wells supplying 39MGD of water
- Intermittent supply 10-12 hours in a day
- Distribution length (3" to 24" inches with length of 481km

Salient Features of Water Supply System in Five WASAs (Year 2014-15)

12

Sr. No.	Water Supply Parameters	WASA Lahore	WASA Faisalabad	WASA Multan	WASA Rawalpindi	WASA Gujranwala
1	Water Source	Ground water	Combination of Ground and Surface Water	Ground water	Combination of Ground and Surface Water	Ground water
2	Total Population (Millions)	9.2	7.19	4.22	4.57	4.66
3	Population Served (Millions)	5.89	1.9	1.43	1.65	0.21
4	WASA served water supply area (km^2)	350	225	365.3	276	25.2

Salient Features of Water Supply System in Five WASAs (Year 2014-15)

13

Sr. No.	Water Supply Parameters	WASA Lahore	WASA Faisalabad	WASA Multan	WASA Rawalpindi	WASA Gujranwala
5	Number of Tube wells	528	77	102	362	67
6	Water Coverage (%)	90	60	65	90	40
7	Average amount of water supplied (MGD)	450	93.5	221	68	39
8	Average per capita water supplied GPCD	80	25	50	40	50
9	Supply Hours	14-18	6-7	6	2-4	10-12
10	NRW (% age)	38.4	32.9	22	43	39

Salient Features of Water Supply System in Five WASAs (Year 2014-15)

14

Sr. No.	Water Supply Parameters	WASA Lahore	WASA Faisalabad	WASA Multan	WASA Rawalpindi	WASA Gujranwala
11	Metering Ratio (%)	5	1	-	-	-
12	Reservoirs (No. and Capacity) Million Gallons	52, 3.16	37, 2.2	18, 2.35	27, 2.77	10, 1.58
13	Total length of Distribution System (km)	5,444	1,218	1,280	1,200	481
14	Total Annual O&M Cost (Rs. Million)	7,354	1,652	1,075	700	643
15	Total water supply connections	636,338	270,451	66,900	114,655	26,091

Lecture 1: Key Issues in Water Distribution System

Key Issues in Water Distribution System

Non Revenue Water	Metering	Tarrif	Intermittent Water supply
Low Pressure	Aging Network	Water Quality	Cross Connections
Lack of records	Inadequate O&M	Financial constraints	

Non Revenue Water (NRW)

"NRW is the difference in water put into the supply and the amount of water to be billed to consumption"

- NRW Comprises of three components:

1. Unbilled authorized consumption (Water used for Public buildings, parks etc.)
2. Physical losses (leakages from transmission and distribution pipelines)
3. Commercial losses (illegal connections, inaccuracies in meters)

Non Revenue Water (NRW)

17

- Major factors contributing towards NRW include:
  - Old aged pipe Infrastructure
  - illegal Connections
  - Inadequate metering System
  - Invisible leaks

Lecture 1: Key Issues in Water Distribution System

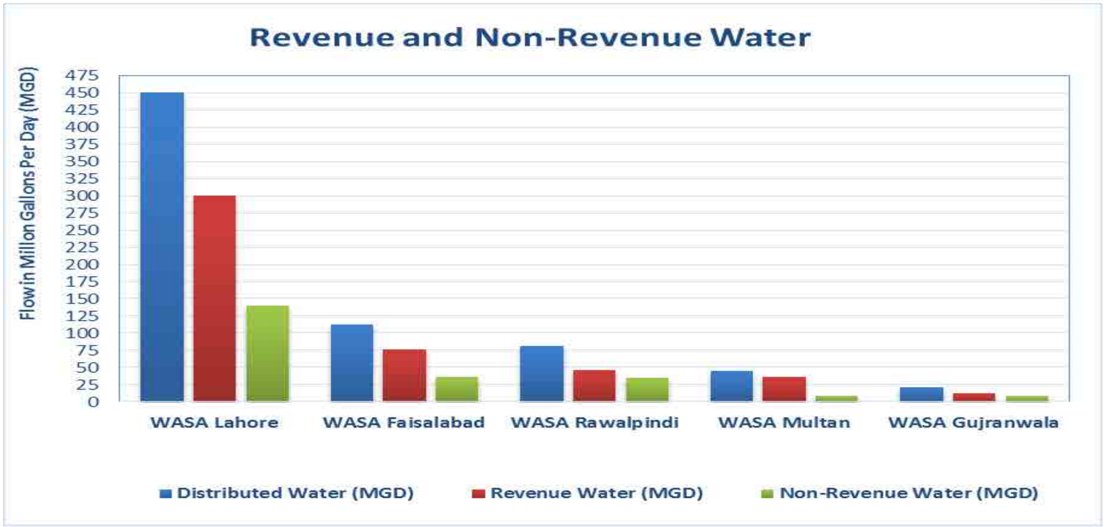
Present Status of Revenue and Non-Revenue Water across Five WASAs (Year 2014-15)

18

Sr. No.	Name of WASA	Distributed Water (MGD)	Revenue Water (MGD)	NRW Water (MGD)
1	WASA Lahore	450	300	140
2	WASA Faisalabad	112	76	36
3	WASA Rawalpindi	81	46	35
4	WASA Multan	45	36	9
5	WASA Gujranwala	21	13	8

Lecture 1: Key Issues in Water Distribution System

NRW Scenario in Five WASAs



Metering

Metering Ratio in Five WASA`s

Sr. No.	Name of WASA	Metering Ratio
1	WASA Lahore	5 %
2	WASA Faisalabad	1 %
3	WASA Gujranwala	-
4	WASA Multan	-
5	WASA Rawalpindi	-

Metering

21

- Absence of Metering System except LHR & FSD
- Bill collection on flat rate basis
- Installation of meters at domestic & non domestic connections to ensure actual consumption used by consumers

Lecture 1: Key Issues in Water Distribution System

Tariff

22

- Present tariff is based on plot sizes (varying from 5 Marla to more than 20 Marla)
- A gradual increase in Tariff is required to improve the financial position of five WASA`s
- The tariff increase needs to address at affordable cost to consumers

Lecture 1: Key Issues in Water Distribution System

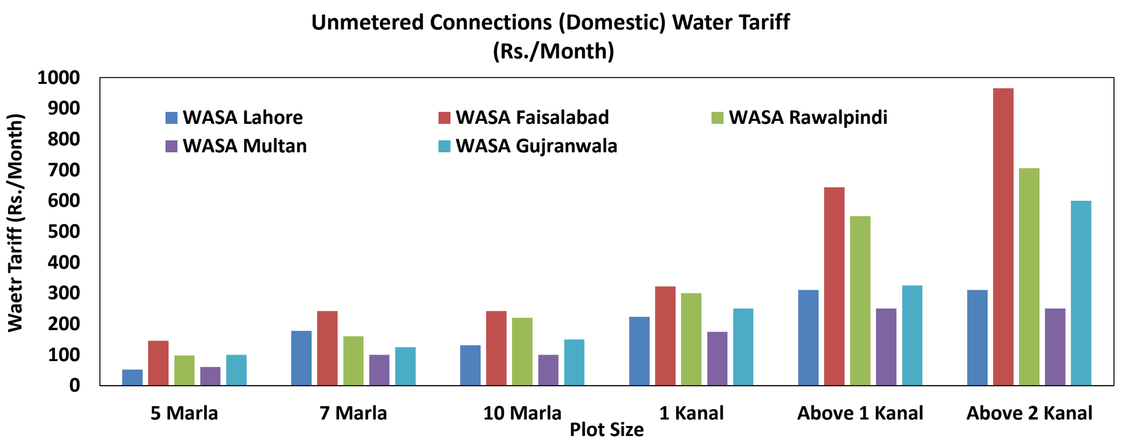
Water Supply Tariff (Rs./Month) in 5 WASAs

23

Sr. No.	Connections	Plot Size	WASA LHR	WASA FSD	WASA RWP	WASA MUL	WASA GRW
1	Unmetered Connections (Domestic)	5 Marla	52	145	98	60	100
		7 Marla	78	242	160	100	125
		10 Marla	131	242	220	100	150
		1 Kanal	223	322	300	175	250
		Above 1 Kanal	311	644	500	250	325
		Above 2 Kanal	311	966	706	250	600

Domestic Tariff on Un Metered Connections

24



Intermittent Water Supply

25

- Intermittent supply system in all WASA`s varying from 2-18 hours
- WASA Lahore 14-18 hours/ day (maximum duration)
- WASA Rawalpindi 2-4 hours / day (minimum duration)
- Supplying water on intermittent basis is major cause of negative pressure which causes contamination of water supply lines

Lecture 1: Key Issues in Water Distribution System

Cross Connections

26

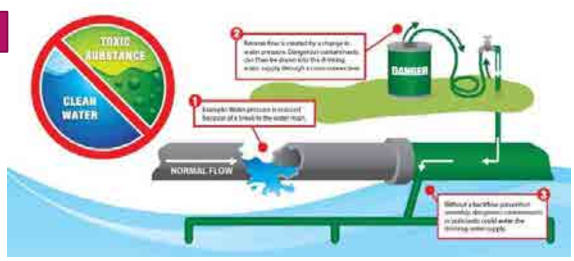
- Any connection between a potable water system and any source of contamination through which contaminated water could enter the potable water system
- **Backflow** : the flow of any water, foreign liquids, gases, or other substances back into a potable water system
- **Backpressure** : the foreign substance is forced into a water system under a higher pressure than the system pressure
- **Backsiphonage** : the water system pressure is less than atmospheric , and the foreign substance is essentially sucked into the potable water system

Lecture 1: Key Issues in Water Distribution System

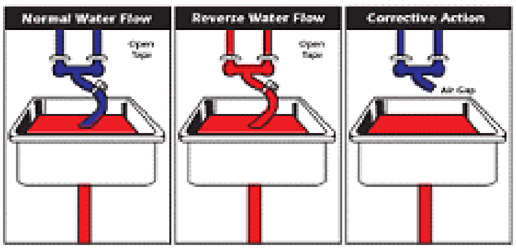
Example of Cross Connections

27

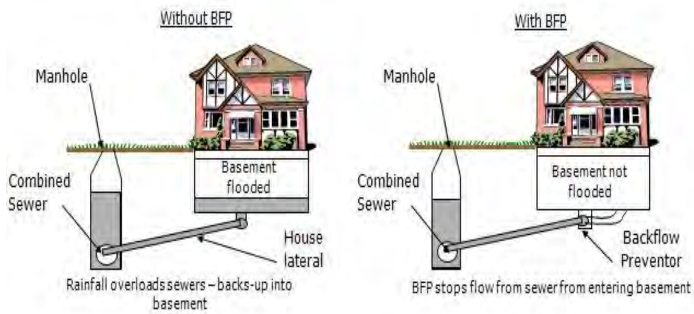
Backsiphonage



Backsiphonage



Backpressure



Low Pressure

28

- Low pressure frequently encountered in areas distant from Tube wells

Aging Network

- Water Supply Pipes used by Five WASAs include:
  - Asbestos Cement (AC)
  - Ductile Iron (DI)
  - Galvanized Iron (GI)
  - Polyvinyl Chloride (PVC)
  - High Density Polyethylene (HDPE)
  - Cast Iron (CI)
  - Mild Steel (MS)

Aging Network…Contd

- AC pipes are laid more than 90% in all WASA`s
- Corrosion of pipelines and leakages
- Reduction in carrying capacity and inability to sustain high pressures
- Low pressure at user end due to leakages

Aging Network…Contd

31

Sr. No.	Pipe Material	Age
1	Ductile Iron (DI)	70 Years
2	Mild Steel (MS)	60 Years
3	Cast Iron (CI)	50 Years
4	Galvanized Iron (GI)	50 Years
5	Poly Vinyl Chloride (PVC)	40 Years
6	Asbestos Cement Pipes	40 Years

Water Quality

32

- Water quality is main issue confronting all WASA`s
- Sources of water in Multan Gujranwala and Rawalpindi are low in viruses and bacteria
- Presence of High levels of Arsenic in water sources of WASA Lahore and Faisalabad
- Water of Faisalabad not fit for drinking due to presence of salts in water

Water Born Diseases in Children

Lecture 1: Key Issues in Water Distribution System

Water Quality Analysis Results of Five WASAs (Year 2016-17)

33

Sr. No.	Water Quality Parameter	WHO Permissible Guideline Value	Water Quality Analysis Results				
			WASA LHR	WASA FSD	WASA GRW	WASA RWP	WASA MUL
1	Appearance	Clear	Clear	Clear	Clear	Clear	Clear
2	Temperature	-	-	-	25 ^{o}C	18	NA
3	Turbidity	5 NTU	0.76	0	0.51	2.5	Unobjectiona ble

Water Quality Analysis Results of Five WASAs (Year 2016-17)

34

Sr. No.	Water Quality Parameter	WHO Permissible Guideline Value	Water Quality Analysis Results				
			LHR	FSD	GRW	RWP	MUL
4	pH	6.5-8.5	8.1	7.55	7.1	7.15	6.52
5	Alkalinity (mg/l)	500	160		50	200	110
6	Hardness asCaCO3 (mg/l)	500	136	182	50	175	140

Water Quality Analysis Results of Five WASAs (Year 2016-17)

35

Sr. No.	Water Quality Parameter	WHO Permissible Guideline Value	Water Quality Analysis Results				
			LHR	FSD	GRW	RWP	MUL
7	Electrical Conductivity (uS/cm)	2000	453	432	204	865	710
8	Calcium (mg/l)	200	37.6	32	32	61	45
9	Total Dissolved Solids (TDS) (mg/l)	1000	285.3	250	143	604	345

Water Quality Analysis Results of Five WASAs (Year 2016-17)

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Sr. No	Water Quality Parameter	WHO Permissible Guideline Value	Water Quality Analysis Results				
			LHR	FSD	GRW	RWP	MUL
10	Chlorides (mg/l)	200	37	10	52	10	130
11	Fluoride (mg/l)	< 1.5	NA	NA	0.06	NA	NA
12	Arsenic (mg/l)	0.05	49.2	6.34	0.01	-	Nil
13	Fecal Coliform	Nil/100 ml	Nil	Nil	Nil	Nil	Nil

Lack of Records

37

- Almost all WASA`s field offices lack in record keeping related to operational and maintenance data , Updation of Distribution Maps
- Good record keeping is vital to operate the system efficiently

Inadequate Operation and Maintenance

38

- Adequate O&M is necessary to run the system efficiently
- Need of Routine as well as Preventive maintenance are tools for successful O&M
- Training of WASA staff
- Need of best O&M practices

Financial Constraints

39

- Financial Constraints being faced by all WASA`s
  - Expenditures are more than the collected revenue per annum
  - More spendings on power cost (about 70% in all WASAs) due to pumping of water through tube wells
  - Increase in tariff is required as per actual consumption, however, on an affordability cost of consumers

Contact

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O&M of Tube Well and Pump Facility (W1221)

O&M of Water Distribution System (Module 1)

Components of Water Supply System

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Ramisha Taseer (Research Associate)

December 2017

Outline of the Presentation

- Introduction
- Components of Water Distribution System

Introduction

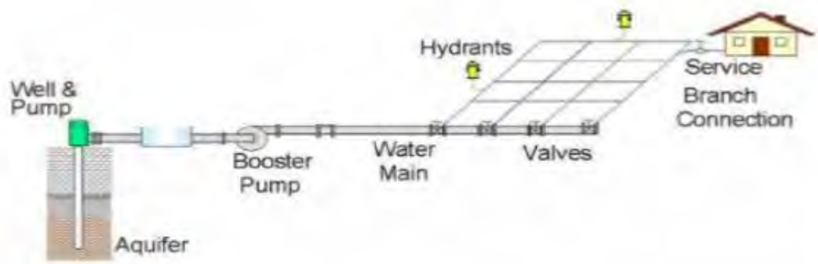
"Water supply system is used to supply water from source to the consumers through different components."

Purpose

- To deliver water to consumers with adequate quantity and quality

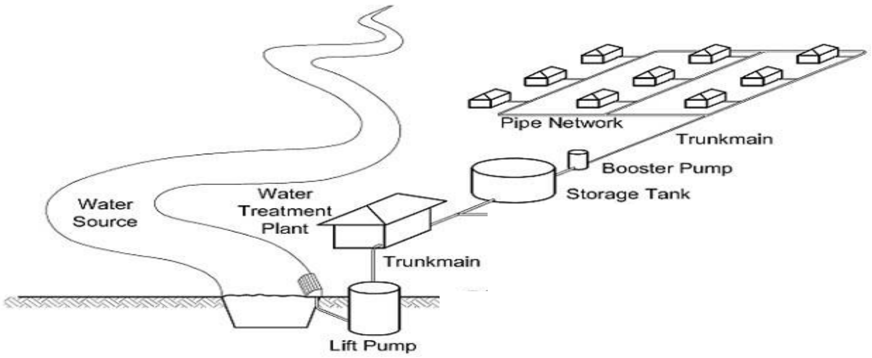
Introduction…contd.

Water Supply System Using a Ground Water Source (Direct Pumping)



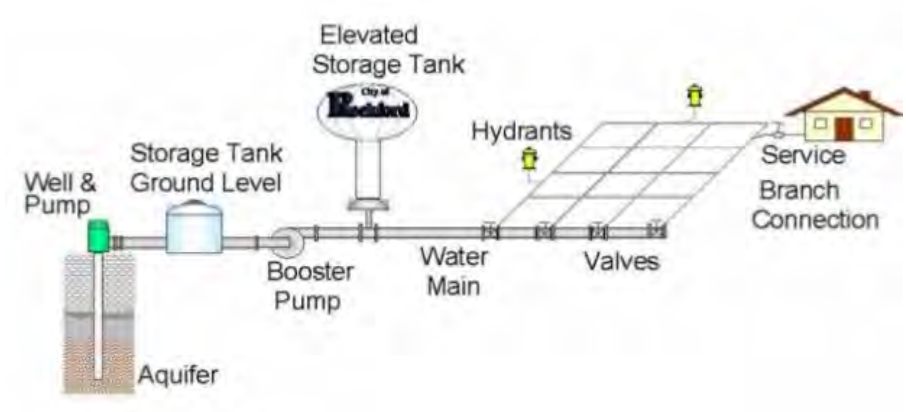
Introduction…contd.

Water Supply System Using a Surface Water Source



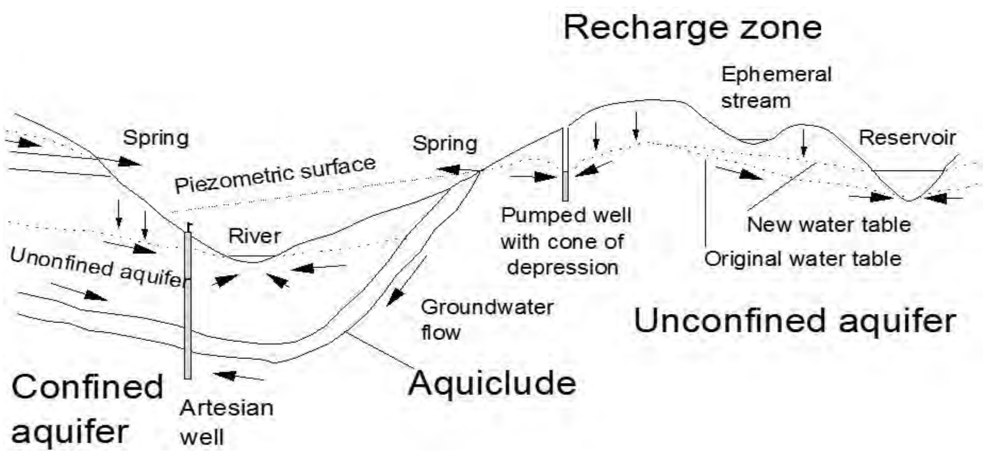
Introduction…contd.

Water Supply System Using a Ground Water Source and Over Head Reservoir



Lecture 2: Components of Water Supply System 7

Groundwater Movement



Lecture 2: Components of Water Supply System 8

Components of Water Supply System

Major components of Water Supply System are as under:

- Water Source (River/ Tube wells)
- Intake Facilities
- Water Purification Plant
- Water Supply Pipelines
- Control Valves (Gate/Sluice valves, Air valves, Drain valves etc)
- Over Head Reservoirs
- Fire Hydrants




Water Sources

Surface Water

- Streams
- Lakes
- Rivers
- Impoundments

Ground Water

- Tube wells


Tube Well

A water well used to draw groundwater to supply onward to consumers

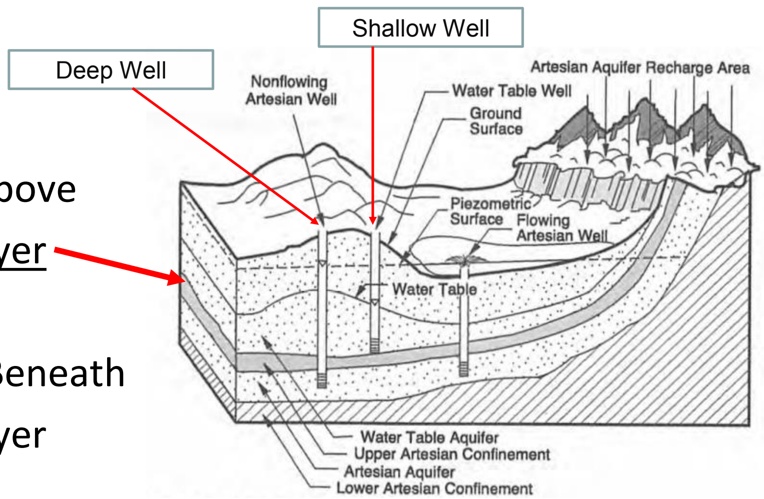
Types of Well

- **Shallow Well**

  Pumping up water above the <u>Impermeable Layer</u>

- **Deep Well**

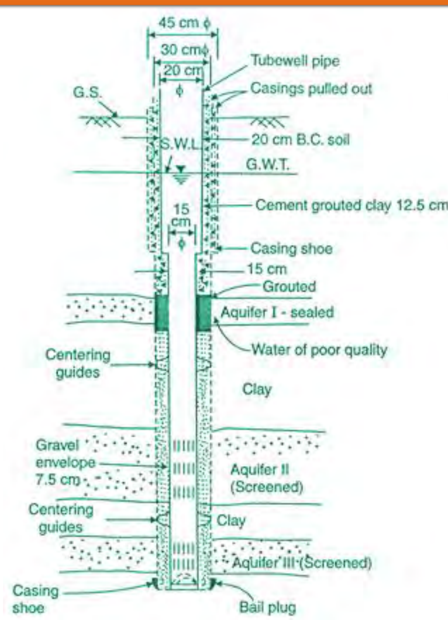
  Pumping up water Beneath the Impermeable Layer



Tube Well….Contd.

Components of Tube well include:

- Housing Pipe/Casing Pipe
- Strainer/Screen Pipe
- Blind Pipe
- Bail Plug
- Vertical Turbine Pump



Tube Well….Contd.

Housing Pipe

Housing Pipe is used to maintain an open access in the earth and to prevent any entrance of surrounding formations

Strainer/Screen Pipe

Strainer is used to keep sand and gravel out of well while allowing groundwater and water from formations to enter into the well

Strainer / Screen Pipe

Tube Well….Contd.

Blind Pipe

Blind pipe is a Plain pipe with no slots which is fixed against an impervious strata

Bail Plug

Bail Plug is provided at the bottom of pipe and strainer assembly

Tube Well….Contd.

Gravel Pack

Gravel is placed around the outside of the screen to prevent sand from entering into the well and to stabilize the well assembly

Vertical Turbine Pump

Vertical turbine pump comprises a shaft rotated by a motor on the surface. The shaft turns the impellers within the pump housing while the water moves up the column

Water Supply Pipelines

Transmission mains

- convey water from the source after treatment to the storage reservoir for onward transmission to distribution system
- larger in diameters

Distribution mains

- deliver water to individual consumer service lines and provide water for fire protection through fire hydrants, if applicable

Water Supply Pipelines

- Pipes used in Water Supply
  - Asbestos Cement (AC)
  - Ductile Iron (DI)
  - Cast Iron (CI)
  - Galvanized Iron (GI)
  - Polyvinyl Chloride (PVC)
  - Unplasticized Poly Vinyl Chloride (UPVC)
  - High Density Poly Ethylene (HDPE)

Water Supply Pipelines

- Selection Criteria
  Soil type , Roughness coefficient, Ability to resist corrosion, Installation & maintenance cost, Ability to withstand desired pressure etc.)

- Pipe Maintenance (repairing leaks and breaks, flushing, disinfecting and relining)

Valves

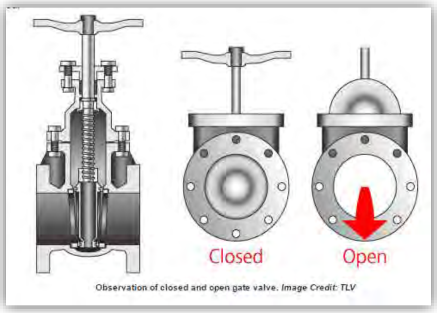
Valves are used to:

- ✓ To shut off or turn on water supply
- ✓ To regulate the flow & pressure
- ✓ To prevent backflow
- ✓ To provide air relief
- ✓ To drain out the sediments accumulated from mains

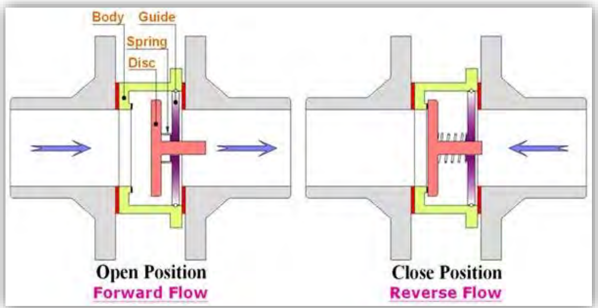
Valves

- Type of Valves (Gate/sluice Valves, Air relief valves, butterfly Valves, shut off valves , altitude valves, Non Return Valve etc.)
- Valve Maintenance (Inspecting valves stem and nut, checking valve condition)

Valves

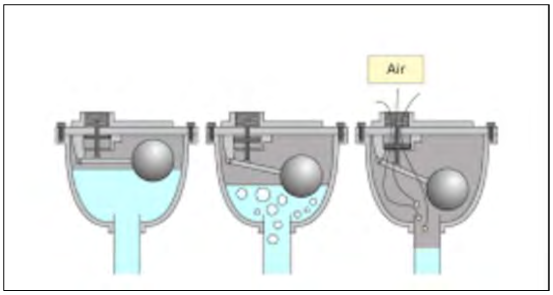


Gate Valve

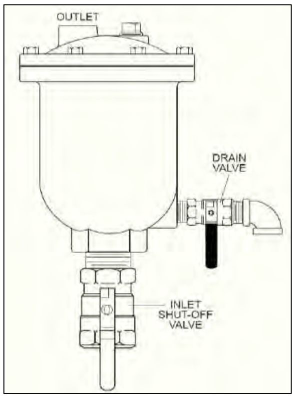


Non Return Valve

Valves



Air Release Valve



Drain/ Scour Valve

Fire Hydrants

Fire Hydrants are used for fire fighting purpose and are provided on distribution main or sub main to tap water for its use during fire

Types Of Fire Hydrants

- Post Type Fire Hydrants
- Flush Fire Hydrants

Overhead Reservoirs

Overhead reservoirs are used for the following purposes:

- To balance supply and demand
- To supply water during emergencies (such as during fires)
- to help in absorbing the hourly fluctuations in the normal water demand

Lecture 2: Components of Water Supply System 25

Overhead Reservoirs

Components of Overhead Reservoirs include:

- Inlet pipe (for entry of water in the reservoir)
- Outlet pipe (connected to the distribution mains)
- Overflow Pipes (discharging extra water into drain gutters)
- Air Vents (for fresh air circulation)
- Manholes (for providing entry into the overhead tank for inspection purposes)
- Ladder (to reach bottom of the reservoir)

Lecture 2: Components of Water Supply System 26

Contact

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O&M of Water Distribution System (Module 1)

Arrangement of Water Distribution System

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Ramisha Taseer (Research Associate)

December 2017

Outline of the Presentation

- Types of Water Supply Facilities Arrangement
- Surface Water Treatment Alternative
- Types of Distribution Networks
- Valves and Fire hydrants
- Water Pressure Requirement

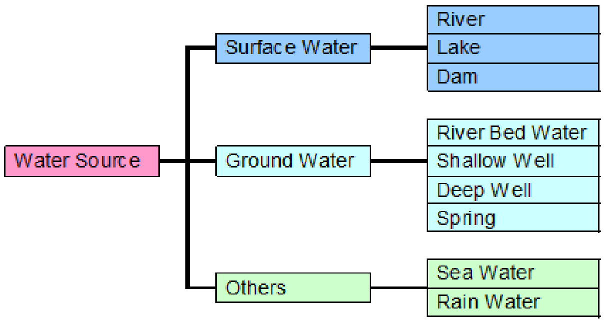
Types of Water Supply Facilities Arrangement

Planning and Design of a water supply system depends on the following:

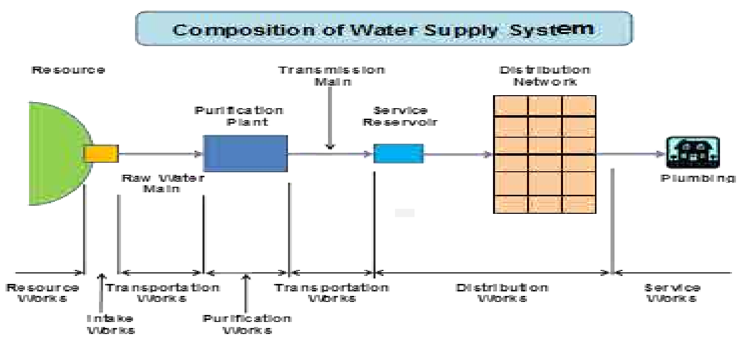
- Source of water
- Transmission of water to overhead Reservoir
- Distribution through distribution pipelines

Types of Water Supply Facilities Arrangement ….Contd.

- Detail of sources of water are as under:

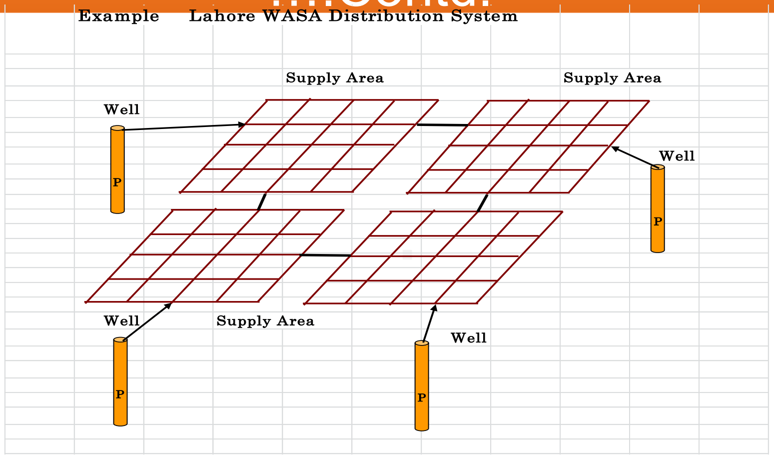


Types of Water Supply Facilities Arrangement ….Contd.



(Layout of Water Distribution System based on Surface Water Source)

Types of Water Supply Facilities Arrangement ….Contd.



(Layout of Water Distribution System based on Groundwater)

Surface Water Treatment Alternative

- Decline of Ground Water on increased levels across all Five WASAs to meet future demand of population
- More water quality concerns in Five WASAs leading to surface water treatment alternative
- Improvement in service delivery by utility service providers

Types of Distribution Network

"Networks are a system of pipes and valves providing the appropriate quality and quantity of water to a community."

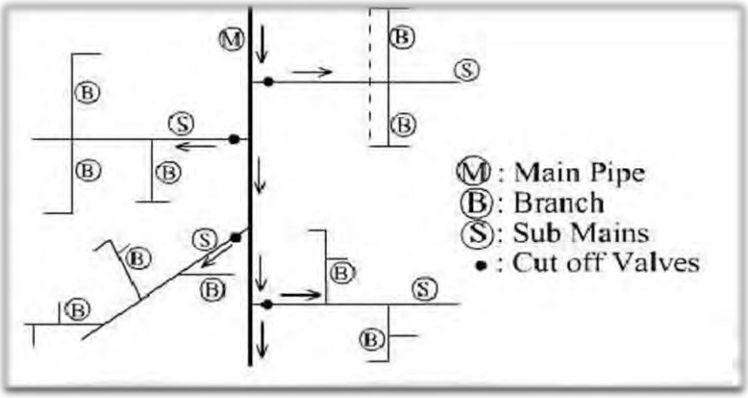
Three ways in which distribution systems are laid include:

- Dead End or Tree System
- Grid System
- Radial System

Selection Criteria for a Distribution Network

- Water quality should be maintained throughout the network
- System capability to supply water to all intended places with sufficient pressure head
- No consumer should be without water supply, during the repair of any section of the system
- Watertight to keep losses to a minimum (e.g. due to leakages)

Dead End or Tree System



one main pipeline runs through the center of the populated area and sub-mains branch off from both sides

Dead End or Tree System

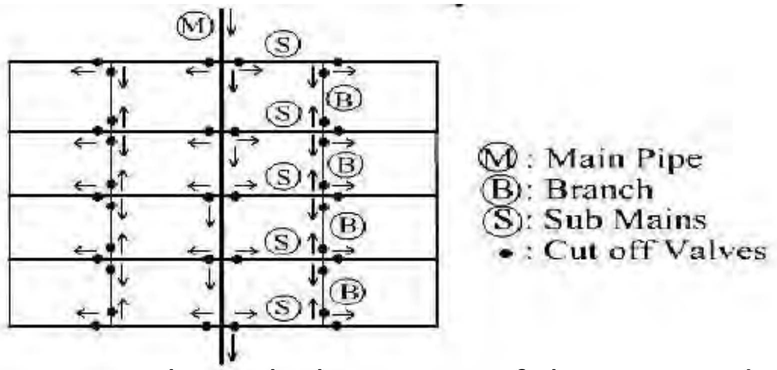
Advantages:

- ✓ Simple pipe laying
- ✓ Less cut off valves are required
- ✓ Low O&M cost

Disadvantages:

- ✓ Low pressure in remote points
- ✓ Interruption of supply in case of main failure
- ✓ Sedimentation and bacterial growth at dead ends
- ✓ Scour valves required at dead ends

Grid Iron System



Main supply line runs through the center of the area and sub mains branch off in perpendicular directions

All of the pipes are interconnected and there are no dead ends

Grid Iron System

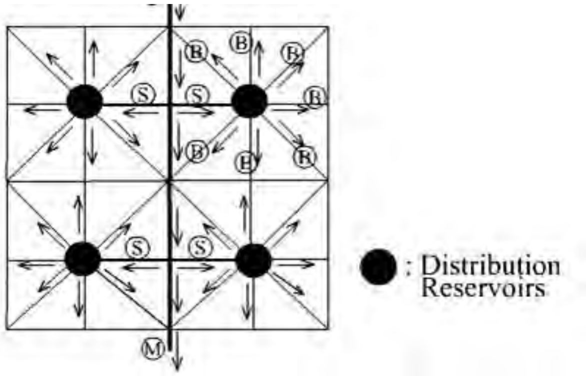
Advantages:

- ✓ Minimal chance of stagnation
- ✓ No sedimentation
- ✓ Repairs require small area to be interrupted

Disadvantages:

- ✓ Greater cost of pipe laying
- ✓ Large number of cutoff valves required
- ✓ Longer pipe lengths with larger diameter

Radial System



Area is divided into distribution districts
Each District has a centrally located distribution *reservoir* (elevated)

Valves and Hydrants

- Provision of shut off valves at frequent intervals in water distribution system
- Provision of Fire Hydrant at frequent intervals to meet emergencies due to fire

Water Pressure Requirement

- Minimum Residual Pressure required in Water Distribution System 14m
- Development of pressure zones in areas with varying elevations

Contact

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O&M of Water Distribution System (Module 1)

Pipe Materials

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December 2017

2

Outline of the Presentation

- Selection Criteria for Pipes
- Types of Pipes used in Water Supply System
- Factors affecting installation cost

Selection Criteria for Pipes

1. Corrosion Resistance
   - External & internal Corrosion
2. Roughness Coefficient
   - Smoothness of internal pipe surface
3. Soil Condition
   - Loss of support (bedding)
4. Overall Cost
   - Capital Cost
   - O&M cost

Types of Pipes Used in Water Supply

- Cast Iron (CI) Pipes
- Ductile Iron (DI)Pipes
- Asbestos Cement (AC) Pipes
- Steel Pipes
- Galvanized Iron (GI) Pipes
- Reinforced Cement Concrete (RCC) Pipes
- PVC (Polyvinyl Chloride) Pipes
- UPVC (Unplasticized Polyvinyl Chloride) Pipes
- HDPE (High Density Polyethylene) Pipes

Cast Iron Pipes

Advantages

- ➢ Withstand high pressures
- ➢ Inexpensive
- ➢ Durable
- ➢ Leak detection straightforward
- ➢ Easy to install

Disadvantages

- ➢ Heavy & brittle
- ➢ Difficult to transport
- ➢ Corrodes in soft water
- ➢ Metallic taste due to iron leaching

Ductile Iron Pipes

Advantages

- High strength for supporting earth loads
- Lighter than Cast iron
- Less Brittle than CI
- Easy jointing

Disadvantages

- May require wrapping or cathodic protection in corrosive soils or water
- Thrust blocks needed

Asbestos Cement Pipes

Advantages

- Rigid
- High tensile strength
- Easily tapped, cut
- Low friction to water flow
- Corrosion resistant to most soils and water

Disadvantages

- Can release asbestos fibers under corrosive conditions
- Easy breakage when bent
- Difficult to locate

Steel Pipes

Advantages
- High strength for supporting earth loads
- High in cost
- Easy handling & transport

Disadvantages
- Poor corrosion resistance

Galvanized Iron Pipes

Advantages
- Low initial cost
- Toughness
- Long life
- Easy inspection
- Fast assembly

Disadvantages
- Contain lead and Corrode easily
- Deposits buildup causing blockages

Reinforced Concrete Pipes

Advantages

- Durable
- Easy installation

Disadvantages

- Gravity flow pipe

Polyvinyl Chloride (PVC) Pipes

Advantages

- Inert and Resists corrosion
- Doesn’t support combustion
- Cheap
- Easy to install
- Smooth interior surface
- Very low frictional losses

Disadvantages

- Very brittle (break or crack easily)
- Less flame resistant
- At higher temperature their strength reduces

Unplasticized Polyvinyl Chloride (UPVC) Pipes

Advantages

- Good corrosion resistance
- Light weight
- Ease of jointing
- Low cost
- Smooth internal surface

Disadvantages

- Susceptible to impact damage
- Degradation by certain organic compounds
- Susceptible to poor installation practice

HDPE Pipes

Advantages

- Flexible
- Easily transported because can be rolled
- Used in trenchless installations
- Lightweight
- Resistant to cracking

Disadvantages

- Fusion jointing require skilled installer & special equipment
- Not suitable for large diameters

Factors Affecting Installation Costs

- ✓ Weight of the pipe:
  A pipe that is lightweight can be handled easier and faster
- ✓ Ease of assembling:
  Push-on joints can be assembled much faster than bolted joints
- ✓ Pipe strength:
  If one type of pipe requires special bedding to withstand external pressures while another pipe does not, the choice can impact installation costs significantly

Contact

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O&M of Water Distribution System (Module 1)

Valves in Water Supply System

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Ramisha Taseer (Research Associate)

December 2017

Outline of the Presentation

- Valves in Water Supply System
- Types of Valves
- Maintenance of Valves

Valves in Water Supply System

Valves are used to:

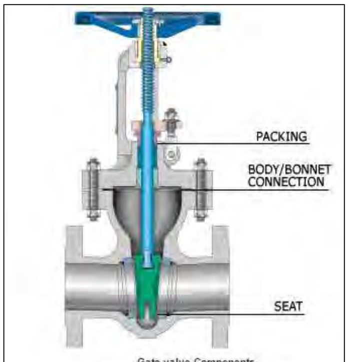
✓ To isolate flow
✓ To regulate the flow & pressure
✓ To prevent backflow
✓ To drain out the sediments accumulated from mains

Types of Valves

- Gate Valve/Butterfly Valve
- Air Release Valves
- Drain Valve/ Wash Outs
- Altitude Valves
- Pressure Relief Valves
- Check Valves/ Non return valve

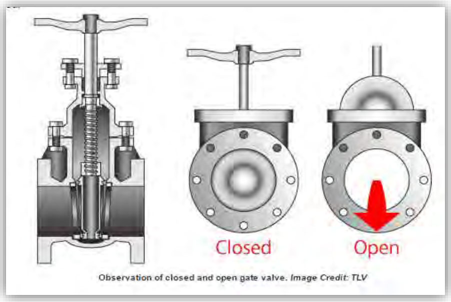
Gate Valve /Butterfly Valve

- Gate valves are used to isolate sections of the distribution system to permit emergency repairs without interrupting service to large numbers of customers
- Components of gate valves include:
  - Body
  - Bonnet
  - Trim



Gate valve Components
Image Credit: profmaster.blogspot.com

Gate Valve/Butterfly Valve



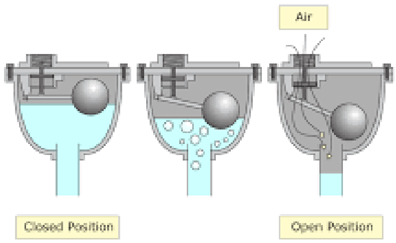
- A sliding flat metal disc is moved at right angles to the direction of flow by a screw operated stem
- Provides very little resistance to flow when it is opened

Butterfly Valves

- Mainly installed in lines 300mm and above in diameter
- Used for isolating the water supply lines for repair purpose

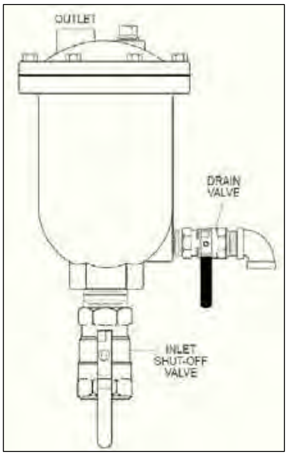
Air Release Valves

- Air valves are used to remove air accumulated in pipe
- Provided at summit points
- Float drops off and air is released



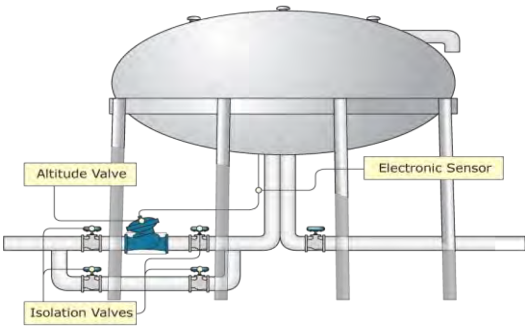
Drain Valves/ Washouts

- Allow sediment to be flushed out and to enable the pipeline to be drained for maintenance and repair work



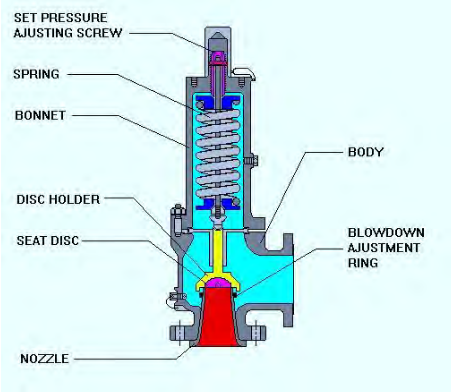
Altitude Valves

- Normally installed at rising mains
- To prevent overflow of overhead reservoirs
- closes at a preset maximum water level to prevent overflow of reservoir and opens to refill when the water level in the tank or reservoir lowers



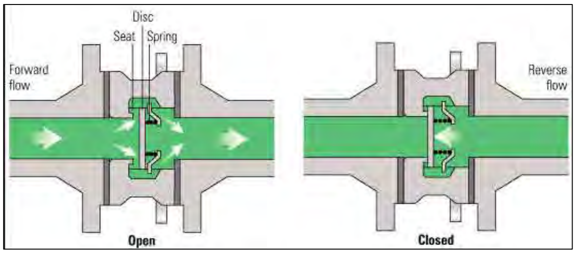
Pressure Relief Valve

- Also known as safety valves
- Used to release high pressures in system to prevent damage



Check Valve/ Non-return valve

- Used for unidirectional flow



Maintenance of Valves

Components of a Valve Maintenance Program:

✓ An updated system map
✓ Documentation for each valve
✓ Record of maintenance work
✓ Sample Valve Operation Worksheet
✓ A schedule for routine maintenance

Maintenance of Valves

Components of a Routine Valve Inspection:

- Verify accuracy of location of valve boxes on map
- Updation of map when necessary
- Remove valve box cover
- Inspect stem and nut for damage or obvious leakage
- Close the valve fully

Maintenance of Valves

- Record condition of valve (any maintenance required)
- Replace a valve if it does not completely open or close
- Clean the valve box cover seat
- Place the valve in its operating position (open or closed) when inspection is complete.

Valve Exercising

Valve exercising must be done for flushing dead end lines at least quarterly
Following information must be collected:

1	Unique Valve identification number
2	Visibility and proper elevation
3	Accessibility
4	Location and GPS coordinates
5	Manufacturer
6.	Size and Style of Valve
7.	Number or turns and direction for opening
8.	Check for leakage with detection equipment
9.	Condition of valve
10	Age of valve in system

Valve Operation Worksheet

Date	Valve No.	Location	Size	# of Turns	Direction of Closing	Remarks/ Maintenance/ Deficiencies

Contact

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Assignment 1

Critical Report on Major Issues of Five WASA`s

Guidelines for Preparing Assignment

- List down main issues faced by the water utility (Respective WASA).
- Prioritize the issues
- What are the factors that are contributing towards these issues
- How to rectify or improve the current WASA`s Situation in your opinion

JICA ALJAZARI ACADEMY Urban Sector Planning & Management Services Unit (Pvt.) Ltd. A Public Sector Company Government of the Punjab

O&M of Tube Well and Pump Facility (W1221)

O&M of Water Distribution System (Module 1)

Operational Action Plan for Water Supply System

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December 2017

Outline of the Presentation

- Operation of Water Supply System
- Why Operational Action Plan Needed?
- Features of Water Supply Operational Action Plan
- Operational Action Plan for Water Supply System

Operation of Water Supply System

Operation of Water Supply System refers to daily operations of various components of Water Supply System such as Pipelines, Valves, Overhead Reservoirs, Fire Hydrants, Equipment etc. to deliver reliable and safe Supply of Water to Consumers with adequate Pressure

Why Operational Action Plan Needed?

- To deliver adequate Supply of Water to Consumers without interruption
- To ensure Safe Water requirement without any contamination to Consumers
- To know about System Component Failure (Pumps, Chlorinators, Valves, Meters etc.)
- To find causes of main breaks in Water Distribution System

Features of a Water Supply Operational Plan

Generally, Water Supply Operational Action Plan Comprises of the following:

- Prevailing operational issues in the system
- Possible causes
- Control measures in the form of Checklists
- Key Responsibilities

Operational Action Plan for Water Supply System

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
1	Non availability of updated Water Supply Maps	• Lack of GIS Mapping	• Update water supply Maps with - Clear description of pipe diameter - Location of valves • Ensure availability of updated Maps at respective WASA sub division offices	Sub Divisional Officer (SDO), Supervisor
2	Taste and Odor in water	• High Chlorine Residual • Presence of salts in water	• Lower Chlorine Dose • Apply routine flushing of supply lines or appropriate treatment method	Sub Divisional Officer (SDO), Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
3	Turbidity	• Due to presence of Silt or Clay in water (suspended solids)	• Apply flushing of pipelines and appropriate treatment Method	Sub Divisional Officer (SDO), Supervisor
4	Presence of Coliforms or Bacteria	• Water contaminated due to inadequate chlorine • Ingress of contamination transmitted from sewer line in vicinity of water supply line due to cross connections	• Increase chlorine dose as per requirement of WHO Guidelines	Sub Divisional Officer (SDO), Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
5	Loss of Residual Chlorine	• Inadequate quantity of Chlorine Solution (Sodium Hypochlorite) injected • Some operational problems linked with chlorine feed pump to supply chlorine in main line at tube well	• Inspect Chlorine solution tanks on regular basis at tube well • Check condition of chlorine feed pump to deliver required amount of chlorine solution tank	Supervisor and Operator
6	Cross Connection	• Ingress of contamination from sewer line to water supply lines due to cracks in pipelines during periods of no supply	• Proper horizontal and Vertical Clearance between water supply and sewer/drain pipe need to be provided	Sub Divisional Officer (SDO), Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
7	Pipeline Leakages	• Corrosion, old aged pipes • Absence of leak detection equipment for buried pipe line leakages	• Repair Pipelines leakages • Ensure Gradual replacement of old aged pipes in the network • Conduct Water Audit on regular basis	Supervisor and Operator
8	Leakages from Valves	• Corrosion of Valves • Worn packing material • Improper closure of valves	• Ensure Periodic Inspection of valve chambers • Lubricate gland bolts • Replace cover/bonnet gasket after certain duration • Ensure periodic cleaning of Valve Chambers	Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
9	Leakages through Reservoirs	• Leakage from cracks in reservoirs • Internal corrosion of connected piping (inlet, outlet, overflow, bypass pipe) • Improper closure of valves	• Inspect the reservoir on regular intervals from inside and outside • Inspection of connecting pipes and valves on regular basis • Monitor water levels in Reservoirs on regular basis	Supervisor and Operator
10	House Connection Leakages	• Corroded and sub standard material used for plumbing • Poor plumbing practices	• Ensure Polyethylene Pipe for House Connection • Ensure provision of meters at consumer end • Ensure standard pipe material for House connection	Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
			• Replace Mild Steel Clamps in the Consumer Connections by Polyethylene or PPR saddles and use S/S bolts instead of ordinary MS bolts	
11	Water loss	• Old and deteriorating pipe network • Illegal connections	• All connections (domestic and commercial) need to be metered	SDO, Supervisor and Operator
12	Defective Meters	• Repair Problems • Rotation of meters due to pressurized air and starting of supply on intermittent basis	• Replace defective meters with new meters	SDO, Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
13	Improper Metering	• Majority connections are unmetered • Faulty Meters	• Ensure metering system at consumers end • Ensure routine repair of meters	Executive Engineer, SDO, Supervisor and Operator
14	Low Pressure	• Under Capacity pipes present in the system, distant from tube well • Corrosion of pipelines	• Control buried pipeline leakages • Replace under capacity pipes with increased sizes as per water demand of the area	SDO, Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
		• leakages in supply lines • Valve in system partially closed	• Replace gradually old aged pipes in the network • Inspect the valve chamber condition in service areas to identify leakages	
15	Lack of recording Water abstraction at source and consumption by community	• Absence or presence of faulty bulk flow meters at source (tube well) • Absence of consumer meters	• Provide Bulk Flow meters at sources for recording the flow • Ensure hundred percent consumers metering in the system	SDO, Supervisor and Operator

Operational Action Plan for Water Supply System …Contd.

Sr. No	Problem	Possible Cause	Mitigation Measure	Key Responsibility
16	Lack of Monitoring of Pressure at source and in distribution system	• Absence of pressure gauges at various tube wells • Faulty Pressure gauges	• Ensure presence of pressure gauges at all WASA tube wells • Make repair of faulty pressure gauges on priority basis	SDO, Supervisor and Operator

Contact

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O&M of Water Distribution System (Module 1)

Maintenance Action Plan for Water Supply System

Zia Mustafa (Water Specialist)
Ramisha Taseer (Research Associate)

December 2017

Outline of the Presentation

- Introduction
- Types of Maintenance
- Requirements for Preventive Maintenance
- Required Preventive Maintenance Activities in Five WASA`s
- Repair Action Plan For Water Supply System
- Availability of tools

Introduction

"Maintenance refers to contain all the system components (supply pipes, valves, equipment etc.) in a good optimum working order by repair and maintenance"

Types of Maintenance

- Routine Maintenance
- Preventive Maintenance

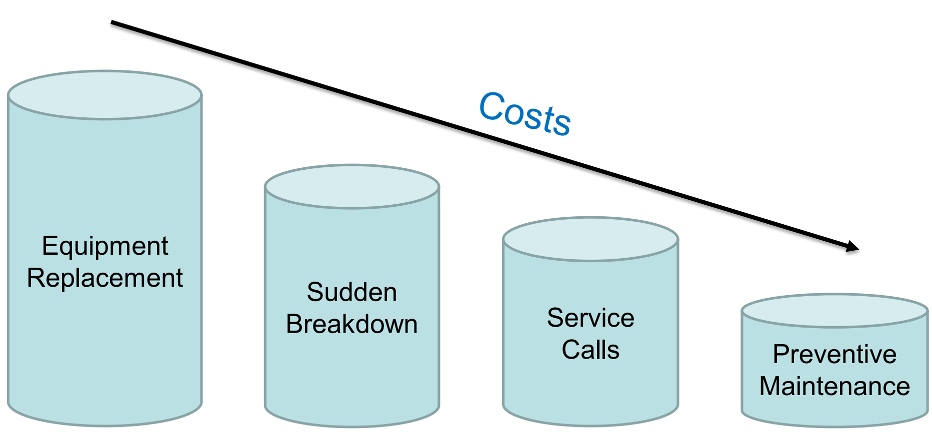
Routine Maintenance

- Routine Maintenance refers to accomplish repair and replacement of parts of the system (Pipes, Valves, Fittings etc.) when damaged or leakages becomes evident from them
- Required to run the system efficiently

Preventive Maintenance

Preventive Maintenance Includes planned activities for maintenance of the system (Pumps, Valves, Flushing of Pipelines etc.) to Prevent their failure at much earlier stage of their design life

Preventive Maintenance



The best way to deal with a Problem is to Prevent it !!

Requirements of Preventive Maintenance Plan

- Regular Planned Maintenance Activities
- Defining Clear Roles and Responsibilities
- Training of Staff
- Availability of Tools

Required Preventive Maintenance Activities in Five WASAs

Sr. No.	Activity	Frequency of Duration	Key Responsibility
1	Flushing of Pipe Lines	Fortnightly	Supervisor and Operator
2	Patrolling of Water Supply Network (To over view Leakages)	Every Month	Supervisor and Operator
3	Water Quality Analysis	Fortnightly	Laboratory Incharge and WASA Sub Division Staff
4	Checking of Pressure in Supply Lines	Daily	Supervisor and Operator
5	Inspection of Bulk Flow Meters	Every Month	Supervisor and Operator
6	Inspection of Consumer Meters	Every Month	Supervisor and Operator
7	Reservoir Cleaning	After every 6 Months	Operators
8	Inspection of Valve Chamber	Every Month	Supervisor and Operator

Repair Action Plan

Sr. No.	Problem	Possible Causes	Mitigation Measures	Key Personnel Responsibility
1	Corrosion of Pipe Line	• Due to completion of service life of pipe • Excess dosage of chlorine in pipeline adversely affecting material of pipe	• Ensure replacement of corroded pipe portion with new pipe • Painting of pipelines if present on ground (especially walled city) • Ensure chlorine dosage as per requirement	Supervisor and Operator

Repair Action Plan

Sr. No.	Problem	Possible Causes	Mitigation Measures	Key Personnel Responsibility
2	Leakages through Pipelines	• External or Internal Pipe Metal Loss due to developed cracks • Faulty and corroded Joints • Aging Pipe Network	• Ensure Replacement of damaged pipe portion with new one • Undertake Regular maintenance audit in service areas	Supervisor and Operator

Repair Action Plan

Sr. No.	Problem	Possible Causes	Mitigation Measures	Key Personnel Responsibility
3	Leakages of Valves (at seat, at cover/ bonnet, at gland packing)	• Corrosion of seat • Settling of Gasket as a result of temperature variations • Worn packing material • Poor maintenance	• Ensure reseating of valve disc • Retighten the bolts at bonnet • Retight the gland packing at nuts • Check opening and closing of valve • Ensure periodic inspection of valve chambers	Supervisor and Operator

Repair Action Plan

Sr. No.	Problem	Possible Causes	Mitigation Measures	Key Personnel Responsibility
4	Valves hard to operate	• Damaged Seat • Valve not fully lubricated	• Provide valves with proper lubrication	Supervisor and Operator
5	Ineffective inventory control system for spare parts and supplies	• Poor Inventory System, based on recording listing of spare parts in registers	• Ensure computerized system at stock yards • Provide adequate inventory of maintenance items	Supervisor and Operator

Availability of Tools

A list of spares required for maintenance shall be prepared and the spares shall be procured and kept for use.

- ✓ Spare check nuts, spindle rods and bolts
- ✓ Nuts and washers for the flanged joints
- ✓ Gaskets for flanged joints for all sizes of sluice valves installed in the transmission system
- ✓ Spare manhole covers
- ✓ Consumables like the gland rope, grease, cotton waste

Contact

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Updation of Water Supply Maps

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Ramisha Taseer (Research Associate)

December 2017

Outline of the Presentation

- Introduction
- Importance of Mapping
- Features of updated Water Supply Map
- Example of updated Map
- Procedure for Preparation and Updating of Maps

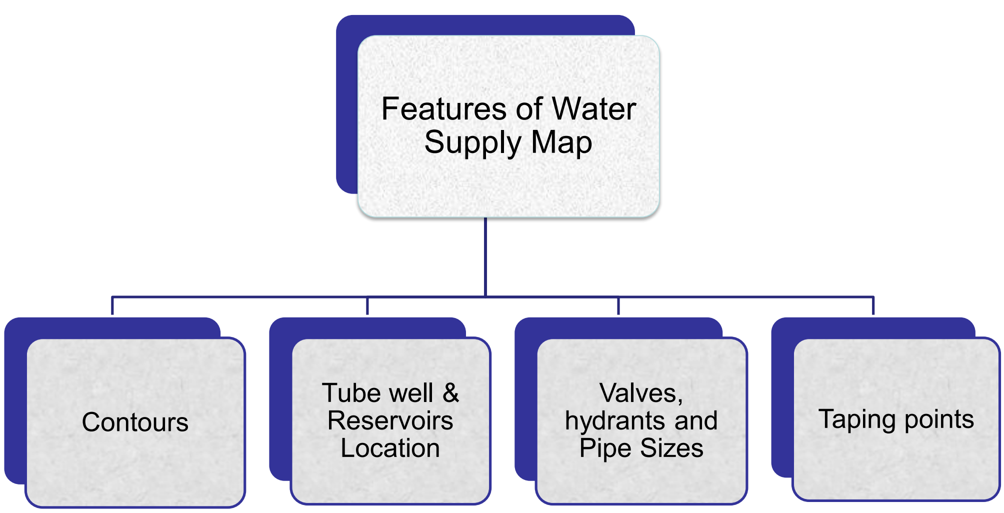
Introduction

- Updated Distribution Maps is pivotal factor for improved operations of utility service providers
- Required to contain updated water distribution system information

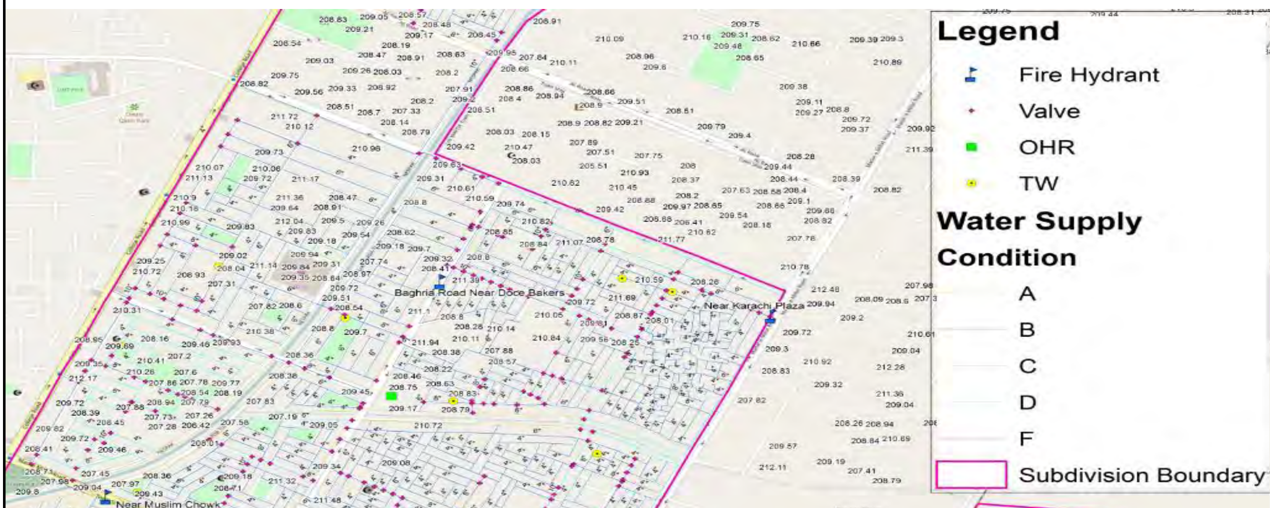
Importance of Mapping

- ✓ Provides a comprehensive knowledge about water distribution network
- ✓ To identify location of buried mains for repair purposes (pipe leakages, bursts)
- ✓ To locate position of valves and hydrants
- ✓ Existing maps can be used to identify areas where future installation can be made

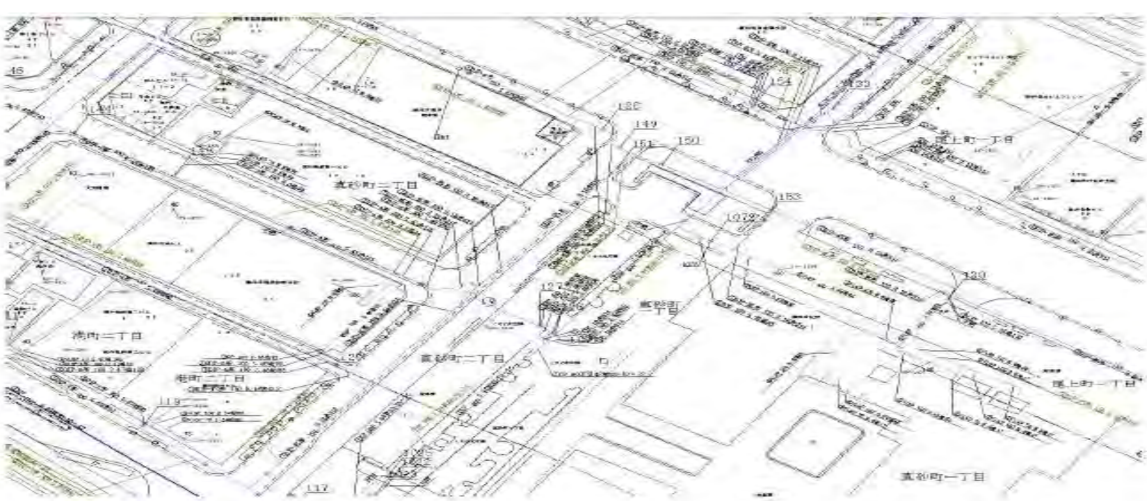
Features of Updated Water Supply Map



Example of Updated Map



Example of Updated Map



Procedure for Preparation and Updation of Maps

GIS Maps

Geographic Information System (GIS) is a computer program that combines mapping with detailed information on physical structures with geographic area

Procedure for Preparation and Updation of Maps

GIS Mapping

- Compatible with AutoCAD Design Systems
- Layers of information on a single map such as water Lines, Sewers, power Cables etc.
- Number of valve chambers/manholes, pipe lengths , diameters, reservoir locations, pumping stations are indicated in the form of attributes
- Helps the maintenance crew to locate place of work

Contact

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O&M of Water Distribution System (Module 1)

Overhead Reservoirs

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December 2017

Outline of the Presentation

- Introduction
- Present Situation of Five WASA`s in Context of Overhead Reservoir
- Shapes of Overhead Reservoirs
- Components of Overhead Reservoir
- Maintenance of Overhead Reservoir
- O&M Plan of Overhead Reservoir

Introduction

Purpose of Overhead Reservoir:

- To equalize the demand during peak hours
- To equalize operating pressure
- To provide storage for emergencies
  (In case of source failure)
- Maintain desired pressure

Introduction

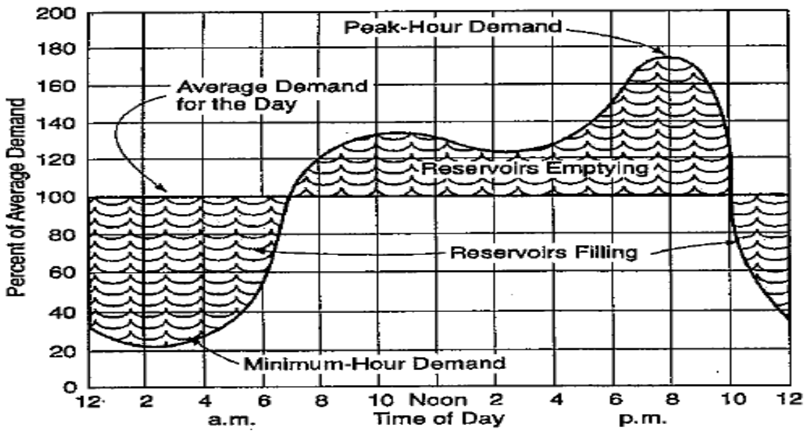
Equalizing Supply and Demand

- Designed for 4-6 hour supply at average demand
- During periods of low demand, OHR are refilled

Advantages of Overhead Reservoirs

- Absorb the hourly variations in demand
- Maintain constant pressure in the distribution mains
- Water stored can be supplied during emergencies
- To facilitate carrying out repairs without interruption to the supply of water

Demand Fluctuation in a Day

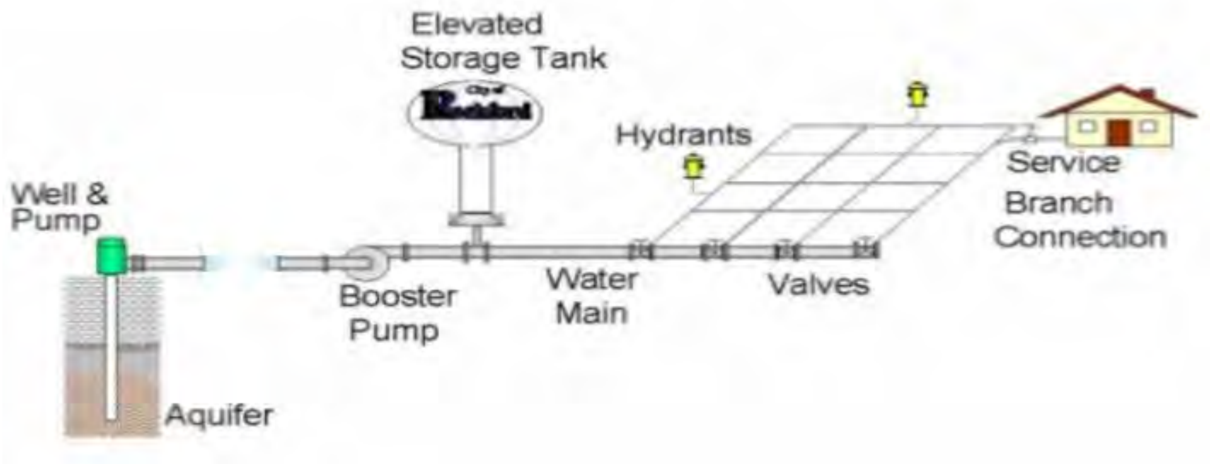


(Function of distribution reservoirs with respect to demand fluctuations)

Present Situation of Five WASA`s in Context of Overhead Reservoir

Sr. No	Water Supply Parameter	WASA LHR	WASA FSD	WASA MUL	WASA RWP	WASA GRW
1	Total Reservoirs	52	37	18	27	10
2	Total Capacity MG	3.16	2.2	2.35	2.77	1.58
3	In Use	1	17	-	25	8
4	Abandoned	51	20	-	2	2

Overhead Reservoir and Gravity Storage System



Shapes of Overhead Reservoirs


Intze Type

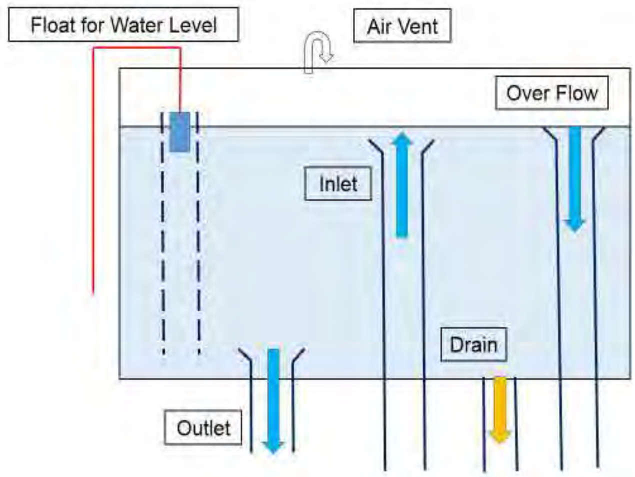

Circular Type


Rectangular Type


Spherical Type

Components of Overhead Reservoir

- Inlet pipe
- Outlet pipe
- Overflow Pipes
- Float for Water Level
- Air Vents
- Manhole for entry
- Ladder
- Valves



Components of Overhead Reservoir

Ladder or Stairs

Inlet Pipe

Bottom of Reservoir

Float Gauge for water level

Maintenance of Overhead Reservoirs

Following are the main maintenance activities:

- Repairing of cracks & leaks
- Proper Screening of air vents & overflow pipes
- Inspection of manhole covers
- Cleaning & inspection of internal structure
- Preventing littoral growth
- Painting of internal surface
- Replacing corroded pipes
- Inspection of valves

Cleaning of Overhead Reservoirs

- Empty the Tank
- Clean the tank with Detergent using steel wire brush
- Fill the Reservoir with water and drain the water
- Fill again the Reservoir for supplying water to consumers
- Add chlorine doze as per requirement in the Reservoir
- Reservoir Cleaning After every 6 Month

Maintenance of Reservoirs

Safety Precautions while cleaning of OHR

- Use of PPE (Gum boots, Hand Gloves, Respirators)
- Proper ventilation by opening air vents
- Guard rails provided at the top roof and around ladder
- Trained personnel

O&M Plan of Overhead Reservoir

Sr. No.	Problem	Cause	Control Measure
1	Structural failure	• Poor engineering design • Poor maintenance • Use of poor quality material	• Improved engineering design • Apply preventive maintenance measures
2	Leakages	• Structural Cracks in reservoir	• Monitoring of Water Level and pressure of water in storage reservoir • Relining • Inspection of Pressure gauges, flow meters and flow level indicator

O&M Plan of Overhead Reservoir…Contd.

Sr. No	Problem	Cause	Control Measure
		• Poor lining material used for water proofing	• Storage tank internal cleaning and lining
		• Aging of piping material	• Replacing older pipe materials
		• Internal corrosion of connected piping (inlet, outlet, overflow, bypass pipe)	• Replacing older pipe materials
		• Improper closure of valves	• Lubrication of valves

O&M Plan of Overhead Reservoir…Contd.

Sr. No	Problem	Cause	Control Measure
		• Corroded entry cover in the reservoir	• Inspection of vents and hatches • Replacing corroded covers
3	Taste and odor complaints	• Long detention time	• Proper opening/closing of outlet valve
		• Contaminant entry	• Check seals on hatches and screens on vents • Install bird wires and fences if necessary
		• Leaching from Internal coatings or new concrete tank	• Check chlorine level • Improve influent water quality • Flush distribution system • Clean and disinfect storage tank

O&M Plan of Overhead Reservoir…Contd.

Sr. No	Problem	Cause	Control Measure
		• Long detention time	• Proper opening/closing of outlet valve
		• Contaminant entry	• Check seals on hatches and screens on vents • Install bird wires and fences if necessary
		• Leaching from Internal coatings or new concrete tank	• Check chlorine level • Improve influent water quality • Flush distribution system • Clean and disinfect storage tank

Contact

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O&M of Water Distribution System (Module 1)

Water Safety Plan linked with Distribution Pipelines & Reservoir

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December 2017

Outline of the Presentation

- Introduction
- Developing Water Safety Plan
- Water Safety Plan for Water Distribution System

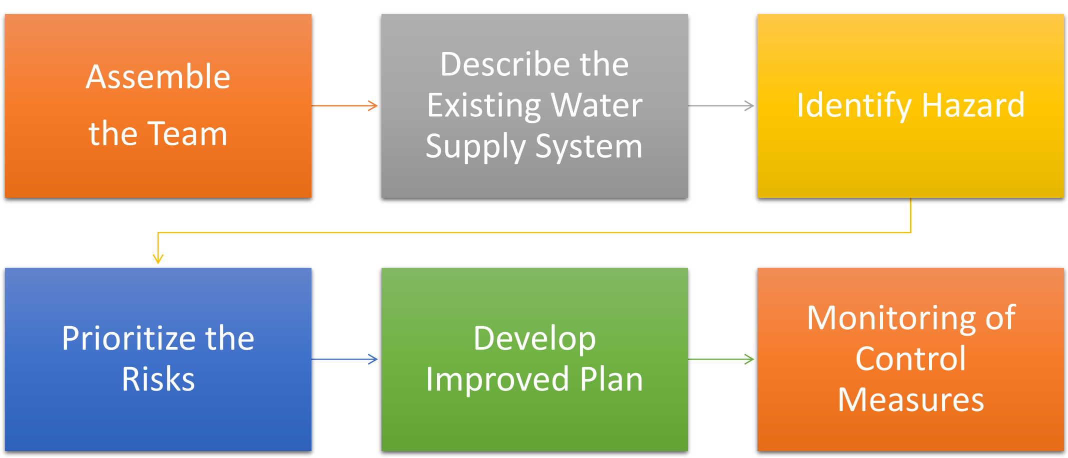
Introduction

"Water Safety Plan is a tool to address the water quality concerns from source to tap in distribution system incorporating possible expected hazards, their possible associated risk setting (risk levels) and finally control measures to address those hazards"

Introduction…..Contd.

Health Impacts of Poor Water Quality

Developing Water Safety Plan



Assembling the Team

- ✓Assemble of team with adequate operational experience
- ✓Major role of team is to identify possible hazards linked with poor water quality in water distribution system and apply control measures in turn

System Assessment

- ✓ Assessment of existing water supply system
- ✓ Developing system flow diagrams from source up to consumers

System Assessment…contd.

Ground Water Abstraction → **Chlorination** → **Distribution System** → **Consumers**

System Flow Diagram based on Groundwater Source

System Assessment…contd.

Surface Water Abstraction → Water Treatment Plant → Reservoir → Distribution System → Consumers

System Flow Diagram based on Surface Water Source

Hazard Identification and Setting Risk Level

- ✓Identification of possible potential hazards
- ✓Prioritizing risks associated with hazards
- ✓Risk level determining

Risk Level = Frequency x Severity

Hazard Analysis and Setting Setting Risk Level

Hazard Analysis **Risk level matrix**

				Severity of damage				
				Almost no	Requires consideration	Slightly significant	Important	Worst
				No effects observed	unsatisfactory , but not serious enough for people to turn to other drinking water	Serious enough to turn to other drinking water	May affect health	May result in fatalities
				1	2	3	4	5
Frequency of hazard	Frequently	Every month	5	5	10	15	20	25
	Often	Once every few months	4	4	8	12	16	20
	Occasion-ally	Once every 1 to 3 years	3	3	6	9	12	15
	Rarely	Once every 3 to 10 years	2	2	4	6	8	10
	Almost never	Once every10 years or less frequently	1	1	2	3	4	5

Water Safety Plan(WSP) For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
	Water Source			
1	Microbial and chemical Hazards	• Deterioration of water quality	• Good practices of source protection through installation of filtration plant • Implementation of Industrial Effluent Standards and Volume Controls	SDO, Supervisor, Operator

Water Safety Plan(WSP) For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
	Transmission Mains			
1	Microbial Hazard	• Poor water quality due to source contamination • Deposits of sediments • Disinfection failure due to high loads of organic contents in water from source	• Stop the flow of water by closing valves of problem area • Provide a temporary bypass or alternative supply line, if possible • Water sampling and its testing	SDO, Supervisor, Sub Engineer

Water Safety Plan(WSP) For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
2	Structural Hazard	• Contamination due to poor jointing • Deterioration of pipe materials • Ingress of contaminated water from leaking valves	• Apply periodic Inspection of supply lines • Gradual replacement of old aged pipe infrastructure • Exercising of valves	SDO, Supervisor, Sub Engineer

Water Safety Plan(WSP) For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
	Reservoir			
1	Microbial hazard	• Poor water quality due to inadequate disinfection method	• Minimizing ingress of contamination to system • Fitting alarms triggered by low disinfectant level • Ensure inspection covers and ventilator covers remain in place	SDO, Supervisor, Sub Engineer

Water Safety Plan(WSP) For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
2	Structural failure hazard	• leakage through reservoir • leakage from partially open valves • taste in water due to internal corrosion of pipelines • deterioration of internal lining	• Regular reservoir inspections • Proper opening/closing of valves • Proper pipe material as per specifications should be used • Relining/painting of internal surface • Routine inspection to see any failure in piping and lining	SDO, Supervisor, Sub Engineer

Water Safety Plan(WSP) For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
Distribution Supply lines				
1	Microbial and Chemical Hazards	• Low chlorine residual in distribution system • Ingress of contamination due to pressure fluctuations	• Maintain chlorine residual in the system as per requirement • Pressure Management • Apply flushing of pipelines	SDO, Supervisor, Sub Engineer

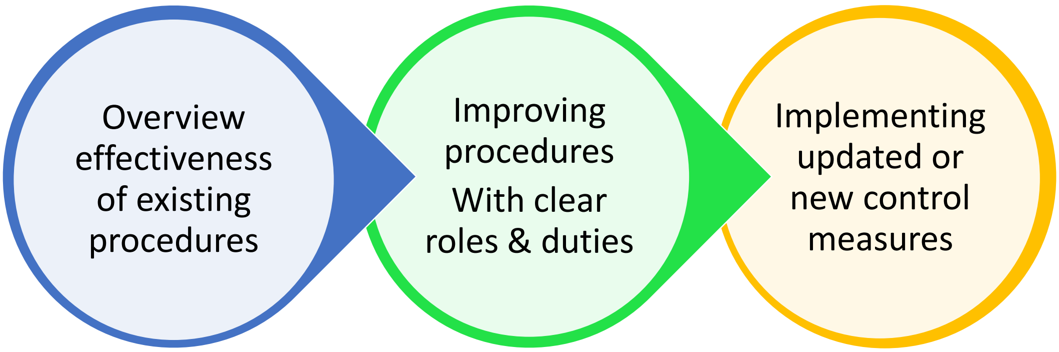
Water Safety Plan(WSP) For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
		• Contamination during water main repair due to debris, soil or groundwater remaining in the main after repairs	• Disinfection prior to commissioning of water main • Follow design specifications for water supply system	SDO, Supervisor, Sub Engineer

Water Safety Plan For Water Distribution System

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
		• Cross connection between water system and another system carrying non-potable water		
2	Structural failure hazard	• Ingress of contamination due to main burst • Ingress of contamination due to cracks in pipelines • Ingress of contamination due to improper closure of valves	• Maintenance of pipelines and valves • Use of approved pipeline types	SDO, Supervisor, Sub Engineer

Developing, Implementing & Maintaining an Improved/Upgrade Plan



Monitoring of Control Measures

- ✓ Important for reviewing effectiveness of water safety plan
- ✓ Measuring residual chlorine, pH, turbidity, pressure changes in service area and periodic inspection of infrastructure

Contact

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Water Specialist

Assignment 2

Preparation of Water Safety Plan (WSP)

Guidelines for Preparing Assignment

- What are major hazard in water distribution system
- Identify problems associated to these hazard
- Control measures
- Responsible persons to apply the control measures

ALJAZARI
ACADEMY

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O&M of Water Distribution System (Module 1)

EPA Net Analysis Exercise

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December 2017

Outline of the Presentation

- Introduction
- Purpose of Exercise
- Target Area for Exercise
- Steps in Using EPANET
- Simple Example Network Analysis
- Exercise at Supply Area in Green Town

3

Introduction of EPANET

- A network analysis computer program developed by the U.S. Environmental Protection Agency that analyzes Water Distribution Network
- A tool to determine pressure, velocity in different pipes in a Network

4

Purpose of Exercise

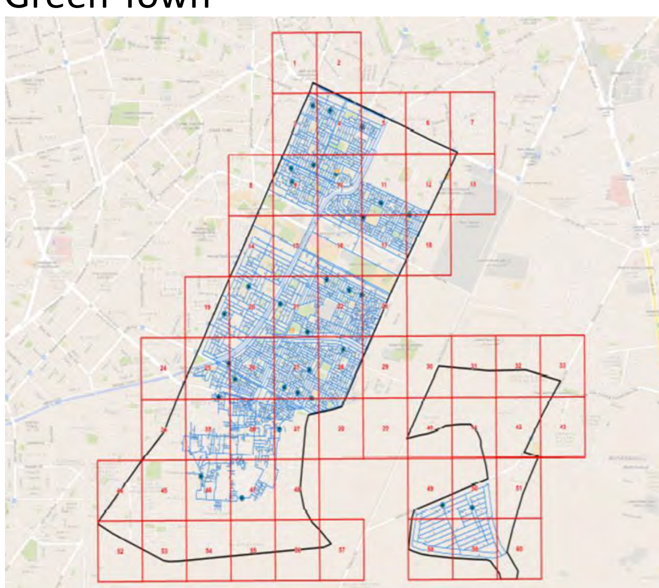
For checking and confirming that sufficient water is supplied to customers within supply area with appropriate pressure or not

- How water pressure within the supply area is changing
- Diameter of pipe is appropriate or not
- Capacity of pump is appropriate or not
- Possibilities of improving

5

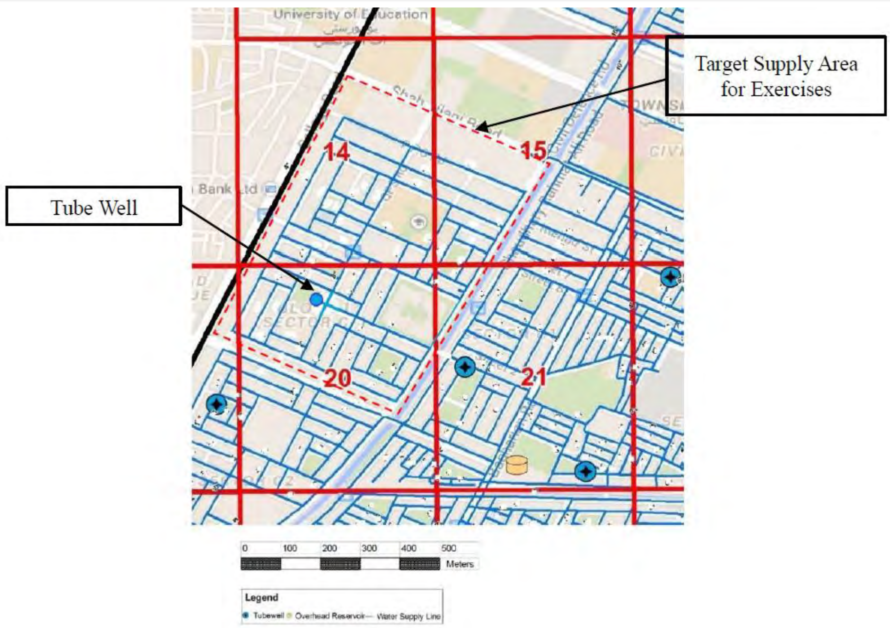
Target Area for the Exercise

Grid Map of Green Town



6

Target Area for the Exercise



7

Steps in Using EPANET

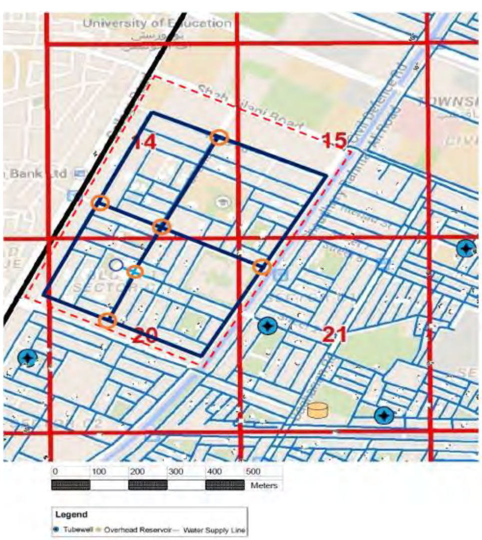
Steps to model a Water Distribution System using EPANET:

1. Draw a network representation of your distribution system or import a basic description of the network placed in a text file
2. Edit the properties of the objects that make up the system
3. Describe how the system is operated
4. Select a set of analysis options
5. Run a hydraulic analysis
6. View the results of the analysis

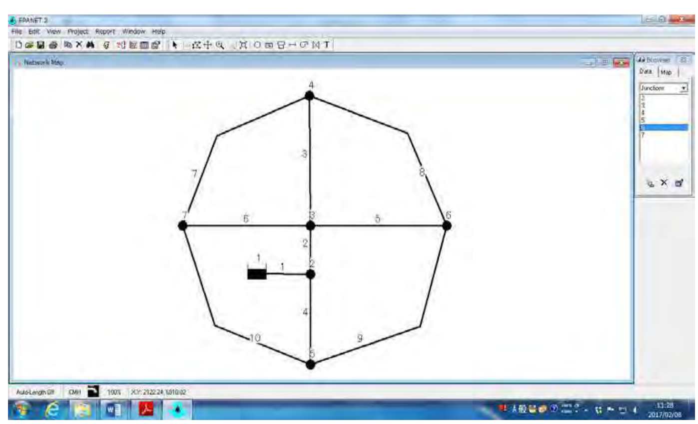
8

Simple Example Network Analysis

Simple Example Network Analysis



Main Distribution Network Example for Analysis



Network Model on the EPANET

10

Node Properties

Network Node Properties

Node	Elevation(m)	Demand(m3/H)
1	GL+30	(406.8)
2	GL	68.0
3	GL	68.0
4	GL	68.0
5	GL	68.0
6	GL	68.0
7	GL	66.8

11

Pipe Properties

Pipe	Start Node	End Node	Length(m)	Diameter(mm)	C-Factor
1	1	2	100	200	100
2	2	3	100	200	100
3	3	4	300	100	100
4	2	5	200	200	100
5	3	6	300	100	100
6	3	7	200	100	100
7	7	4	500	100	100
8	6	4	600	100	100
9	5	6	600	100	100
10	5	7	500	100	100

12

Project Setup

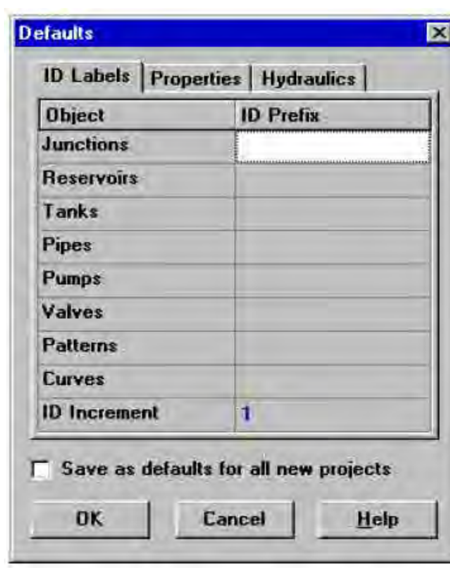
Project Setup

- Launch EPANET
- Create a new project
- Select Project >> Defaults to open the dialog form shown in Figure

13

Selecting Flow Unit

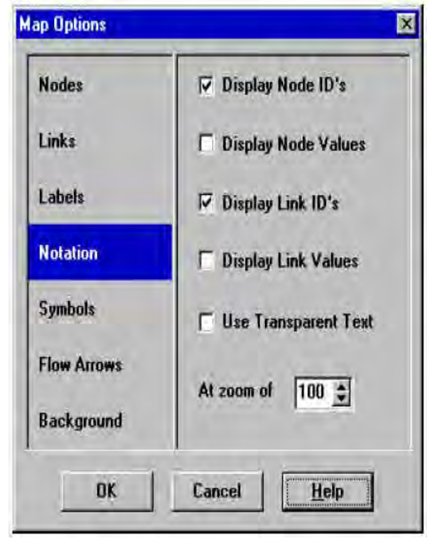
- On the ID Labels page of the dialog, clear all of the ID Prefix fields and set the ID Increment to 1
- Select the Hydraulics page of the dialog and set the choice of Flow Units to GPM (gallons per minute)



14

Map Options Dialog Form

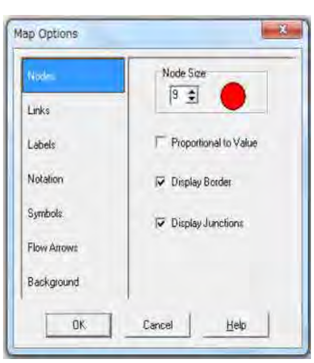
- Select **View >> Options** to bring up the Map Options dialog form
- Select the Notation page on this form and check the settings
- Then switch to the Symbols page and check all of the boxes
- Click the **OK** button to accept these choices and close the dialog

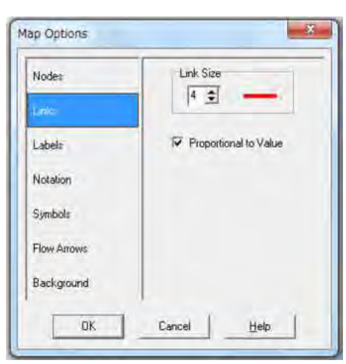


15

Map Dimensions Dialog

- Select **View >> Dimensions** to bring up the Map Dimensions dialog
- Note the default dimensions assigned for a new project. click the **OK** button



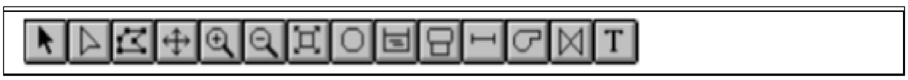


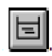
16

Drawing the Network

Drawing the Network

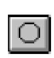
- Select View >> Toolbars >> Map



- Click the Reservoir button 
- Then click the mouse on the map at the location of the reservoir

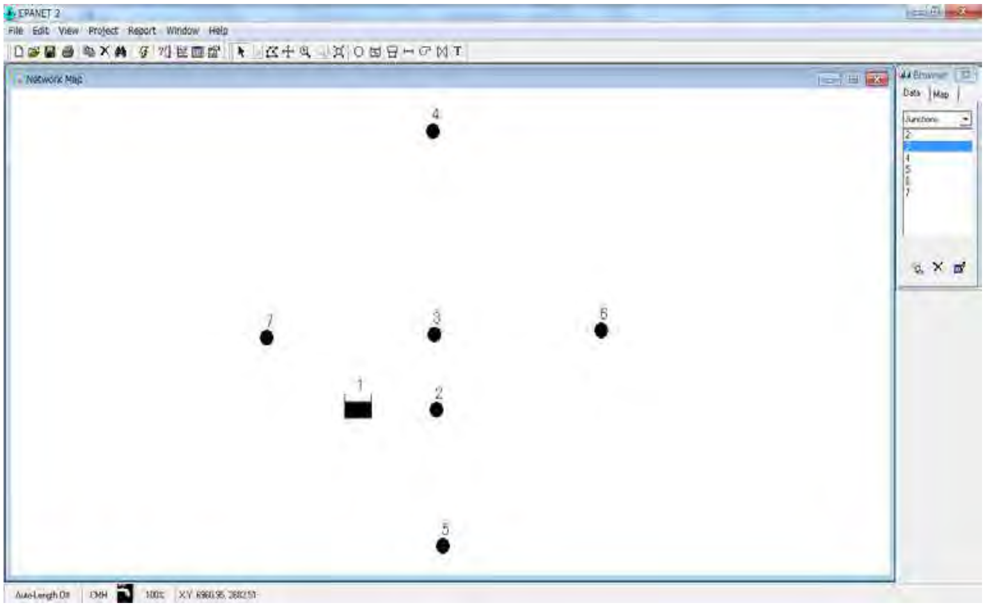
17

Adding the Nodes and Pipes

- Click the Junction button  and click on the map at the locations of nodes 2 through 7
- Click the Pipe button .  (Note how an outline of the pipe is drawn as you move the mouse from node 2 to 3). Repeat this procedure for pipes 2 through 8.

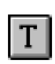
18

Nodes on the EPANET



19

Labeling the Reservoir

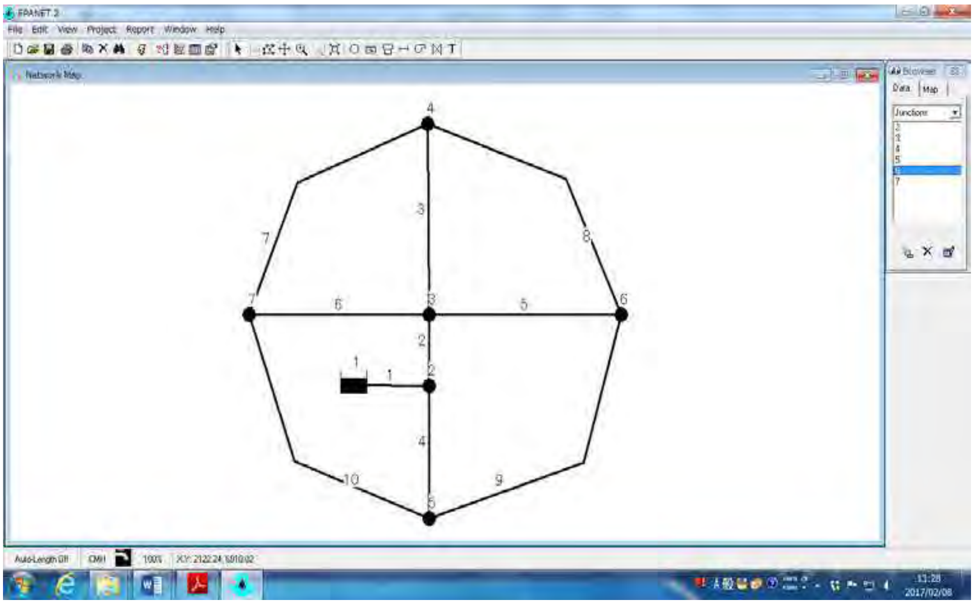
- Label the reservoir by selecting 

on the Map Toolbar. Edit Box will appear. Type here SOURCE and then
hit the ENTER key

- Click the selection button  to put the map on the Objection Selection Mode

20

Example Network on the EPANET



21

Setting Object properties

Setting Object Properties

- Double-click the object on the map
- Right-click on the object and select Properties from the pop-up menu that appears
- Select the object from the Data page of the Browser window and then click the Browser's Edit button
- Add Elevation and Base Demand (Node 2)
- Click on link to add length, diameter and roughness (c factor) for links

22

Properties Editor

Reservoir 1

Property	Value
*Reservoir ID	1
X-Coordinate	2801.36
Y-Coordinate	3412.56
Description	
Tag	
*Total Head	30
Head Pattern	
Initial Quality	

Junction 2

Property	Value
*Junction ID	2
X-Coordinate	4618.00
Y-Coordinate	3395.59
Description	
Tag	
*Elevation	0
Base Demand	68
Demand Pattern	

Pipe 2

Property	Value
*Pipe ID	2
*Start Node	2
*End Node	3
Description	
Tag	
*Length	100
*Diameter	200
*Roughness	100

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Saving and Opening Projects

- From the File menu select the Save As option.
- In the Save As dialog that appears, select a folder and file name under which to save this project.
- Click OK to save the project to file.

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Saving and Opening Projects

Saving and Opening Projects

- The project data is saved to the file in a special binary format. If you wanted to save the network data to file as readable text, use the **File >> Export >> Network** command instead.
- To open project at some later time, select the **Open** command from the **File** menu.

Running a Single Period Analysis

- Select Project >> Run Analysis or click the Run button . (If the toolbar is not visible select View >> Toolbars >> Staard from the menu bar).
- Select Node Pressure from the Browser's Map page and observe how pressure values at the nodes become color-coded.
- To view the legend for the color-coding, select **View >> Legends >> Node** (or right click on an empty portion of the map and select Node Legend from the popup menu).

Running a Single Period Analysis

Running A Single Period Analysis

- To change the legend intervals and colors, right click on the legend to make the Legend Editor appear
- Bring up the Property Editor (double-click on any node or link) and note how the computed results are displayed at the end of the property list
- Create a tabular listing of results by selecting **Report >> Table** (or by clicking the Table button)

27

The Link Result

Network Table - Links

Link ID	Length m	Diameter mm	Roughness	Flow CMH	Velocity m/s	Unit Headloss m/km	Friction Factor	Reaction Rate mg/L/d	Quality	Status
Pipe 1	100	200	100	406.80	3.60	94.41	0.029	0.00	0.00	Open
Pipe 2	100	200	100	208.49	1.84	27.38	0.032	0.00	0.00	Open
Pipe 3	300	100	100	45.88	1.62	48.54	0.036	0.00	0.00	Open
Pipe 4	200	200	100	130.31	1.15	11.46	0.034	0.00	0.00	Open
Pipe 5	300	100	100	44.25	1.56	45.39	0.036	0.00	0.00	Open
Pipe 6	200	100	100	50.36	1.78	57.69	0.036	0.00	0.00	Open
Pipe 7	500	100	100	14.91	0.53	6.05	0.043	0.00	0.00	Open
Pipe 8	600	100	100	7.21	0.26	1.58	0.048	0.00	0.00	Open
Pipe 9	600	100	100	30.97	1.10	23.44	0.038	0.00	0.00	Open
Pipe 10	500	100	100	31.34	1.11	23.97	0.038	0.00	0.00	Open

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The Nodes Result

Network Table - Nodes

Node ID	Elevation m	Base Demand CMH	Demand CMH	Head m	Pressure m
Junc 2	0	68	68.00	20.56	20.56
Junc 3	0	68	68.00	17.82	17.82
Junc 4	0	68	68.00	3.26	3.26
Junc 5	0	68	68.00	18.27	18.27
Junc 6	0	68	68.00	4.20	4.20
Junc 7	0	66.8	66.80	6.28	6.28
Resvr 1	30	#N/A	-406.80	30.00	0.00

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Exercise

at Supply Area in Green Town

Exercise at Supply Area in Green Town

1. Select and make your main distribution network on your map

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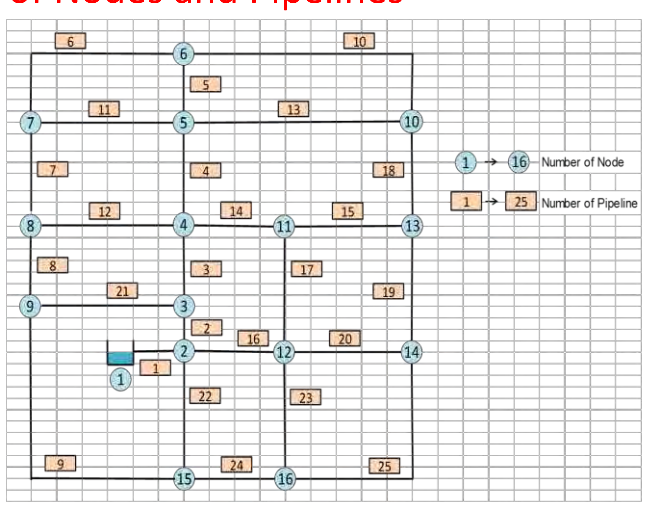
Exercise at Supply Area in Green Town

2. Numbering of Nodes and Pipelines



If number of Nodes is small, you will not be able to get good result from network analysis.
Or if number of Nodes is too big, analysis will be complicated and it will take long hours.

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Exercise at Supply Area in Green Town

3. Data Sheet of Nodes

No.	Elevation	Water Demand or Supply Amount from Node

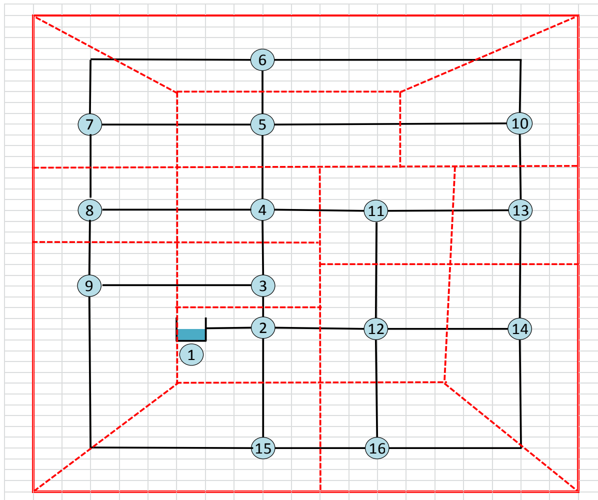
Exercise at Supply Area in Green Town

4. Data Sheet for Pipelines

No.	Start Node	End Node	Length in meter	Diameter in mm	Roughness Coefficient

Exercise at Supply Area in Green Town

Supply amount from each node will be calculated according to area, number of customer, population density and types of customers.



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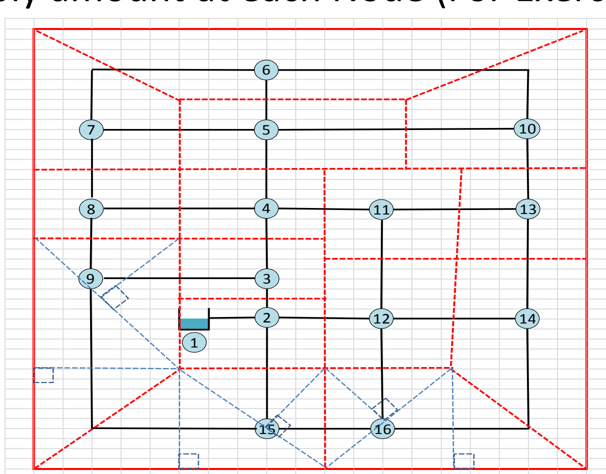
Exercise at Supply Area in Green Town

- Divide each supply area with two right triangle and calculate base times height
- Equal supply amount at each Node (For Exercise Purpose)



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Exercise at Supply Area in Green Town

Supply amount from each Node = Q/(N-1)

Where

Q is Capacity of Tube Well Pump

N is number of Nodes

- Node No.1 is reservoir and we assume water level of the reservoir as lift of Tube Well pump
- Flow amount from reservoir is calculated by Software

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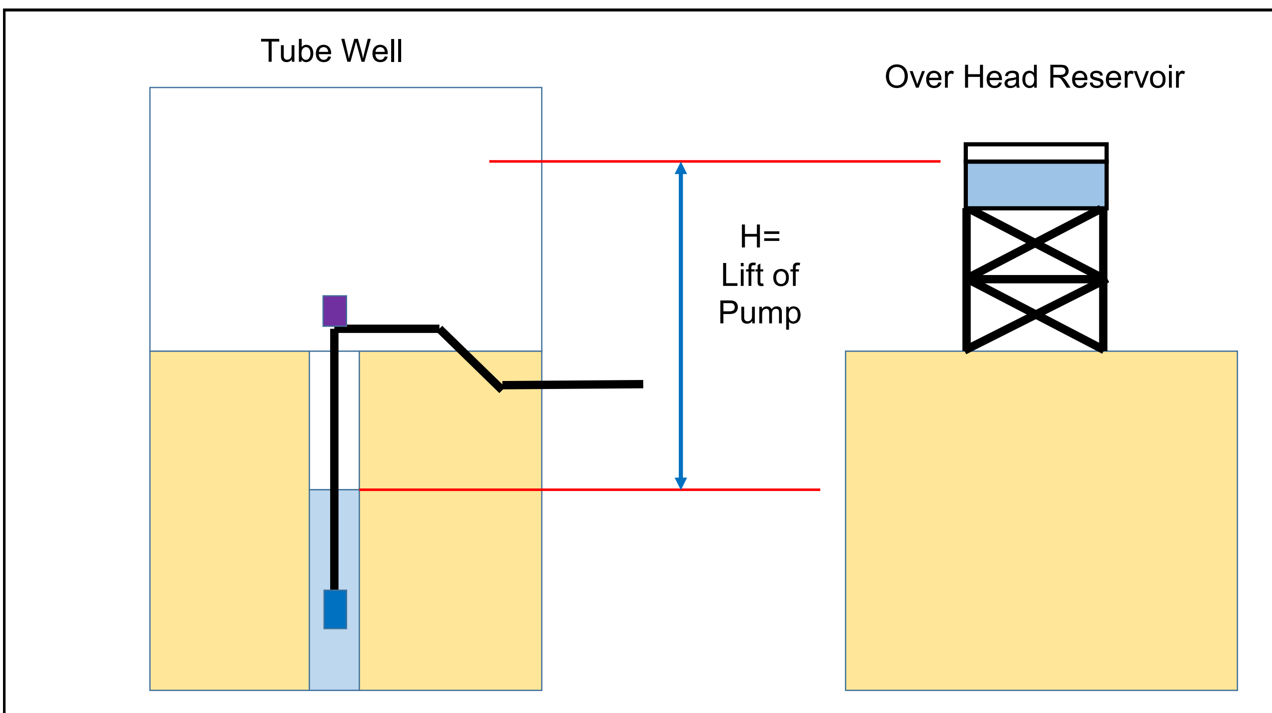

Exercise at Supply Area in Green Town

5. Putting data into EPANET

- Drawing network by making use of mouse and buttons on the Map Toolbar
- First add the reservoir (Lift of Tubewell Pump)
- Add the junction nodes
- Then add the pipes (Begin with pipe 1 connecting node 1 to node 2)
- Put all data of Nodes and Pipelines into EPA Net

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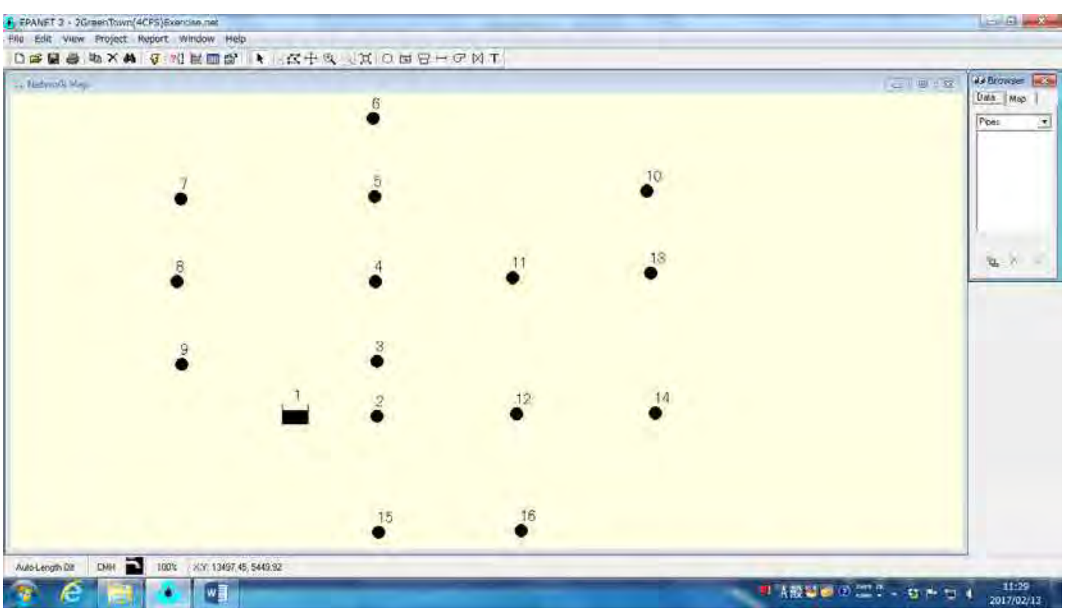
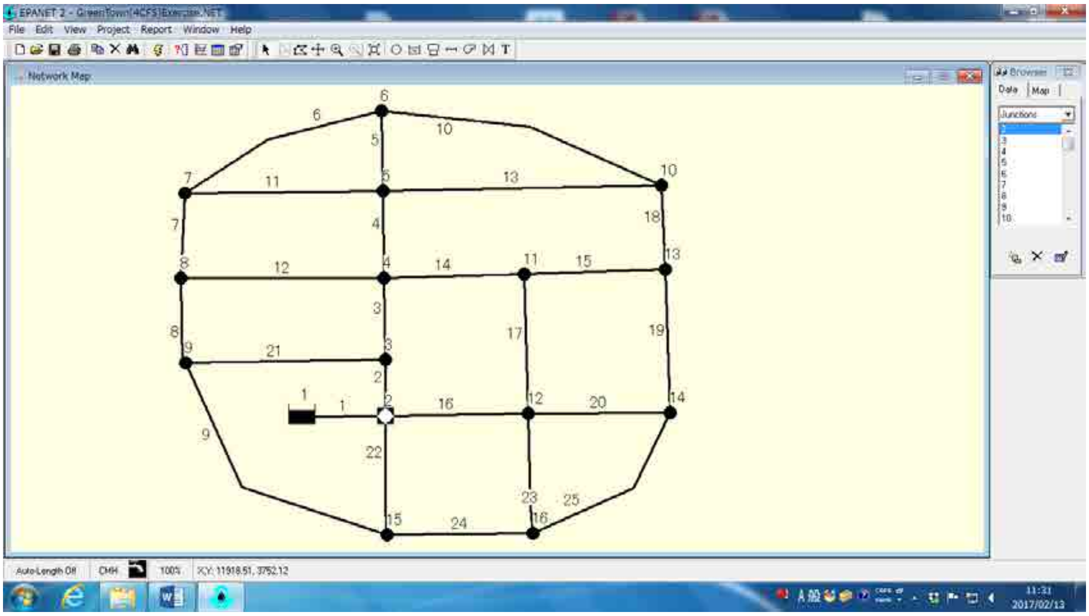
Nodes on the EPANET



40

Network on the EPANET



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Analysis and Evaluation

5. Analysis

Run the analysis

6. Evaluation of analysis result

- Water pressure at each node
- Velocity of each pipe

7.

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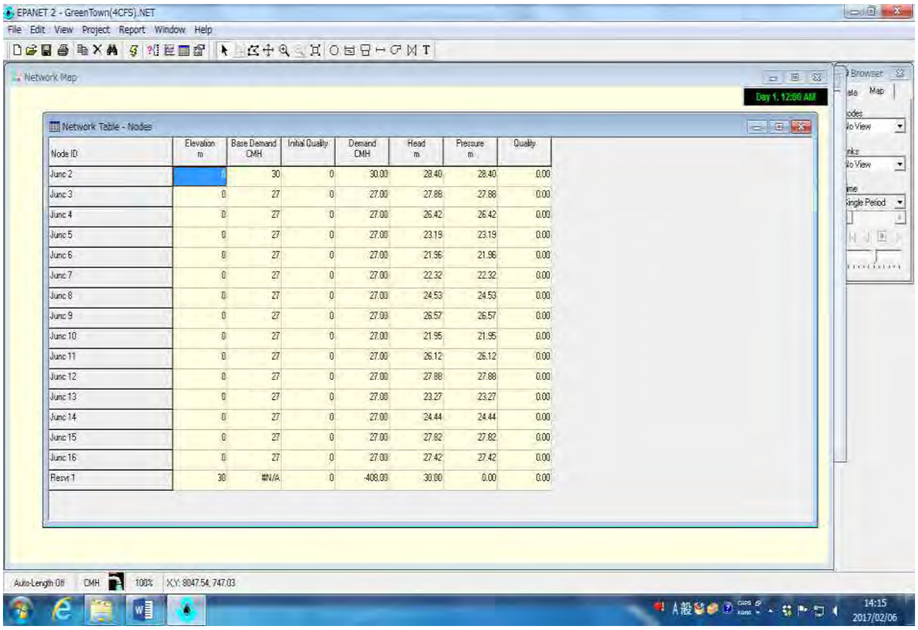
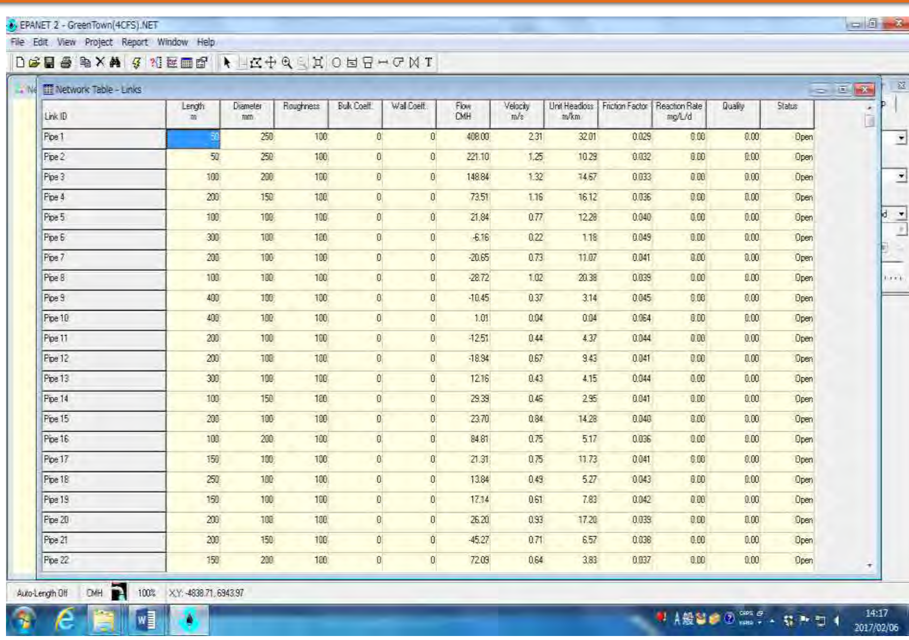
The Node Result



Node ID	Elevation m	Base Demand CMH	Initial Quality	Demand CMH	Head m	Pressure m	Quality
Junc 2	0	30	0	30.00	28.40	28.40	0.00
Junc 3	0	27	0	27.00	27.88	27.88	0.00
Junc 4	0	27	0	27.00	26.42	26.42	0.00
Junc 5	0	27	0	27.00	23.19	23.19	0.00
Junc 6	0	27	0	27.00	21.96	21.96	0.00
Junc 7	0	27	0	27.00	22.32	22.32	0.00
Junc 8	0	27	0	27.00	24.53	24.53	0.00
Junc 9	0	27	0	27.00	26.57	26.57	0.00
Junc 10	0	27	0	27.00	21.95	21.95	0.00
Junc 11	0	27	0	27.00	26.12	26.12	0.00
Junc 12	0	27	0	27.00	27.88	27.88	0.00
Junc 13	0	27	0	27.00	23.27	23.27	0.00
Junc 14	0	27	0	27.00	24.44	24.44	0.00
Junc 15	0	27	0	27.00	27.82	27.82	0.00
Junc 16	0	27	0	27.00	27.42	27.42	0.00
Resvr 1	30	#N/A	0	-408.00	30.00	0.00	0.00

The Link Result



Link ID	Length m	Diameter mm	Roughness	Bulk Coeff.	Wall Coeff.	Flow CMH	Velocity m/s	Unit Headloss m/km	Friction Factor	Reaction Rate mg/L/d	Quality	Status
Pipe 1	50	250	100	0	0	408.00	2.31	32.01	0.029	0.00	0.00	Open
Pipe 2	50	250	100	0	0	221.10	1.25	10.29	0.032	0.00	0.00	Open
Pipe 3	100	200	100	0	0	148.84	1.32	14.67	0.033	0.00	0.00	Open
Pipe 4	200	150	100	0	0	73.51	1.16	16.12	0.036	0.00	0.00	Open
Pipe 5	100	100	100	0	0	21.84	0.77	12.28	0.040	0.00	0.00	Open
Pipe 6	300	100	100	0	0	-6.16	0.22	1.18	0.049	0.00	0.00	Open
Pipe 7	200	100	100	0	0	-20.65	0.73	11.07	0.041	0.00	0.00	Open
Pipe 8	100	100	100	0	0	-28.72	1.02	20.38	0.039	0.00	0.00	Open
Pipe 9	400	100	100	0	0	-10.45	0.37	3.14	0.045	0.00	0.00	Open
Pipe 10	400	100	100	0	0	1.01	0.04	0.04	0.064	0.00	0.00	Open
Pipe 11	200	100	100	0	0	-12.51	0.44	4.37	0.044	0.00	0.00	Open
Pipe 12	200	100	100	0	0	-18.94	0.67	9.43	0.041	0.00	0.00	Open
Pipe 13	300	100	100	0	0	12.16	0.43	4.15	0.044	0.00	0.00	Open
Pipe 14	100	150	100	0	0	29.39	0.46	2.95	0.041	0.00	0.00	Open
Pipe 15	200	100	100	0	0	23.70	0.84	14.28	0.040	0.00	0.00	Open
Pipe 16	100	200	100	0	0	84.81	0.75	5.17	0.036	0.00	0.00	Open
Pipe 17	150	100	100	0	0	21.31	0.75	11.73	0.041	0.00	0.00	Open
Pipe 18	250	100	100	0	0	13.84	0.49	5.27	0.043	0.00	0.00	Open
Pipe 19	150	100	100	0	0	17.14	0.61	7.83	0.042	0.00	0.00	Open
Pipe 20	200	100	100	0	0	26.20	0.93	17.20	0.039	0.00	0.00	Open
Pipe 21	200	150	100	0	0	-45.27	0.71	6.57	0.038	0.00	0.00	Open
Pipe 22	150	200	100	0	0	72.09	0.64	3.83	0.037	0.00	0.00	Open

Trial for Good Result

7. Changing Diameter of some Pipes and Analysis again

For Example

- Increase diameter of inlet side pipe of the Node which water pressure is low.
- Increase diameter of the pipe which velocity is too high.
- Or decrease diameter of the pipe with opposite condition.

- Try analysis again and again

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Contact

Zia Mustafa
Water Specialist

OJT Exercise

Checking of Pressure in Supply Area using Pressure Recorder FJN -501

Zia Mustafa (Water Specialist)
Ramisha Taseer (Research Associate)

December 2017

Detail of OJT Plan

Date	December 07, 2017
Training Facility	Tube Well located at Green Town WASA Sub Division
Equipment/Machinery	Pressure Recorder FJN -501
Time	2 Hours (10:00AM to 12:00 PM)

2

FJN-501 Pressure Recorder

Water Pressure Recorder is used to measure the pressure of water with the help of graph inside the gauge for specific hours.

Pressure Recorder FJN-501

Applications of Water Pressure Recorder

Pressure Recorders are used to:

- Verify low water pressure complaints
- Provide water distribution system modelling data
- Checking for fluctuations in water pressure
- Keeping track of water pressure at night when controlling water leakages by decreasing pressure
- Making a water pressure distribution chart to identify low, high pressure in Supply Area

Specifications of Equipment

Model and Type	FJN-501 (A-Type)	FJN-501 (C-Type)
Recording Time	4,12,24,72, 168 hours	15,30,60 Minutes
Maximum Pressure Record	1.0 MPa (10bar)	2.0 MPa (20bar)
Power Check	CPU does not work at voltage less than 2.2 V	
Mode Check	LED indicates by blinking	

Scale: I.0 MPa = 10 Bar

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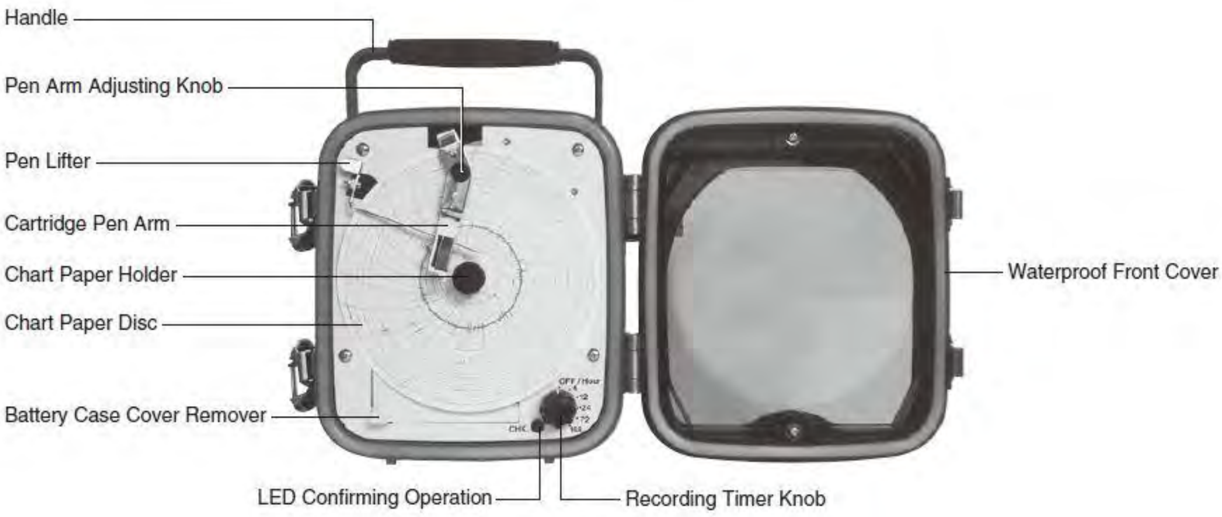
Specifications of Equipment

Model and Type	FJN-501 (A-Type)	FJN-501 (C-Type)
Operation Power	3.0 Volts (Minimum 2.2V)	
Weight & Size	1.35kg (Main Unit)	
Gross Weight	3.7kg (with the carrying case)	
Battery Type & Battery Life	AA - Alkaline Battery	
	4 h ··· 80 days 12h ··· 220 days 24h ··· 380 days 72h ··· 720 days 168h ··· 970 days	15 min. ··· 150 days 30 min. ··· 250 days 60 min. ··· 400 days

6

Components of Equipment



Components of Equipment

Fuji Coupling

13 mm Dia. Faucet Adaptor

Coupler of Fuji Coupling

Cartridge Pen

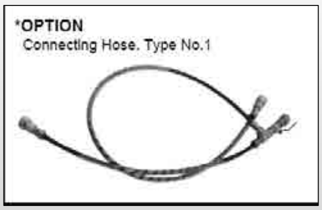
Leather Packing

Components of Equipment

Alkaline Battery- AA Size

Chart Paper Disc
(100 Sheets per package)

Connecting Hose Type No. 4

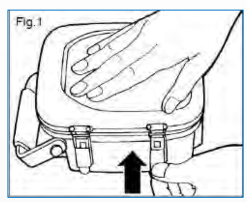


Connecting Hose

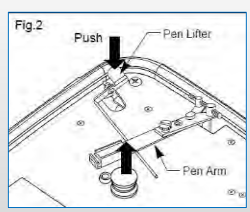
Carrying Case

Procedure for Measuring Pressure in Water Distribution

1. Unlock the clip and open the front cover

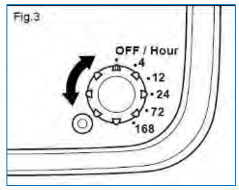


2. Push down the pen lifter to raise the lift arm. Remove chart paper holder by pulling upward and put new chart paper

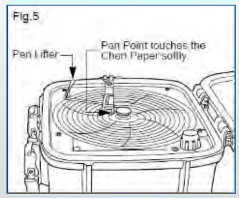


Procedure for Measuring Pressure in Water Distribution

3. Before mounting the chart paper, check battery status (Turn the knob to 4 hour Selector position and confirm blinking of LED for 1 minute, if LED does not light up, change the batteries)

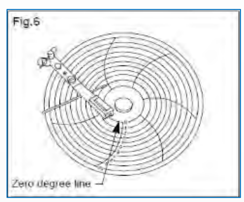


4. Open the cartridge pen and fit it on the pen holder. Release the Pen lifter so that the pen point will touch the chart paper softly

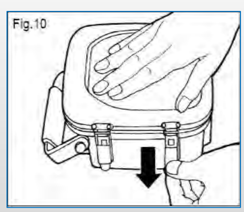


Procedure for Measuring Pressure in Water Distribution

5. Rotate the chart paper Disc so that the pen point will come to the starting point



6. Close the front cover and lock it with catch clips



Procedure for Measuring Pressure in Water Distribution

7. Open the Pipeline Valve slowly and drain water to eliminate air trapped in the water supply pipeline
8. Connect the hose pipe with supply line (through FUJI Adapter)
9. Attach the other side of Hose Pipe to the Pressure Recorder
10. Open the valve of Supply Line gradually to its full supply level

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Procedure for Measuring Pressure in Water Distribution

11. Now open the Valve of Pressure Recorder

12. Open the Air Bleed knob to confirm that air is removed (continuous drop of water) and then close it

13. Place the Pressure Recorder on Firm Space for recording pressure in supply line

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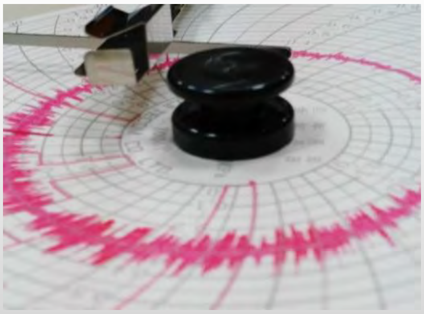
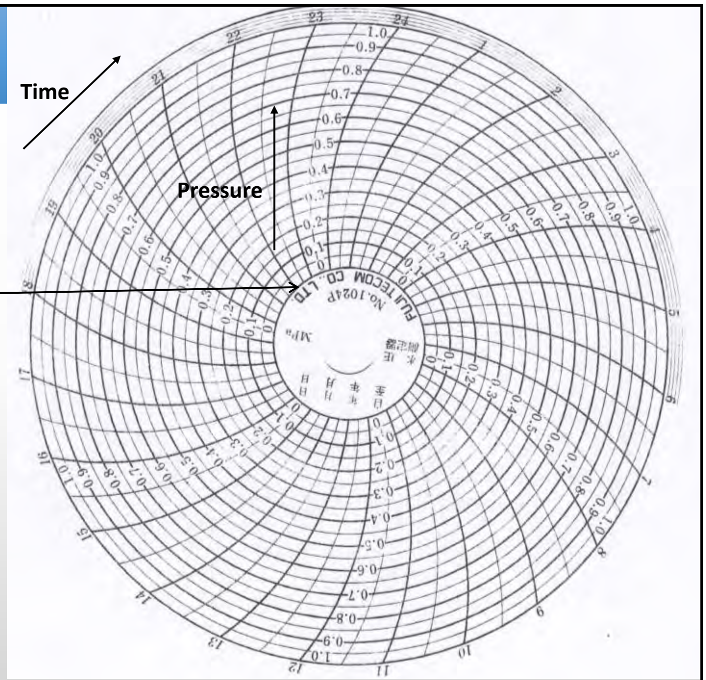
Chart Interpretation





Precautions

- The Pen Point should touch the Zero Line (If it is not on Zero Line adjust it with the help of screw on the pen arm)
- Always turn the knob to OFF, before changing chart paper
- After use, remove the connecting hose after releasing air completely by use of Air bleed knob
- Open the valve of supply line slowly to avoid malfunctions caused by the water pressure changes

17

Checking of Residual Chlorine in Supply Area using DPD Reagent

OJT Exercise
Zia Mustafa (Water Specialist)
Ramisha Taseer (Research Associate)

December 2017

Outline of the Presentation

- Objective
- Detail of OJT Schedule
- Specifications of Equipment
- Components of Apparatus
- Applications of Residual Chlorine Measuring Kits
- Procedure

Detail of OJT Schedule

Day	December 07, 2017
Place	Green Town WASA Sub Division
Equipment/Machinery	DPD (N,N Diethyl-P-Phenylene diamine Reagent Kit
Time	2 hours (10:00am to 12:00pm

Specifications of Apparatus

Range	0 to 2.5 mg/l (ppm) Chlorine
Smallest Increment	0.5 mg/l (ppm) Chlorine
Analysis Method	Colorimetric
Sample Size	5 ml
Number of tests	50 (average)
Shipping Weight	176g (6.6oz.)
Case Dimensions	220*145*55mm

5

Components of Apparatus

Residual Measuring Kit comprises:

- 1 Color Comparator Cube
- Reagent 1 (20mL)
- Reagent 2 (15mL)

6

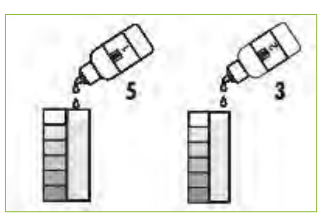
Applications

- To measure Residual Chlorine Levels in Water Supply Pipelines , reservoirs

7

Procedure

- Add 5 drops of Reagent 1 and 3 drops of Reagent 2 to the color comparator cube

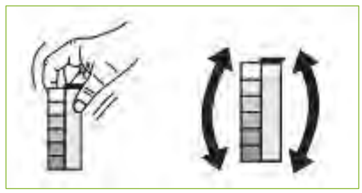


- Fill the color comparator tube with water sample to the 5 mL mark

8

Procedure

- Replace the Cap and mix by carefully swirling the cube in tight circles and inverting it several times



- Determine which color band best matches the solution in the vessel and record the results in mg/L (ppm) free chlorine

9

10

OJT at Green Town WASA Sub Division , Lahore

1

Day 4

- Checking of Valves, Hydrants and pipeline crossing river as per Drawing
- Checking of Pressure and Residual Chlorine
- Checking of Water Level at Tubewell

添付資料 4.14

2017 年秋期研修「Leakage Detection」の教材

In the Name of Allah the Most Beneficent, the Most Merciful

Current Scenario of Leak Detection at WASA's

By

Zia Mustafa

Water Specialist

October 2017

Course Team

Mr. Zia Mustafa

Course Leader

Mr. Chiaki Suzuki

JICA Expert

Mr. Rizwan Jabbar

Research Associate

Mr. M. Faisal

Research Associate

Mr. Usman Ali

JICA Coordinator

Mr. Wajih ud DIn

JICA Coordinator

What are your Training Expectations?

Outline of Presentation

- Basic knowledge of Leak Detection
- Water Network Maintenance and Leakage Detection
- Types and Sounds of Leakage
- Factors causing Leakages
- Existing Situation of Five WASA’s for Leakage Control

Basic Knowledge of Leakage Detection

Day 1

- Current Scenario of Leak Detection
- Countermeasures for Leakage Control
- Leakage Survey Equipment
- Repairing of Burst Pipeline
- Case Study

Water Network Maintenance & Leakage Detection (OJT)

Day 2

- On Site Leakage Detection
  - Acoustic Leak Detector
  - Acoustic Bar
  - Non Metal Pipe Locater
- Visit of Leakage Repairing Site (Green Town, WASA Sub Division)

Installation & Operation of Leakage Detection Equipment (OJT)

Day 3

- Equipment Installation & Operation
  - Metal Pipe Locator
  - Ultrasonic Flow Meter
  - Pressure Recorder

Site Visit and Leak Detection Action Plan

Day 4

- Visit of BBJ Pipe Industry, Lahore

Day 5

- Preparation of Leak Detection Action Plan by Training Participants

Learning Outcomes

- Build Basic Knowledge of Leak Detection through use of the Leakage Detection Equipment
- Understand Installation and Operation of Equipment(Pressure Recorder, Ultrasonic Flowmeter etc.)
- Develop Leak Detection Action Plan

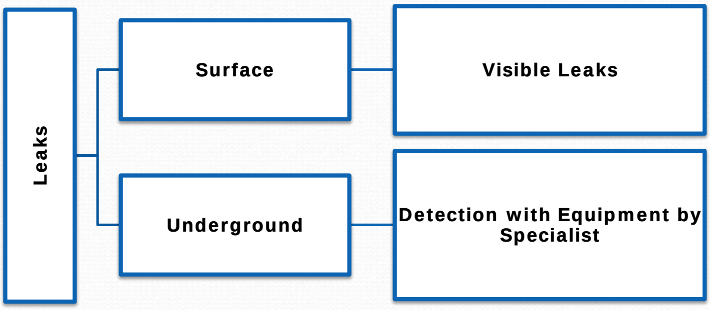
Current Scenario of Leakage Detection

- Introduction to Leakage
- Types and Sounds of Leaks
- Factors Causing Pipe Leakages
- Situational Analysis of Leakage Detection in Five WASAs

Water Balance

System Input Volume	**Authorised Consumption**	Billed Authorised Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorised Consumption	Unbilled Metered Consumption	Non- Revenue Water (NRW)
			Unbilled Unmetered Consumption (e.g. flat rates not billed)	
	Water Losses	Commercial (Apparent Losses)	Unauthorised Consumption (e.g. illegal connections)	
			Metering Inaccuracies	
		Physical (Real Losses)	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to point of Customer use	

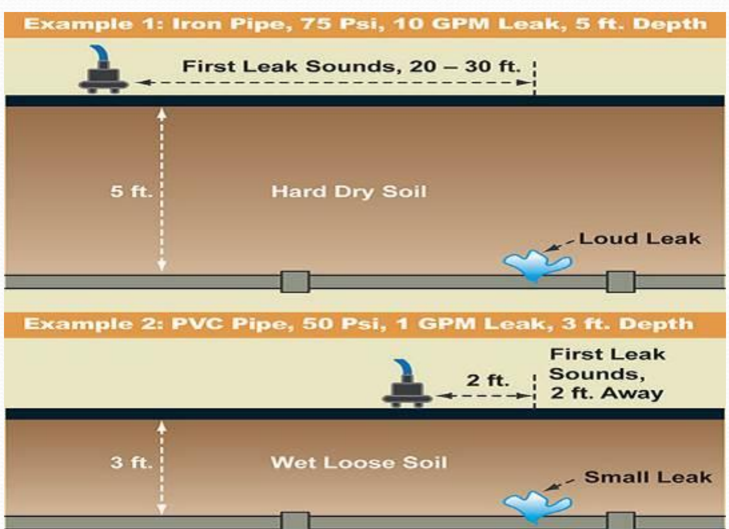
Types & Sounds of Leakage



Leak Sound Depending on:
- Pipe Diameter
- Material
- Kind of Joints
- Leakage Flow
- Depth
- Soil Density

False Leak Sound:
- Water Flow Sound
- Sewage Flow into Manhole
- Breeze Sound
- Driving Vehicles Sound
- Urban Noise

Types & Sounds of Leakage



Factors Causing Leakage

Internal Factors
- Pipe Quality & Material Deterioration
- Design Mistake and Installation (Poor connections & joints)
- High Pressure, Water Hammering, Water Acidity/Basicity (Corrosion)

External Factors
- Heavy Traffic and Load, Earth Movement
- Seasonal Variation in Temperature
- Earthquake and Construction Work by Other Utilities

Existing Situation of Five WASA's for Leakage Control

Items	Lahore	Faisalabad	Gujranwala	Multan	Rawalpindi
No. of leakage survey teams	52	2	0	9	15
No. of person in one team	3	8	0	4	2-3
No. of days of leakage survey (person*days/year)	62	8*150=1200	0	4*1=4	Every day
No. of hours of leakage survey (person*hours/month)	9.6	8*250=2000	0	24	Office hour
Length of leakage survey (km/year)	9.1	750	0	0	300
No. of surface leakage detection (number/year)	2700	68	0	576	640
No. of underground leakage detection (number/year)	300	427	0	2880	Nil
How to detect underground leakage	Manual detect	Helium gas	Manual detect	Manual detect	N/A

(Source: JICA Quarterly Report, January 2016)

Existing Situation of Five WASA's for Leakage Control

Items	Lahore	Faisalabad	Gujranwala	Multan	Rawalpindi
No. of repairing leakage	3,000	672	1,137	3,456	Nil
No. of leakage per kilometer of distribution pipeline	0.389	0.456	3.056	3.294	0.556
No. of leakage report from citizens	2,950	1,737	1,137	3,110	225
Done the Minimum Flow Measurement	N/A	Yes	N/A	N/A	N/A
Equipment : Acoustic Rod	0	0	0	0	0
Equipment : Correlative leak detector	0	0	0	0	0
Equipment : Leak noise correlator	1	5	0	0	0

(Source: JICA Quarterly Report, January 2016)

Existing Situation of Five WASA's for Leakage Control

Items	Lahore	Faisalabad	Gujranwala	Multan	Rawalpindi
Equipment : Metal Pipe Locator	1	0	0	0	0
Equipment : Non-Metal Pipe Locator	0	0	0	0	0
Equipment : Other Leakage Detector	0	Helium gas	0	0	0
Metering Ratio (%)	1	18	0	0	0
NRW (%)	41	32.9	35	22	31
Mapping System / DMA	(GIS/DMA)	Yes(Mapping/ DMA)	Yes (Mapping)	N/A	(GIS)

(Source: JICA Quarterly Report, January 2016)

Leak Detection Equipment (JICA)

Equipment	Lahore	Faisalabad	Gujranwala	Multan	Rawalpindi
Metal Pipe Locator	1	1	1	1	1
Non-Metal Pipe Locator	1	1	1	1	1
Acoustic Leak Detector	1	1	1	1	1
Acoustic Bar	1	1	1	1	1
Ultrasonic Flow Meter	1	1	1	1	1
Pressure Recorder	1	1	1	1	1
Metal Detector	1	1	1	1	1

Leak Detection Equipment at WASA Lahore

Old Type Leak Correlator

Acoustic Leak Detector

Metal Pipe Locator

Electromagnetic Flow Meter

Leak Detection Equipment at WASA Faisalabad

Helium Gas Leak Detector

Acoustic Leak Detector

Leak Detector

Metal Detector

Installed Pipe Network by Material & Length

Pipe Material	Faisalabad	Gujranwala	Lahore	Multan	Rawalpindi
Cast Iron Pipe (CI), km	4		449	38	4
Asbestos Cement Pipe (ACP), km	1,200	209	3,567	1,176	225
Polyvinyl Chloride (PVC), km	8	241	254	62	116
High Density Polyethylene (HDPE), km	7	-	802	10	186
Concrete (Hume) Pipe, km	-	16	-		14
Ductile Iron Pipe (DIP), km	-	-	326		4
Steel Pipe, km	-	-	-		35
Galvanized Iron (GI) pipe, km	-	29	-	162	29
Total	**1,219**	**495**	**5,398**	**1,149**	**613**

(Source: JICA Quarterly Report, January 2016)

Contact Information

Zia Mustafa
Water Specialist

Present Status of Revenue and Non-Revenue Water across Five WASAs (Year 2014-15)

Sr. No.	Name of WASA	Distributed Water (MGD)	Revenue Water (MGD)	NRW Water (MGD)
1	WASA Lahore	450	300	140
2	WASA Faisalabad	112	76	36
3	WASA Rawalpindi	81	46	35
4	WASA Multan	45	36	9
5	WASA Gujranwala	21	13	8

In the Name of Allah the Most Beneficent, the Most Merciful

1

Counter Measures for Leakage Control

By
Zia Mustafa
Water Specialist

October 2017

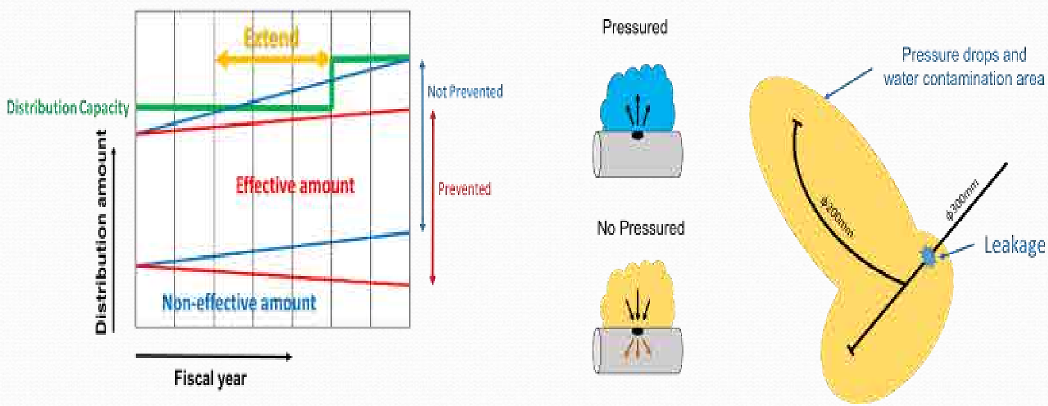
Outline of Presentation

- Leakage Survey Methods
- Water Quality Based Leakage Detection
- Leakage Prevention Work

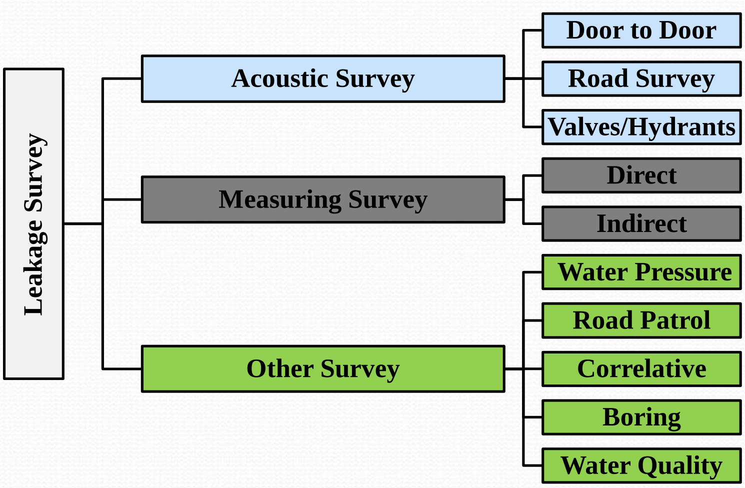
Objectives of Leakage Control

- To Maximize Utilization of Limited Water Resources
- To Maintain Water Pressure in the Network
- To Prevent Water Contamination
- To Prevent Potential Accidents Leading to Leakage

Importance of Leakage Prevention Work



Leakage Survey Methods



Acoustic Survey

Detection from Valves

Detection from Water Meter

Acoustic Survey with Leak Detector

Measuring Survey

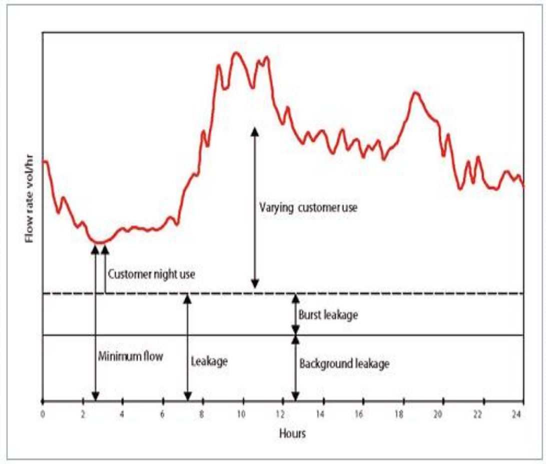
- A Service Area (Block) is Isolated by Closing the Valves
- Water can be supplied temporarily by Pipe or with a Hose connected with Fire Hydrant
- Water Lost due to Leakage in Area is Determined by Using Electromagnetic or Ultrasonic Flowmeter
- Minimum Flow is Recorded at Midnight with Continuous Supply of Water
- Process is Repeated Several Times to Find Accurate Leakage Flow Value

Measuring Survey

1. Minimum Night Flow or Bottom-Up Approach

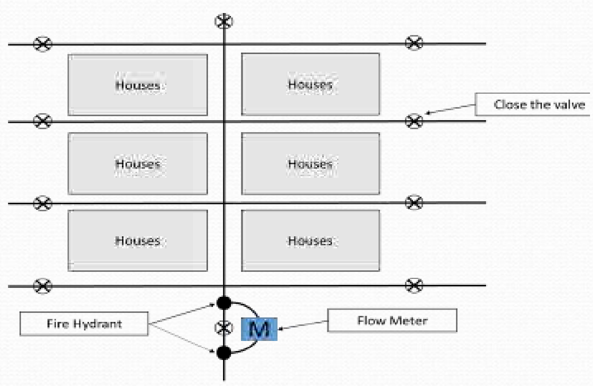
[Net Night Flow] = [Minimum Night Flow] - [Minimum Night Consumption]

- Customer Demand is Minimum at Night, Water Operators have to account for the Minimum Night Consumption (MNC), i.e. the Night-time Customer Demand, such as Toilet Flushing, Washing Machines, etc.



Measuring Survey

- In a system with 100% Metering, MNC is calculated by Measuring the Hourly Night Flow for all Non-Domestic Demand and a portion (e.g. 10%) of Domestic Meters within the DMA
- Measured Directly from the Data Logging Devices or the Flow Graph



Measuring Survey

2. Integrated or Top Down Approach

Leakage = Distribution Input – Consumption

- Leakage is the remaining amount of the Annual Water Balance
- Consistent Approach is used to Estimate Leakage using this Method

Distribution Volume Analysis (WASA Faisalabad)

System Input Volume 93.5 MGD	Authorized Consumption 62.7 MGD	Billed Authorized Consumption 61.7 MGD	Billed Metered Consumption (including water exported)	0%	Revenue Water 64.6%
			Billed Non-metered Consumption	64.6%	
		Unbilled Authorized Consumption 0.94 MGD	Unbilled Metered Consumption	0%	Non-Revenue Water (NRW) 35.4%
			Unbilled Non-metered Consumption	1.5%	
	Water Losses 30.8 MGD	Apparent Losses 14.76 MGD	Unauthorized Consumption	13%	
			Metering Inaccuracies	1%	
		Real Losses 16.1 MGD	Leakage on Transmission and/or Distribution Mains	5%	
			Leakage and Overflows at Utilities Storage Tanks	0.2%	
			Leakage on Service Connections up to Customers' Meters	14.7%	
				Total	93.5 MGD/100 %

Index of International Water Association (IWA)

ILI = CAPL/MAAPL

- ILI = Infrastructure Leakage Index
- CAPL (liters/day): Current Annual Volume of Physical Losses
- MAAPL (liters/day): Minimum Achievable Annual Physical Losses

- MAAPL (liters/day) = $(18\times L_m + 0.8\times N_c + 25\times L_p)\times P$
  - MAAPL (liters/day): Minimum Achievable Annual Physical Losses
  - L_m : mains length (km)
  - N_c : number of service connections
  - L_p : total length of private pipe, property boundary to customer meter (km)
  - P : average pressure (m)

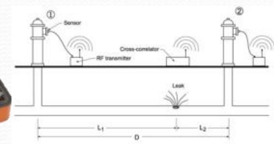
Infrastructure Leakage Index (ILI)

Ratio of the CAPL to MAAPL, or the ILI, is a Measure of How Well the Utility Implements the three Infrastructure Management Functions:

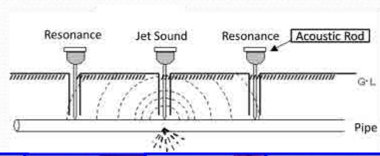
- Repairs
- Pipelines and Asset Management
- Active leakage control

- ILI is particularly useful in networks where NRW is relatively low, below 20%.

Other Survey



- Water Pressure Recording Survey
- Road Surface Survey
- Correlative Survey
  Leak sound correlator installed at two points – at divide valve and fire hydrant - between a stop valve and a meter.
  Leaks are detected by moving the device point to point above the pipeline
- Boring Survey
  Leak point detection is easy by the use of bore survey in combination with Acoustic Rod
- Residual Chlorine Based Survey

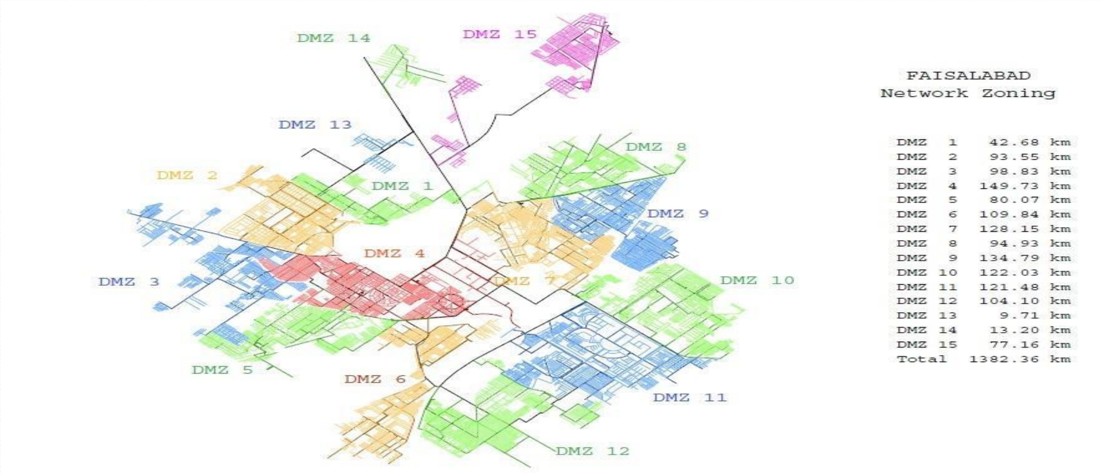


-Inject sample water & switched on "ZERO"
-Inject A&B, drop by drop
-Inject sample water 2mL by syringe
-"READ" switched on

District Metered Area (DMA)

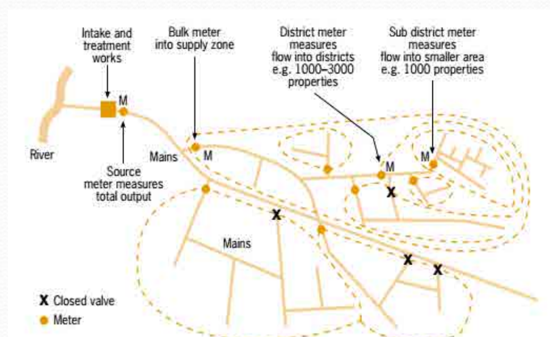
- Water Network Area is divided into Zones to Minimize Physical Losses
- Zones can be Further sub divided into a series of small sub-systems to make easy for losses calculation, often referred to as District Metered Areas (DMAs)
- Each DMA should be hydraulically isolated to calculate volume of water lost within that area
- Purpose of this Division is:
  - To Reduce NRW,
  - Minimize the Water Quality Problems, and
  - To Sustain Water Pressure in the lines to Supply Uniform Quantity of Water

District Metered Area Zones



DMA Establishment

- Size of DMA (Number of Connections - Generally Between 1,000 and 3,000)
- Number of Valves that must be closed to isolate the DMA – should be kept to a minimum – Natural Boundaries should be used wherever possible to Reduce Cost
- Topographic Features that can serve as Boundaries for the DMA, such as Rivers, Drainage Channels, Railroads, Highways, etc.
- Number of Flow Meters to measure Inflows and Outflows, Minimum Meters Required
- Flat Area Selection, more easy to Control Pressure Fluctuation
- Ensure all Pipes within and out of the DMA are either Closed or Metered



(Source: WHO Manual, 2001)

Water Quality Based Leakage Detection

- Residual Chlorine
- PH judgment
- Conductivity Based Judgment

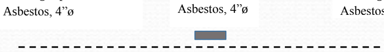
Water Source	pH value	Conductibility (μs/cm)
Drinking water	Approx. 6.7～7.5	Approx. 100～300
Rain water	Under 6.0	Approx. 40～90
Groundwater	Approx. 6.4～7.5	Approx. 300～1000
Sewage	Over 7.0 (High)	Over 500 (High)

Site Record Sheet

Date and Time	10:50 am; 11 February, 2016
Address	Civic Centre Near Cine Star Cinema
Person in charge	Mr. Shamas Ayoub Gujjar – SDO Green Town
Organization of repairing team	Pipe fitter x 1, Helper x 2
Diameter(mm)	4"
Material and Kind of Joint	Asbestos, wooden cork inserted into the hole and metal clamp along-with water proof sponge was used
Age (installation year)	45
Shape of leak point	Hole of 0.5" diameter
Pressure (kg/m^2)	Low
Depth(m)	4.5'
Soil around the pipe	Rough soil and garbage
Traffic density	Medium
Supply Hour	14
Cause of the leak	
Quantity of leak (m^3/min)	
Time of Repairing (Hour)	3

【Sketch of Repairing】

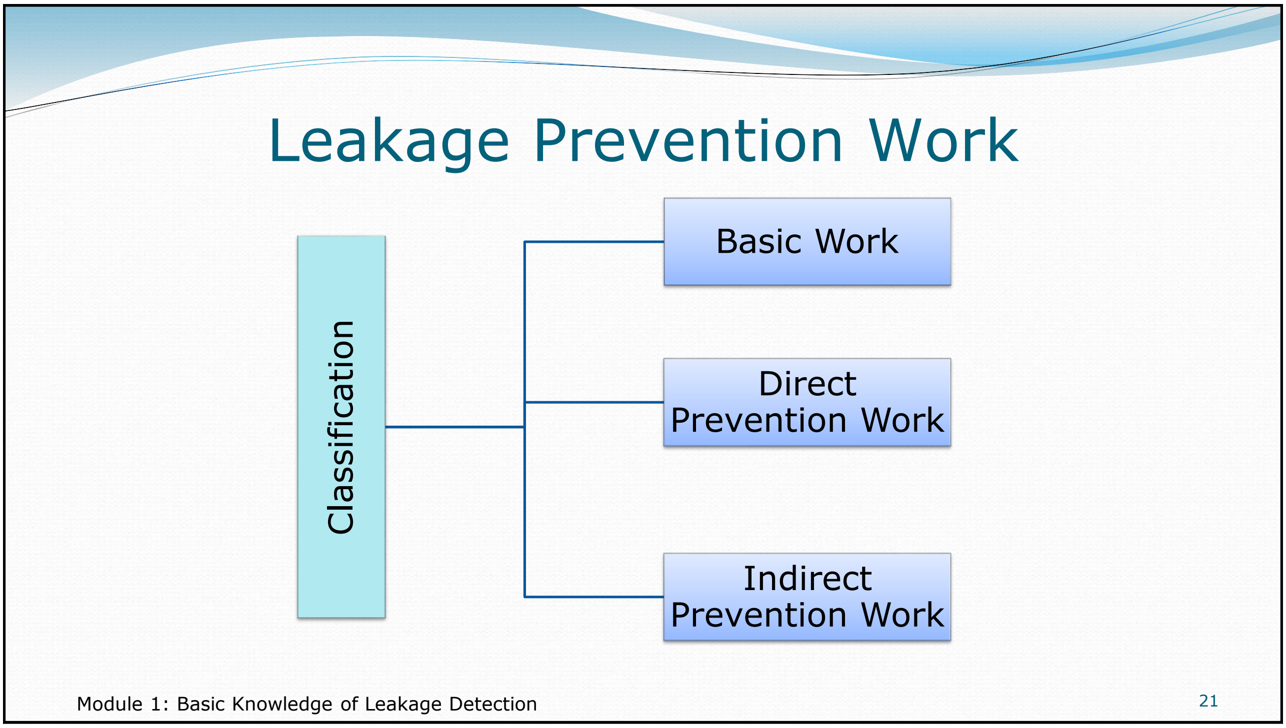
Existing Pipe Asbestos, 4"ø — Repaired Pipe Asbestos, 4"ø — Existing Pipe Asbestos. 4"ø

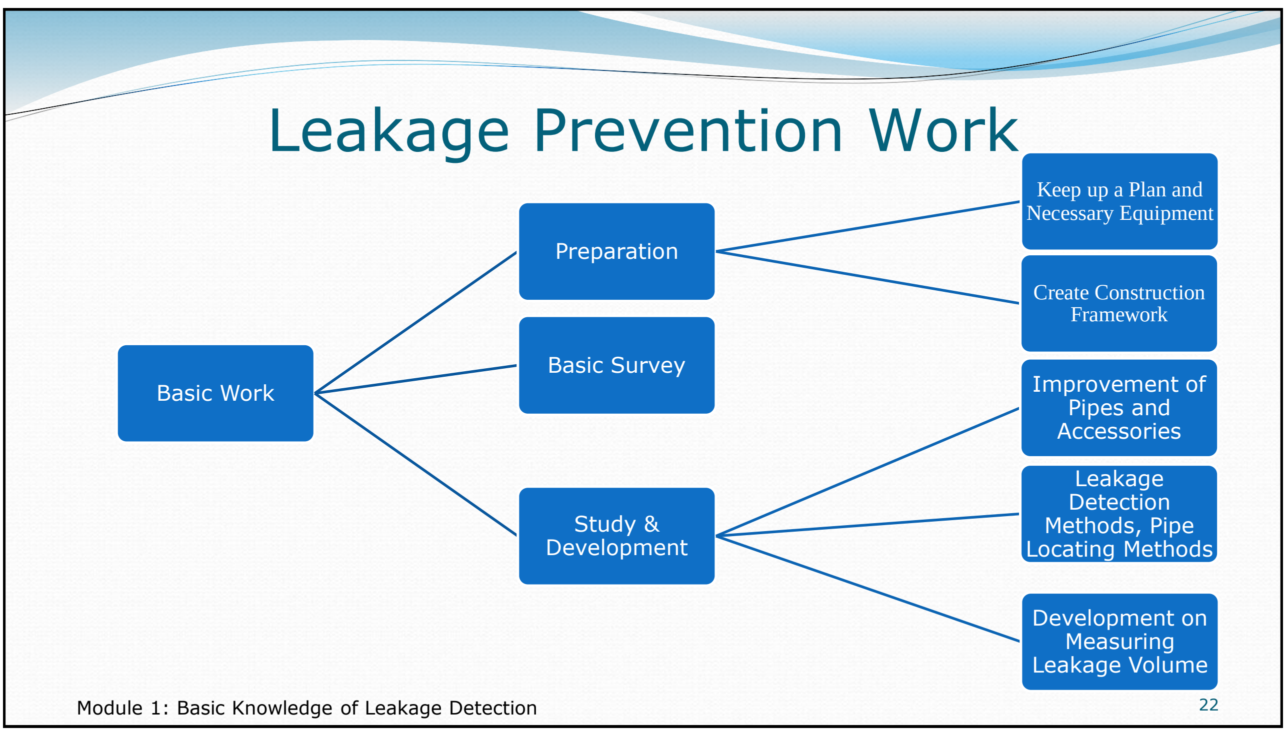


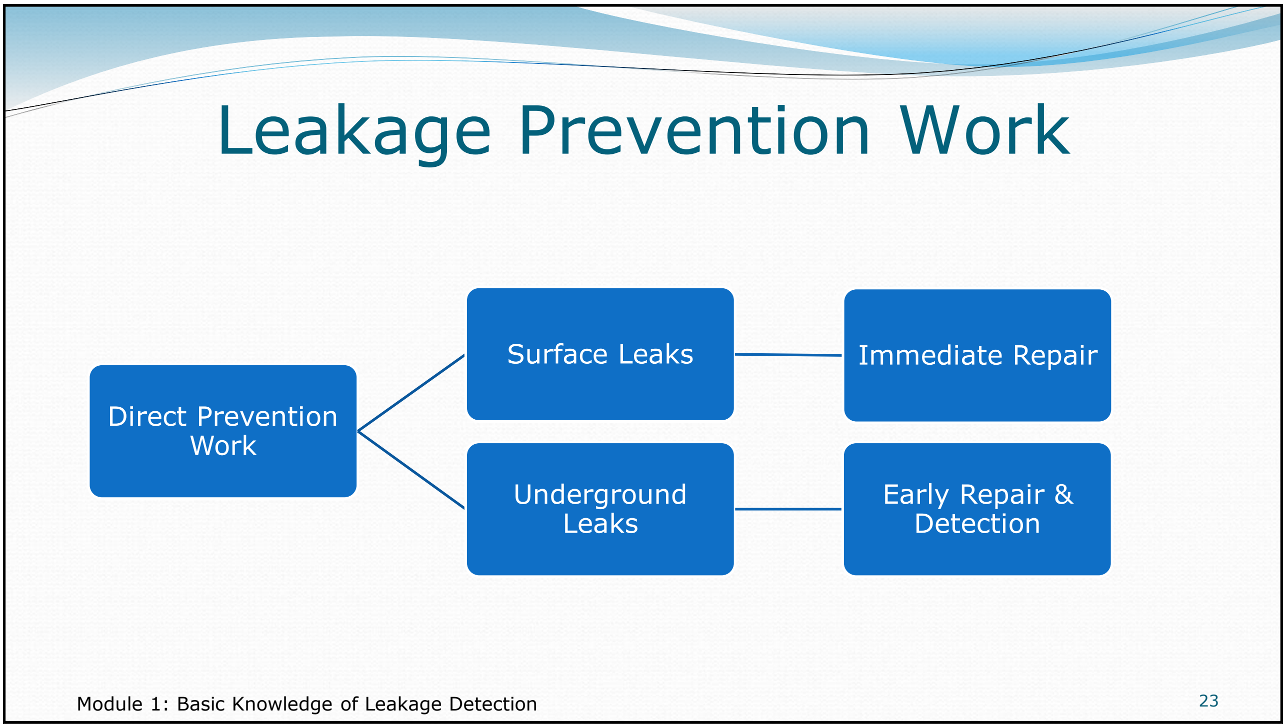
Clamp Joint

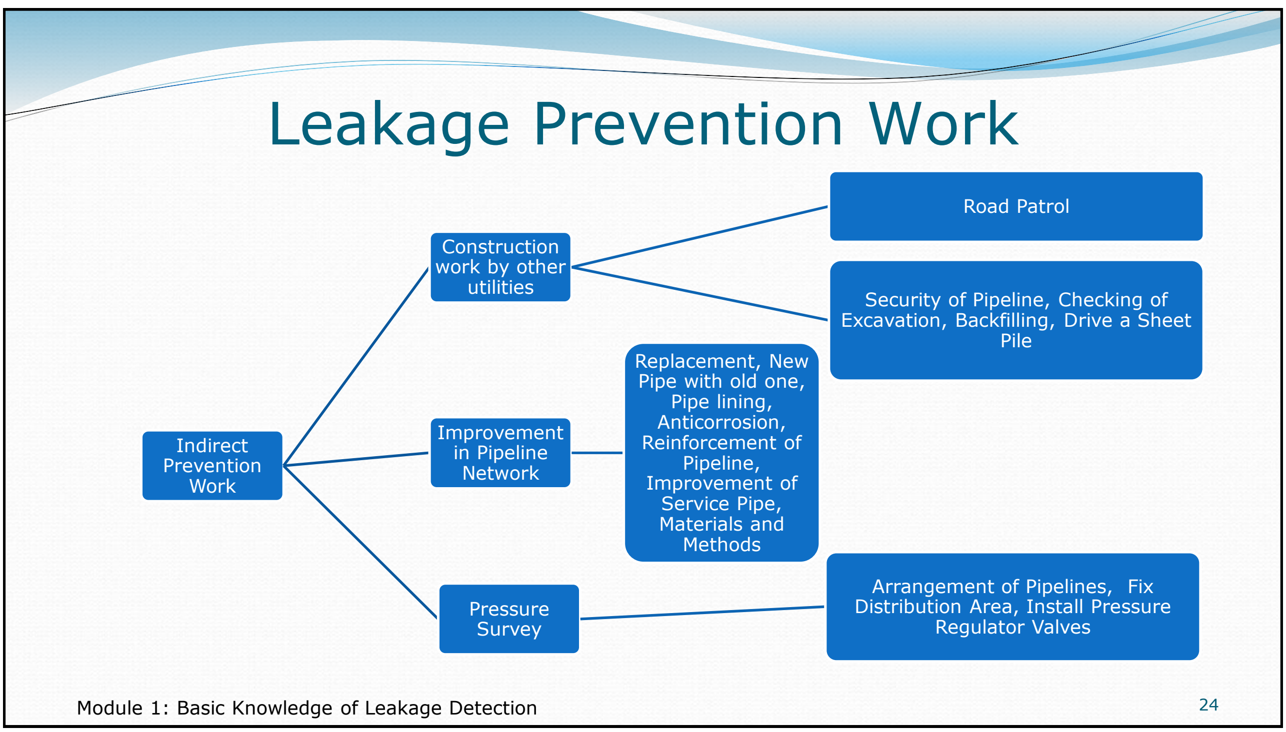
【Picture of Repairing】

Location on the Map】
Coordinates: 31.450828 N, 74.310791 E

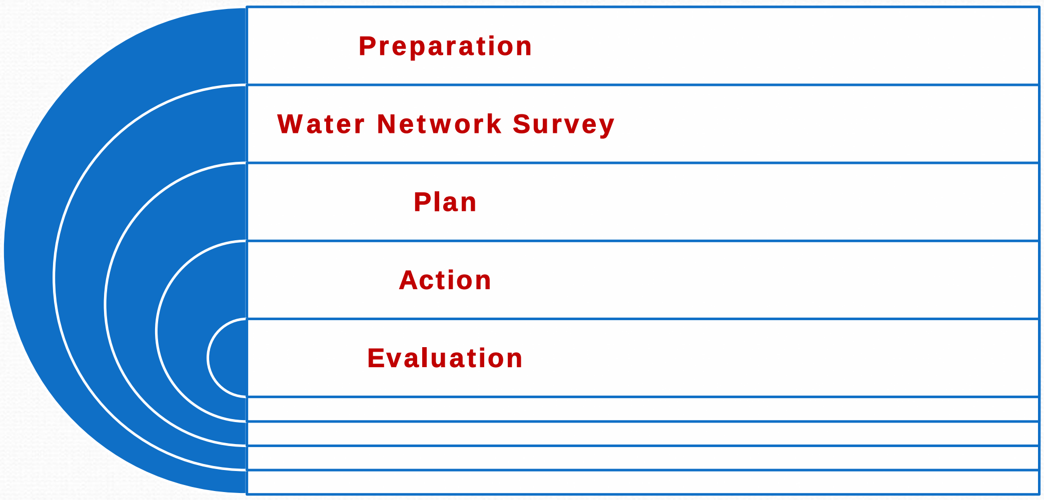

Leakage Prevention Work
Classification
Basic Work
Direct Prevention Work
Indirect Prevention Work
Module 1: Basic Knowledge of Leakage Detection
21


Leakage Prevention Work
Basic Work
Preparation
Basic Survey
Study & Development
Keep up a Plan and Necessary Equipment
Create Construction Framework
Improvement of Pipes and Accessories
Leakage Detection Methods, Pipe Locating Methods
Development on Measuring Leakage Volume
Module 1: Basic Knowledge of Leakage Detection
22


Leakage Prevention Work
Direct Prevention Work
Surface Leaks
Immediate Repair
Underground Leaks
Early Repair & Detection
Module 1: Basic Knowledge of Leakage Detection
23


Leakage Prevention Work
Road Patrol
Construction work by other utilities
Security of Pipeline, Checking of Excavation, Backfilling, Drive a Sheet Pile
Replacement, New Pipe with old one, Pipe lining, Anticorrosion, Reinforcement of Pipeline, Improvement of Service Pipe, Materials and Methods
Indirect Prevention Work
Improvement in Pipeline Network
Pressure Survey
Arrangement of Pipelines, Fix Distribution Area, Install Pressure Regulator Valves
Module 1: Basic Knowledge of Leakage Detection
24

Leakage Prevention Procedure



Procedure For Leakage Prevention

- Preparation
  - Establishment of Leakage Detection Cell and Team
  - Procurement of Equipment
  - Preparation of Maps for Water Distribution
- Water Network Survey
  - Distribution Analysis and Analysis of Water Volume Error
  - Analysis and Distribution of Groundwater, Cause of Leakage Volume

Leakage Prevention Procedure

- Plan
  - Set the Target Value
  - Set the Planning Year
  - Decide the Survey Method
- Action
  - Leakage Survey
  - Analysis of Cause of Leakage
  - Measuring of Prevention Volume
  - Preventive Work
  - Countermeasures of Leakage
- Evaluation
  - Analysis of Results
  - Compare the Plan and Action

Contact Information

Zia Mustafa

Water Specialist

In the Name of Allah the Most Beneficent, the Most Merciful

1

Leakage Survey Equipment

By
Zia Mustafa
Water Specialist

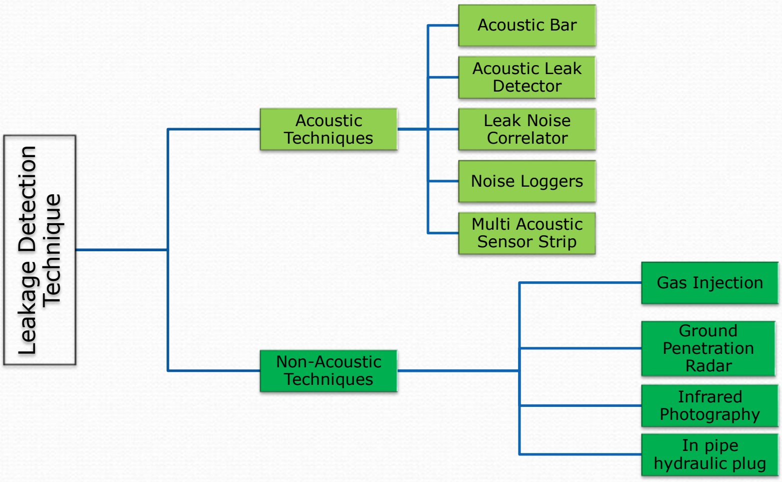
October 2017

2

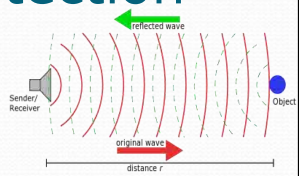
Outline of Presentation

- Leakage Detection Techniques
- Working Principle of Leakage Detection
- Types of Leak Detector

Leakage Detection Techniques



Working Principle of Leakage Detection



- Based on Multiple Scientific Information
- Vibrations and Noise caused by the leak & Electromagnetism Contributing in Amplifying Sound Effects

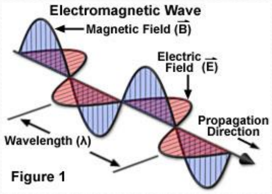
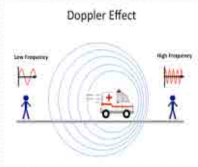
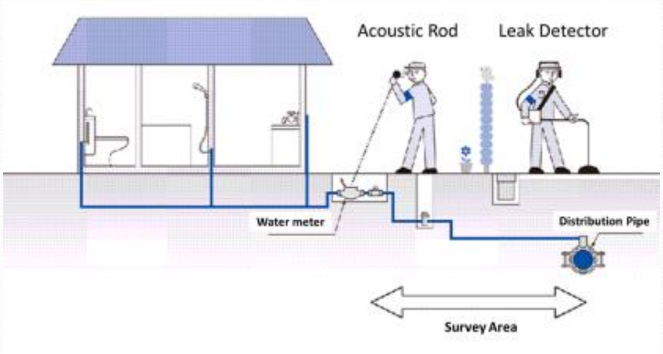


Figure 1



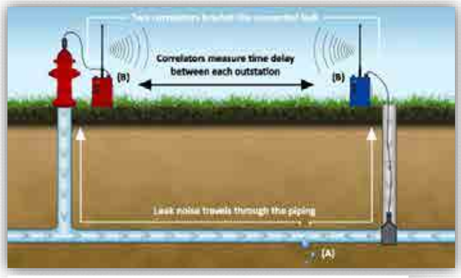
Acoustic Rod & Electronic Leak Detector

- Sound is Amplified and Transmitted to Headphones
- High Sound on Leak Point



Leak Correlator

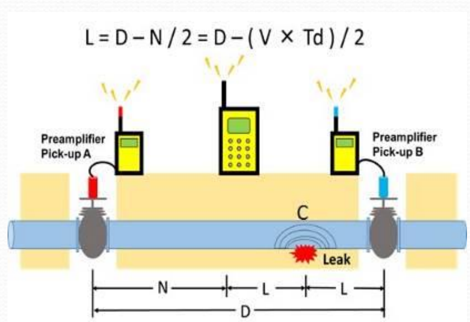
- Water Leakage in Pipelines Produce Noise
- Noise Travels by Two Routes:
  - Travels through the ground to the surface
  - Travels through wall of the pipe & water
- Correlator Detects noise sound transmitted in the wall of the Pipe and Water
- Pipe Fittings, Flow Meters, Valves & Hydrants are used as Access Points
- Leak Position is pinpointed by selecting two approximate location around the leak



Leak Correlator

Leak sound is transmitted through the pipe to either side of leakage. At randomly selected points on both sides of the leak, it shows "noise travel time difference or time delay" due to difference in distance from the leak, represented by "Td"

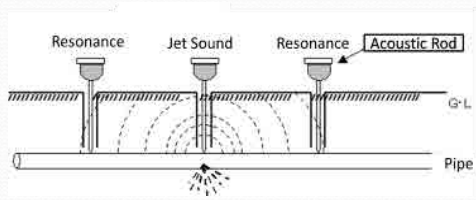
- When this time delay (Td) is multiplied by the sound velocity (V) through the pipeline, the distance (N) between points A and C is calculated
- Subtracted "N" from the distance (D) between A and B, and divided by 2 to determine the distance (L) to the leak point



Acoustic Rod/Bar

Specification				
Type	**Cap dia.* Thickness (mm)**	**Total Length (mm)**	**Dia. of Iron Bar (mm)**	**Material**
LSP-1	ø 67x29	1,013	7	Stainless Steel

Use:
- Place the tip of Acoustic Rod at the point where doubt of leakage is evident
- Catch the stick below the listening cap and place ear on the cap of acoustic rod
- Hear the sound of leaked water, if no leakage at that place repeat the same procedure aside this place
- Very useful to listen leaks sound at hydrants and valves



Factors Affecting Performance:
- Pressure
- Depth

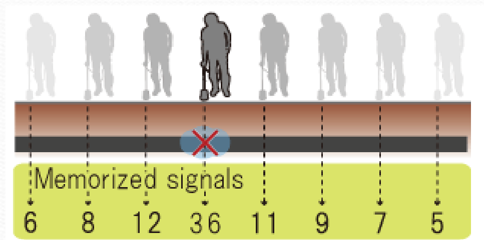
Leak Detector

Operation:
- Use head phones remembering Left and Right direction
- Turn volume up to half using the dial on the headphone cable
- Ensure good contact of microphone and surface area
- Press and hold silver button to listen sound
- With every press and release of the silver button, the noise level will be recorded in the memory
- To see memory data for the last eight soundings, press and hold the pink "M" button on the amplifier
- To turn filter on, press and hold the green + & - filter buttons simultaneously. The filter bandwidth is +/- 100Hz

Components:
- Amplifier with waist belt
- Hand probe microphone
- Ground microphone plate
- Probe rods
- Stereo headphones
- Connecting cable

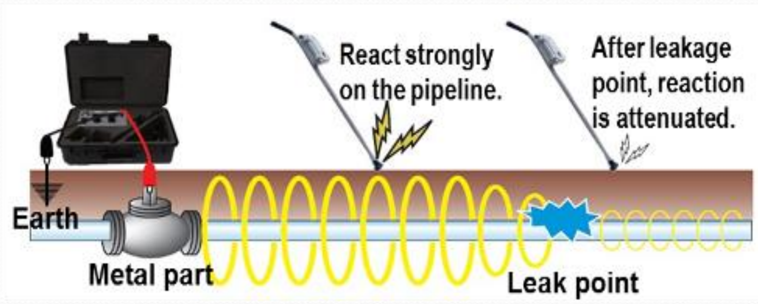
Leak Detector Important Points & Precautions

- Use filter in case of high background noises
- Leakage sound depends upon,
  - Water pressure
  - Crack or hole size
- Operator should stay stable during its use
- Required practice to pinpoint or identify leaks.
- Don't use in rainy days
- Sensors are water resistant, but control unit and head phones are not resistive, Keep them away from water



Non-Metal Pipe Locator

- Works on electrical insulation properties of the non-metal pipes
- Does not require "leak noise"
- Pass a high frequency electromagnetic waves through the "water" in the pipe
- Plastic pipe' electrical insulation properties creates a boundary with the earth, making the tracing of pipe routes easy using the same essential idea as a buried cable detector

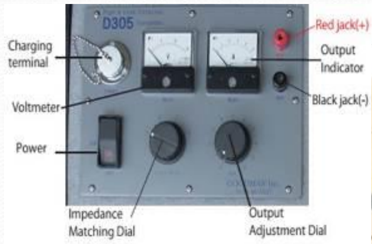


Non-Metal Pipe Locator

Components:

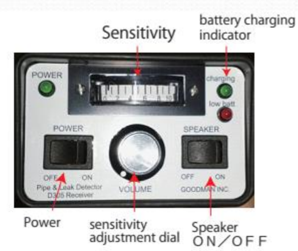
- Transmitter with current meter and voltmeter
- Receiver
- Cord with alligator clips
- For earth 25 m extension cable with drum Earth rod
- Charger for transmitter
- Charger for receiver
- Locking Plier

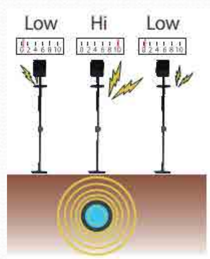
Installation



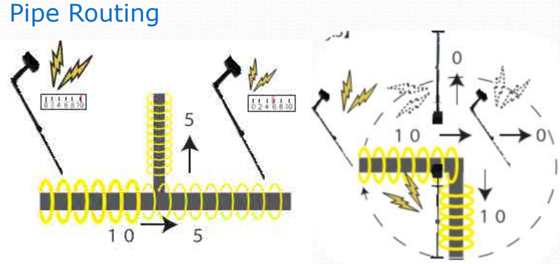
Non-Metal Pipe Locator Operation:

Move Receiver like a Pendulum

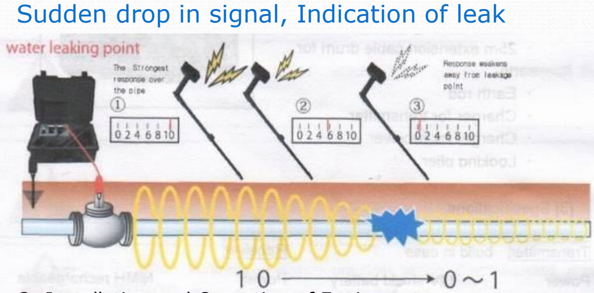




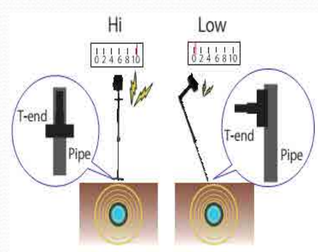
Pipe Routing



Sudden drop in signal, Indication of leak



Identification of Buried Appurtenances



Metal Pipe Locator

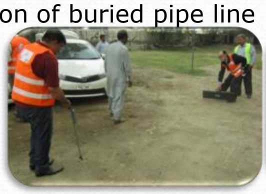
Operation:

Direct Method

- Battery test for transmitter and receiver
- Use cords inside the box, attach one alligator clip to the coupler clamp and the second with rod for grounding. Attach the plugs in transmitter
- Put coupler clamp on valve or house meter that is above the pipe line
- Use receiver and walk on the surface with receiver similar as like pendulum motion
- High value on the meter of receiver and high pitch of the sound identifies the location of buried pipe line

Indirect Method

No clamping & no grounding



Components

- Transmitter
- Receiver
- Carrying Case with Inductive Antenna
- Chord Set
- Inductive Coupler
- Optional Headset

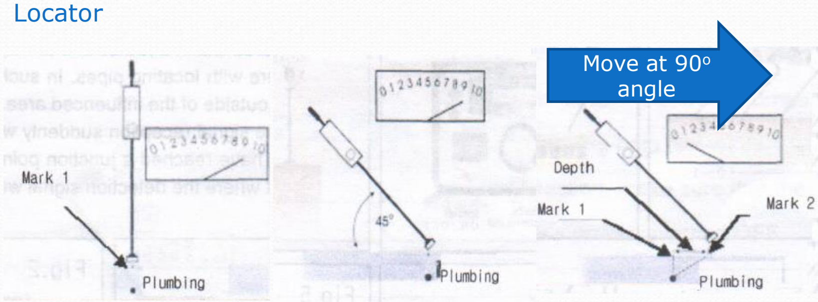
Module 3: Installation and Operation of Equipment 15

Metal Pipe Locator

Module 1: Basic Knowledge of Leakage Detection 16

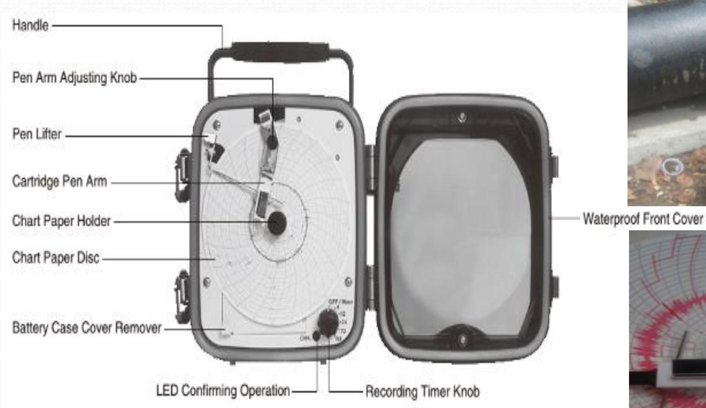
Determining Pipe Depth

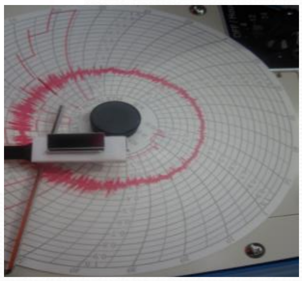
Using Both Non-Metal Pipe Locator and Metal Pipe Locator

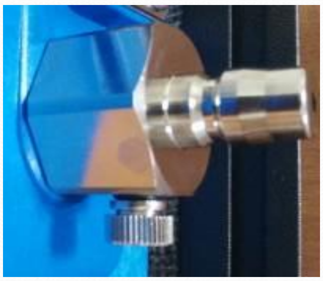


Depth= approx. 4 ft. etc.

Pressure Recorder

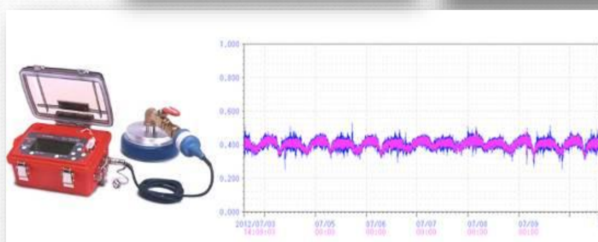






Pressure Recorder

- Develop the pressure charts to check fluctuation of water flow in distribution system
- Can be used for pressure testing of new pipelines
- Installation can be made in the chamber, at pumping station, at fire hydrants and at the valves in water networking system



Ultrasonic Flowmeter

Components

- Device Setting:

Configuration Menu (SIMPLE) → Pipe & Fluid Setting (Outside diameter & thickness) → Probe Distance

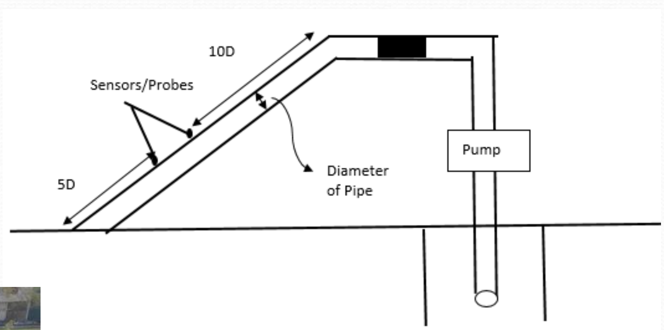
- Installation:

Ultrasonic Flowmeter

Installation Procedure

Data Required

- Pipe Diameter
- Pipe Material
- Probes ID Number
- Pipe Thickness



Gas-Permeation Inspection Method

- Identify the leaks by injecting gas having less specific gravity
- *Helium gas* due to its high cost is replaced with the *gas mixture* (5% hydrogen, 95% Nitrogen).
- Mixture is non-soluble in water, compliance with ISO 10156 standard and its safety is globally recognized
- In areas where “acoustic type leak detection” is difficult due to surrounding noise (traffic area, congested area and factory area), gas injection method is used

Leakage Detection Video

Localizing, Locating & Pinpointing

Contact Information

Zia Mustafa
Water Specialist

In the Name of Allah the Most Beneficent, the Most Merciful

Repairing of Leakage & Burst Pipe line (OJT)

By
Zia Mustafa
Water Specialist

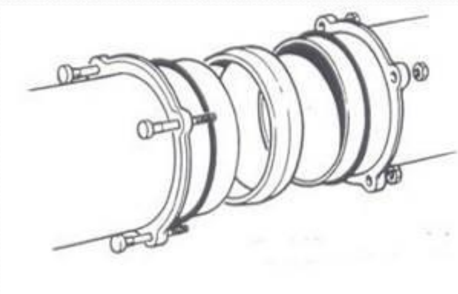
October 2017

Outline of Presentation

- Repairing Materials
- Repairing Procedure at Site (AC Pipe)
- On Site Leakage Repairing
- Repairing Tools and Machinery
- Pipe Jointing
- Comparison of Materials and Methods of AC Pipe

AC Pipe Repairing Material

- Gibault Joint Material



AC Pipe Repairing Material

- Clamps & Water Proof Rubber

AC Pipe Repairing Material

- Rubber Tube & Wooden Piece/Cork

- Tire Tube Rubber

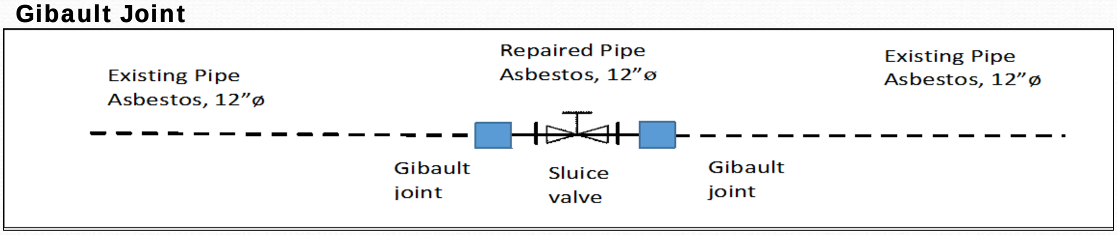
AC Pipe Repairing Material

- Socket & Socket Ring

- Flange

Repairing Procedure at Site

Gibault Joint



Repairing Procedure at Site

Clamp Joint

Existing Pipe
Asbestos, 4”ø

Repaired Pipe
Asbestos, 4”ø

Existing Pipe
Asbestos, 4”ø

Clamp Joint

Repairing Procedure at Site

Rubber Tube

Existing Pipe
Asbestos, 4”ø

Repaired Pipe
Asbestos, 4”ø

Existing Pipe
Asbestos, 4”ø

Rubber Tape

Repairing Procedure at Site

Wooden Piece or Cork

Existing Pipe
Asbestos, 6”ø

Repaired Pipe
Asbestos, 6”ø

Existing Pipe
Asbestos, 6”ø

Wooden Cork

Repairing Procedure at Site

End Plug

Existing Pipe
Asbestos, 4”ø

Repaired Pipe
Asbestos, 4”ø

Existing Pipe
Asbestos, 4”ø

On Site Leakage Repairing

Cordon off the Site → Pavement Cutting → Broken the Pavement → Excavation

Cut Water Supply → Repair the Leak → Cross Checking of Leak → Back Filling

Restore the Site

Cordon off Site

- Cones
- Reflection Tape
- Diversion Board

Personal Protective Equipment

- Mask
- Gloves
- Shoes
- Hamlet
- Goggles (Eye Wear)

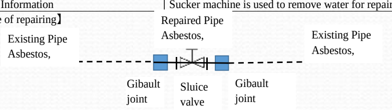
Repairing Tools & Machinery

- **Hand Tools**
  - Adjustable Wrench
  - Screw Driver
  - Hammer & Maul
  - Hand Saw
  - Bucket
- **Cutting Tools**
  - Snap Cutter
  - Pipe Cutter
- **Excavation Tools**
  - Shovel
  - Grape Hoe
  - Pick Axe
- **Excavation Machinery**
  - Pavement Breaker
  - Sucker Machine
  - Excavator
  - Portable Soil Compactor

Site Data Recording

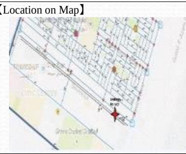
Date and time	10:20 am, 11 February, 2016
Address	Hamdard Chowk, Ali Road
Person in charge	Mr. Shamas Ayoub Gujjar – SDO Green Town
Organization of repairing team	Pipe Fitter x 2, Helper x 2, Worker x 2 (Sucker Machine)
Diameter(mm)	12”
Material and Kind of joint	Asbestos, a sluice valve is installed after removing the cracked portion
Age (installation year)	45 years
Shape of leak point	5” long crack
Pressure (kg/m2)	High
Depth(m)	4.5’
Soil around the pipe	Rough mud, but after repairing a cemented valve chamber will be formed to operate valve in the future
Traffic density	High
Supply Hour	18
Cause of the leak	Old pipe and high Pressure (main transmission line connected with four tube wells
Quantity of leak (m3/min)	
Time of Repairing (Hour)	4-5
Other Information	Sucker machine is used to remove water for repairing

Figure of repairing】



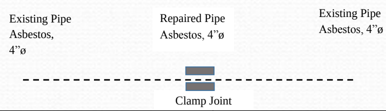
【Picture of repairing】

【Location on Map】



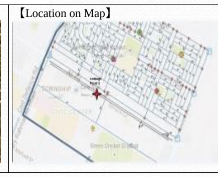
Date and time	10:50am 11 February, 2016
Address	Civic Centre near Cine Star Cinema
Person in charge	Mr. Shamas Ayoub Gujjar – SDO Green Town
Organization of repairing team	Pipe fitter x 1, Helper x 2
Diameter(mm)	4”
Material and Kind of joint	Asbestos, wooden cork inserted into the hole and metal clamp along-with water proof sponge was used
Age (installation year)	45
Shape of leak point	Hole of 0.5” diameter
Pressure (kg/m2)	Low
Depth(m)	4.5’
Soil around the pipe	Rough soil and garbage
Traffic density	Medium
Supply Hour	14
Cause of the leak	
Quantity of leak (m3/min)	
Time of Repairing (Hour)	3

【Figure of repairing】



【Picture of repairing】

【Location on Map】



Polyethylene Pipe

- Polyethylene (PE) is fast replacing conventional material in piping for Water supply system. HDPE Pipe Size range from 20mm to 500mm

- ❑ Clamp Pipe and Fitting
- ❑ Align in Axial Direction
- ❑ Joint end Cleaning
- ❑ Facing
- ❑ Fusion Pressure Adjustment
- ❑ Time & Voltage Adjustment
- ❑ Insert Heat Plates or Wire Connection
- ❑ Pipe Fusion

Thermal Electrofusion Jointing

Butt Fusion Video

Butt Fusion Jointing Videos

Pipe Jointing

- Jointing of AC Pipe with HDPE through Use of Flanges and Bolts

Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Rubber Tube	Low 25 PKR/piece	Short ~ 1 year	Easy	No	Short ~ 40 minutes	Low ~ 4 bar	Temporary	Hole /Crack	Only Recommended in the case of emergency but not a permanent remedy. Clamps should be used to increase the joint life.
Cork	Low 100 PKR/piece for 3” dia. Pipe 1000 PKR/piece for 12” dia pipe	Short ~ 1 year along with tube	Easy	No	Medium ~ 1.5 hr	Low ~ 4 bar	Temporary	Hole	Recommended only in case of emergency along with rubber tube. The piece of cork should be accurate, do not put extra size cork in hole of the pipe that results in the biological contamination of water. Not a permanent method, use it with clamps.

Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Clamp	Medium 125-150 PKR/kg for 4" dia. pipe e.g. Clamp for 4"dia pipe 2 kg iron plate is used.	Medium ~ 8-10 years	Easy	Basic	Medium ~ 1-1.5 hr	High ~ 7-8 bar	Permanent	Hole/ crack	Used where cracks or hole sizes are not so large. (e.g. Ø 4"~ 10.16 cm Ø 6"~ 15.24 cm).Use clamps with at least length of 2 inch more than the crack or hole diameter to cover it safely. It has long life as compare to rubber tube and cork. Can be used at shallow depth with low pressure but in case of high pressure we recommend to use Gibault joint. Clamp joint considered as a permanent remedy with maximum durability.

Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Gibault Joint	High 1200 PKR/piece for 6" dia. pipe	Long ~ 15 years	Medium	Skilled	Medium ~ 2 hr	High ~ 9 bar	Permanent	Burst /Replace of line	It is an expensive but permanent method for repair. Used where we have to repair the burst line or replace a pipe with another pipe of 5-7 feet of length. The rubber ring of Gibault joint becomes hard with the passage of time (duration 4-5 years), cracks are formed on it that lead to the leakage of water. Check the rubber ring before using Gibault joint. Replace the rubber ring after 4-5 years of usage, to prevent leakage.

Comparison of Materials and Methods of AC Pipe

Method	Cost	Life	Availability	Skill Level Required	Time to Repair	Pressure of Line	Remedy	Shape of Leakage Point	Remarks
Socket Joint	High 450 PKR/ piece for 4" pipe. 550 PKR/ piece for 6" pipe.	Long ~ 20 years	Medium	Skilled	Medium ~ 2 hr	High ~ 9 bar	Permanent	Burst/ replace of line	It is a little bit expensive compared with clamp joint but a permanent method for repair. . Used only in AC pipe only where we have to repair the burst line or replace pipe with another pipe of 5-7 feet of length. This method is not mostly used in routine repairs, used where new pipe line is being laid. It is a time taking process, and very inconvenient in presence of water.

Contact Information

Zia Mustafa
Water Specialist

Group Activity

“A City” Water Supply Authority Case Study

The “A City” Water Supply is the municipal water utility that serves the “A City” area and surrounding areas. Recent data reveals that utility provides low-quality piped water at very low pressure (6 psi) for only 06 hours per day to only 20% of the city's residents. Non -Revenue Water (NRW) is extremely high at 72% due to illegal connections, manipulation of bills and physical leakage. Tariffs are extremely low, there are no metering and less than half of the amounts billed are collected. Staff are underpaid and demoralized and most of them are engaged in corrupt activities.

Instructions:

In your groups please analyze the case using the systematic approach and present it.

1) What is the issue?
2) What is the context of the problem?
3) What key facts should be considered?
4) What alternatives are available to the decision-maker?
5) What would you recommend — and why?

Acoustic Leak Detector

The Acoustic Leak Detector is used to diagnose and localize the underground leak to a specific area of a property. The equipment consists of;

- Control Unit
- Headphones
- Connection wire
- Electromagnetic micro sensors
- Handle

Procedure:

- At first, connect the connection wire with headphones & the control unit.
- Volume of the sound detected by headphones can be increased or decreased by the buttons on the control unit.
- Filter can also be turned ON or OFF by simultaneously pressing the two buttons (+ & -) on control unit.

- Now connect the electromagnetic micro sensor with the control unit. The equipment will be turned ON as soon as you connect the electromagnetic sensor.
- Now wear the headphones, place the electromagnetic sensor on the ground with care and grab the handle in your hand.

- Move the sensor on ground at the offset of 1 ft and keep focusing the different sounds that you hear on the headphones.
- Meanwhile, keep noticing the signal on control unit having readings from 0 to 99. The maximum value at that reading indicates the leakage point.

Closing of Equipment:

Disconnect the Electromagnetic sensor from the control unit. Disconnect the connection wire from the control unit and the headphones. Place back all the things in the equipment casing with care.

Check List of using Acoustic Leak Detector

Following steps should be performed while using the device in Field:

- Check the battery on the control unit
- Connect the connection wire with the control unit & headphones
- Connect the electromagnetic sensor with the control unit
- Wear headphones and place the electromagnetic sensor on ground with care
- Concentrate on different sounds detected on headphones and keep noticing the signals on the control unit

Closing of the equipment:

Following points must be taken into account while packing up the equipment after use:

- Disconnect the connection wire from control unit & headphones
- Disconnect the Electromagnetic sensor from the control unit
- Keep all the things back in the equipment casing with care

Note: Use the Acoustic Leak Detector when there is a flow of water through pipeline.

DATA RECORDING SHEET FOR LEAKAGE & PIPE REPAIRING

Date and Time	
Address	
Person in charge	
Organization of repairing team	
Diameter(mm)	
Material and Kind of Joint	
Age (installation year)	
Shape of leak point	
Pressure (kg/m^2)	
Depth(m)	
Soil around the pipe	
Traffic density	
Supply Hour	
Cause of the leak	
Quantity of leak (m^3/min)	
Time of Repairing (Hour)	

【Signature】

Supervisor ______________________ Sub Engineer______________________

Non Metal Pipe Locator

Non metal pipe locator is used to locate the underground water pipe and to indicate the underground leakage point by developing electromagnetic field around the pipe.

Procedure:

- First of all, check that knobs of 'impedance' & 'power' should be at zero before switching ON the equipment.
- Red probe should be connected to valve of the underground pipe in a chamber & is considered as positive.

- Black probe is treated as negative & should be grounded with the help of a screw driver.

- Grounding should be done at 45^o to the opposite direction of identifying pipe.
- Now, switch on the equipment.
- At first, keep the impedance & power at 1 or 2. Then, keep on increasing the values as you move away from the starting point.
- Move the receiver along the direction of pipe & keep noticing the needle on device.
- Also note that while moving the receiver, its distance above the ground should at least be 2 or 3 cm.
- Set the impedance & power such that at the starting point where you know that there is a pipe, the value should be from 8 to 10.
- As you move away, keep setting the impedance & power so that the value should be between 8 to 10,
- If you notice any sudden fall in the reading of the needle (For example, if the needle comes suddenly to 1 or 2 from 8 or 10) it means that either there is a sharp bend or there is a leakage at the point.

.

Closing of Equipment:

Turn off all the knobs. Remove the red probe from the valve. Also, remove the black probe from the grounding and clean the screw driver with tissue paper. Place back equipment along with its accessories in casing with care.

Check List of using Non Metal Pipe Locator

Following steps should be performed while using the device in Field:

- Check the knobs (Impedance & power knobs should be zero before starting)
- Red probe should be connected to valve in the chamber
- Black probe should be grounded in soil
- Grounding should be done at 45^{o} to the opposite direction of identifying pipe
- The distance of receiver while moving should not be more than 2 or 3 cm from the ground surface
- Keep on increasing the impedance & power as you move away from the starting point
- The needle lying between 8 or 10 indicates the underlying pipe
- Any reading lying between 2 or 3 indicates the absence of pipe

Closing of the equipment:

Following points must be taken into account while packing up the equipment after use:

- Turn off the knob of the recording device after use
- Turn off the knobs of the impedance & power
- Remove the red probe from the valve
- Remove the black probe from the grounding and clean the screw gauge with the help of tissue paper
- Keep all the things back in the equipment casing with care

Metal Pipe Locator

The Metal Pipe Locator consists of the following components:

- Transmitter
- Receiver
- Inductive Coupler
- Inductive Antenna
- Connecting Wires

Checklist

- Check the battery of the transmitter before using it.
- Connect the wires carefully onto the pipe before carrying out the procedure.
- External metal interruptions and electromagnetic field should be minimum for better results.
- Handle the equipment parts carefully during the procedure.
- Clean the equipment before closing it and place into the box according to the previous configurations.
- Beware of the surroundings while carrying out the procedure.

Procedure

There are two methods of doing this procedure

1. Direct Method
2. Indirect Method

Direct Method

For direct method, we have to first establish the transmitter connection. Connect the first lead to the pipe and the other to the ground via screwdriver. After the connection has been completed, switch on the transmitter and first adjust the impedance/frequency to the lowest and increase it along with the distance. Hold the receiver with T end perpendicular to suspected path of metal pipe. The frequency both at the transmitter and receiver has to be adjusted according to the distance from each other. The noise and the peak value (varies between 0 to 10) at the receiver end will show the location of the metal pipe, where higher value indicates the presence of metal.

Indirect Method

In the indirect method, we do not establish the ground connection, rather we move both the receiver and transmitter simultaneously 6 inch above the ground in the similar suspected path to locate the metal pipe.

This method is rather easy, quick but inaccurate as compared to the direct method.

Ultrasonic Flowmeter Device

Checklist:

- Place the containing box carefully before opening as the equipment is sensitive and expensive.
- Remember the placed configuration of different parts of the equipment like connecting wires, portable device, gel bottle and transducers.
- Use the correct port of the device while connecting the transducer wires.
- Place the transducers carefully on the pipe and then use the screws to adjust the probe distance.
- Apply the optimum quantity of gel onto the transducers and after using it remove it.
- After carrying out the procedure remove the cables carefully with minimum force both from the device and transducers.
- Clean the gel from the transducers and pipe and separate them carefully.
- Assemble the equipment in order carefully and close the containing box.

*Note: Tube well must be working to carry out the procedure.

Introduction

The ultrasonic flowmeter uses the ultrasonic pulse transit time difference to measure the flow of a fluid. It is a portable device to carry the on field flow measurements. The equipment consists of

- Ultrasonic Portable Device
- Two Transducers/Probes (One for the large probe distance and other for relatively small distance, probe selection also depends upon the pipe conditions etc.)
- Two chords connected from device to the probe other than charging and computer connecting device.
- Ultra flux Gel

Procedure:

After selecting the pipe location, the first step is to check the external surface of the pipe as it should be smooth before carrying out the procedure for flow measuring. Check the condition of all the equipment before proceeding. First check the battery condition of device by turning on the device. After this press the "F" button and select the flow measurement option. By selecting this option, you have to put the required data in the device which includes the following

1. Perimeter of Pipe
2. Diameter (Which would be based on perimeter of the pipe calculated manually)
3. Thickness of the Pipe
4. Type of the Material E.g. Cast Iron, Stainless Steel, PVC etc.
5. Type of the ultrasonic pulse velocity pattern i.e. V, W, N etc. (Which depends upon the pipe length available and accuracy desired)
6. Select the Unit of flow measurement i.e. m^3/hr. etc.

After selecting these values, the ultra-flux device will show the probe distance which depends upon the factors mentioned above, also you can select the different unit for the flow measurement. Before proceeding further, we have to apply the ultra-flux gel which will smooth the movement of ultrasonic pulse in the pipe. The transducer should be placed at distance "5D" where "D" is the diameter of Pipe.

After the gel application on the transducers' magnet portions we can assemble the probes/transducers to the distance provided by the device. After the distance is adjusted then we connect the chords to the probes/transducers and by pressing the "F" we can have the flow measurement of the fluid in the pipe.

After the field measurement we can transfer the data to the computer through connecting with the ultra-flux device.

Pressure Recorder (FJN-501)

Procedure:

- First of all, install the battery (Dry cells).
- Fully rotate the knob (Indicating hours) to test the battery; if the red light starts blinking then it means that battery is in working condition.
- Now, place the graph paper at its place & plug in the cap.
- Install the pen in pen holder.
- Keep the knob at that hour of which the graph paper is installed.
  (e.g. 4, 12, 24, 72, 168 hr).
- Set the graph paper & pen holder in such a way that pen needle is at zero of pressure axis & the time axis (at specified hour) by adjusting the movement of the screw of pen holder.
- Do not press the pen needle hard because in that case, pen ink will get spread on graph paper.

- Now, drain the air from the pipe installed at tube well by slowly opening the valve.
- Also, drain the air by opening the screw attached with nozzle of the Pressure Recorder.
- After completion of all these above steps, place the instrument on ground for recording of pressure for specific duration.

After using the equipment, remove the hose pipe from the tube well and pressure recorder. Take out the graph paper and the pen from the pen holder. Keep all the things back in the equipment casing with care.

Note: Use the Pressure Recorder when the tube well is in working condition and flow of water is passing through pipeline.

Check List of using Pressure Recorder

Following steps should be performed while using the device in Field:

- Check the battery status of equipment by fully rotating the knob. If red light blinks for a minute then equipment is ready for its use
- Place the graph paper on specified portion of pressure recorder
- Install the pen in pen holder properly
- Set the graph paper & pen needle as per requirement by adjusting the movement of the screw of pen holder
- Do not press the needle hard
- Drain the air from the hose pipe by opening the valve of tube well
- Drain the air from pressure recorder by opening the screw attached with pressure recorder
- Attach the hose pipe properly with nozzle at tube well and pressure recorder

Closing of the equipment:

Following points must be taken into account while packing up the equipment after use:

- Remove the hose pipe properly from the nozzle of tube well and pressure recorder
- Pen holder should be lifted up properly so that the pen and the graph paper can be removed safely
- Put on the cap of the pen
- Keep all the things back in the equipment casing with care

Note: Use the Pressure Recorder when the tube well is in working condition and flow of water is passing through pipeline.

Leakage Detection Activity

1

Day 4

Visit to BBJ Pipe Factory, Lahore

PROCEDURE FOR LEAK DETECTION ACTION PLAN

Sr. No.	Guideline	
1.	Preparation	1. Establishment of Leakage Detection Cell and Team 2. Preparation of Water Distribution Network Maps and Drawings 3. Procurement of Equipment
2.	Basic Survey	1. Analysis of Water Supplied and Pressure 2. Divide the City into Blocks 3. Study of Pipe Age, Material and Quality 4. Preventive Works
3.	Plan	1. Set the Target Value 2. Set the Planning year 3. Decide the Survey Methods
4.	Action/ Implementation	1. Leakage Survey 2. Analysis of Causes of Leakage 3. Leakage Volume Calculation 4. Quick Repairs (Surface Leakage) 5. Systematic Detection and Repair (Underground Leakage) 6. Countermeasures for Leakage
5.	Evaluation	1. Analysis of Results 2. Compare Plan with Action